

3GPP TSG-SA2#36
New York, USA, 24-28 November, 2003

Tdoc S2-034375

Title: LS on Serving network identity from SGSN to GGSN

Response to: -

Source: SA2

To: SA

Cc: SA5, CN4

Contact Person:

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Attachments: S2-034243 to S2-034246

1. Overall Description:

SA2 has considered a request from SA5 (S2-033339/S5-034557 received at SA2#35) to develop Stage 2 descriptions for the inclusion of the serving network identity from the SGSN to the GGSN. This is also following a recommendation from CN4 (S2-033315/N4-031013 received at SA2#35).

As a result of this, SA2 has developed CRs to 23.060/03.60 implementing this requirement. These are available in S2-034243 to S2-034248 as technically correct CRs, with a high-level cover sheet. These CRs are provided for:

- R97 with a mirror for R98
- R99 with a mirror for Rel4
- Rel5 (same technical contents as R97 and R98 changes). **This CR was approved by SA2**
- Rel6 with the difference that the strong recommendation (“should”) used in previous versions is changed to a requirement (“shall”). **This CR was approved by SA2**

SA2 could not agree on the merits of providing this change earlier than Release 5. The pre-rel5 CRs are therefore provided to the SA plenary as attachments to this liaison so that SA plenary can decide whether to include the changes for these earlier versions of 23.060 and 03.60.

2. Actions:

- Approve Rel5 and Rel6 CRs on this issue.
- Make a decision on whether to approve, or not, pre-rel5 CRs.

3. Dates of Next TSG-SA2 Meetings:

TSG-SA2 Meeting #37	12-16 January 2004	Innsbruck, Austria
TSG-SA2 Meeting #38	16-20 February 2004	Atlanta, USA

CR-Form-v7	
CHANGE REQUEST	
⌘ 03.60 CR 217 ⌘ rev 3 ⌘	Current version: 6.11.0 ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: UICC apps ME Radio Access Network Core Network

Title:	⌘ Serving network identity from SGSN to GGSN		
Source:	⌘ Nortel Networks		
Work item code:	⌘ TEI	Date:	⌘ 24/11/03
Category:	⌘ F	Release:	⌘ R97
	Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:
	F (correction)		2 (GSM Phase 2)
	A (corresponds to a correction in an earlier release)		R96 (Release 1996)
	B (addition of feature),		R97 (Release 1997)
	C (functional modification of feature)		R98 (Release 1998)
	D (editorial modification)		R99 (Release 1999)
	Detailed explanations of the above categories can be found in 3GPP TR 21.900 .		Rel-4 (Release 4)
			Rel-5 (Release 5)
			Rel-6 (Release 6)

Reason for change:	⌘ In an LS from SA5 (S2-033339), SA2 are asked to add the requirement of including the MCC and MNC of the location of where the MS is registered in messaging between SGSN and GGSN (inside the RAI). This is necessary for accurate content filtering. Previous liaisons from T2, CPWP and BARG indicated problems with the implementation of integrated pricing structures without such additions.
Summary of change:	⌘ Information is added to the Create PDP Context Req and Update PDP Context Req, to provide to the GGSN with the network identity on which the MS is registered.
Consequences if not approved:	⌘ Stage 2 requirement missing.

Clauses affected:	⌘ 6.9.1.2.2, 6.9.1.3.2, 9.2.2.1, 9.2.3.1					
Other specs affected:	<table border="1" style="font-size: x-small;"> <tr> <td style="width: 20px;">Y</td> <td style="width: 20px;">N</td> </tr> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">X</td> </tr> </table>	Y	N	X	X	Other core specifications ⌘
	Y	N				
	X	X				
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X	X					
Other comments:	⌘					

6.9.1.2.2 Inter SGSN Routing Area Update

The Inter SGSN Routing Area Update procedure is illustrated in figure 28. Each step is explained in the following list.

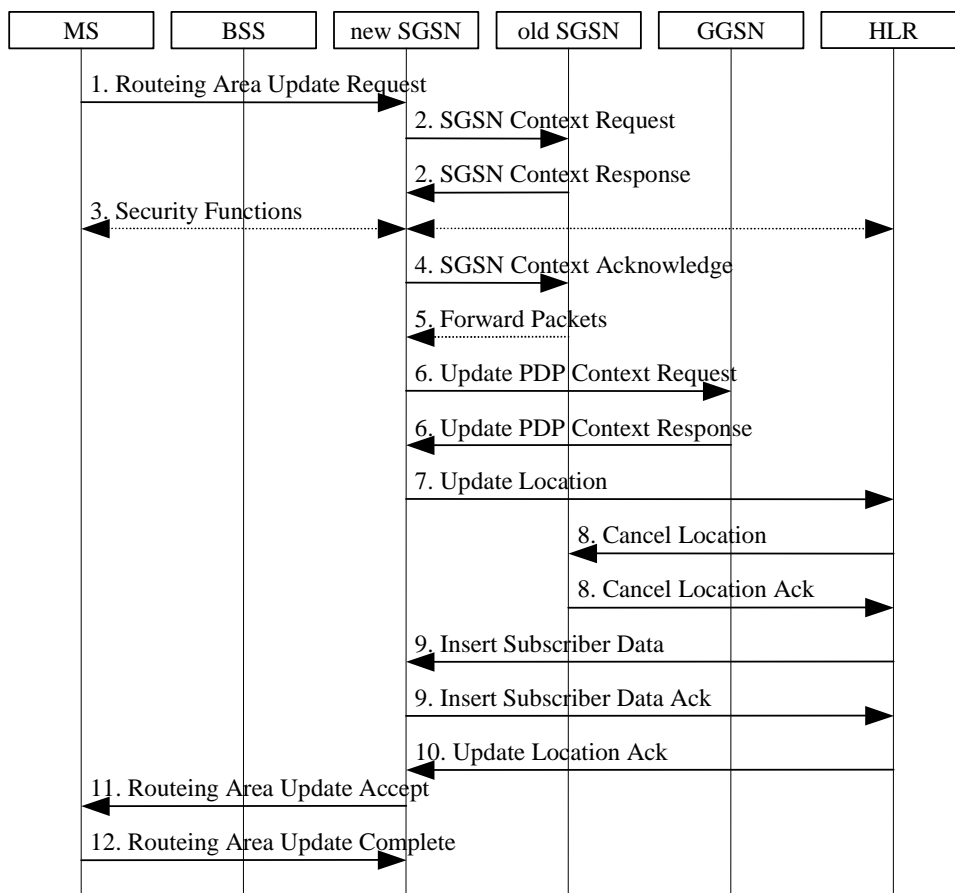


Figure 1: Inter SGSN Routing Area Update Procedure

- 1) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type) to the new SGSN. Update Type shall indicate RA update or periodic RA update. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN.
- 2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN stops assigning SMDCP N-PDU numbers to downlink N-PDUs received, and responds with SGSN Context Response (MM Context, PDP Contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address, to allow the old SGSN to forward data packets to the new SGSN. Each PDP Context includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode from the MS, the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. The old SGSN starts a timer and stops the transmission of N-PDUs to the MS.
- 3) Security functions may be executed. These procedures are defined in subclause "Security Function". Ciphering mode shall be set if ciphering is supported. If the security functions fail (e.g. the SGSN cannot determine the

HLR address to establish the Send Authentication Info dialogue), the Inter SGSN RAU Update procedure fails. A reject shall be returned to the MS with an appropriate cause.

- 4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, then the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received from the GGSN before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS in acknowledged mode and that are not yet acknowledged by the MS are tunnelled together with the SNDCP N-PDU number. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.
- 6) The new SGSN sends Update PDP Context Request (new SGSN Address, TID, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. The GGSNs update their PDP context fields and return Update PDP Context Response (TID). [The SGSN should send the serving network identity to the GGSN.](#)
- 7) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 8) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, then the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 9) The HLR sends Insert Subscriber Data (IMSI, GPRS subscription data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routeing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful then the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 10) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
- 11) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the SGSN, or if subscription checking fails, then the new SGSN rejects the routeing area update with an appropriate cause. If all checks are successful then the new SGSN constructs MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routeing Area Update Accept (P-TMSI, P-TMSI Signature, Receive N-PDU Number). Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.
- 12) The MS acknowledges the new P-TMSI by returning a Routeing Area Update Complete (Receive N-PDU Number) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms reception of N-PDUs that were forwarded from the old SGSN, then these N-PDUs shall be discarded by the new SGSN. LLC and SNDCP in the MS are reset.

In the case of a rejected routeing area update operation due to regional subscription or roaming restrictions, or because the SGSN cannot determine the HLR address in order to establish the GPRS location update dialogue, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routeing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, then the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routeing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, then the old SGSN shall stop forwarding N-PDUs to the new SGSN.

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter IDLE state.

Next change

6.9.1.3.2 Combined Inter SGSN RA / LA Update

The Combined RA / LA Update (inter SGSN) procedure is illustrated in figure 30. Each step is explained in the following list.

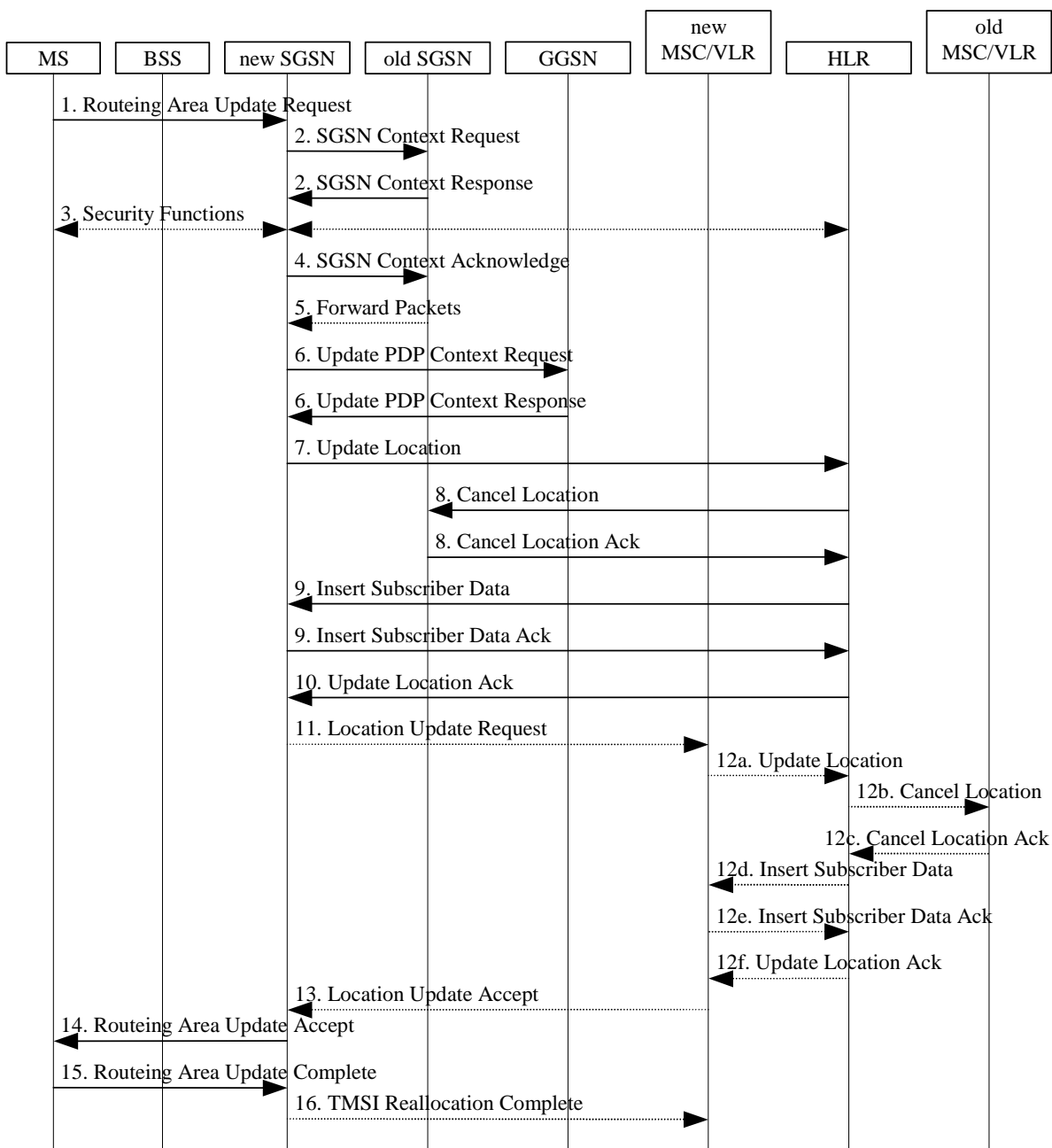


Figure 2: Combined RA / LA Update in the Case of Inter SGSN RA Update Procedure

- 1) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type) to the new SGSN. Update Type shall indicate combined RA / LA update, or, if the MS wants to perform an IMSI attach, combined RA / LA update with IMSI attach requested. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN.

- 2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN stops assigning SMDCP N-PDU numbers to downlink N-PDUs received, and responds with SGSN Context Response (MM Context, PDP Contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address until the old MM context is cancelled, to allow the old SGSN to forward data packets to the new SGSN. Each PDP Context includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode from the MS, the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. The old SGSN starts a timer and stops the downlink transfer.
- 3) Security functions may be executed. These procedures are defined in subclause "Security Function". Ciphering mode shall be set if ciphering is supported. If the security functions fail (e.g. the SGSN cannot determine the HLR address in order to establish the Send Authentication Info dialogue), the Inter SGSN RAU Update procedure fails. A reject shall be returned to the MS with an appropriate cause.
- 4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, then the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received from the GGSN before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS in acknowledged mode and that are not yet acknowledged by the MS are tunnelled together with the SMDCP N-PDU number. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.
- 6) The new SGSN sends Update PDP Context Request (new SGSN Address, TID, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. The GGSNs update their PDP context fields and return an Update PDP Context Response (TID). [The SGSN should send the serving network identity to the GGSN.](#)
- 7) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 8) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, then the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 9) The HLR sends Insert Subscriber Data (IMSI, GPRS subscription data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routeing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful then the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 10) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
- 11) If the association has to be established, if Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routeing area update, then the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with IMSI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI via a table in the SGSN. The SGSN starts the location update procedure towards the new MSC/VLR upon

- receipt of the first Insert Subscriber Data message from the HLR in step 9). The VLR creates or updates the association with the SGSN by storing SGSN Number.
- 12) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) the new VLR sends an Update Location (new VLR) to the HLR;
 - b) the HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR;
 - c) the old VLR acknowledges with Cancel Location Ack (IMSI);
 - d) the HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR;
 - e) the new VLR acknowledges with Insert Subscriber Data Ack (IMSI);
 - f) the HLR responds with Update Location Ack (IMSI) to the new VLR.
 - 13) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the SGSN. VLR TMSI is optional if the VLR has not changed.
 - 14) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the SGSN, or if subscription checking fails, then the SGSN rejects the routing area update with an appropriate cause. If all checks are successful then the new SGSN establishes MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature, Receive N-PDU Number). Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.
 - 15) The MS confirms the reallocation of the TMSIs by returning a Routing Area Update Complete (Receive N-PDU Number) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms reception of N-PDUs that were forwarded from the old SGSN, then these N-PDUs shall be discarded by the new SGSN. LLC and SNDPCP in the MS are reset.
 - 16) The new SGSN sends a TMSI Reallocation Complete message to the new VLR if the VLR TMSI is confirmed by the MS.

In the case of a rejected routing area update operation, due to regional subscription or roaming restrictions, or because the SGSN cannot determine the HLR address to establish the locating updating dialogue, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, then the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter IDLE state.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, then the old SGSN shall stop forwarding N-PDUs to the new SGSN.

If the Location Update Accept message indicates a reject, then this should be indicated to the MS, and the MS shall not access non-GPRS services until a successful location update is performed.

Next change

9.2.2 Activation Procedures

9.2.2.1 PDP Context Activation Procedure

The PDP Context Activation procedure is illustrated in figure 35. Each step is explained in the following list.

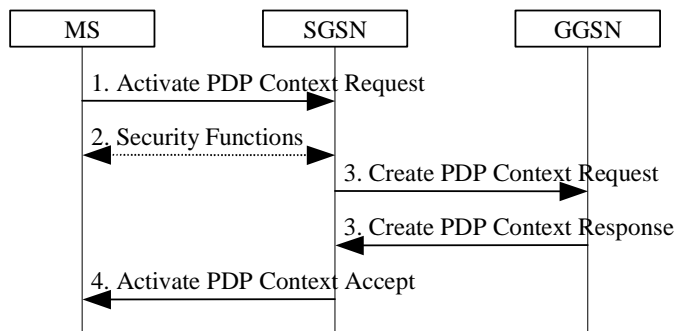


Figure 3: PDP Context Activation Procedure

- 1) The MS sends an Activate PDP Context Request (NSAPI, TI, PDP Type, PDP Address, Access Point Name, QoS Requested, PDP Configuration Options) message to the SGSN. The MS shall use PDP Address to indicate whether it requires the use of a static PDP address or whether it requires the use of a dynamic PDP address. The MS shall leave PDP Address empty to request a dynamic PDP address. The MS may use Access Point Name to select a reference point to a certain external network. Access Point Name is a logical name referring to the external packet data network that the subscriber wishes to connect to. QoS Requested indicates the desired QoS profile. PDP Configuration Options may be used to request optional PDP parameters from the GGSN (see GSM 09.60). PDP Configuration Options is sent transparently through the SGSN.
- 2) Security functions may be executed. These procedures are defined in subclause "Security Function".
- 3) The SGSN validates the Activate PDP Context Request using PDP Type (optional), PDP Address (optional), and Access Point Name (optional) provided by the MS and the PDP context subscription records. The validation criteria, the APN selection criteria, and the mapping from APN to a GGSN are described in annex A.

If no GGSN address can be derived or if the SGSN has determined that the Activate PDP Context Request is not valid according to the rules described in annex A, then the SGSN rejects the PDP context activation request.

If a GGSN address can be derived, the SGSN creates a TID for the requested PDP context by combining the IMSI stored in the MM context with the NSAPI received from the MS. If the MS requests a dynamic address, then the SGSN lets a GGSN allocate the dynamic address. The SGSN may restrict the requested QoS attributes given its capabilities, the current load, and the subscribed QoS profile. The SGSN sends a Create PDP Context Request (PDP Type, PDP Address, Access Point Name, QoS Negotiated, TID, MSISDN, Selection Mode, PDP Configuration Options, [serving network identity](#)) message to the affected GGSN. [The SGSN should send the serving network identity to the GGSN.](#) Access Point Name shall be the APN Network Identifier of the APN selected according to the procedure described in annex A. PDP Address shall be empty if a dynamic address is requested. The GGSN may use Access Point Name to find an external network. Selection Mode indicates whether a subscribed APN was selected, or whether a non-subscribed APN sent by MS or a non-subscribed APN chosen by SGSN was selected. Selection Mode is set according to annex A. The GGSN may use Selection Mode when deciding whether to accept or reject the PDP context activation. For example, if an APN requires subscription, then the GGSN is configured to accept only the PDP context activation that requests a subscribed APN as indicated by the SGSN with Selection Mode. The GGSN creates a new entry in its PDP context table and generates a Charging Id. The new entry allows the GGSN to route PDP PDUs between the SGSN and the external PDP network, and to start charging. The GGSN may further restrict QoS Negotiated given its capabilities and the current load. The GGSN then returns a Create PDP Context Response (TID, PDP Address, Reordering Required, PDP Configuration Options, QoS Negotiated, Charging Id, Cause) message to the SGSN. PDP Address is included if the GGSN allocated a PDP address. Reordering Required indicates whether the SGSN shall reorder N-PDUs before delivering the N-PDUs to the MS. PDP Configuration Options contain optional PDP parameters that the GGSN may transfer to the MS. These optional PDP parameters may be requested by the MS in the Activate PDP Context Request message, or may be sent unsolicited by the GGSN. PDP Configuration Options is sent transparently through the SGSN. The Create PDP Context messages are sent over the GPRS backbone network.

If QoS Negotiated received from the SGSN is incompatible with the PDP context being activated (e.g., the reliability class is insufficient to support the PDP type), then the GGSN rejects the Create PDP Context Request message. The compatible QoS profiles are configured by the GGSN operator.

- 4) The SGSN inserts the NSAPI along with the GGSN address in its PDP context. If the MS has requested a dynamic address, the PDP address received from the GGSN is inserted in the PDP context. The SGSN selects Radio Priority based on QoS Negotiated, and returns an Activate PDP Context Accept (PDP Type, PDP Address, TI, QoS Negotiated, Radio Priority, PDP Configuration Options) message to the MS. The SGSN is now able to route PDP PDUs between the GGSN and the MS, and to start charging.

For each PDP Address a different quality of service (QoS) profile may be requested. For example, some PDP addresses may be associated with E-mail that can tolerate lengthy response times. Other applications cannot tolerate delay and demand a very high level of throughput, interactive applications being one example. These different requirements are reflected in the QoS profile. The QoS profile is defined in subclause "Quality of Service Profile". If a QoS requirement is beyond the capabilities of a PLMN, the PLMN negotiates the QoS profile as close as possible to the requested QoS profile. The MS either accepts the negotiated QoS profile, or deactivates the PDP context.

After an SGSN has successfully updated the GGSN, the PDP contexts associated with an MS is distributed as shown in clause "Information Storage".

If the PDP Context Activation Procedure fails or if the SGSN returns an Activate PDP Context Reject (Cause, PDP Configuration Options) message, then the MS may attempt another activation to the same APN up to a maximum number of attempts.

Next change

9.2.3 Modification Procedures

An SGSN can decide, possibly triggered by the HLR as explained in subclause "Insert Subscriber Data Procedure", to modify parameters that were negotiated during an activation procedure for one or several PDP contexts. The following parameters can be modified:

- QoS Negotiated; and
- Radio Priority.

The SGSN can request the modification of parameters by sending a Modify PDP Context Request message to the MS.

9.2.3.1 PDP Context Modification Procedure

The PDP Context Modification procedure is illustrated in figure 40. Each step is explained in the following list.

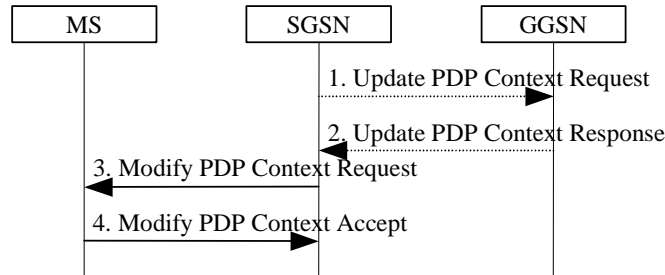


Figure 4: PDP Context Modification Procedure

- 1) The SGSN may send an Update PDP Context Request (TID, QoS Negotiated, [serving network identity](#)) message to the GGSN. [The SGSN should send the serving network identity to the GGSN.](#) If QoS Negotiated received from the SGSN is incompatible with the PDP context being modified (e.g., the reliability class is insufficient to support the PDP type), then the GGSN rejects the Update PDP Context Request. The compatible QoS profiles are configured by the GGSN operator.
- 2) The GGSN may restrict QoS Negotiated given its capabilities and the current load. The GGSN stores QoS Negotiated and returns an Update PDP Context Response (TID, QoS Negotiated) message.
- 3) The SGSN sends a Modify PDP Context Request (TI, QoS Negotiated, Radio Priority) message to the MS.
- 4) The MS acknowledges by returning a Modify PDP Context Accept message. If the MS does not accept the new QoS Negotiated it shall de-activate the PDP context with the PDP Context Deactivation Initiated by MS procedure.

CR-Form-v7	
CHANGE REQUEST	
⌘ 03.60 CR 218 ⌘ rev 3 ⌘	Current version: 7.9.0 ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: UICC apps ME Radio Access Network Core Network

Title:	⌘ Serving network identity from SGSN to GGSN		
Source:	⌘ Nortel Networks		
Work item code:	⌘ TEI	Date:	⌘ 24/11/03
Category:	⌘ A	Release:	⌘ R98
	Use <u>one</u> of the following categories: F (correction) A (corresponds to a correction in an earlier release) B (addition of feature), C (functional modification of feature) D (editorial modification) Detailed explanations of the above categories can be found in 3GPP TR 21.900 .		Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) Rel-4 (Release 4) Rel-5 (Release 5) Rel-6 (Release 6)

Reason for change:	⌘ In an LS from SA5 (S2-033339), SA2 are asked to add the requirement of including the MCC and MNC of the location of where the MS is registered in messaging between SGSN and GGSN (inside the RAI). This is necessary for accurate content filtering. Previous liaisons from T2, CPWP and BARG indicated problems with the implementation of integrated pricing structures without such additions.
Summary of change:	⌘ Information is added to the Create PDP Context Req and Update PDP Context Req, to provide to the GGSN with the network identity on which the MS is registered.
Consequences if not approved:	⌘ Stage 2 requirement missing.

Clauses affected:	⌘ 6.9.1.2.2, 6.9.1.3.2, 9.2.2.1, 9.2.3.1										
Other specs affected:	<table border="1" style="font-size: x-small;"> <tr> <td style="text-align: center;">Y</td> <td style="text-align: center;">N</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table>	Y	N	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Other core specifications ⌘ Test specifications ⌘ O&M Specifications ⌘	
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Other comments:	⌘										

6.9.1.2.2 Inter SGSN Routing Area Update

The Inter SGSN Routing Area Update procedure is illustrated in Figure 1. Each step is explained in the following list.

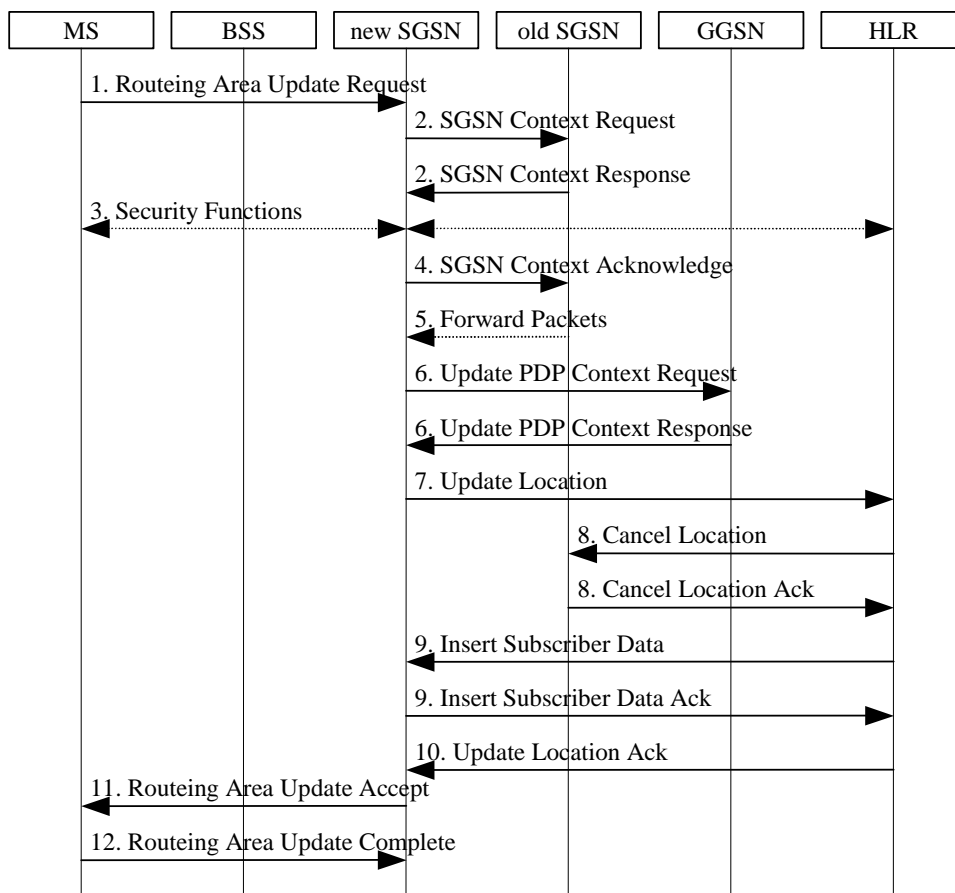


Figure 1: Inter SGSN Routing Area Update Procedure

- 1) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type) to the new SGSN. Update Type shall indicate RA update or periodic RA update. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN.
- 2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN stops assigning SMDCP N-PDU numbers to downlink N-PDUs received, and responds with SGSN Context Response (MM Context, PDP Contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address, to allow the old SGSN to forward data packets to the new SGSN. Each PDP Context includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode from the MS, the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. The old SGSN starts a timer and stops the transmission of N-PDUs to the MS.
- 3) Security functions may be executed. These procedures are defined in sub-clause "Security Function". Ciphering mode shall be set if ciphering is supported. If the security functions fail (e.g. because the SGSN cannot

- determine the HLR address to establish the Send Authentication Info dialogue), the Inter SGSN RAU Update procedure fails. A reject shall be returned to the MS with an appropriate cause.
- 4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, then the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
 - 5) The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received from the GGSN before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS in acknowledged mode and that are not yet acknowledged by the MS are tunnelled together with the SMDCP N-PDU number. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.
 - 6) The new SGSN sends Update PDP Context Request (new SGSN Address, TID, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. The GGSNs update their PDP context fields and return Update PDP Context Response (TID). [The SGSN should send the serving network identity to the GGSN.](#)
 - 7) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
 - 8) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, then the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
 - 9) The HLR sends Insert Subscriber Data (IMSI, GPRS subscription data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routeing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful then the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
 - 10) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
 - 11) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the SGSN, or if subscription checking fails, then the new SGSN rejects the routeing area update with an appropriate cause. If all checks are successful then the new SGSN constructs MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routeing Area Update Accept (P-TMSI, P-TMSI Signature, Receive N-PDU Number). Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.
 - 12) The MS acknowledges the new P-TMSI by returning a Routeing Area Update Complete (Receive N-PDU Number) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms reception of N-PDUs that were forwarded from the old SGSN, then these N-PDUs shall be discarded by the new SGSN. LLC and SMDCP in the MS are reset.

In the case of a rejected routeing area update operation, due to regional subscription or roaming restrictions, or because the SGSN cannot determine the HLR address to establish the locating updating dialogue, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routeing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, then the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routeing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, then the old SGSN shall stop forwarding N-PDUs to the new SGSN.

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter IDLE state.

Next change

6.9.1.3.2 Combined Inter SGSN RA / LA Update

The Combined RA / LA Update (inter SGSN) procedure is illustrated in Figure 2. Each step is explained in the following list.

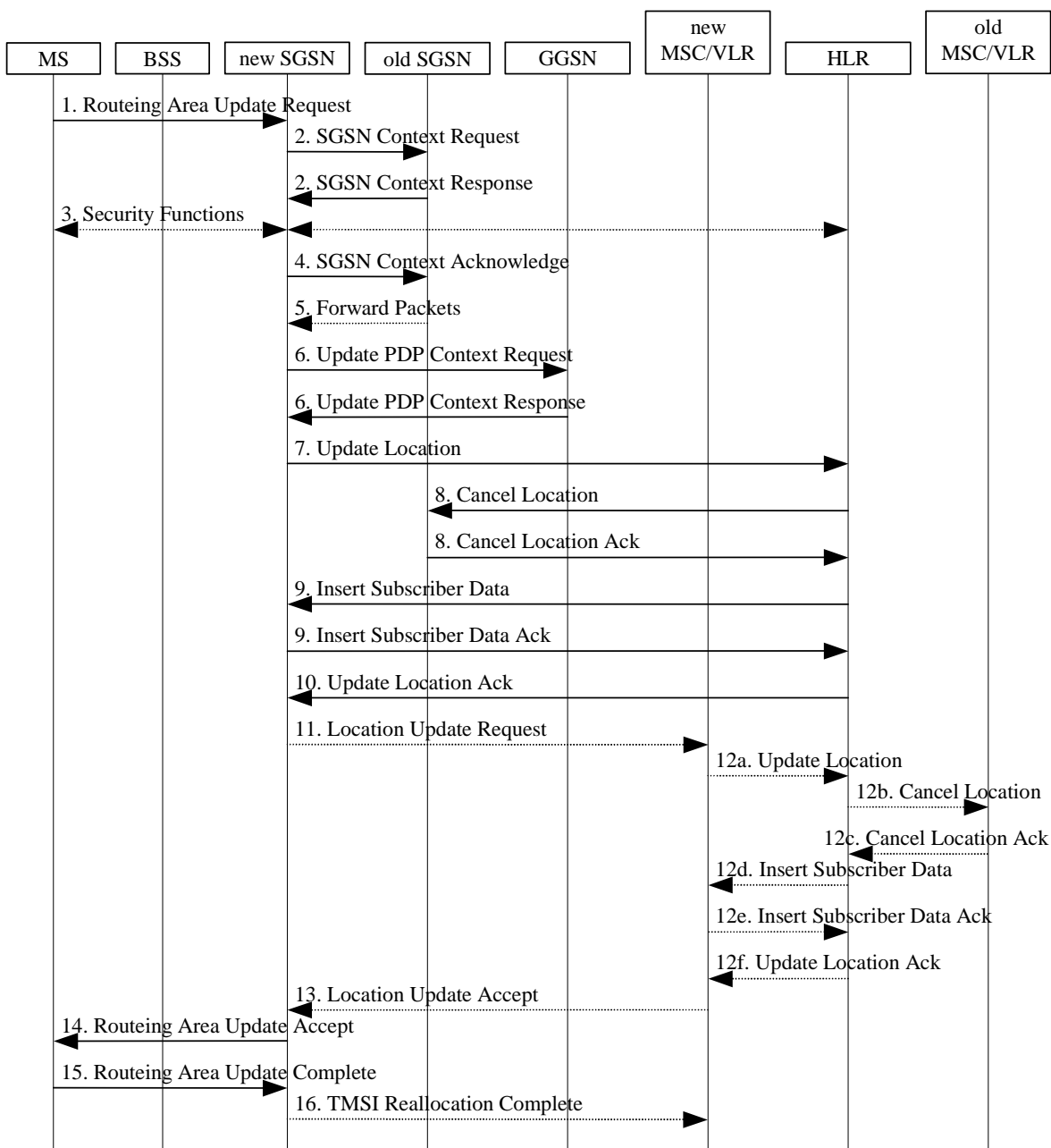


Figure 2: Combined RA / LA Update in the Case of Inter SGSN RA Update Procedure

- 1) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type) to the new SGSN. Update Type shall indicate combined RA / LA update, or, if the MS wants to perform an IMSI attach, combined RA / LA update with IMSI attach requested. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN.

- 2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN stops assigning SMDCP N-PDU numbers to downlink N-PDUs received, and responds with SGSN Context Response (MM Context, PDP Contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address until the old MM context is cancelled, to allow the old SGSN to forward data packets to the new SGSN. Each PDP Context includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode from the MS, the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. The old SGSN starts a timer and stops the downlink transfer.
- 3) Security functions may be executed. These procedures are defined in subclause "Security Function". Ciphering mode shall be set if ciphering is supported. If the security functions fail (e.g. because the SGSN cannot determine the HLR address to establish the Send Authentication Info dialogue), the Inter SGSN RAU Update procedure fails. A reject shall be returned to the MS with an appropriate cause.
- 4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, then the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received from the GGSN before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS in acknowledged mode and that are not yet acknowledged by the MS are tunnelled together with the SMDCP N-PDU number. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.
- 6) The new SGSN sends Update PDP Context Request (new SGSN Address, TID, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. The GGSNs update their PDP context fields and return an Update PDP Context Response (TID). [The SGSN should send the serving network identity to the GGSN.](#)
- 7) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 8) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, then the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 9) The HLR sends Insert Subscriber Data (IMSI, GPRS subscription data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routeing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful then the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 10) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
- 11) If the association has to be established, if Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routeing area update, then the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with IMSI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI via a table in the SGSN. The SGSN starts the location update procedure towards the new MSC/VLR upon

- receipt of the first Insert Subscriber Data message from the HLR in step 9). The VLR creates or updates the association with the SGSN by storing SGSN Number.
- 12) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.
 - e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
 - 13) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the SGSN. VLR TMSI is optional if the VLR has not changed.
 - 14) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the SGSN, or if subscription checking fails, then the SGSN rejects the routing area update with an appropriate cause. If all checks are successful then the new SGSN establishes MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature, Receive N-PDU Number). Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.
 - 15) The MS confirms the reallocation of the TMSIs by returning a Routing Area Update Complete (Receive N-PDU Number) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms reception of N-PDUs that were forwarded from the old SGSN, then these N-PDUs shall be discarded by the new SGSN. LLC and SNDPCP in the MS are reset.
 - 16) The new SGSN sends a TMSI Reallocation Complete message to the new VLR if the VLR TMSI is confirmed by the MS.

In the case of a rejected routing area update operation, due to regional subscription or roaming restrictions, or because the SGSN cannot determine the HLR address to establish the locating updating dialogue, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, then the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter IDLE state.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, then the old SGSN shall stop forwarding N-PDUs to the new SGSN.

If the Location Update Accept message indicates a reject, then this should be indicated to the MS, and the MS shall not access non-GPRS services until a successful location update is performed.

Next change

9.2.2 Activation Procedures

9.2.2.1 PDP Context Activation Procedure

The PDP Context Activation procedure is illustrated in Figure 3. Each step is explained in the following list.

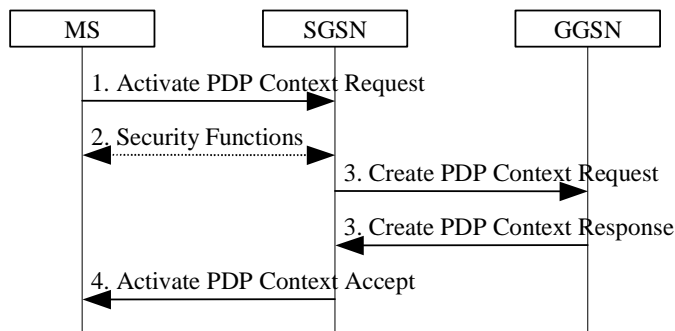


Figure 3: PDP Context Activation Procedure

- 1) The MS sends an Activate PDP Context Request (NSAPI, TI, PDP Type, PDP Address, Access Point Name, QoS Requested, PDP Configuration Options) message to the SGSN. The MS shall use PDP Address to indicate whether it requires the use of a static PDP address or whether it requires the use of a dynamic PDP address. The MS shall leave PDP Address empty to request a dynamic PDP address. The MS may use Access Point Name to select a reference point to a certain external network. Access Point Name is a logical name referring to the external packet data network that the subscriber wishes to connect to. QoS Requested indicates the desired QoS profile. PDP Configuration Options may be used to request optional PDP parameters from the GGSN (see GSM 09.60). PDP Configuration Options is sent transparently through the SGSN.
- 2) Security functions may be executed. These procedures are defined in subclause "Security Function".
- 3) The SGSN validates the Activate PDP Context Request using PDP Type (optional), PDP Address (optional), and Access Point Name (optional) provided by the MS and the PDP context subscription records. The validation criteria, the APN selection criteria, and the mapping from APN to a GGSN are described in annex A.

If no GGSN address can be derived or if the SGSN has determined that the Activate PDP Context Request is not valid according to the rules described in annex A, then the SGSN rejects the PDP context activation request.

If a GGSN address can be derived, the SGSN creates a TID for the requested PDP context by combining the IMSI stored in the MM context with the NSAPI received from the MS. If the MS requests a dynamic address, then the SGSN lets a GGSN allocate the dynamic address. The SGSN may restrict the requested QoS attributes given its capabilities, the current load, and the subscribed QoS profile. The SGSN sends a Create PDP Context Request (PDP Type, PDP Address, Access Point Name, QoS Negotiated, TID, MSISDN, Selection Mode, PDP Configuration Options, [serving network identity](#)) message to the affected GGSN. [The SGSN should send the serving network identity to the GGSN.](#) Access Point Name shall be the APN Network Identifier of the APN selected according to the procedure described in annex A. PDP Address shall be empty if a dynamic address is requested. The GGSN may use Access Point Name to find an external network. Selection Mode indicates whether a subscribed APN was selected, or whether a non-subscribed APN sent by MS or a non-subscribed APN chosen by SGSN was selected. Selection Mode is set according to annex A. The GGSN may use Selection Mode when deciding whether to accept or reject the PDP context activation. For example, if an APN requires subscription, then the GGSN is configured to accept only the PDP context activation that requests a subscribed APN as indicated by the SGSN with Selection Mode. The GGSN creates a new entry in its PDP context table and generates a Charging Id. The new entry allows the GGSN to route PDP PDUs between the SGSN and the external PDP network, and to start charging. The GGSN may further restrict QoS Negotiated given its capabilities and the current load. The GGSN then returns a Create PDP Context Response (TID, PDP Address, Reordering Required, PDP Configuration Options, QoS Negotiated, Charging Id, Cause) message to the SGSN. PDP Address is included if the GGSN allocated a PDP address. Reordering Required indicates whether the SGSN shall reorder N-PDUs before delivering the N-PDUs to the MS. PDP Configuration Options contain optional PDP parameters that the GGSN may transfer to the MS. These optional PDP parameters may be requested by the MS in the Activate PDP Context Request message, or may be sent unsolicited by the GGSN. PDP Configuration Options is sent transparently through the SGSN. The Create PDP Context messages are sent over the GPRS backbone network.

If QoS Negotiated received from the SGSN is incompatible with the PDP context being activated (e.g., the reliability class is insufficient to support the PDP type), then the GGSN rejects the Create PDP Context Request message. The compatible QoS profiles are configured by the GGSN operator.

- 4) The SGSN inserts the NSAPI along with the GGSN address in its PDP context. If the MS has requested a dynamic address, the PDP address received from the GGSN is inserted in the PDP context. The SGSN selects Radio Priority based on QoS Negotiated, and returns an Activate PDP Context Accept (PDP Type, PDP Address, TI, QoS Negotiated, Radio Priority, PDP Configuration Options) message to the MS. The SGSN is now able to route PDP PDUs between the GGSN and the MS, and to start charging.

For each PDP Address a different quality of service (QoS) profile may be requested. For example, some PDP addresses may be associated with E-mail that can tolerate lengthy response times. Other applications cannot tolerate delay and demand a very high level of throughput, interactive applications being one example. These different requirements are reflected in the QoS profile. The QoS profile is defined in subclause "Quality of Service Profile". If a QoS requirement is beyond the capabilities of a PLMN, the PLMN negotiates the QoS profile as close as possible to the requested QoS profile. The MS either accepts the negotiated QoS profile, or deactivates the PDP context.

After an SGSN has successfully updated the GGSN, the PDP contexts associated with an MS is distributed as shown in clause "Information Storage".

If the PDP Context Activation Procedure fails or if the SGSN returns an Activate PDP Context Reject (Cause, PDP Configuration Options) message, then the MS may attempt another activation to the same APN up to a maximum number of attempts.

Next change

9.2.3 Modification Procedures

An SGSN can decide, possibly triggered by the HLR as explained in subclause "Insert Subscriber Data Procedure", to modify parameters that were negotiated during an activation procedure for one or several PDP contexts. The following parameters can be modified:

- QoS Negotiated; and
- Radio Priority.

The SGSN can request the modification of parameters by sending a Modify PDP Context Request message to the MS.

9.2.3.1 PDP Context Modification Procedure

The PDP Context Modification procedure is illustrated in Figure 4. Each step is explained in the following list.

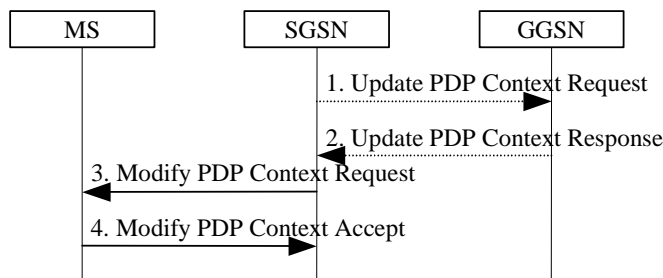


Figure 4: PDP Context Modification Procedure

- 1) The SGSN may send an Update PDP Context Request (TID, QoS Negotiated, [serving network identity](#)) message to the GGSN. [The SGSN should send the serving network identity to the GGSN.](#) If QoS Negotiated received from the SGSN is incompatible with the PDP context being modified (e.g., the reliability class is insufficient to support the PDP type), then the GGSN rejects the Update PDP Context Request. The compatible QoS profiles are configured by the GGSN operator.
- 2) The GGSN may restrict QoS Negotiated given its capabilities and the current load. The GGSN stores QoS Negotiated and returns an Update PDP Context Response (TID, QoS Negotiated) message.
- 3) The SGSN sends a Modify PDP Context Request (TI, QoS Negotiated, Radio Priority) message to the MS.
- 4) The MS acknowledges by returning a Modify PDP Context Accept message. If the MS does not accept the new QoS Negotiated it shall de-activate the PDP context with the PDP Context Deactivation Initiated by MS procedure.

CR-Form-v7	
CHANGE REQUEST	
⌘ 23.060 CR 471 ⌘ rev 3 ⌘	Current version: 3.15.0 ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: UICC apps ME Radio Access Network Core Network

Title:	⌘ Serving network identity from SGSN to GGSN		
Source:	⌘ Nortel Networks		
Work item code:	⌘ TEI	Date:	⌘ 24/11/03
Category:	⌘ F	Release:	⌘ R99
	Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:
	F (correction)	R96	2 (GSM Phase 2)
	A (corresponds to a correction in an earlier release)	R97	(Release 1996)
	B (addition of feature),	R98	(Release 1997)
	C (functional modification of feature)	R99	(Release 1998)
	D (editorial modification)	Rel-4	(Release 1999)
	Detailed explanations of the above categories can be found in 3GPP TR 21.900 .	Rel-5	(Release 4)
		Rel-6	(Release 5)
			(Release 6)

Reason for change:	⌘ In an LS from SA5 (S2-033339), SA2 are asked to add the requirement of including the MCC and MNC of the location of where the MS is registered in messaging between SGSN and GGSN (inside the RAI). This is necessary for accurate content filtering. Previous liaisons from T2, CPWP and BARG indicated problems with the implementation of integrated pricing structures without such additions.
Summary of change:	⌘ Information is added to the Create PDP Context Req and Update PDP Context Req, to provide to the GGSN with the network identity on which the MS is registered.
Consequences if not approved:	⌘ Stage 2 requirement missing.

Clauses affected:	⌘ 6.9.1.2.2, 6.9.1.3.2, 6.9.2.1, 6.9.2.2.1, 6.9.2.2.2, 6.13.2.1, 6.13.2.2, 9.2.2.1, 9.2.2.1.1, 9.2.3.1, 9.2.3.3						
Other specs affected:	<table border="1" style="font-size: x-small;"> <tr> <td style="padding: 2px;">Y</td> <td style="padding: 2px;">N</td> </tr> <tr> <td style="text-align: center;">⌘</td> <td style="text-align: center;">X</td> </tr> </table>	Y	N	⌘	X	Other core specifications	⌘
	Y	N					
	⌘	X					
<table border="1" style="font-size: x-small;"> <tr> <td style="padding: 2px;">⌘</td> <td style="padding: 2px;">X</td> </tr> </table>	⌘	X	Test specifications				
⌘	X						
<table border="1" style="font-size: x-small;"> <tr> <td style="padding: 2px;">⌘</td> <td style="padding: 2px;">X</td> </tr> </table>	⌘	X	O&M Specifications				
⌘	X						
Other comments:	⌘						

6.9.1.2.2 Inter SGSN Routing Area Update

The Inter SGSN Routing Area Update procedure is illustrated in Figure 1.

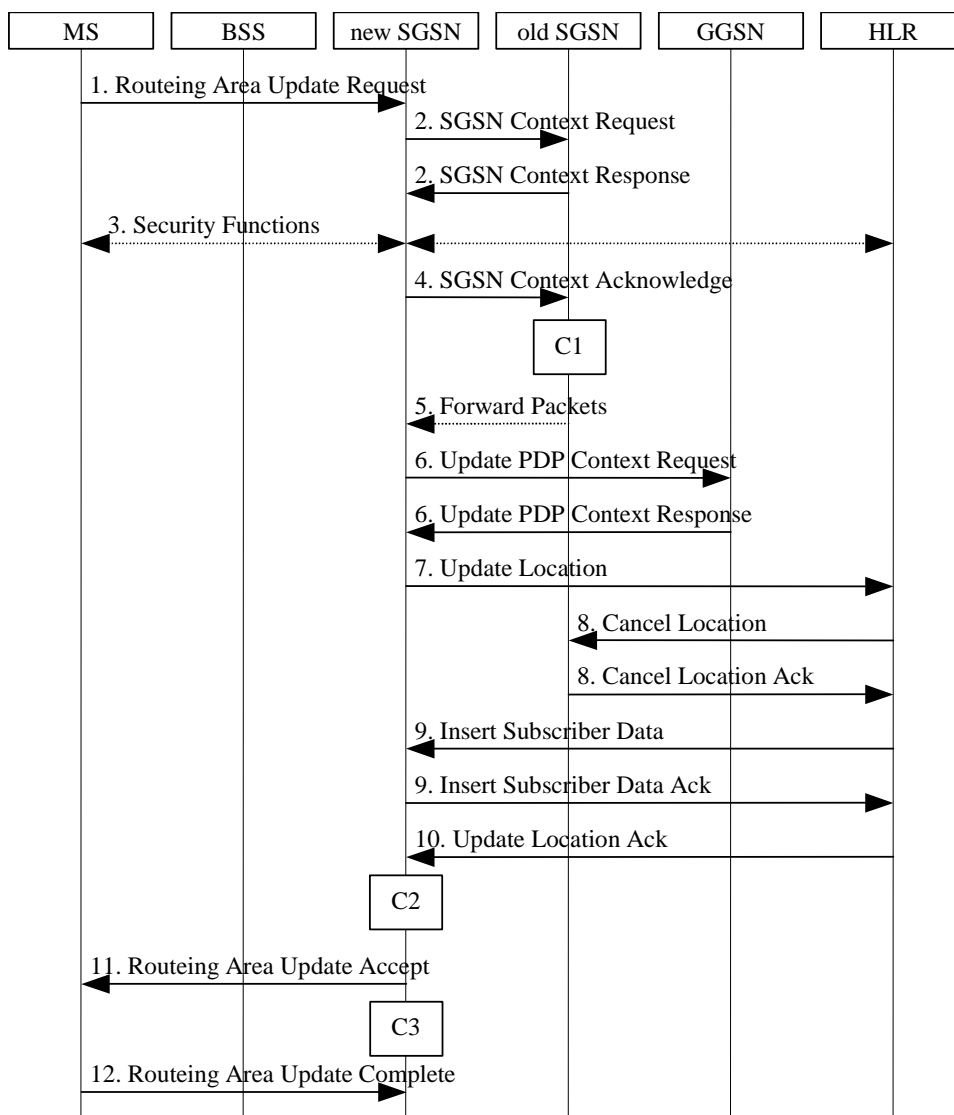


Figure 1: Inter SGSN Routing Area Update Procedure

- 1) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type, Classmark, DRX parameters and MS Network Capability) to the new SGSN. Update Type shall indicate RA update or periodic RA update. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN. Classmark contains the MS GPRS multislot capabilities and supported GPRS ciphering algorithms as defined in TS 24.008. DRX Parameters indicates whether or not the MS uses discontinuous reception and the DRX cycle length.
- 2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN stops assigning SMDCP N-PDU numbers to downlink N-PDUs received, and responds with SGSN Context Response

(MM Context, PDP Contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address, to allow the old SGSN to forward data packets to the new SGSN. Each PDP Context includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode from the MS, the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. The old SGSN starts a timer and stops the transmission of N-PDUs to the MS. The new SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routeing Area Request.

- 3) Security functions may be executed. These procedures are defined in subclause "Security Function". Ciphering mode shall be set if ciphering is supported.

If the security functions fail (e.g. because the SGSN cannot determine the HLR address to establish the Send Authentication Info dialogue), the Inter SGSN RAU Update procedure fails. A reject shall be returned to the MS with an appropriate cause.

- 4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, then the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received from the GGSN before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS in acknowledged mode and that are not yet acknowledged by the MS are tunnelled together with the SMDCP N-PDU number. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.
- 6) The new SGSN sends Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return Update PDP Context Response (TEID).
- 7) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 8) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter-SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 9) The HLR sends Insert Subscriber Data (IMSI, GPRS Subscription Data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routeing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful, the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 10) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
- 11) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS, is not allowed to be attached in the SGSN, or if subscription checking fails, the new SGSN rejects the routeing area update with an appropriate cause. If all checks are successful, the new SGSN constructs MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routeing Area Update Accept (P-TMSI, P-TMSI Signature, Receive N-PDU Number). Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.
- 12) The MS acknowledges the new P-TMSI by returning a Routeing Area Update Complete (Receive N-PDU Number) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-terminated N-PDUs successfully

transferred before the start of the update procedure. If Receive N-PDU Number confirms reception of N-PDUs that were forwarded from the old SGSN, these N-PDUs shall be discarded by the new SGSN. LLC and SNDCP in the MS are reset.

In the case of a rejected routing area update operation, due to regional subscription or roaming restrictions, , or because the SGSN cannot determine the HLR address to establish the locating updating dialogue, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS does not re-attempt a routing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, the old SGSN stops forwarding N-PDUs to the new SGSN.

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter IDLE state.

CAMEL procedure calls shall be performed, see referenced procedures in 3G TS 23.078:

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach.

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

C2) CAMEL_GPRS_Routing_Area_Update_Session.

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

Next change

6.9.1.3.2 Combined Inter SGSN RA / LA Update

The Combined RA / LA Update (inter-SGSN) procedure is illustrated in Figure 2.

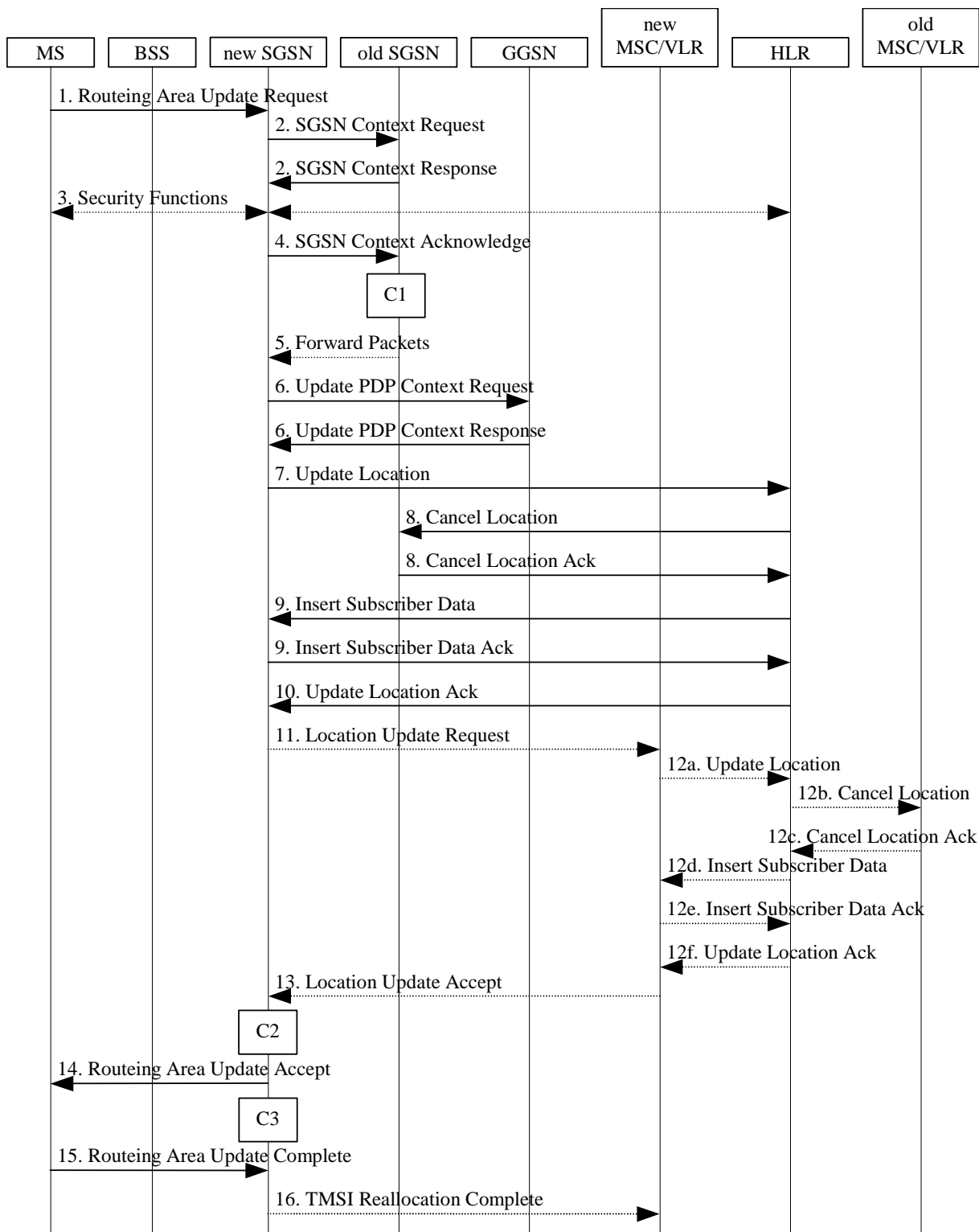


Figure 2: Combined RA / LA Update in the Case of Inter SGSN RA Update Procedure

- 1) The MS sends a Routeing Area Update Request (old RAI, old P-TMSI Signature, Update Type, Classmark, DRX parameters and MS Network Capability) to the new SGSN. Update Type shall indicate combined RA / LA update, or, if the MS wants to perform an IMSI attach, combined RA / LA update with IMSI attach requested. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN. Classmark contains the MS GPRS multislot capabilities and supported GPRS ciphering algorithms as defined in TS 24.008. DRX Parameters indicates whether or not the MS uses discontinuous and the DRX cycle length.
- 2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN stops assigning SMDCP N-PDU numbers to downlink N-PDUs received, and responds with SGSN Context Response (MM Context, PDP Contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address until the old MM context is cancelled, to allow the old SGSN to forward data packets to the new SGSN. Each PDP Context includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode from the MS, the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. The old SGSN starts a timer and stops the downlink transfer. The new SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routeing Area Request.
- 3) Security functions may be executed. These procedures are defined in subclause "Security Function". Ciphering mode shall be set if ciphering is supported. If the security functions fail (e.g. because the SGSN cannot determine the HLR address to establish the Send Authentication Info dialogue), the Inter SGSN RAU Update procedure fails. A reject shall be returned to the MS with an appropriate cause.
- 4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received from the GGSN before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS in acknowledged mode and that are not yet acknowledged by the MS are tunnelled together with the SMDCP N-PDU number. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.
- 6) The new SGSN sends Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (TEID).
- 7) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 8) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 9) The HLR sends Insert Subscriber Data (IMSI, GPRS Subscription Data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routeing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful, the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.

- 10) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
- 11) If the association has to be established, if Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routing area update, the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with IMSI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI via a table in the SGSN. The SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 9). The VLR creates or updates the association with the SGSN by storing SGSN Number.
- 12) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.
 - e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
- 13) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the SGSN. VLR TMSI is optional if the VLR has not changed.
- 14) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the RA, or if subscription checking fails, the SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new SGSN establishes MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature, Receive N-PDU Number). Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.
- 15) The MS confirms the reallocation of the TMSIs by returning a Routing Area Update Complete (Receive N-PDU Number) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms reception of N-PDUs that were forwarded from the old SGSN, these N-PDUs shall be discarded by the new SGSN. LLC and SNDCP in the MS are reset.
- 16) The new SGSN sends a TMSI Reallocation Complete message to the new VLR if the MS confirms the VLR TMSI.

In the case of a rejected routing area update operation, due to regional subscription or roaming restrictions, or because the SGSN cannot determine the HLR address to establish the locating updating dialogue, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter IDLE state.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, the old SGSN shall stop forwarding N-PDUs to the new SGSN.

If the Location Update Accept message indicates a reject, this should be indicated to the MS, and the MS shall not access non-GPRS services until a successful location update is performed.

CAMEL procedure calls shall be performed, see referenced procedures in 3G TS 23.078:

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach.

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

C2) CAMEL_GPRS_Routeing_Area_Update_Session.

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routeing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

Next change

6.9.2.1 Routeing Area Update Procedure

A routeing area update takes place when an attached MS detects that it has entered a new RA or when the periodic RA update timer has expired or when RRC connection is released with cause "Directed Signalling connection re-establishment", or when the MS has to indicate new access capabilities to the network.

The SGSN detects that it is an intra-SGSN routeing area update by noticing that it also handles the old RA. In this case, the SGSN has the necessary information about the MS and there is no need to inform the GGSNs or the HLR about the new MS location. A periodic RA update is always an intra-SGSN routeing area update. If the network operates in mode I, an MS that is both GPRS-attached and IMSI-attached shall perform the Combined RA / LA Update procedures.

In Iu mode, an RA update is either an intra-SGSN or inter-SGSN RA update, either combined RA / LA update or only RA update, either initiated by an MS in PMM-CONNECTED (only valid after a Serving RNS Relocation Procedure, see sub-clause 6.9.2.2) or in PMM-IDLE state. All the RA update cases are contained in the procedure illustrated in Figure 3.

NOTE: The network may receive an RA update from a UE in PMM-CONNECTED state over a new Iu signalling connection. This could happen when the UE enters PMM-IDLE state on receipt of RRC Connection Release with cause "Directed Signalling connection re-establishment" and initiates an RA or Combined RA update procedure (see sub-clause 6.1.2.4.1).

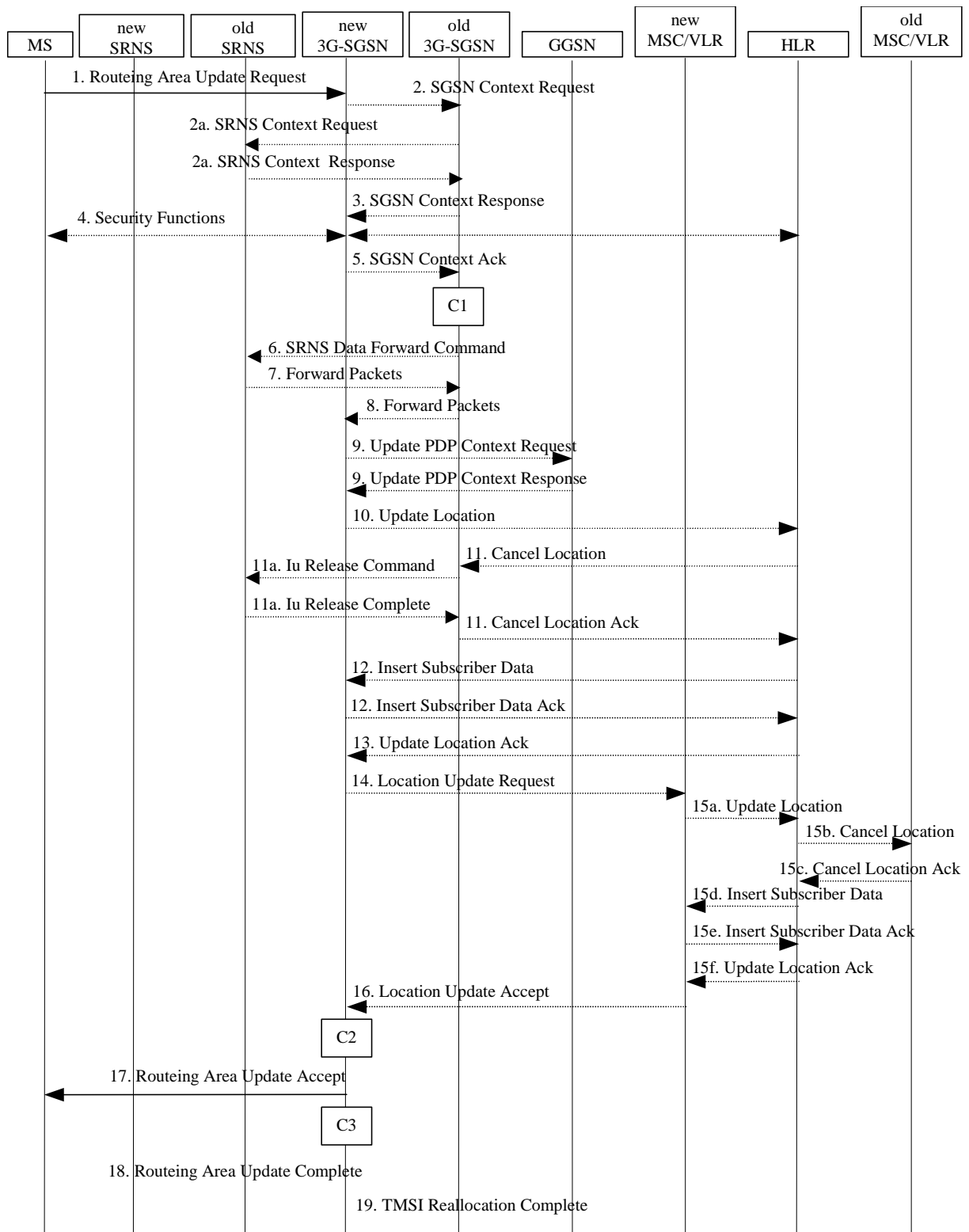


Figure 3: UMTS RA Update Procedure

- 1) The RRC connection is established, if not already done. The MS sends a Routeing Area Update Request message (P-TMSI, old RAI, old P-TMSI Signature, Update Type, follow on request, Classmark, DRX Parameters, MS Network Capability) to the new SGSN. The MS shall set a follow-on request if there is pending uplink traffic (signalling or user data). The SGSN may use, as an implementation option, the follow-on request indication to release or keep the Iu connection after the completion of the RA update procedure. Update Type shall indicate:
 - RA Update if the RA Update is triggered by a change of RA;
 - Periodic RA Update if the RA update is triggered by the expiry of the Periodic RA Update timer;
 - Combined RA / LA Update if the MS is also IMSI-attached and the LA update shall be performed in network operation mode I (see subclause "Interactions Between SGSN and MSC/VLR"); or
 - Combined RA / LA Update with IMSI attach requested if the MS wants to perform an IMSI attach in network operation mode I.

The SRNC shall add the Routeing Area Identity including the RAC and LAC of the area where the MS is located before forwarding the message to the 3G-SGSN. This RA identity corresponds to the RAI in the MM system information sent by the SRNC to the MS. Classmark is described in subclause "MS Network Capability". DRX Parameters indicates whether or not the MS uses discontinuous reception and the DRX cycle length.

NOTE: Sending the Routeing Area Update Request message to the SGSN triggers the establishment of a signalling connection between UTRAN and SGSN for the concerned MS.

- 2) If the RA update is an Inter-SGSN Routeing area update and if the MS was in PMM-IDLE state, the new SGSN sends an SGSN Context Request message (old P-TMSI, old RAI, old P-TMSI Signature) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (IMSI, old RAI, MS Validated) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN starts a timer. If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause.
- 2a) If the MS is PMM-CONNECTED in the old 3G-SGSN or, in case of an intra-SGSN RA update, if the MS is PMM connected and the RAU was received over another Iu connection than the established one, the old SGSN shall send SRNS Context Request (IMSI) message to the old SRNS to retrieve the sequence numbers for the PDP context for inclusion in the SGSN Context Response message. Upon reception of this message, the SRNS buffers and stops sending downlink PDUs to the MS and returns an SRNS Context Response (IMSI, GTP-SNDs, GTP-SNUs, PDCP-SNUs) message. The SRNS shall include for each PDP context the next in-sequence GTP sequence number to be sent to the MS and the GTP sequence number of the next uplink PDU to be tunnelled to the GGSN. For each active PDP context which uses lossless PDCP, the SRNS also includes the uplink PDCP sequence number (PDCP-SNU). PDCP-SNU shall be the next in-sequence PDCP sequence number expected from the MS (per each active radio bearer). No conversion of PDCP sequence numbers to SDCP sequence numbers shall be done in the 3G-SGSN.
- 3) The old 3G-SGSN responds with an SGSN Context Response (MM Context, PDP Contexts) message. For each PDP context the old 3G-SGSN shall include the GTP sequence number for the next uplink GTP PDU to be tunnelled to the GGSN and the next downlink GTP sequence number for the next PDU to be sent to the MS. Each PDP Context also includes PDCP sequence numbers if PDCP sequence numbers are received from the old SRNS. The new 3G-SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routeing Area Request. The GTP sequence numbers received from the old 3G-SGSN are only relevant if delivery order is required for the PDP context (QoS profile).
- 4) Security functions may be executed. These procedures are defined in subclause "Security Function". If the security functions do not authenticate the MS correctly, the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) If the RA update is an Inter-SGSN Routeing area update, the new SGSN sends an SGSN Context Acknowledge message to the old SGSN. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure.

- 6) If the MS is in PMM-CONNECTED state in the old 3G-SGSN or, in case of an intra-SGSN RA update, if the MS is PMM connected and the RAU was received over another Iu connection than the established one, the old 3G-SGSN sends an SRNS Data Forward Command (RAB ID, Transport Layer Address, Iu Transport Association) message to the SRNS. Upon receipt of the SRNS Data Forward Command message from the 3G-SGSN, the SRNS shall start the data-forwarding timer.
- 7) For each indicated RAB the SRNS starts duplicating and tunnelling the buffered GTP PDUs to the old 3G-SGSN. For each radio bearer which uses lossless PDCP the SRNS shall start tunnelling the partly transmitted and the transmitted but not acknowledged PDCP-PDUs together with their related PDCP downlink sequence number, and start duplicating and tunnelling the buffered GTP PDUs to the old 3G-SGSN. Upon receipt of the SRNS Data Forward Command message from the 3G-SGSN, the SRNS shall start the data-forwarding timer.
- 8) If the RA update is an Inter-SGSN RA Update, the old 3G-SGSN tunnels the GTP PDUs to the new 3G-SGSN. No conversion of PDCP sequence numbers to SMDCP sequence numbers shall be done in the 3G-SGSN.
- 9) If the RA update is an Inter-SGSN RA Update and if the MS was not in PMM-CONNECTED state in the new 3G-SGSN, the new SGSN sends Update PDP Context Request (new SGSN Address, QoS Negotiated, Tunnel Endpoint Identifier, [serving network identity](#)) to the GGSNs. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (Tunnel Endpoint Identifier). Note: If the RA update is an Inter-SGSN routing area update initiated by an MS in PMM-CONNECTED state in the new 3G-SGSN, the Update PDP Context Request message is sent as described in subclause "Serving RNS Relocation Procedures".
- 10) If the RA update is an Inter-SGSN RA Update, the new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 11) If the RA update is an Inter-SGSN RA Update, the HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, the old SGSN removes the MM context. Otherwise, the contexts are removed only when the timer expires. It also ensures that the MM context is kept in the old SGSN in case the MS initiates another inter SGSN routing area update before completing the ongoing routing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 11a) On receipt of Cancel Location, if the MS is PMM-CONNECTED in the old 3G-SGSN, the old 3G-SGSN sends an Iu Release Command message to the old SRNC. When the data-forwarding timer expires, the SRNS responds with an Iu Release Complete message.
- 12) If the RA update is an Inter-SGSN RA Update, the HLR sends Insert Subscriber Data (IMSI, subscription data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful, the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 13) If the RA update is an Inter-SGSN RA Update, the HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
- 14) If Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routing area update, the association has to be established, and the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with ISI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI via a table in the SGSN. The SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 8). The VLR creates or updates the association with the SGSN by storing SGSN Number.
- 15) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.

- e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
- 16) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the SGSN. VLR TMSI is optional if the VLR has not changed.
- 17) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the RA, or if subscription checking fails, the SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new SGSN establishes MM context for the MS. The new SGSN responds to the MS with Routing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature).
- 18) The MS confirms the reallocation of the TMSIs by returning a Routing Area Update Complete message to the SGSN.
- 19) The new SGSN sends a TMSI Reallocation Complete message to the new VLR if the MS confirms the VLR TMSI.

NOTE: Steps 15, 16, and 19 are performed only if step 14 is performed.

In the case of a rejected routing area update operation, due to regional subscription or roaming restrictions, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routing area update to that RA. The RAI value shall be deleted when the MS is powered up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

NOTE: In case MS was in PMM-CONNECTED state the PDP Contexts are sent already in the Forward Relocation Request message as described in subclause "Serving RNS relocation procedures".

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter PMM-DETACHED state.

If the Location Update Accept message indicates a reject, this should be indicated to the MS, and the MS shall not access non-PS services until a successful location update is performed.

CAMEL procedure calls shall be performed; see referenced procedures in 3G TS 23.078:

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach.

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

C2) CAMEL_GPRS_Routing_Area_Update_Session.

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

Next change

6.9.2.2.1 SRNS Relocation Procedure

This procedure is only performed for an MS in PMM-CONNECTED state where the Iur interface carries both the control signalling and the user data.

The Serving SRNS Relocation procedure is used to move the UTRAN to CN connection point at the UTRAN side from the source SRNC to the target RNC, from a "standing still position". In the procedure, the Iu links are relocated. If the target RNC is connected to the same SGSN as the source SRNC, an Intra-SGSN SRNS Relocation procedure is performed. If the routing area is changed, this procedure is followed by an Intra-SGSN Routing Area Update procedure. The SGSN detects that it is an Intra-SGSN routing area update by noticing that it also handles the old RA. In this case, the SGSN has the necessary information about the MS and there is no need to inform the HLR about the new MS location.

Figure 4 shows SRNS relocation when source SRNC and target RNC are connected to different SGSNs. Figure 5 shows the situation after SRNS Relocation procedure and Routing Area Update procedure have been completed. In the case described in Figure 4 and Figure 5, the MS is in state PMM-CONNECTED.

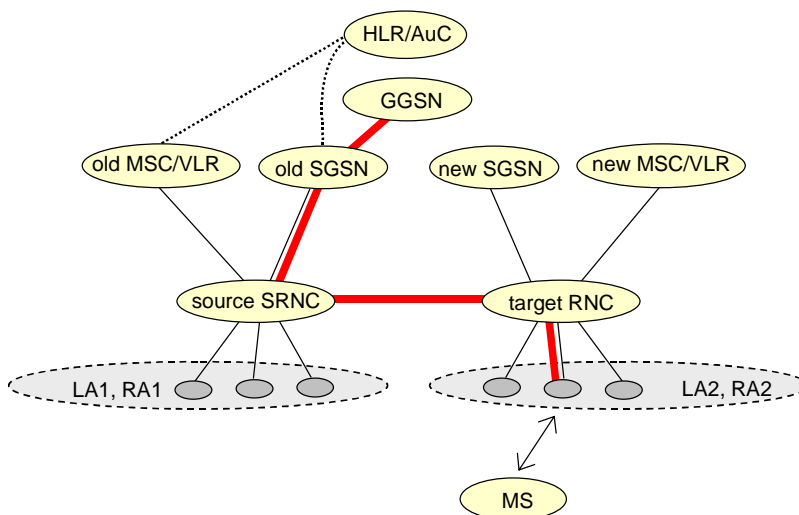


Figure 4: Before SRNS Relocation and Routing Area Update

Before the Serving SRNS Relocation procedure and RA update, the MS is registered in the old SGSN. The source RNC is acting as a serving RNC (SRNC).

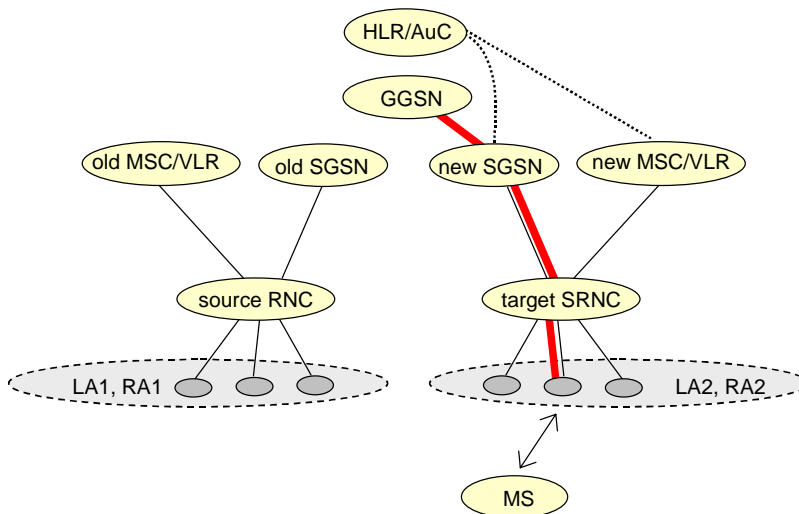


Figure 5: After SRNS Relocation and Routing Area Update

After the Serving SRNS Relocation procedure and RA update, the MS is registered in the new SGSN. The MS is in the state PMM-CONNECTED towards the new SGSN, and the target RNC is acting as the serving RNC.

The Serving SRNS Relocation procedure is illustrated in Figure 6. The sequence is valid for both intra-SGSN SRNS relocation and inter-SGSN SRNS relocation.

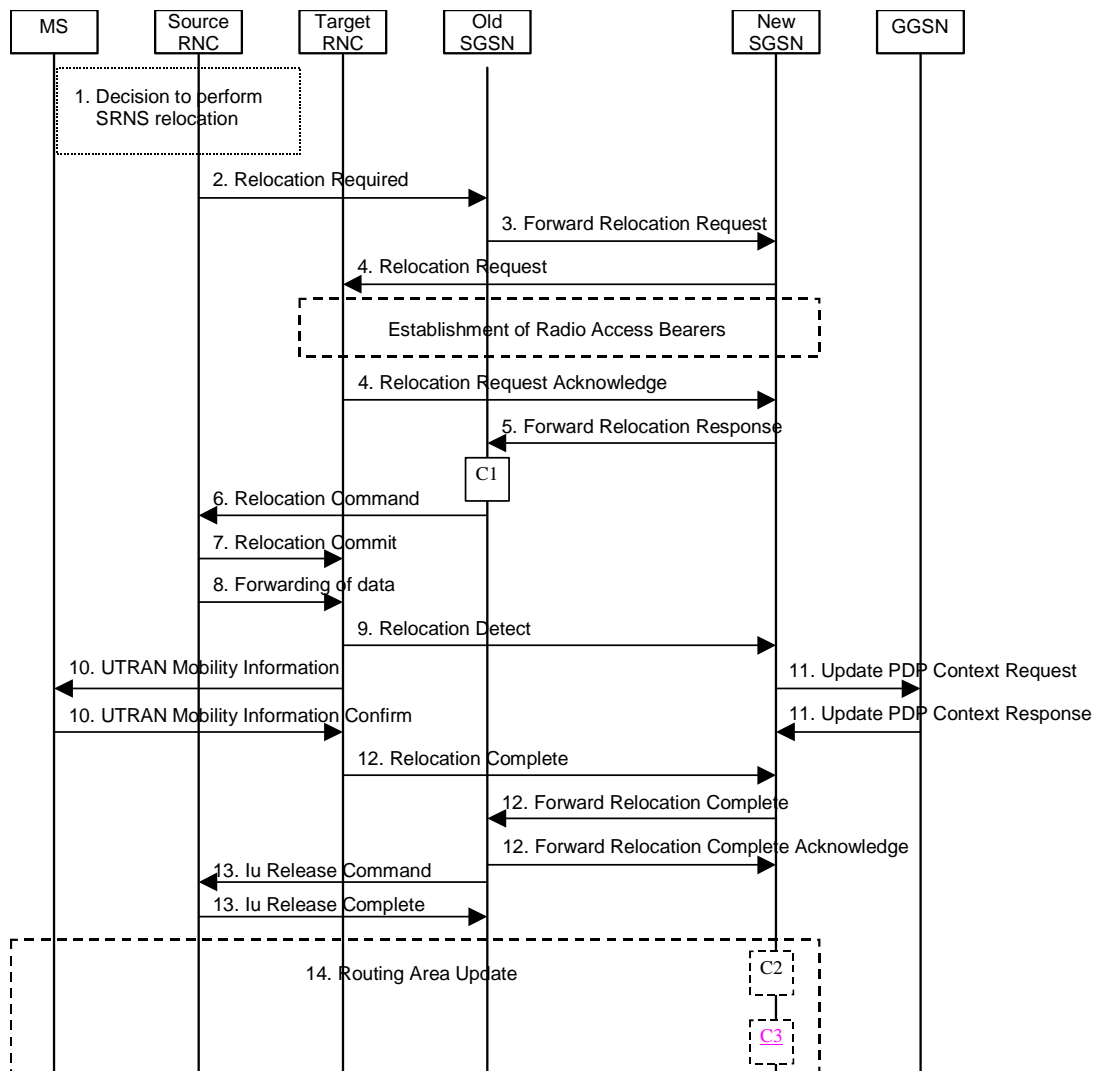


Figure 6: Serving SRNS Relocation Procedure

- 1) The source SRNC decides to perform/initiate SRNS relocation. At this point both uplink and downlink user data flows via the following tunnel(s): Radio Bearer between MS and source SRNC (data flows via the target RNC, which acts as a drift RNC); GTP-U tunnel(s) between source SRNC and old-SGSN; GTP-U tunnel(s) between old-SGSN and GGSN.
- 2) The source SRNC sends a Relocation Required message (Relocation Type, Cause, Source ID, Target ID, Source RNC to target RNC transparent container) to the old SGSN. The source SRNC shall set the Relocation Type to "UE not involved". The Source SRNC to Target RNC Transparent Container includes the necessary information for Relocation co-ordination, security functionality and RRC protocol context information (including MS Capabilities).
- 3) The old SGSN determines from the Target ID if the SRNS Relocation is intra-SGSN SRNS relocation or inter-SGSN SRNS relocation. In case of inter-SGSN SRNS relocation, the old SGSN initiates the relocation resource allocation procedure by sending a Forward Relocation Request message (IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, UTRAN transparent container, RANAP Cause) to the new SGSN. PDP context contains GGSN Address for User Plane and Uplink TEID for Data (to this GGSN Address and Uplink TEID for Data, the old SGSN and the new SGSN send uplink packets). At the same time a timer is started on the MM and PDP contexts in the old SGSN (see the Routing Area Update procedure in subclause "Location Management Procedures (UMTS only)"). The Forward Relocation Request message is applicable only in the case of inter-SGSN SRNS relocation.

- 4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source RNC to target RNC transparent container, RABs to be setup) to the target RNC. Only the Iu Bearers of the RABs are setup between the target RNC and the new-SGSN as the existing Radio Bearers will be reallocated between the MS and the target RNC when the target RNC takes the role of the serving RNC. For each requested RAB, the RABs to be setup information elements shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. SGSN shall not establish RABs for PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to the uplink Tunnel Endpoint Identifier Data. After all necessary resources for accepted RABs including the Iu user plane are successfully allocated; the target RNC shall send the Relocation Request Acknowledge message (RABs setup, RABs failed to setup) to the new SGSN. Each RAB to be setup is defined by a Transport Layer Address, which is the target RNC Address for user data, and an Iu Transport Association, which corresponds to the downlink Tunnel Endpoint Identifier for user data. For each RAB to be set up, the target RNC may receive simultaneously downlink user packets both from the source SRNC and from the new SGSN.

After the new SGSN receives the Relocation Request Acknowledge message, the GTP-U tunnels are established between the target RNC and the new-SGSN.

- 5) When resources for the transmission of user data between the target RNC and the new SGSN have been allocated and the new SGSN is ready for relocation of SRNS, the Forward Relocation Response message (Cause, RANAP Cause, and RAB Setup Information) is sent from the new SGSN to old SGSN. This message indicates that the target RNC is ready to receive from source SRNC the forwarded downlink PDUs, i.e. the relocation resource allocation procedure is terminated successfully. RANAP Cause is information from the target RNC to be forwarded to the source SRNC. The RAB Setup Information, one information element for each RAB, contains the RNC Tunnel Endpoint Identifier and the RNC IP address for data forwarding from the source SRNC to the target RNC. If the target RNC or the new SGSN failed to allocate resources, the RAB Setup Information element contains only NSAPI indicating that the source SRNC shall release the resources associated with the NSAPI. The Forward Relocation Response message is applicable only in case of inter-SGSN SRNS relocation.
- 6) The old SGSN continues the relocation of SRNS by sending a Relocation Command message (RABs to be released, and RABs subject to data forwarding) to the source SRNC. The old SGSN decides the RABs to be subject for data forwarding based on QoS, and those RABs shall be contained in RABs subject to data forwarding. For each RAB subject to data forwarding, the information element shall contain RAB ID, Transport Layer Address, and Iu Transport Association. These are the same Transport Layer Address and Iu Transport Association that the target RNC had sent to new SGSN in Relocation Request Acknowledge message, and these are used for forwarding of downlink N-PDU from source SRNC to target RNC. The source SRNC is now ready to forward downlink user data directly to the target RNC over the Iu interface. This forwarding is performed for downlink user data only.
- 7) Upon reception of the Relocation Command message from the PS domain, the source SRNC shall start the data-forwarding timer.

NOTE: The order of steps, starting from step 7 onwards, does not necessarily reflect the order of events. For instance, source RNC may start data forwarding (step 7) and send Relocation Commit message (step 8) almost simultaneously except in the delivery order required case where step 7 triggers step 8. Target RNC may send Relocation Detect message (step 9) and UTRAN Mobility Information message (step 10) at the same time. Hence, target RNC may receive UTRAN Mobility Information Confirm message (step 10) while data forwarding (step 7) is still underway, and before the new SGSN receives Update PDP Context Response message (step 11).

When the source SRNC is ready, the source SRNC shall trigger the execution of relocation of SRNS by sending a Relocation Commit message (SRNS Contexts) to the target RNC over the Iur interface. The purpose of this procedure is to transfer SRNS contexts from the source RNC to the target RNC, and to move the SRNS role from the source RNC to the target RNC. SRNS contexts are sent for each concerned RAB and contain the sequence numbers of the GTP-U PDUs next to be transmitted in the uplink and downlink directions and the next PDCP sequence numbers that would have been used to send and receive data from the MS. For PDP context(s) using delivery order not required (QoS profile), the sequence numbers of the GTP-U PDUs next to be transmitted are not used by the target RNC. PDCP sequence numbers are only sent by the source RNC for radio bearers which used lossless PDCP [57]. The use of lossless PDCP is selected by the RNC when the radio bearer is set up or reconfigured.

If delivery order is required (QoS profile), consecutive GTP-PDU sequence numbering shall be maintained throughout the lifetime of the PDP context(s). Therefore, during the entire SRNS relocation procedure for the PDP context(s) using delivery order required (QoS profile), the responsible GTP-U entities (RNCs and GGSN)

shall assign consecutive GTP-PDU sequence numbers to user packets belonging to the same PDP context for uplink and downlink respectively.

Before sending the Relocation Commit uplink and downlink data transfer in the source, SRNC shall be suspended for RABs, which require maintaining the delivery order.

- 8) The source RNC begins the forwarding of data for the RABs to be subject for data forwarding. The data forwarding at SRNS relocation shall be carried out through the Iu interface, meaning that the GTP-U PDUs, which are exchanged between the source RNC and the target RNC, are duplicated in the source RNC and routed at IP layer towards the target RNC. For each radio bearer which uses lossless PDCP the GTP-U PDUs corresponding to transmitted but not yet acknowledged PDCP PDUs are duplicated and routed at IP layer towards the target RNC together with their related downlink PDCP sequence numbers.
- 9) The target RNC shall send a Relocation Detect message to the new SGSN when the relocation execution trigger is received. For SRNS relocation type "UE not involved", the relocation execution trigger is the reception of the Relocation Commit message from the Iur interface. When the Relocation Detect message is sent, the target RNC shall start SRNC operation.
- 10) The target SRNC sends a UTRAN Mobility Information message. This message contains UE information elements and CN information elements. The UE information elements include among others new SRNC identity and S-RNTI. The CN information elements contain among others Location Area Identification and Routing Area Identification. The procedure shall be co-ordinated in all Iu signalling connections existing for the MS.

The target SRNC establishes and/or restarts the RLC, and exchanges the PDCP sequence numbers (PDCP-SNU, PDCP-SND) between the target SRNC and the MS. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received in the MS per radio bearer, which used lossless PDCP in the source RNC. PDCP-SND confirms all mobile-terminated packets successfully transferred before the SRNC relocation. If PDCP-SND confirms reception of packets that were forwarded from the source SRNC, the target SRNC shall discard these packets. PDCP-SNU is the PDCP sequence number for the next expected in-sequence uplink packet to be received in the RNC per radio bearer, which used lossless PDCP in the source RNC. PDCP-SNU confirms all mobile originated packets successfully transferred before the SRNC relocation. If PDCP-SNU confirms reception of packets that were received in the source SRNC, the MS shall discard these packets.

Upon reception of the UTRAN Mobility Information message the MS may start sending uplink user data to the target SRNC. When the MS has reconfigured itself, it sends the UTRAN Mobility Information Confirm message to the target SRNC. This indicates that the MS is also ready to receive downlink data from the target SRNC.

If the new SGSN has already received the Update PDP Context Response message from the GGSN, it shall forward the uplink user data to GGSN over this new GTP-U tunnel. Otherwise, the new SGSN shall forward the uplink user data to that GGSN IP address and TEID(s), which the new SGSN had received earlier by the Forward Relocation Request message.

- 11) Upon receipt of the Relocation Detect message, the CN may switch the user plane from source RNC to target SRNC. If the SRNS Relocation is an inter SGSN SRNS relocation, the new SGSN sends Update PDP Context Request messages (new SGSN Address, SGSN Tunnel Endpoint Identifier, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (GGSN Tunnel Endpoint Identifier).
- 12) When the target SRNC receives the UTRAN Mobility Information Confirm message, i.e. the new SRNC-ID + S-RNTI are successfully exchanged with the MS by the radio protocols, the target SRNC shall initiate the Relocation Complete procedure by sending the Relocation Complete message to the new SGSN. The purpose of the Relocation Complete procedure is to indicate by the target SRNC the completion of the relocation of the SRNS to the CN. If the user plane has not been switched at Relocation Detect and upon reception of Relocation Complete, the CN shall switch the user plane from source RNC to target SRNC. If the SRNS Relocation is an inter-SGSN SRNS relocation, the new SGSN shall signal to the old SGSN the completion of the SRNS relocation procedure by sending a Forward Relocation Complete message.
- 13) Upon receiving the Relocation Complete message or if it is an inter-SGSN SRNS relocation; the Forward Relocation Complete message, the old SGSN sends an Iu Release Command message to the source RNC. When the RNC data-forwarding timer has expired the source RNC responds with an Iu Release Complete.
- 14) After the MS has finished the RNTI reallocation procedure and if the new Routing Area Identification is different from the old one, the MS initiates the Routing Area Update procedure. See subclause "Location

Management Procedures (UMTS only)". Note that it is only a subset of the RA update procedure that is performed, since the MS is in PMM-CONNECTED mode.

If the SRNS Relocation is inter-SGSN, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach.

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result ""Continue"".

If the SRNS Relocation is intra-SGSN, then the above mentioned CAMEL procedures calls shall not be performed.

If Routing Area Update occurs, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

C2) CAMEL_GPRS_Routeing_Area_Update_Session.

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routeing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

For C2 and C3: refer to Routing Area Update procedure description for detailed message flow.

6.9.2.2.2 Combined Hard Handover and SRNS Relocation Procedure

This procedure is only performed for an MS in PMM-CONNECTED state in case the Iur interface is not available.

The Combined Hard Handover and SRNS Relocation procedure is used to move the UTRAN to CN connection point at the UTRAN side from the source SRNC to the target RNC, while performing a hard handover decided by the UTRAN. In the procedure, the Iu links are relocated. If the target RNC is connected to the same SGSN as the source SRNC, an Intra-SGSN SRNS Relocation procedure is performed. If the routeing area is changed, this procedure is followed by an Intra-SGSN Routeing Area Update procedure. The SGSN detects that it is an intra-SGSN routeing area update by noticing that it also handles the old RA. In this case, the SGSN has the necessary information about the MS and there is no need to inform the HLR about the new MS location.

If the target RNC is connected to a different SGSN than the source SRNC, an Inter-SGSN SRNS Relocation procedure is performed. This procedure is followed by an Inter-SGSN Routeing Area Update procedure.

Figure 7 shows the situation before a Combined Hard Handover and SRNS Relocation procedure when source and target RNC are connected to different SGSNs. Figure 8 shows the situation after the Combined Hard Handover and SRNS Relocation procedure and RA update procedure have been completed. In the case described in Figure 7 and Figure 8 the MS is in PMM-CONNECTED state.

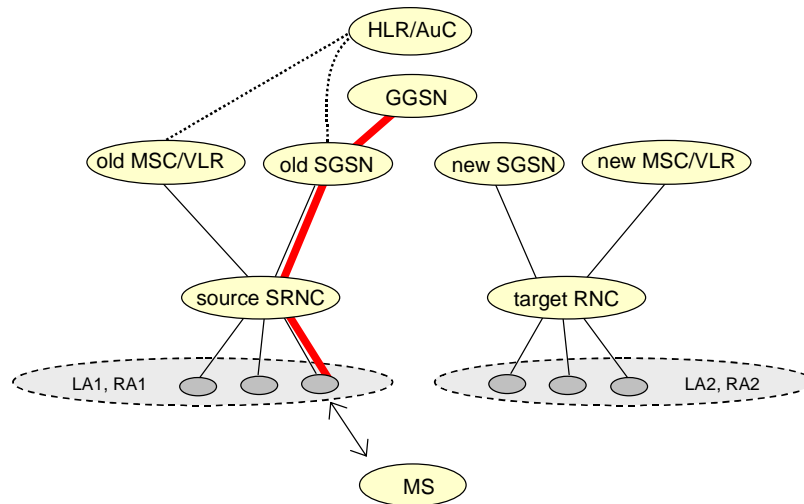


Figure 7: Before Combined Hard Handover and SRNS Relocation and Routing Area Update

Before the SRNS Relocation and Routing Area Update the MS is registered in the old SGSN and in the old MSC/VLR. The source RNC is acting as serving RNC.

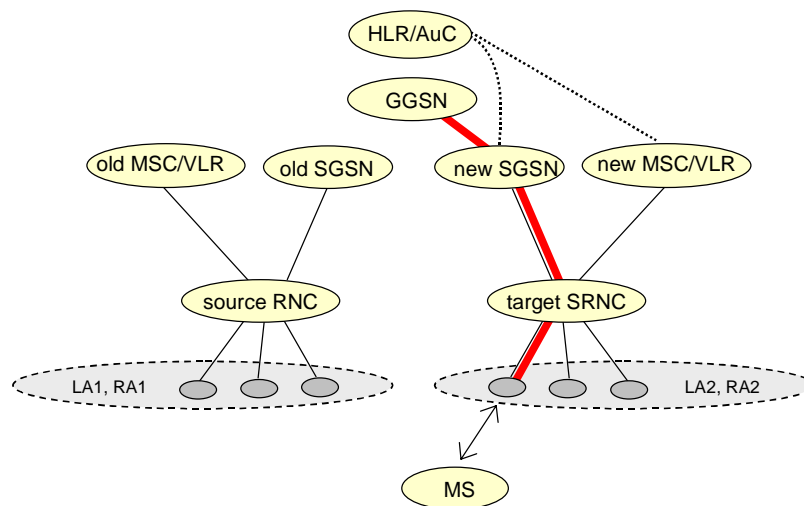


Figure 8: After Combined Hard Handover and SRNS Relocation and Routing Area Update

After the SRNS relocation and RA update, the MS is registered in the new SGSN and in the new MSC/VLR. The MS is in state PMM-CONNECTED towards the new SGSN and in MM IDLE state towards the new MSC/VLR. The target RNC is acting as serving RNC.

The Combined Hard Handover and SRNS Relocation procedure for the PS domain is illustrated in Figure 9. The sequence is valid for both intra-SGSN SRNS relocation and inter-SGSN SRNS relocation.

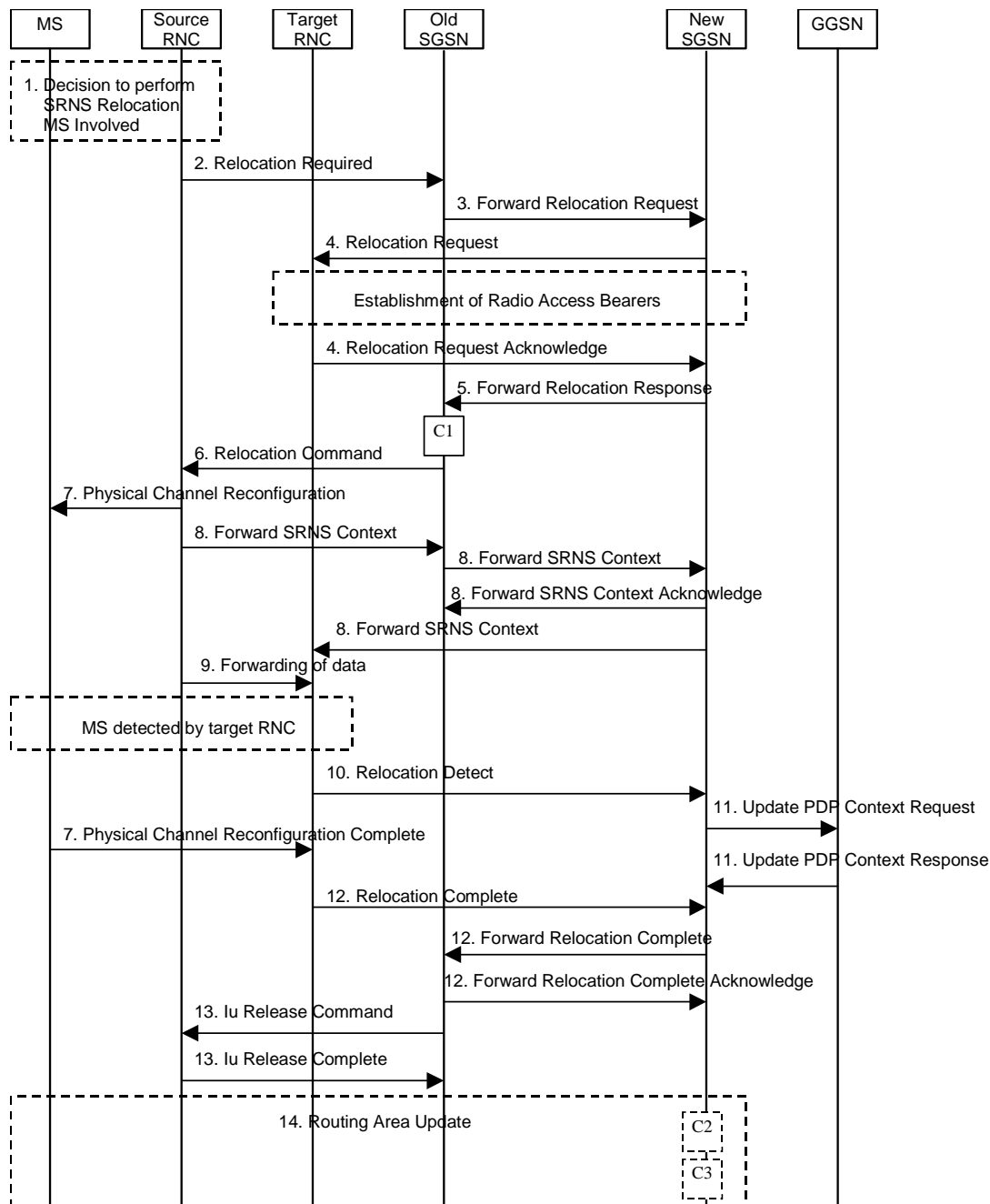


Figure 9: Combined Hard Handover and SRNS Relocation Procedure

- 1) Based on measurement results and knowledge of the UTRAN topology, the source SRNC decides to initiate a combined hard handover and SRNS relocation. At this point both uplink and downlink user data flows via the following tunnel(s): Radio Bearer between the MS and the source SRNC (no drift RNC available); GTP-U tunnel(s) between the source SRNC and the old SGSN; GTP-U tunnel(s) between the old SGSN and the GGSN.
- 2) The source SRNC sends a Relocation Required message (Relocation Type, Cause, Source ID, Target ID, Source RNC To Target RNC Transparent Container) to the old SGSN. The source SRNC shall set Relocation Type to "UE Involved". Source RNC To Target RNC Transparent Container includes the necessary information for relocation co-ordination, security functionality and RRC protocol context information (including MS Capabilities).

- 3) The old SGSN determines from the Target ID if the SRNS relocation is intra-SGSN SRNS relocation or inter-SGSN SRNS relocation. In case of inter-SGSN SRNS relocation the old SGSN initiates the relocation resource allocation procedure by sending a Forward Relocation Request message (IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, UTRAN Transparent Container, RANAP Cause) to the new SGSN. PDP context contains GGSN Address for User Plane and Uplink TEID for Data (to this GGSN Address and Uplink TEID for Data, the old SGSN and the new SGSN send uplink packets). At the same time a timer is started on the MM and PDP contexts in the old SGSN (see Routeing Area Update procedure in subclause "Location Management Procedures (UMTS only)"). The Forward Relocation Request message is applicable only in case of inter-SGSN SRNS relocation
- 4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source RNC To Target RNC Transparent Container, RABs To Be Setup) to the target RNC. For each requested RAB, RABs To Be Setup shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. SGSN shall not establish RABs for PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to the uplink Tunnel Endpoint Identifier Data.

After all the necessary resources for accepted RABs including the Iu user plane are successfully allocated, the target RNC shall send the Relocation Request Acknowledge message (Target RNC To Source RNC Transparent Container, RABs Setup, RABs Failed To Setup) to the new SGSN. Each RAB to be setup is defined by a Transport Layer Address, which is the target RNC Address for user data, and the Iu Transport Association, which corresponds to the down-link Tunnel Endpoint Identifier for user data. The transparent container contains all radio-related information that the MS needs for the handover, i.e., a complete RRC message (e.g., Physical Channel Reconfiguration) to be sent transparently via CN and source SRNC to the MS. For each RAB to be set up, the target RNC may receive simultaneously downlink user packets both from the source SRNC and from the new SGSN.

After the new SGSN receives the Relocation Request Acknowledge message, the GTP-U tunnel(s) are established between the target RNC and the new SGSN. However at this point, the target RNC has not yet established the Radio Bearer(s) with the MS yet.

- 5) When resources for the transmission of user data between target RNC and new SGSN have been allocated and the new SGSN is ready for relocation of SRNS, the Forward Relocation Response (Cause, UTRAN Transparent Container, RANAP Cause, Target RNC Information) message is sent from the new SGSN to the old SGSN. This message indicates that the target RNC is ready to receive from source SRNC the forwarded downlink PDUs, i.e., the relocation resource allocation procedure is terminated successfully. UTRAN transparent container and RANAP Cause are information from the target RNC to be forwarded to the source SRNC. The Target RNC Information, one information element for each RAB to be set up, contains the RNC Tunnel Endpoint Identifier and RNC IP address for data forwarding from the source SRNC to the target RNC. The Forward Relocation Response message is applicable only in case of inter-SGSN SRNS relocation.
- 6) The old SGSN continues the relocation of SRNS by sending a Relocation Command message (Target RNC To Source RNC Transparent Container, RABs To Be Released, RABs Subject To Data Forwarding) to the source SRNC. The old SGSN decides the RABs to be subject for data forwarding based on QoS, and those RABs shall be contained in RABs subject to data forwarding. For each RAB subject to data forwarding, the information element shall contain RAB ID, Transport Layer Address, and Iu Transport Association. These are the same Transport Layer Address and Iu Transport Association that the target RNC had sent to new SGSN in Relocation Request Acknowledge message, and these are used for forwarding of downlink N-PDU from the source SRNC to the target RNC. The source SRNC is now ready to forward downlink user data directly to the target RNC over the Iu interface. This forwarding is performed for downlink user data only.
- 7) Upon reception of the Relocation Command message from the PS domain, the source RNC shall start the data-forwarding timer.

NOTE: The order of steps, starting from step 7 onwards, does not necessarily reflect the order of events. For instance, source RNC may send RRC message to MS (step 7), Forward SRNS Context message to the old SGSN (step 8) and starts data forwarding (step 9) almost simultaneously.

When the source SRNC is ready, the source RNC shall trigger the execution of relocation of SRNS by sending to the MS the RRC message provided in the Target RNC to source RNC transparent container, e.g., a Physical Channel Reconfiguration (UE Information Elements, CN Information Elements) message. UE Information Elements include among others new SRNC identity and S-RNTI. CN Information Elements contain among others Location Area Identification and Routeing Area Identification.

Before the RRC message is sent (e.g. Physical Channel Reconfiguration) uplink and downlink data transfer in the source RNC shall be suspended for RABs which require to maintain the delivery order.

When the MS has reconfigured it self, it sends e.g., a Physical Channel Reconfiguration Complete message to the target SRNC. If the Forward SRNS Context message with the sequence numbers is received, the exchange of packets with the MS may start. If this message is not yet received, the target RNC may start the packet transfer for all RABs, which do not require maintaining the delivery order.

- 8) The source SRNC continues the execution of relocation of SRNS by sending a Forward SRNS Context (RAB Contexts) message to the target RNC via the old and the new SGSN, which is acknowledged by a Forward SRNS Context Acknowledge message. The purpose of this procedure is to transfer SRNS contexts from the source RNC to the target RNC, and to move the SRNS role from the source RNC to the target RNC. SRNS contexts are sent for each concerned RAB and contain the sequence numbers of the GTP PDUs next to be transmitted in the uplink and downlink directions and the next PDCP sequence numbers that would have been used to send and receive data from the MS. PDCP sequence numbers are sent by the source RNC for the radio bearers which used lossless PDCP [57]. The use of lossless PDCP is selected by the RNC when the radio bearer is set up or reconfigured. For PDP context(s) using delivery order not required (QoS profile), the sequence numbers of the GTP-PDUs next to be transmitted are not used by the target RNC.

If delivery order is required (QoS profile), consecutive GTP-PDU sequence numbering shall be maintained throughout the lifetime of the PDP context(s). Therefore, during the entire SRNS relocation procedure for the PDP context(s) using delivery order required (QoS profile), the responsible GTP-U entities (RNCs and GGSN) shall assign consecutive GTP-PDU sequence numbers to user packets belonging to the same PDP context for uplink and downlink, respectively.

The target RNC establishes and/or restarts the RLC and exchanges the PDCP sequence numbers (PDCP-SNU, PDCP-SND) between the target RNC and the MS. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received in the MS per radio bearer, which used lossless PDCP in the source RNC. PDCP-SND confirms all mobile terminated packets successfully transferred before the SRNC relocation. If PDCP-SND confirms reception of packets that were forwarded from the source SRNC, then the target RNC shall discard these packets. PDCP-SNU is the PDCP sequence number for the next expected in-sequence uplink packet to be received in the RNC per radio bearer, which used lossless PDCP in the source RNC. PDCP-SNU confirms all mobile originated packets successfully transferred before the SRNC relocation. If PDCP-SNU confirms reception of packets that were received in the source RNC, the MS shall discard these packets.

- 9) The source RNC begins the forwarding of data for the RABs to be subject for data forwarding. The data forwarding at SRNS relocation shall be carried out through the Iu interface, meaning that the data exchanged between the source RNC and the target RNC are duplicated in the source RNC and routed at the IP layer towards the target RNC. For each radio bearer using lossless PDCP, the GTP-PDUs corresponding to transmitted but not yet acknowledged PDCP-PDUs are duplicated and routed at IP layer towards the target RNC together with the corresponding downlink PDCP sequence numbers.
- 10) The target RNC shall send a Relocation Detect message to the new SGSN when the relocation execution trigger is received. For SRNS relocation type "UE Involved", the relocation execution trigger may be received from the Uu interface; i.e., when target RNC detects the MS on the lower layers. When the Relocation Detect message is sent, the target RNC shall start SRNC operation.
- 11) Upon reception of the Relocation Detect message, the CN may switch the user plane from the source RNC to the target SRNC. If the SRNS relocation is an inter-SGSN SRNS relocation, the new SGSN sends an Update PDP Context Request (New SGSN Address, SGSN Tunnel Endpoint Identifier, QoS Negotiated, [serving network identity](#)) message to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (GGSN Tunnel Endpoint Identifier) message.
- 12) When the target SRNC receives the Physical Channel Reconfiguration Complete message or the Radio Bearer Release Complete message, i.e. the new SRNC-ID + S-RNTI are successfully exchanged with the MS by the radio protocols, the target SRNC shall initiate a Relocation Complete procedure by sending the Relocation Complete message to the new SGSN. The purpose of the Relocation Complete procedure is to indicate by the target SRNC the completion of the relocation of the SRNS to the CN. If the user plane has not been switched at Relocation Detect, the CN shall upon reception of Relocation Complete switch the user plane from source RNC to target SRNC. If the SRNS Relocation is an inter-SGSN SRNS relocation, the new SGSN signals to the old SGSN the completion of the SRNS relocation procedure by sending a Forward Relocation Complete message.
- 13) Upon receiving the Relocation Complete message or if it is an inter-SGSN SRNS relocation, the Forward Relocation Complete message, the old SGSN sends an Iu Release Command message to the source RNC. When the RNC data-forwarding timer has expired, the source RNC responds with an Iu Release Complete message.

- 14) After the MS has finished the reconfiguration procedure and if the new Routing Area Identification is different from the old one, the MS initiates the Routing Area Update procedure. See subclause "Location Management Procedures (UMTS only)". Note that it is only a subset of the RA update procedure that is performed, since the MS is in PMM-CONNECTED state.

If the SRNS Relocation is inter-SGSN, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

- C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

If the SRNS Relocation is intra-SGSN, then the above mentioned CAMEL procedures calls shall not be performed.

If Routing Area Update occurs, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

- C2) CAMEL_GPRS_Routing_Area_Update_Session.

In Figure 9, the procedure returns as result "Continue".

- C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

For C2 and C3: refer to Routing Area Update procedure description for detailed message flow.

6.9.2.2.3 Combined Cell / URA Update and SRNS Relocation Procedure

This procedure is only performed for an MS in PMM-CONNECTED state, where the Iur interface carries control signalling but no user data.

The Combined Cell / URA Update and SRNS Relocation procedure is used to move the UTRAN to CN connection point at the UTRAN side from the source SRNC to the target RNC, while performing a cell re-selection in the UTRAN. In the procedure, the Iu links are relocated. If the target RNC is connected to the same SGSN as the source SRNC, an Intra-SGSN SRNS Relocation procedure is performed. If the routing area is changed, this procedure is followed by an Intra-SGSN Routing Area Update procedure. The SGSN detects that it is an intra-SGSN routing area update by noticing that it also handles the old RA. In this case, the SGSN has the necessary information about the MS and there is no need to inform the HLR about the new MS location.

Before the Combined Cell / URA Update and SRNS Relocation and the Routing Area Update, the MS is registered in the old SGSN. The source RNC is acting as serving RNC.

After the Combined Cell / URA Update and SRNS Relocation and the Routing Area Update, the MS is registered in the new SGSN. The MS is in state PMM-CONNECTED towards the new SGSN, and the target RNC is acting as serving RNC.

The Combined Cell / URA Update and SRNS Relocation procedure for the PS domain is illustrated in Figure 10. The sequence is valid for both intra-SGSN SRNS relocation and inter-SGSN SRNS relocation.

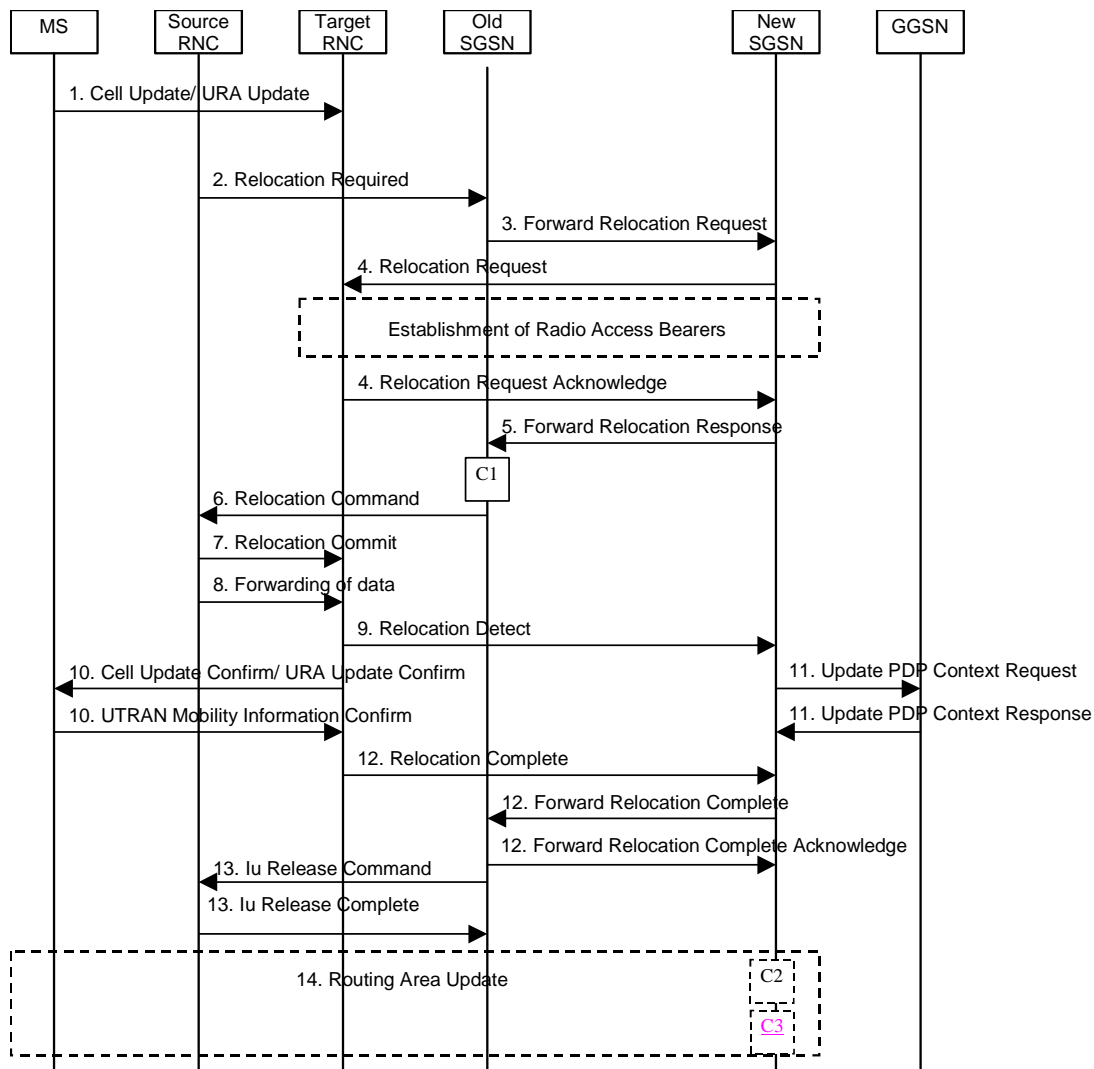


Figure 10: Combined Cell / URA Update and SRNS Relocation Procedure

- 1) The MS sends a Cell Update / URA Update message to the source SRNC (if the cell is located under another RNC the message is routed via the DRNC to SRNC over the Iur). The source SRNC decides whether or not to perform a combined cell / URA update and SRNS relocation towards the target RNC. The rest of this subclause describes the case where a combined cell / URA update and SRNS relocation applies. In this case no radio bearer is established between the source SRNC and the UE. Nonetheless the following tunnel(s) are established: GTP-U tunnel(s) between source SRNC and old-SGSN; GTP-U tunnel(s) between old-SGSN and GGSN.
- 2) The source SRNC sends a Relocation Required message (Relocation Type, Cause, Source ID, Target ID, Source RNC to Target RNC Transparent Container) to the old SGSN. The source SRNC shall set Relocation Type to "UE not involved". Source RNC to Target RNC Transparent Container includes the necessary information for Relocation co-ordination, security functionality, and RRC protocol context information (including MS Capabilities).
- 3) The old SGSN determines from the Target ID if the SRNS Relocation is intra-SGSN SRNS relocation or inter-SGSN SRNS relocation. In the case of inter-SGSN SRNS relocation the old SGSN initiates the relocation resource allocation procedure by sending a Forward Relocation Request (IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, UTRAN Transparent Container, RANAP Cause) message to the new SGSN. PDP context contains GGSN Address for User Plane and Uplink TEID for Data (to this GGSN Address and Uplink TEID for Data, the old SGSN and the new SGSN send uplink packets). At the same time a timer is started on the MM and PDP contexts in the old SGSN, see Routeing Area Update procedure

in subclause "Location Management Procedures (UMTS only)". The Forward Relocation Request message is applicable only in case of inter-SGSN SRNS relocation.

- 4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source RNC to Target RNC Transparent Container, RABs To Be Setup) to the target RNC. For each requested RAB, RABs To Be Setup shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. SGSN shall not establish RABs for PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to the uplink Tunnel Endpoint Identifier Data.

After successful allocation of all necessary resources for accepted RABs including the Iu user plane, the target RNC shall send the Relocation Request Acknowledge message (RABs setup, RABs failed to setup) to the new SGSN. Each RAB to be setup is defined by a Transport Layer Address, which is the target RNC Address for user data, and an Iu Transport Association, which corresponds to the downlink Tunnel Endpoint Identifier for user data. For each RAB to be set up, the target-RNC may receive simultaneously downlink user packets both from the source SRNC and from the new SGSN.

After the new SGSN receives the Relocation Request Acknowledge message, the GTP-U tunnels are established between the target RNC and the new-SGSN.

- 5) When resources for the transmission of user data between the target RNC and the new SGSN have been allocated and the new SGSN is ready for relocation of SRNS, the Forward Relocation Response message (Cause, RANAP Cause, and Target RNC Information) is sent from the new SGSN to the old SGSN. This message indicates that the target RNC is ready to receive from the source SRNC the forwarded downlink packets, i.e., the relocation resource allocation procedure is terminated successfully. RANAP Cause is information from the target RNC to be forwarded to the source SRNC. The RAB Setup Information, one information element for each RAB, contains the RNC Tunnel Endpoint Identifier and RNC IP address for data forwarding from the source SRNC to the target RNC. If the target RNC or the new SGSN failed to allocate resources, the RAB Setup Information element contains only NSAPI indicating that the source SRNC shall release the resources associated with the NSAPI. The Forward Relocation Response message is applicable only in case of inter-SGSN SRNS relocation.
- 6) The old SGSN continues the relocation of SRNS by sending a Relocation Command (RABs to be released, and RABs subject to data forwarding) message to the source SRNC. The old SGSN decides the RABs subject to data forwarding based on QoS, and those RABs shall be contained in RABs subject to data forwarding. For each RAB subject to data forwarding, the information element shall contain RAB ID, Transport Layer Address, and Iu Transport Association. These are the same Transport Layer Address and Iu Transport Association that the target RNC had sent to new SGSN in Relocation Request Acknowledge message, and these are used for forwarding of downlink N-PDU from the source SRNC to the target RNC. The source SRNC is now ready to forward downlink data directly to the target RNC over the Iu interface. This forwarding is performed for downlink user data only.
- 7) Upon reception of the Relocation Command message from the PS domain, the source SRNC shall start the data-forwarding timer.

NOTE: The order of steps, starting from step 7 onwards, does not necessarily reflect the order of events. For instance, source RNC may send Relocation Commit message (step 7) and starts data forwarding (step 8) almost simultaneously. Target RNC may send Relocation Detect message (step 9) and Cell Update Confirm/URA Update Confirm message (step 10) at the same time. Hence, target RNC may receive the UTRAN Mobility Information Confirm message from MS (step 10) while data forwarding (step 8) is still underway, and before the new SGSN receives Update PDP Context Response message (step 11).

When the source SRNC is ready, the source SRNC shall trigger the execution of relocation of SRNS by sending a Relocation Commit message (SRNS Contexts) to the target RNC over the Iur interface. The purpose of this procedure is to transfer SRNS contexts from the source RNC to the target RNC, and to move the SRNS role from the source RNC to the target RNC. SRNS contexts are sent for each concerned RAB and contain the sequence numbers of the GTP-PDUs next to be transmitted in the uplink and downlink directions and the next PDCP sequence numbers that would have been used to send and receive data from the MS. PDCP sequence numbers are only sent by the source RNC for radio bearers which used lossless PDCP [57]. The use of lossless PDCP is selected by the RNC when the radio bearer is set up or reconfigured. For PDP context(s) using delivery order not required (QoS profile), the sequence numbers of the GTP-PDUs next to be transmitted are not used by the target RNC.

If delivery order is required (QoS profile), consecutive GTP-PDU sequence numbering shall be maintained throughout the lifetime of the PDP context(s). Therefore, during the entire SRNS relocation procedure for the PDP context(s) using delivery order required (QoS profile), the responsible GTP-U entities (RNCs and GGSN)

shall assign consecutive GTP-PDU sequence numbers to user packets belonging to the same PDP context for uplink and downlink respectively.

- 8) The source RNC begins the forwarding of data for the RABs subject to data forwarding. The data forwarding at SRNS relocation shall be carried out through the Iu interface, meaning that the GTP-U PDUs exchanged between the source RNC and the target RNC are duplicated in the source RNC and routed at the IP layer towards the target RNC. For each radio bearer using lossless PDCP, the GTP-PDUs corresponding to transmitted but not yet acknowledged PDCP-PDUs are duplicated and routed at IP layer towards the target RNC together with the corresponding downlink PDCP sequence numbers.
- 9) The target RNC shall send a Relocation Detect message to the new SGSN when the relocation execution trigger is received. For SRNS relocation type "UE not involved", the relocation execution trigger is the reception of the Relocation Commit message from the Iur interface. When the Relocation Detect message is sent, the target RNC shall start SRNC operation.
- 10) The target SRNC sends a Cell Update Confirm / URA Update Confirm message. This message contains UE information elements and CN information elements. The UE information elements include among others new SRNC identity and S-RNTI. The CN information elements contain among others Location Area Identification and Routing Area Identification. The procedure shall be co-ordinated in all Iu signalling connections existing for the MS.

Upon reception of the Cell Update Confirm / URA Update Confirm message the MS may start sending uplink user data to the target SRNC. When the MS has reconfigured itself, it sends the UTRAN Mobility Information Confirm message to the target SRNC. This indicates that the MS is also ready to receive downlink data from the target SRNC.

If the new SGSN has already received the Update PDP Context Response message from the GGSN, it shall forward the uplink user data to the GGSN over this new GTP-U tunnel. Otherwise, the new SGSN shall forward the uplink user data to that GGSN IP address and TEID(s), which the new SGSN had received earlier by the Forward Relocation Request message.

The target SRNC and the MS exchange the PDCP sequence numbers; PDCP-SNU and PDCP-SND. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received in the MS per radio bearer, which used lossless PDCP in the source RNC. PDCP-SND confirms all mobile terminated packets successfully transferred before the SRNC relocation. If PDCP-SND confirms the reception of packets that were forwarded from the source SRNC, the target SRNC shall discard these packets. PDCP-SNU is the PDCP sequence number for the next expected in-sequence uplink packet to be received in the RNC per radio bearer, which used lossless PDCP in the source RNC. PDCP-SNU confirms all mobile originated packets successfully transferred before the SRNC relocation. If PDCP-SNU confirms reception of packets that were received in the source SRNC, the target SRNC shall discard these packets.

- 11) Upon receipt of the Relocation Detect message, the CN may switch the user plane from the source RNC to the target SRNC. If the SRNS Relocation is an inter-SGSN SRNS relocation, the new SGSN sends Update PDP Context Request messages (new SGSN Address, SGSN Tunnel Endpoint Identifier, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (GGSN Tunnel Endpoint Identifier) message.
- 12) When the target SRNC receives the UTRAN Mobility Information Confirm message, i.e. the new SRNC-ID + S-RNTI are successfully exchanged with the MS by the radio protocols, the target SRNC shall initiate the Relocation Complete procedure by sending the Relocation Complete message to the new SGSN. The purpose of the Relocation Complete procedure is to indicate by the target SRNC the completion of the relocation of the SRNS to the CN. If the user plane has not been switched at Relocation Detect, the CN shall upon reception of Relocation Complete switch the user plane from the source RNC to the target SRNC. If the SRNS Relocation is an inter SGSN SRNS relocation, the new SGSN signals to the old SGSN the completion of the SRNS relocation procedure by sending a Forward Relocation Complete message.
- 13) Upon receiving the Relocation Complete message or if it is an inter-SGSN SRNS relocation, the Forward Relocation Complete message, the old SGSN sends an Iu Release Command message to the source RNC. When the RNC data-forwarding timer has expired the source RNC responds with an Iu Release Complete.
- 14) After the MS has finished the Cell / URA update and RNTI reallocation procedure and if the new Routing Area Identification is different from the old one, the MS initiates the Routing Area Update procedure. See subclause "Location Management Procedures (UMTS only)". Note that it is only a subset of the RA update procedure that is performed, since the MS is in PMM-CONNECTED state.

If the SRNS Relocation is inter-SGSN, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

If the SRNS Relocation is intra-SGSN, then the above mentioned CAMEL procedures calls shall not be performed.

If Routing Area Update occurs, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

C2) CAMEL GPRS Routing Area Update-Session

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

For C2 and C3: refer to Routing Area Update procedure description for detailed message flow.

Next change

6.13.2.1 UMTS to GSM Inter-SGSN Change

An inter-SGSN inter-system change from UMTS to GSM takes place when an MS in PMM-IDLE or PMM-CONNECTED state changes from UTRAN to GSM radio access and the GSM radio access node serving the MS is served by a different SGSN. In this case, the RA changes. Therefore, the MS shall initiate a GSM RA update procedure. The RA update procedure is either combined RA / LA update or only RA update. These RA update cases are illustrated in Figure 11.

A combined RA / LA update takes place in network operation mode I when the MS enters a new RA or when a GPRS-attached MS performs IMSI attach. The MS sends a Routing Area Update Request indicating that an LA update may also need to be performed, in which case the SGSN forwards the LA update to the VLR. This concerns only idle mode (see 3G TS 23.122), as no combined RA / LA updates are performed during a CS connection.

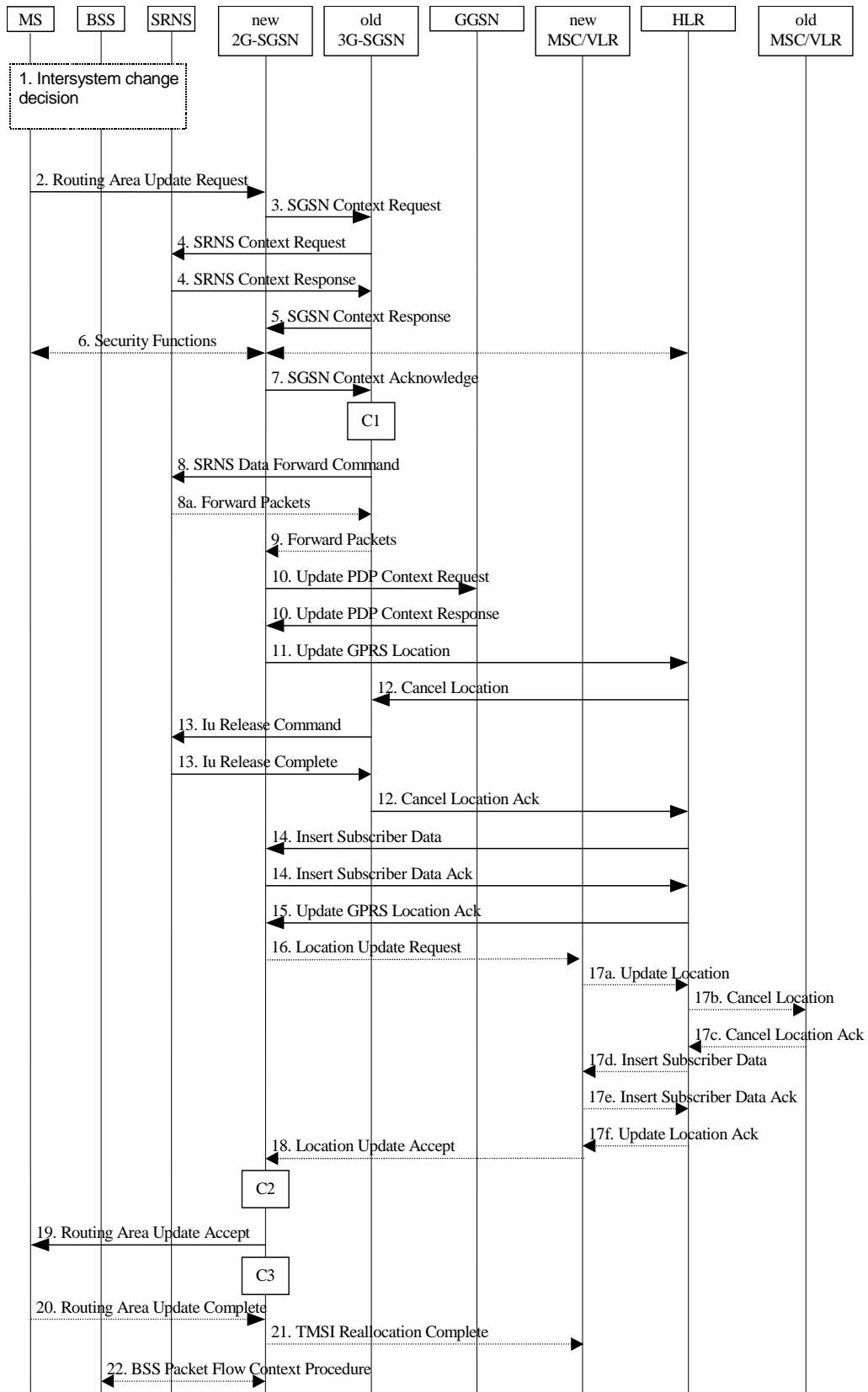


Figure 11: UMTS to GSM Inter-SGSN Change

- 1) The MS or BSS or UTRAN decides to perform an inter-system change, which makes the MS switch to a new cell that supports GSM radio technology, and stops transmission to the network.

- 2) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type, MS Network Capability) message to the new 2G-SGSN. Update Type shall indicate RA update or combined RA / LA update, or, if the MS wants to perform an IMSI attach, combined RA / LA update with IMSI attach requested. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the new 2G-SGSN.
- 3) The new 2G-SGSN sends an SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) message to the old 3G-SGSN to get the MM and PDP contexts for the MS. The old 3G-SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old 3G-SGSN. If the received old P-TMSI Signature does not match the stored value, the security functions in the new 2G-SGSN should be initiated. If the security functions authenticate the MS correctly, the new 2G-SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old 3G-SGSN. MS Validated indicates that the new 2G-SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new 2G-SGSN indicates that it has authenticated the MS correctly, the old 3G-SGSN starts a timer. If the MS is not known in the old 3G-SGSN, the old 3G-SGSN responds with an appropriate error cause.
- 4) If the MS is PMM-CONNECTED the old 3G-SGSN sends an SRNS Context Request (IMSI) message to the SRNS. Upon receipt of this message the SRNS buffers and stops sending downlink PDUs to the MS and returns an SRNS Context Response (GTP-SNDs, GTP-SNUs, PDCP-SNDs, PDCP-SNUs) message. The SRNS shall include for each PDP context the next in-sequence GTP sequence number to be sent to the MS and the GTP sequence number of the next uplink PDU to be tunnelled to the GGSN. For each active PDP context using lossless PDCP, the SRNS also includes the uplink PDCP sequence number (PDCP-SNU) downlink PDCP sequence number (PDCP-SND). PDCP-SNU shall be the next in-sequence PDCP sequence number expected from the MS. PDCP-SND is the PDCP sequence number for the first downlink packet for which successful transmission has not been confirmed. The 3G-SGSN shall strip off the eight most significant bits of the passed PDCP sequence numbers, thus converting them to SMDCP N-PDU numbers and, subsequently, storing these N-PDU numbers in its PDP contexts.
- 5) The old 3G-SGSN responds with an SGSN Context Response (MM Context, PDP Contexts) message. For each PDP context the old 3G-SGSN shall include the GTP sequence number for the next uplink GTP PDU to be tunnelled to the GGSN and the next downlink GTP sequence number for the next in-sequence N-PDU to be sent to the MS. Each PDP Context also includes the SMDCP Send N-PDU Number (the value is 0) for the next in-sequence downlink N-PDU to be sent in acknowledged mode SMDCP to the MS and the SMDCP Receive N-PDU Number (= converted PDCP-SNU) for the next in-sequence uplink N-PDU to be received in acknowledged mode SMDCP from the MS. The new 3G-SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routing Area Request.
- 6) Security functions may be executed.
- 7) The new 2G-SGSN sends an SGSN Context Acknowledge message to the old 3G-SGSN. This informs the old 3G-SGSN that the new 2G-SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a RA update procedure back to the old SGSN before completing the ongoing RA update procedure.
- 8) If the MS is PMM-CONNECTED, the old 3G-SGSN sends an SRNS Data Forward Command (RAB ID, Transport Layer Address, Iu Transport Association) message to the SRNS. For each indicated RAB the SRNS starts duplicating and tunnelling the buffered GTP PDUs to the old 3G-SGSN. For each radio bearer which uses lossless PDCP, the SRNS shall start tunnelling the GTP-U PDUs related to transmitted but not yet acknowledged PDCP-PDUs to the old 3G-SGSN together with the corresponding downlink PDCP sequence numbers. Upon receipt of the SRNS Data Forward Command message from the 3G-SGSN, the SRNS shall start the data-forwarding timer.
- 9) The old 3G-SGSN tunnels the GTP PDUs to the new 2G-SGSN. In the case of GTPv1, the conversion of PDCP sequence numbers to SMDCP sequence numbers (the eight most significant bits shall be stripped off) shall be done in the new SGSN. No N-PDU sequence numbers shall be indicated for these N-PDUs. If GTPv0 is used between the SGSNs, the conversion of PDCP sequence numbers to SMDCP numbers shall be done in the old 3G-SGSN (by stripping off the eight most significant bits).
- 10) The new 2G-SGSN sends an Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated, [serving network identity](#)) message to each GGSN concerned. [The SGSN should send the serving network identity to the GGSN.](#) Each GGSN updates its PDP context fields and returns an Update PDP Context Response (TEID) message.

- 11) The new 2G-SGSN informs the HLR of the change of SGSN by sending an Update GPRS Location (SGSN Number, SGSN Address, IMSI) message to the HLR.
- 12) The HLR sends a Cancel Location (IMSI) message to the old 3G-SGSN. The old 3G-SGSN acknowledges with a Cancel Location Ack (IMSI) message. The old 3G-SGSN removes the MM and PDP contexts if the timer described in step 3 is not running. If the timer is running, the MM and PDP contexts shall be removed when the timer expires.
- 13) When the MS is PMM-CONNECTED, the old 3G-SGSN sends an Iu Release Command message to the SRNS. When the RNC data-forwarding timer has expired, the SRNS responds with an Iu Release Complete message.
- 14) The HLR sends an Insert Subscriber Data (IMSI, GPRS Subscription Data) message to the new 2G-SGSN. The 2G-SGSN constructs an MM context and PDP contexts for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 15) The HLR acknowledges the Update GPRS Location by returning an Update GPRS Location Ack (IMSI) message to the new 2G-SGSN.
- 16) If the association has to be established i.e., if Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routing area update, the new 2G-SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with IMSI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI by the 2G-SGSN. The 2G-SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 14). The VLR creates or updates the association with the 2G-SGSN by storing SGSN Number.
- 17) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.
 - e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
- 18) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the 2G-SGSN. VLR TMSI is optional if the VLR has not changed.
- 19) The new 2G-SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the RA, or if subscription checking fails, the new 2G-SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new 2G-SGSN constructs MM and PDP contexts for the MS. A logical link is established between the new 2G-SGSN and the MS. The 2G-SGSN initiates the establishment procedure. The new 2G-SGSN responds to the MS with a Routing Area Update Accept (P-TMSI, P-TMSI Signature, Receive N-PDU Number (= converted PDCP-SNU)) message. Receive N-PDU Number contains acknowledgements for each NSAPI which used lossless PDCP before starting the update procedure, thereby confirming all mobile-originated N-PDUs that were successfully transferred. If Receive N-PDU Number confirms the reception of N-PDUs, the MS shall discard these N-PDUs.
- 20) The MS acknowledges the new P-TMSI by returning a Routing Area Update Complete (Receive N-PDU Number (= converted PDCP-SND)) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each lossless PDCP used by the MS before starting the update procedure, thereby confirming all mobile-terminated N-PDUs successfully transferred. If Receive N-PDU Number confirms the reception of N-PDUs that were forwarded from the old 3G-SGSN, the new 2G-SGSN shall discard these N-PDUs. The MS deducts Receive N-PDU number from PDCP-SND by stripping off the eight most significant bits. PDCP-SND is the PDCP sequence number for the next expected by the MS in-sequence downlink per radio bearer, which used lossless PDCP. The new 2G-SGSN negotiates with the MS the use of acknowledged or unacknowledged SDCP for each NSAPI regardless whether the SRNS used lossless PDCP or not.

21) The new 2G-SGSN sends TMSI Reallocation Complete message to the new VLR if the MS confirms the VLR TMSI.

22) The 2G-SGSN and the BSS may execute the BSS Packet Flow Context procedure.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

CAMEL procedure calls shall be performed; see referenced procedures in 3G TS 23.078:

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach

They are called in the following order:

-The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".

-Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

C2) CAMEL_GPRS_Routing_Area_Update_Session.

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times once per PDP context. It returns as result "Continue".

6.13.2.2 GSM to UMTS Inter-SGSN Change

The inter-system change from GSM to UMTS takes place when a GPRS-attached MS changes from GSM radio access to UTRAN and the UTRAN node serving the MS is served by a different SGSN. In this case the RA changes. Therefore, the MS shall initiate a UMTS RA update procedure by establishing an RRC connection and initiating the RA update procedure. The RA update procedure is either combined RA / LA update or only RA update, these RA update cases are illustrated in Figure 12.

If the network operates in mode I, then an MS, that is both PS-attached and CS-attached, shall perform the Combined RA / LA Update procedures. This concerns only idle mode (see 3G TS 23.122), as no combined RA / LA updates are performed during a CS connection.

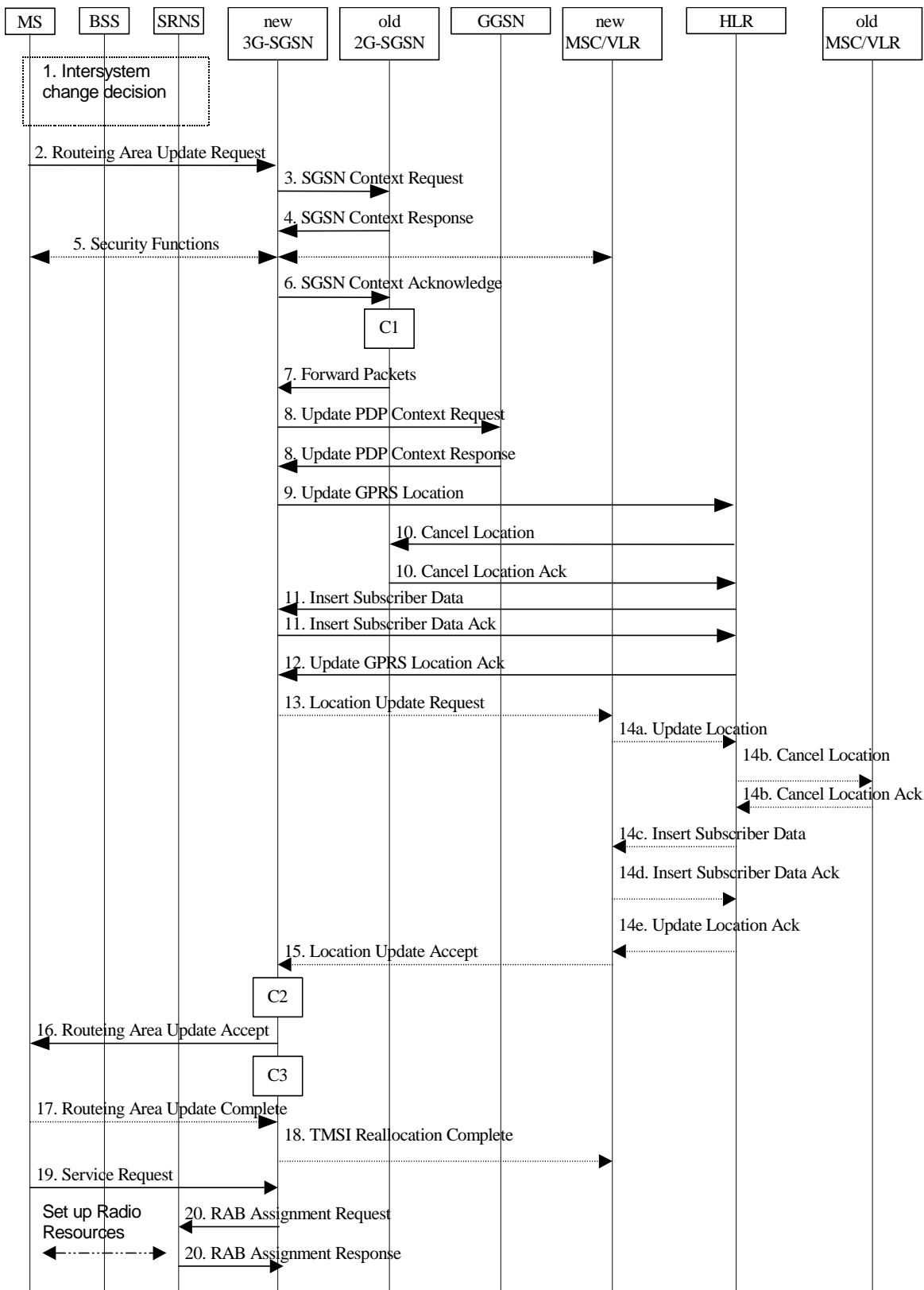


Figure 12: GSM to UMTS Inter SGSN Change

- 1) The MS or BSS or UTRAN decides to perform an inter-system change, which makes the MS switch to a new cell that supports UMTS radio technology, and stops transmission to the network.

- 2) The MS sends a Routing Area Update Request (P-TMSI, old RAI, old P-TMSI Signature, Update Type, CM, MS Network Capability) message to the new 3G-SGSN. Update Type shall indicate RA update or combined RA / LA update, or, if the MS wants to perform an IMSI attach, combined RA / LA update with IMSI attach requested, and also if the MS has a follow-on request, i.e. if there is pending uplink traffic (signalling or data). The SGSN may use, as an implementation option, the follow-on request indication to release or keep the Iu connection after the completion of the RA update procedure. The SRNC shall add the Routing Area Identity including the RAC and LAC of the area where the MS is located before forwarding the message to the 3G-SGSN. This RA identity corresponds to the RAI in the MM system information sent by the SRNC to the MS.
- 3) The new 3G-SGSN uses the old RAI received from the MS to derive the old 2G-SGSN address, and sends an SGSN Context Request (old RAI, old P-TMSI, New SGSN Address) message to the old 2G-SGSN to get the MM and PDP contexts for the MS. The old 2G-SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old 2G-SGSN. If the received old P-TMSI Signature does not match the stored value, the old 2G-SGSN should initiate the security functions in the new 3G-SGSN. If the security functions authenticate the MS correctly, the new 3G-SGSN shall send an SGSN Context Request (old RAI, IMSI, MS Validated, New SGSN Address) message to the old 2G-SGSN. MS Validated indicates that the new 3G-SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new 3G-SGSN indicates that it has authenticated the MS correctly, the old 2G-SGSN starts a timer and stops the transmission of N-PDUs to the MS.
- 4) The old 2G-SGSN responds with an SGSN Context Response (MM Context, PDP Contexts) message. Each PDP Context includes the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. Each PDP Context also includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode SMDCP to the MS and the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode SMDCP from the MS. The new 3G-SGSN derives the corresponding PDCP sequence numbers from these N-PDU sequence numbers by adding eight most significant bits "1". These PDCP sequence numbers are stored in the 3G-SGSN PDP contexts. The new 3G-SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routing Area Request.
- 5) Security functions may be executed.
- 6) The new 3G-SGSN sends an SGSN Context Acknowledge message to the old 2G-SGSN. This informs the old 2G-SGSN that the new 3G-SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routing area update procedure back to the old SGSN before completing the ongoing routing area update procedure.
- 7) The old 2G-SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new 3G-SGSN. Additional N-PDUs received from the GGSN before the timer described in step 3 expires are also duplicated and tunnelled to the new 3G-SGSN. N-PDUs that were already sent to the MS in acknowledged mode SMDCP and that are not yet acknowledged by the MS are tunnelled together with the corresponding SMDCP N-PDU sequence numbers. No PDCP sequence numbers shall be indicated for these N-PDUs. No N-PDUs shall be forwarded to the new 3G-SGSN after expiry of the timer described in step 3.
- 8) The new 3G-SGSN sends an Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated, [serving network identity](#)) message to each GGSN concerned. [The SGSN should send the serving network identity to the GGSN.](#) Each GGSN updates its PDP context fields and returns an Update PDP Context Response (TEID) message.
- 9) The new 3G-SGSN informs the HLR of the change of SGSN by sending an Update GPRS Location (SGSN Number, SGSN Address, IMSI) message to the HLR.
- 10) The HLR sends a Cancel Location (IMSI, Cancellation Type) message to the old 2G-SGSN. The old 2G-SGSN removes the MM and PDP contexts if the timer described in step 3 is not running. If the timer is running, the MM and PDP contexts are removed when the timer expires. The old 2G-SGSN acknowledges with a Cancel Location Ack (IMSI) message.
- 11) The HLR sends an Insert Subscriber Data (IMSI, GPRS Subscription Data) message to the new 3G-SGSN. The 3G-SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 12) The HLR acknowledges the Update GPRS Location by returning an Update GPRS Location Ack (IMSI) message to the new 3G-SGSN.

- 13) If the association has to be established, if Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routing area update, the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with IMSI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI by the 3G-SGSN. The 3G-SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 12). The VLR creates or updates the association with the 3G-SGSN by storing SGSN Number.
- 14) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.
 - e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
- 15) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the 3G-SGSN. VLR TMSI is optional if the VLR has not changed.
- 16) The new 3G-SGSN validate the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the RA, or if subscription checking fails, the new 3G-SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new 3G-SGSN constructs MM and PDP contexts for the MS. The new 3G-SGSN responds to the MS with a Routing Area Update Accept (P-TMSI, P-TMSI signature) message.
- 17) The MS acknowledges the new P-TMSI by returning a Routing Area Update Complete message to the SGSN.
- 18) The new 3G-SGSN sends TMSI Reallocation Complete message to the new VLR, if the MS confirms the VLR TMSI.
- 19) If the MS has uplink data or signalling pending it shall send a Service Request (P-TMSI, RAI, CKSN, Service Type) message to the SGSN. Service Type specifies the requested service. Service Type shall indicate one of the following: Data or Signalling.
- 20) If the MS sent the Service Request, the new 3G-SGSN requests the SRNS to establish a radio access bearer by sending a RAB Assignment Request (RAB ID(s), QoS Profile(s), GTP-SNDs, GTP-SNU_s, PDCP-SNU_s) message to the SRNS. The PDCP sequence numbers are derived from the N-PDU sequence numbers in step 4 and are stored in the SGSN PDP context. The SRNS sends a Radio Bearer Setup Request (PDCP-SNU_s) message to the MS. The MS responds with a Radio Bearer Setup Complete (PDCP-SND_s) message. The MS deducts PDCP-SND from its Receive N-PDU Number by adding eight most significant bits "1". The SRNS responds with a RAB Assignment Response message. The SRNS shall discard all N-PDUs tunnelled from the SGSN with N-PDU sequence numbers older than the eight least significant bits of the PDCP-SND_s received from the MS. Other N-PDUs shall be transmitted to the MS. The MS shall discard all N-PDUs with SNDCP sequence numbers older than the eight least significant bits of the PDCP-SNU_s received from the SRNS. Other N-PDUs shall be transmitted to the SRNS. The SRNS negotiates with the MS for each radio bearer the use of lossless PDCP or not regardless whether the old 2G-SGSN used acknowledged or unacknowledged SNDCP for the related NSAPI or not.

NOTE: The NSAPI value is carried in the RAB ID IE.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "PDP Context Deactivation Initiated by SGSN Procedure". This shall not cause the SGSN to reject the routing area update.

CAMEL procedure calls shall be performed, see referenced procedure in 3G TS 23.078:

- C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach

These procedures are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. It returns as result "Continue".

- C2) CAMEL_GPRS_Routeing_Area_Update_Session.

The procedure returns as result "Continue".

- C3) CAMEL_GPRS_Routeing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

Next change

9.2.2.1 PDP Context Activation Procedure

The PDP Context Activation procedure is illustrated in Figure 13 and Figure 14.

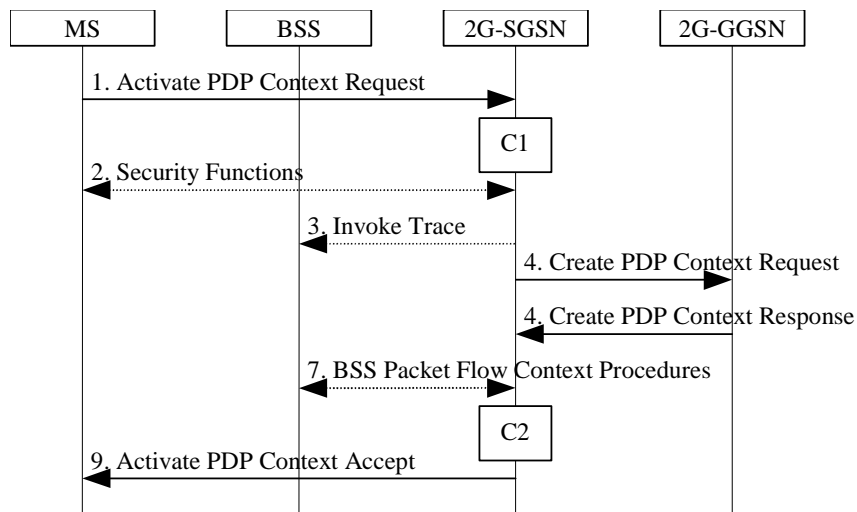


Figure 13: PDP Context Activation Procedure for GSM

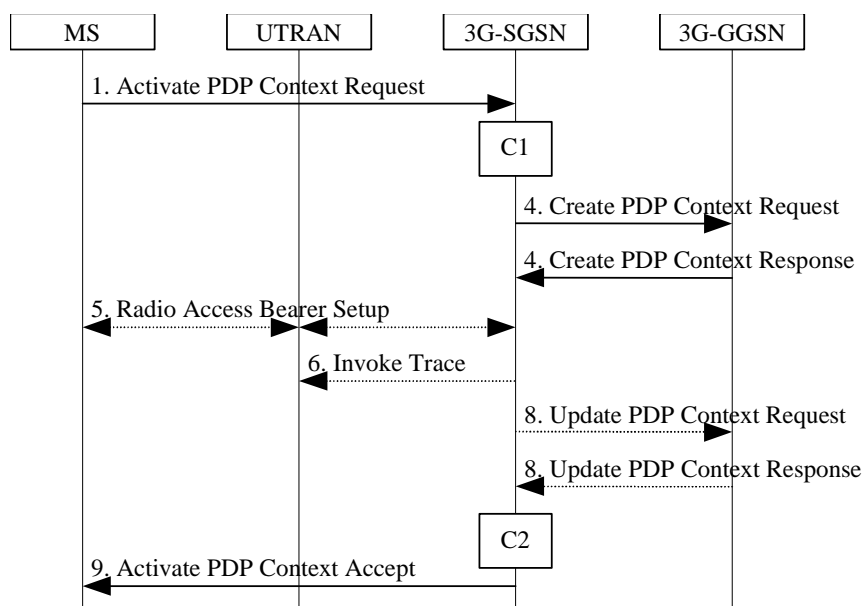


Figure 14: PDP Context Activation Procedure for UMTS

- 1) The MS sends an Activate PDP Context Request (NSAPI, TI, PDP Type, PDP Address, Access Point Name, QoS Requested, PDP Configuration Options) message to the SGSN. The MS shall use PDP Address to indicate whether it requires the use of a static PDP address or whether it requires the use of a dynamic PDP address. The MS shall leave PDP Address empty to request a dynamic PDP address. The MS may use Access Point Name to select a reference point to a certain external network and/or to select a service. Access Point Name is a logical name referring to the external packet data network and/or to a service that the subscriber wishes to connect to. QoS Requested indicates the desired QoS profile. PDP Configuration Options may be used to request optional PDP parameters from the GGSN (see GSM 09.60). PDP Configuration Options is sent transparently through the SGSN.
- 2) In A/Gb mode, security functions may be executed. These procedures are defined in subclause "Security Function".
- 3) In A/Gb mode and if BSS trace is activated, the SGSN shall send an Invoke Trace (Trace Reference, Trace Type, Trigger Id, OMC Identity) message to the BSS. Trace Reference, and Trace Type are copied from the trace information received from the HLR or OMC.
- 4) The SGSN validates the Activate PDP Context Request using PDP Type (optional), PDP Address (optional), and Access Point Name (optional) provided by the MS and the PDP context subscription records. The validation criteria, the APN selection criteria, and the mapping from APN to a GGSN are described in annex A.

If no GGSN address can be derived or if the SGSN has determined that the Activate PDP Context Request is not valid according to the rules described in annex A, the SGSN rejects the PDP context activation request.

If a GGSN address can be derived, the SGSN creates a TEID for the requested PDP context. If the MS requests a dynamic address, the SGSN lets a GGSN allocate the dynamic address. The SGSN may restrict the requested QoS attributes given its capabilities and the current load, and it shall restrict the requested QoS attributes according to the subscribed QoS profile.

The SGSN sends a Create PDP Context Request (PDP Type, PDP Address, Access Point Name, QoS Negotiated, TEID, NSAPI, MSISDN, Selection Mode, Charging Characteristics, Trace Reference, Trace Type, Trigger Id, OMC Identity, PDP Configuration Options, [serving network identity](#)) message to the affected GGSN. [The SGSN should send the serving network identity to the GGSN.](#) Access Point Name shall be the APN Network Identifier of the APN selected according to the procedure described in Annex A. PDP Address shall be empty if a dynamic address is requested. The GGSN may use Access Point Name to find an external network and optionally to activate a service for this APN. Selection Mode indicates whether a subscribed APN was selected, or whether a non-subscribed APN sent by an MS or a non-subscribed APN chosen by the SGSN was selected. Selection Mode is set according to Annex A. The GGSN may use Selection Mode when deciding whether to accept or reject the PDP context activation. For example, if an APN requires subscription, the GGSN is configured to accept only the PDP context activation that requests a subscribed APN as indicated by the SGSN with Selection Mode. Charging Characteristics indicates which kind of charging the PDP context is liable for.

The charging characteristics on the GPRS subscription and individually subscribed APNs as well as the way the SGSN handles Charging Characteristics and chooses to send them or not to the GGSN is defined in 3G TS 32.015 [70]. The SGSN shall include Trace Reference, Trace Type, Trigger Id, and OMC Identity if GGSN 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 GGSN creates a new entry in its PDP context table and generates a Charging Id. The new entry allows the GGSN to route PDP PDUs between the SGSN and the external PDP network, and to start charging. The way the GGSN handles Charging Characteristics that it may have received from the SGSN is defined in 3G TS 32.015 [70]. The GGSN then returns a Create PDP Context Response (TEID, PDP Address, PDP Configuration Options, QoS Negotiated, Charging Id, Cause) message to the SGSN. PDP Address is included if the GGSN allocated a PDP address. If the GGSN has been configured by the operator to use External PDN Address Allocation for the requested APN, PDP Address shall be set to 0.0.0.0, indicating that the PDP address shall be negotiated by the MS with the external PDN after completion of the PDP Context Activation procedure. The GGSN shall relay, modify and monitor these negotiations as long as the PDP context is in ACTIVE state, and use the GGSN-Initiated PDP Context Modification procedure to transfer the currently used PDP address to the SGSN and the MS. PDP Configuration Options contain optional PDP parameters that the GGSN may transfer to the MS. These optional PDP parameters may be requested by the MS in the Activate PDP Context Request message, or may be sent unsolicited by the GGSN. PDP Configuration Options is sent transparently through the SGSN. The Create PDP Context messages are sent over the backbone network.

If QoS Negotiated received from the SGSN is incompatible with the PDP context being activated, the GGSN rejects the Create PDP Context Request message. The GGSN operator configures the compatible QoS profiles.

- 5) In Iu mode, RAB setup is done by the RAB Assignment procedure, see subclause "RAB Assignment Procedure".
- 6) In Iu mode and if BSS trace is activated, the SGSN shall send an Invoke Trace (Trace Reference, Trace Type, Trigger Id, OMC Identity) message to the UTRAN. Trace Reference, and Trace Type are copied from the trace information received from the HLR or OMC.
- 7) In A/Gb mode, BSS packet flow context procedures may be executed. These procedures are defined in subclause "BSS Context".
- 8) In Iu mode and in case the QoS attributes have been downgraded in step 5, the SGSN may inform the GGSN about the downgraded QoS attributes by sending an Update PDP Context Request to the affected GGSN. The GGSN confirms the new QoS attributes by sending an Update PDP Context Response to the SGSN.
- 9) The SGSN inserts the NSAPI along with the GGSN address in its PDP context. If the MS has requested a dynamic address, the PDP address received from the GGSN is inserted in the PDP context. The SGSN selects Radio Priority and Packet Flow Id based on QoS Negotiated, and returns an Activate PDP Context Accept (PDP Type, PDP Address, TI, QoS Negotiated, Radio Priority, Packet Flow Id, PDP Configuration Options) message to the MS. The SGSN is now able to route PDP PDUs between the GGSN and the MS, and to start charging.

For each PDP Address a different quality of service (QoS) profile may be requested. For example, some PDP addresses may be associated with E-mail that can tolerate lengthy response times. Other applications cannot tolerate delay and demand a very high level of throughput, interactive applications being one example. These different requirements are reflected in the QoS profile. The QoS profile is defined in subclause "Quality of Service Profile". If a QoS requirement is beyond the capabilities of a PLMN, the PLMN negotiates the QoS profile as close as possible to the requested QoS profile. The MS either accepts the negotiated QoS profile, or deactivates the PDP context.

After an SGSN has successfully updated the GGSN, the PDP contexts associated with an MS is distributed as shown in clause "Information Storage".

If the PDP Context Activation Procedure fails or if the SGSN returns an Activate PDP Context Reject (Cause, PDP Configuration Options) message, the MS may attempt another activation to the same APN up to a maximum number of attempts.

CAMEL procedure calls shall be performed, see referenced procedures in 3G TS 23.078:

C1) CAMEL_GPRS_PDP_Context_Establishment.

In Figure 13 and Figure 14, procedures return as result "Continue".

C2) CAMEL_GPRS_PDP_Context_Establishment_Acknowledgement.

In Figure 13 and Figure 14, procedures return as result "Continue".

9.2.2.1.1 Secondary PDP Context Activation Procedure

The Secondary PDP Context Activation procedure may be used to activate a PDP context while reusing the PDP address and other PDP context information from an already active PDP context, but with a different QoS profile. Procedures for APN selection and PDP address negotiation are not executed. A unique TI and a unique NSAPI shall identify each PDP context sharing the same PDP address and APN.

The Secondary PDP Context Activation procedure may be executed without providing a Traffic Flow Template (TFT) to the newly activated PDP context if all other active PDP contexts for this PDP address and APN already have an associated TFT. Otherwise a TFT shall be provided. The TFT contains attributes that specify an IP header filter that is used to direct data packets received from the interconnected external packet data network to the newly activated PDP context.

The Secondary PDP Context Activation procedure may only be initiated after a PDP context is already activated for the same PDP address and APN. The procedure is illustrated in Figure 15 and Figure 16.

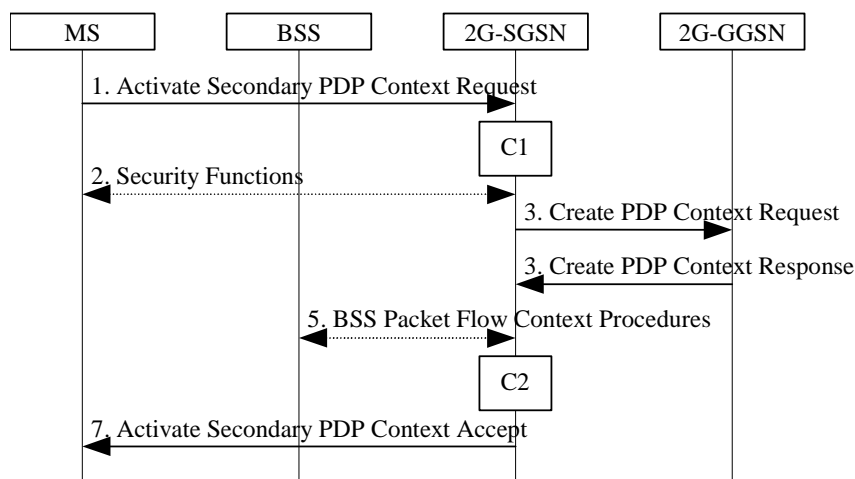


Figure 15: Secondary PDP Context Activation Procedure for GSM

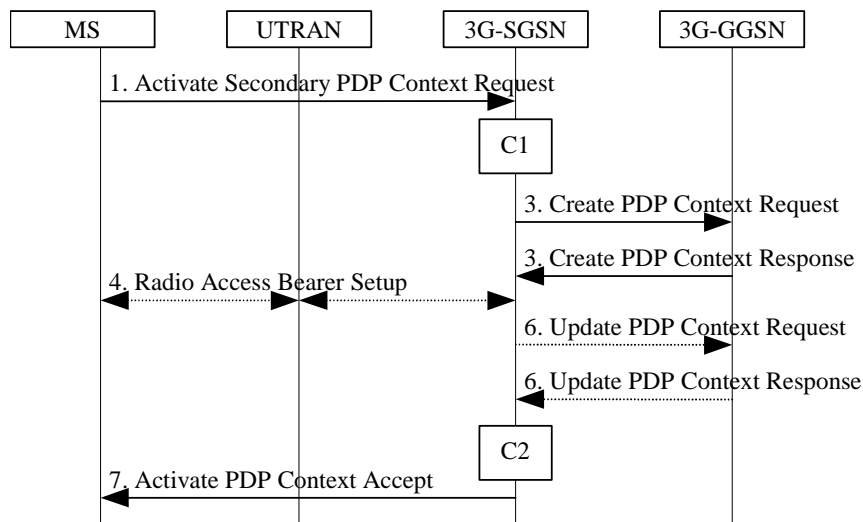


Figure 16: Secondary PDP Context Activation Procedure for UMTS

- 1) The MS sends an Activate Secondary PDP Context Request (Linked TI, NSAPI, TI, QoS Requested, TFT) message to the SGSN. Linked TI indicates the TI value assigned to any one of the already activated PDP contexts for this PDP address and APN. QoS Requested indicates the desired QoS profile. TFT is sent transparently through the SGSN to the GGSN to enable packet classification for downlink data transfer. TI and NSAPI contain values not used by any other activated PDP context.

- 2) In A/Gb mode, security functions may be executed. These procedures are defined in subclause "Security Function".
- 3) The SGSN validates the Activate Secondary PDP Context Request using the TI indicated by Linked TI. The same GGSN address is used by the SGSN as for the already-activated PDP context(s) for that TI and PDP address.

The SGSN may restrict the requested QoS attributes given its capabilities and the current load, and it shall restrict the requested QoS attributes according to the subscribed QoS profile, which represents the maximum QoS per PDP context to the associated APN. The GGSN may restrict and negotiate the requested QoS as specified in subclause "PDP Context Activation Procedure". The SGSN sends a Create PDP Context Request (QoS Negotiated, TEID, NSAPI, Primary NSAPI, TFT, [serving network identity](#)) message to the affected GGSN. [The SGSN should send the serving network identity to the GGSN.](#) Primary NSAPI indicates the NSAPI value assigned to any one of the already activated PDP contexts for this PDP address and APN. TFT is included only if received in the Activate Secondary PDP Context Request message. The GGSN uses the same external network as used by the already-activated PDP context(s) for that PDP address, generates a new entry in its PDP context table, and stores the TFT. The new entry allows the GGSN to route PDP PDUs via different GTP tunnels between the SGSN and the external PDP network. The GGSN returns a Create PDP Context Response (TEID, QoS Negotiated, Cause) message to the SGSN.

- 4) In Iu mode, RAB setup is done by the RAB Assignment procedure.
- 5) In A/Gb mode, BSS packet flow context procedures may be executed. These procedures are defined in subclause "BSS Context".
- 6) In Iu mode and in case when the QoS attributes have been downgraded in step 4, the SGSN may inform the GGSN about the downgraded QoS attributes by sending to it an Update PDP Context Request. The GGSN confirms the new QoS attributes by sending an Update PDP Context Response to the SGSN.
- 7) The SGSN selects Radio Priority and Packet Flow Id based on QoS Negotiated, and returns an Activate Secondary PDP Context Accept (TI, QoS Negotiated, Radio Priority, Packet Flow Id) message to the MS. The SGSN is now able to route PDP PDUs between the GGSN and the MS via different GTP tunnels and possibly different LLC links.

For each additionally activated PDP context a QoS profile and TFT may be requested.

If the secondary PDP context activation procedure fails or if the SGSN returns an Activate Secondary PDP Context Reject (Cause) message, the MS may attempt another activation with a different TFT, depending on the cause.

CAMEL procedure calls shall be performed, see referenced procedures in 3G TS 23.078:

- C1) CAMEL_GPRS_PDP_Context_Establishment.

In Figure 15 and in Figure 16, procedures return as result "Continue".

- C2) CAMEL_GPRS_PDP_Context_Establishment_Acknowledgement.

In Figure 15 and in Figure 16, procedures return as result "Continue".

Next change

9.2.3.1 SGSN-Initiated PDP Context Modification Procedure

The SGSN-Initiated PDP Context Modification procedure is illustrated in Figure 17.

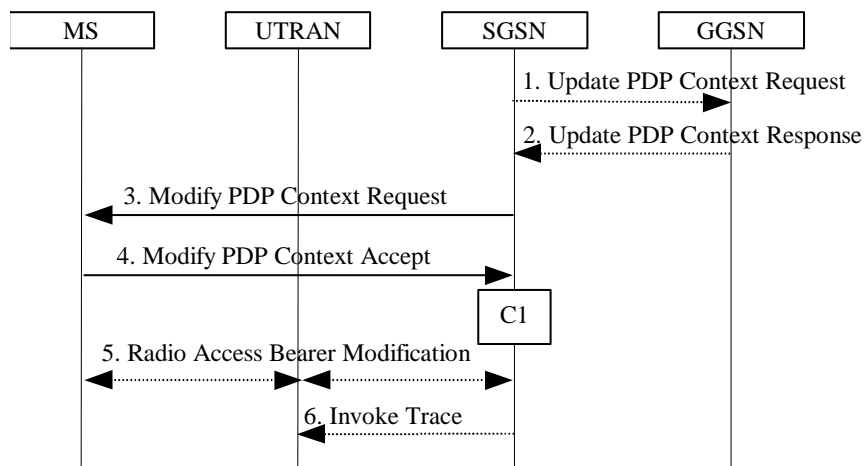


Figure 17: SGSN-Initiated PDP Context Modification Procedure

- 1) The SGSN may send an Update PDP Context Request (TEID, NSAPI, QoS Negotiated, Trace Reference, Trace Type, Trigger Id, OMC Identity, [serving network identity](#)) message to the GGSN. [The SGSN should send the serving network identity to the GGSN.](#) If QoS Negotiated received from the SGSN is incompatible with the PDP context being modified, the GGSN rejects the Update PDP Context Request. The GGSN operator configures the compatible QoS profiles. The SGSN shall include Trace Reference, Trace Type, Trigger Id, and OMC Identity in the message if GGSN trace is activated while the PDP context is active. The SGSN shall copy Trace Reference, Trace Type, and OMC Identity from the trace information received from the HLR or OMC.
- 2) The GGSN may restrict QoS Negotiated given its capabilities and the current load. The GGSN stores QoS Negotiated and returns an Update PDP Context Response (TEID, QoS Negotiated, Cause) message.
- 3) The SGSN selects Radio Priority and Packet Flow Id based on QoS Negotiated, and may send a Modify PDP Context Request (TI, QoS Negotiated, Radio Priority, Packet Flow Id) message to the MS.
- 4) The MS acknowledges by returning a Modify PDP Context Accept message. If the MS does not accept the new QoS Negotiated it shall instead de-activate the PDP context with the PDP Context Deactivation Initiated by the MS procedure.
- 5) In Iu mode, radio access bearer modification may be performed by the RAB Assignment procedure.
- 6) If BSS trace is activated while the PDP context is active, the SGSN shall send an Invoke Trace (Trace Reference, Trace Type, Trigger Id, OMC Identity) message to the BSS or UTRAN. Trace Reference, and Trace Type are copied from the trace information received from the HLR or OMC.

CAMEL procedure calls shall be performed, see referenced procedure in 3G TS 23.078:

- C1) CAMEL_GPRS_Change_Of_QoS.

The procedure returns as result "Continue".

Next change

9.2.3.3 MS-Initiated PDP Context Modification Procedure

The MS-Initiated PDP Context Modification procedure is illustrated in Figure 18.

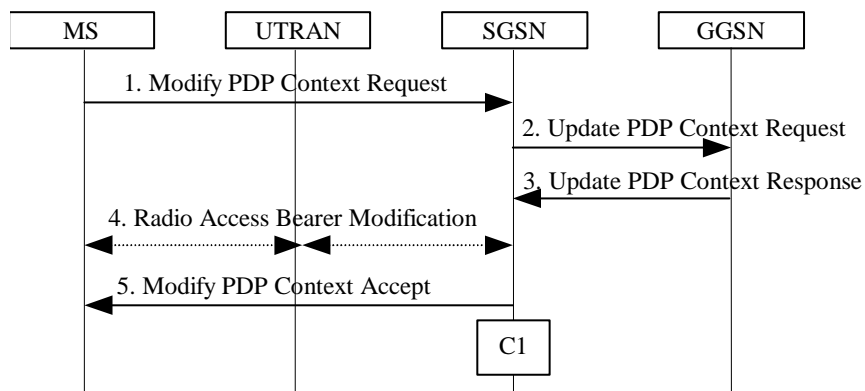


Figure 18: MS-Initiated PDP Context Modification Procedure

- 1) The MS sends a Modify PDP Context Request (TI, QoS Requested, TFT) message to the SGSN. Either QoS Requested or TFT or both may be included. QoS Requested indicates the desired QoS profile, while TFT indicates the TFT that is to be added or modified or deleted from the PDP context.
- 2) The SGSN may restrict the desired QoS profile given its capabilities, the current load, and the subscribed QoS profile. The SGSN sends an Update PDP Context Request (TEID, NSAPI, QoS Negotiated, TFT, [serving network identity](#)) message to the GGSN. [The SGSN should send the serving network identity to the GGSN.](#) If QoS Negotiated and/or TFT received from the SGSN is incompatible with the PDP context being modified (e.g., TFT contains inconsistent packet filters), the GGSN rejects the Update PDP Context Request. The GGSN operator configures the compatible QoS profile.
- 3) The GGSN may further restrict QoS Negotiated given its capabilities and the current load. The GGSN stores QoS Negotiated, stores, modifies, or deletes TFT of that PDP context as indicated in TFT, and returns an Update PDP Context Response (TEID, QoS Negotiated) message.
- 4) In Iu mode, radio access bearer modification may be performed by the RAB Assignment procedure. In case the radio access bearer does not exist the RAB setup is done by the RAB Assignment procedure.
- 5) The SGSN selects Radio Priority and Packet Flow Id based on QoS Negotiated, and returns a Modify PDP Context Accept (TI, QoS Negotiated, Radio Priority, Packet Flow Id) message to the MS.

NOTE: If the SGSN does not accept QoS Requested, then steps 2 and 3 of this procedure are skipped, and the existing QoS Negotiated is returned to the MS in step 4.

CAMEL procedure calls shall be performed, see referenced procedure in 3G TS 23.078:

C1) CAMEL_GPRS_Change_Of_QoS.

The procedure returns as result "Continue".

CR-Form-v7	
CHANGE REQUEST	
⌘ 23.060 CR 472 ⌘ rev 3 ⌘	Current version: 4.8.0 ⌘

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.

Proposed change affects: UICC apps ME Radio Access Network Core Network

Title:	⌘ Serving network identity from SGSN to GGSN		
Source:	⌘ Nortel Networks		
Work item code:	⌘ TEI	Date:	⌘ 24/11/03
Category:	⌘ A	Release:	⌘ Rel-4
	Use <u>one</u> of the following categories:		Use <u>one</u> of the following releases:
	<i>F</i> (correction)	R96	2 (GSM Phase 2)
	<i>A</i> (corresponds to a correction in an earlier release)	R97	(Release 1996)
	<i>B</i> (addition of feature),	R98	(Release 1997)
	<i>C</i> (functional modification of feature)	R99	(Release 1998)
	<i>D</i> (editorial modification)	Rel-4	(Release 1999)
	Detailed explanations of the above categories can be found in 3GPP TR 21.900 .	Rel-5	(Release 4)
		Rel-6	(Release 5)
			(Release 6)

Reason for change:	⌘ In an LS from SA5 (S2-033339), SA2 are asked to add the requirement of including the MCC and MNC of the location of where the MS is registered in messaging between SGSN and GGSN (inside the RAI). This is necessary for accurate content filtering. Previous liaisons from T2, CPWP and BARG indicated problems with the implementation of integrated pricing structures without such additions.
Summary of change:	⌘ Information is added to the Create PDP Context Req and Update PDP Context Req, to provide to the GGSN with the network identity on which the MS is registered.
Consequences if not approved:	⌘ Stage 2 requirement missing.

Clauses affected:	⌘ 6.9.1.2.2, 6.9.1.3.2, 6.9.2.1, 6.9.2.2.1, 6.9.2.2.2, 6.13.2.1, 6.13.2.2, 9.2.2.1, 9.2.2.1.1, 9.2.3.1, 9.2.3.3					
Other specs affected:	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Y</td> <td style="text-align: center;">N</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table> Other core specifications	Y	N	<input type="checkbox"/>	<input checked="" type="checkbox"/>	⌘
Y	N					
<input type="checkbox"/>	<input checked="" type="checkbox"/>					
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table> Test specifications	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<input type="checkbox"/>	<input checked="" type="checkbox"/>					
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table> O&M Specifications	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
<input type="checkbox"/>	<input checked="" type="checkbox"/>					
Other comments:	⌘					

6.9.1.2.2 Inter SGSN Routeing Area Update

The Inter SGSN Routeing Area Update procedure is illustrated in Figure 33.

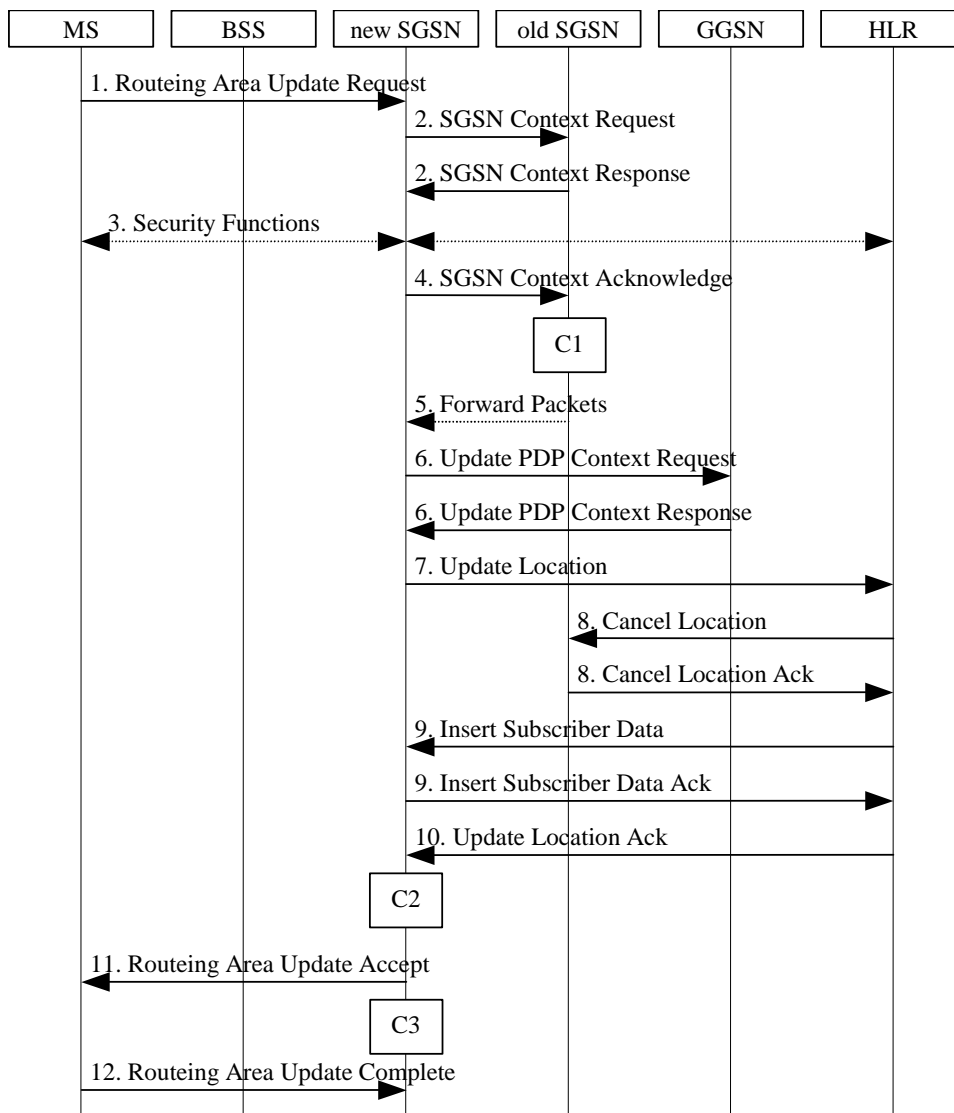


Figure 33: Inter SGSN Routeing Area Update Procedure

- 1) The MS sends a Routeing Area Update Request (old RAI, old P-TMSI Signature, Update Type, Classmark, DRX parameters and MS Network Capability) to the new SGSN. Update Type shall indicate RA update or periodic RA update. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN. Classmark contains the MS GPRS multislot capabilities and supported GPRS ciphering algorithms as defined in TS 24.008. DRX Parameters indicates whether or not the MS uses discontinuous reception and the DRX cycle length.

- 2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN stops assigning SNDCP N-PDU numbers to downlink N-PDUs received, and responds with SGSN Context Response (MM Context, PDP Contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address, to allow the old SGSN to forward data packets to the new SGSN. Each PDP Context includes the SNDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SNDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode from the MS, the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. The old SGSN starts a timer and stops the transmission of N-PDUs to the MS. The new SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routeing Area Request.
- 3) Security functions may be executed. These procedures are defined in clause "Security Function". Ciphering mode shall be set if ciphering is supported.

If the security functions fail (e.g. because the SGSN cannot determine the HLR address to establish the Send Authentication Info dialogue), the Inter SGSN RAU Update procedure fails. A reject shall be returned to the MS with an appropriate cause.

- 4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, then the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received from the GGSN before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS in acknowledged mode and that are not yet acknowledged by the MS are tunnelled together with the SNDCP N-PDU number. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.
- 6) The new SGSN sends Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return Update PDP Context Response (TEID).
- 7) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 8) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter-SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 9) The HLR sends Insert Subscriber Data (IMSI, GPRS Subscription Data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routeing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful, the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 10) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.

11) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS, is not allowed to be attached in the SGSN, or if subscription checking fails, the new SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new SGSN constructs MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routing Area Update Accept (P-TMSI, P-TMSI Signature, Receive N-PDU Number). Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.

12) The MS acknowledges the new P-TMSI by returning a Routing Area Update Complete (Receive N-PDU Number) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms reception of N-PDUs that were forwarded from the old SGSN, these N-PDUs shall be discarded by the new SGSN. LLC and SNDCP in the MS are reset.

In the case of a rejected routing area update operation, due to regional subscription or roaming restrictions, , or because the SGSN cannot determine the HLR address to establish the locating updating dialogue, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS does not re-attempt a routing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in clause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, the old SGSN stops forwarding N-PDUs to the new SGSN.

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter IDLE state.

The CAMEL procedure calls shall be performed, see referenced procedures in 3GPP TS 23.078:

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach.

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

C2) CAMEL_GPRS_Routing_Area_Update_Session.

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

Next change

6.9.1.3.2 Combined Inter SGSN RA / LA Update

The Combined RA / LA Update (inter-SGSN) procedure is illustrated in Figure 35.

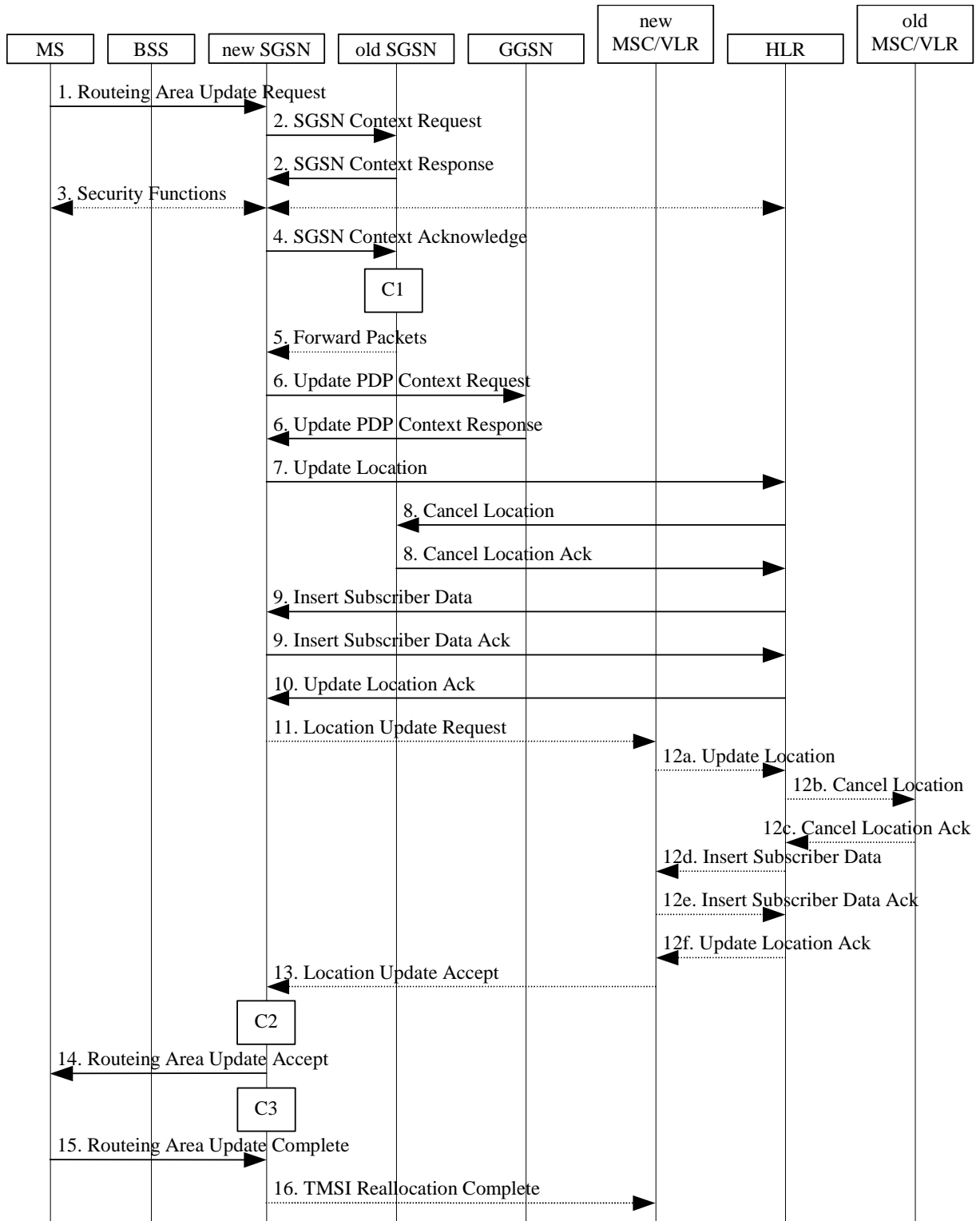


Figure 35: Combined RA / LA Update in the Case of Inter SGSN RA Update Procedure

- 1) The MS sends a Routeing Area Update Request (old RAI, old P-TMSI Signature, Update Type, Classmark, DRX parameters and MS Network Capability) to the new SGSN. Update Type shall indicate combined RA / LA update, or, if the MS wants to perform an IMSI attach, combined RA / LA update with IMSI attach requested. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN. Classmark contains the MS GPRS multislot capabilities and supported GPRS ciphering algorithms as defined in 3GPP TS 24.008. DRX Parameters indicates whether or not the MS uses discontinuous and the DRX cycle length.
- 2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN stops assigning SMDCP N-PDU numbers to downlink N-PDUs received, and responds with SGSN Context Response (MM Context, PDP Contexts). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address until the old MM context is cancelled, to allow the old SGSN to forward data packets to the new SGSN. Each PDP Context includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode from the MS, the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. The old SGSN starts a timer and stops the downlink transfer. The new SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routeing Area Request.
- 3) Security functions may be executed. These procedures are defined in clause "Security Function". Ciphering mode shall be set if ciphering is supported. If the security functions fail (e.g. because the SGSN cannot determine the HLR address to establish the Send Authentication Info dialogue), the Inter SGSN RAU Update procedure fails. A reject shall be returned to the MS with an appropriate cause.
- 4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received from the GGSN before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS in acknowledged mode and that are not yet acknowledged by the MS are tunnelled together with the SMDCP N-PDU number. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.
- 6) The new SGSN sends Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (TEID).
- 7) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 8) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 9) The HLR sends Insert Subscriber Data (IMSI, GPRS Subscription Data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routeing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful, the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.

- 10) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
- 11) If the association has to be established, if Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routing area update, the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with IMSI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI via a table in the SGSN. The SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 9). The VLR creates or updates the association with the SGSN by storing SGSN Number.
- 12) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.
 - e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
- 13) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the SGSN. VLR TMSI is optional if the VLR has not changed.
- 14) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the RA, or if subscription checking fails, the SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new SGSN establishes MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature, Receive N-PDU Number). Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.
- 15) The MS confirms the reallocation of the TMSIs by returning a Routing Area Update Complete (Receive N-PDU Number) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each acknowledged-mode NSAPI used by the MS, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms reception of N-PDUs that were forwarded from the old SGSN, these N-PDUs shall be discarded by the new SGSN. LLC and SNDCP in the MS are reset.
- 16) The new SGSN sends a TMSI Reallocation Complete message to the new VLR if the MS confirms the VLR TMSI.

In the case of a rejected routing area update operation, due to regional subscription or roaming restrictions, or because the SGSN cannot determine the HLR address to establish the locating updating dialogue, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in clause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter IDLE state.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, the old SGSN shall stop forwarding N-PDUs to the new SGSN.

If the Location Update Accept message indicates a reject, this should be indicated to the MS, and the MS shall not access non-GPRS services until a successful location update is performed.

The CAMEL procedure calls shall be performed, see referenced procedures in 3GPP TS 23.078:

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach.

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".

- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

C2) CAMEL_GPRS_Routeing_Area_Update_Session.

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routeing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

Next change

6.9.2.1 Routeing Area Update Procedure

A routeing area update takes place when an attached MS detects that it has entered a new RA or when the periodic RA update timer has expired or when RRC connection is released with cause "Directed Signalling connection re-establishment" or when the MS has to indicate new access capabilities to the network.

The SGSN detects that it is an intra-SGSN routeing area update by noticing that it also handles the old RA. In this case, the SGSN has the necessary information about the MS and there is no need to inform the GGSNs or the HLR about the new MS location. A periodic RA update is always an intra-SGSN routeing area update. If the network operates in mode I, an MS that is both GPRS-attached and IMSI-attached shall perform the Combined RA / LA Update procedures.

In Iu mode, an RA update is either an intra-SGSN or inter-SGSN RA update, either combined RA / LA update or only RA update, either initiated by an MS in PMM-CONNECTED (only valid after a Serving RNS Relocation Procedure, see clause 6.9.2.2) or in PMM-IDLE state. All the RA update cases are contained in the procedure illustrated in Figure 36.

NOTE 1: The network may receive an RA update from a UE in PMM-CONNECTED state over a new Iu signalling connection. This could happen when the UE enters PMM-IDLE state on receipt of RRC Connection Release with cause "Directed Signalling connection re-establishment" and initiates an RA or Combined RA update procedure (see clause 6.1.2.4.1).

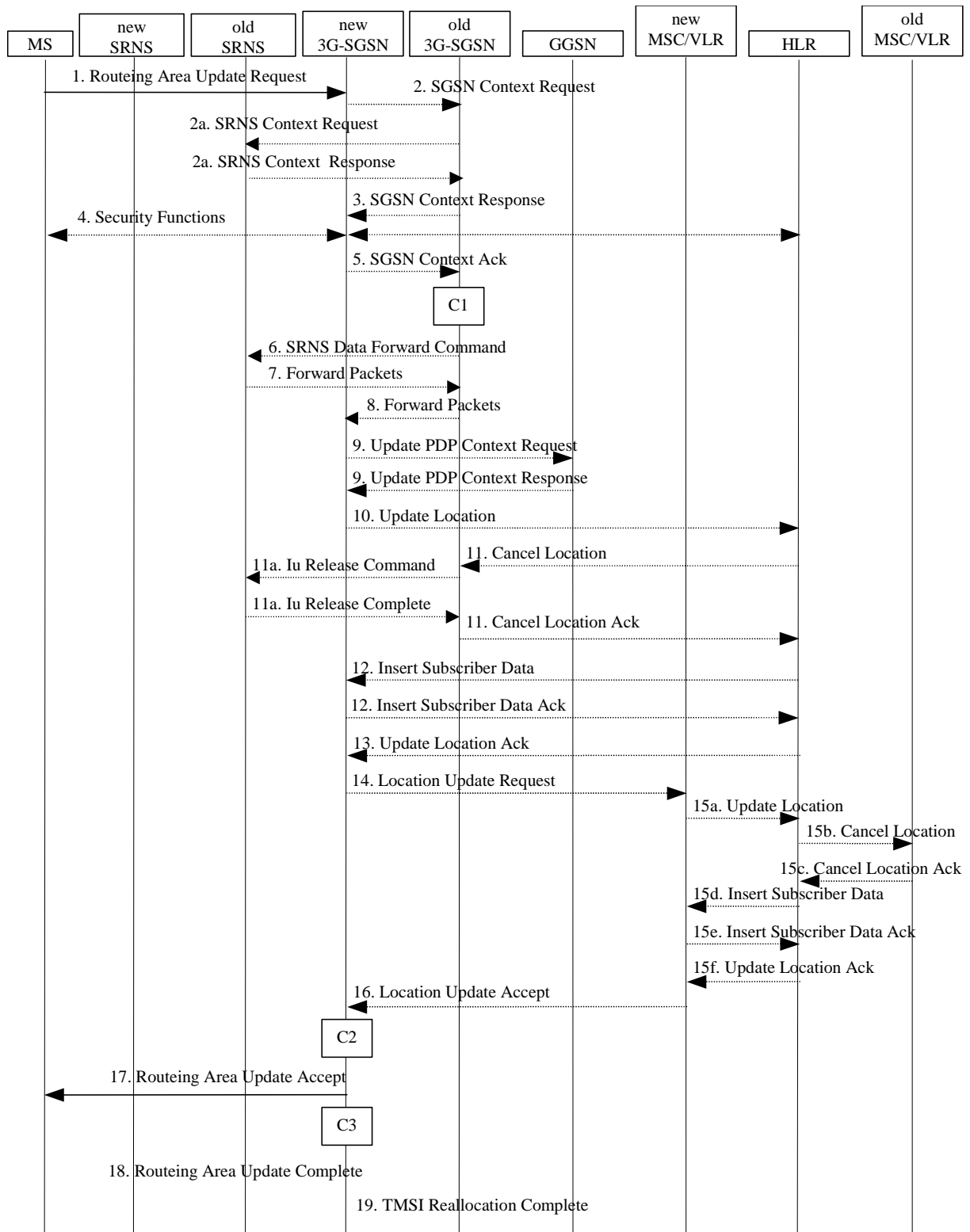


Figure 36: UMTS RA Update Procedure

- 1) The RRC connection is established, if not already done. The MS sends a Routeing Area Update Request message (P-TMSI, old RAI, old P-TMSI Signature, Update Type, follow on request, Classmark, DRX Parameters, MS Network Capability) to the new SGSN. The MS shall set a follow-on request if there is pending uplink traffic (signalling or user data). The SGSN may use, as an implementation option, the follow-on request indication to release or keep the Iu connection after the completion of the RA update procedure. Update Type shall indicate:
 - RA Update if the RA Update is triggered by a change of RA;
 - Periodic RA Update if the RA update is triggered by the expiry of the Periodic RA Update timer;
 - Combined RA / LA Update if the MS is also IMSI-attached and the LA update shall be performed in network operation mode I (see clause "Interactions Between SGSN and MSC/VLR"); or
 - Combined RA / LA Update with IMSI attach requested if the MS wants to perform an IMSI attach in network operation mode I.

The SRNC shall add the Routeing Area Identity including the RAC and LAC of the area where the MS is located before forwarding the message to the 3G-SGSN. This RA identity corresponds to the RAI in the MM system information sent by the SRNC to the MS. Classmark is described in clause "MS Network Capability". DRX Parameters indicates whether or not the MS uses discontinuous reception and the DRX cycle length.

NOTE 2: Sending the Routeing Area Update Request message to the SGSN triggers the establishment of a signalling connection between UTRAN and SGSN for the concerned MS.

- 2) If the RA update is an Inter-SGSN Routeing area update and if the MS was in PMM-IDLE state, the new SGSN sends an SGSN Context Request message (old P-TMSI, old RAI, old P-TMSI Signature) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (IMSI, old RAI, MS Validated) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN starts a timer.. If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause.
- 2a) If the MS is PMM-CONNECTED state in the old 3G-SGSN or, in case of an intra-SGSN RA update, if the MS is in the PMM-CONNECTED state and the RAU was received over another Iu connection than the established one, the old SGSN sends an SRNS Context Request (IMSI) message to the old SRNS to retrieve the sequence numbers for the PDP context for inclusion in the SGSN Context Response message. Upon reception of this message, the SRNS buffers and stops sending downlink PDUs to the MS and returns an SRNS Context Response (IMSI, GTP-SNDs, GTP-SNUs, PDCP-SNUs) message. The SRNS shall include for each PDP context the next in-sequence GTP sequence number to be sent to the MS and the GTP sequence number of the next uplink PDU to be tunnelled to the GGSN. For each active PDP context which uses lossless PDCP, the SRNS also includes the uplink PDCP sequence number (PDCP-SNU). PDCP-SNU shall be the next in-sequence PDCP sequence number expected from the MS (per each active radio bearer). No conversion of PDCP sequence numbers to SMDCP sequence numbers shall be done in the 3G-SGSN.
- 3) The old 3G-SGSN responds with an SGSN Context Response (MM Context, PDP Contexts) message. For each PDP context the old 3G-SGSN shall include the GTP sequence number for the next uplink GTP PDU to be tunnelled to the GGSN and the next downlink GTP sequence number for the next PDU to be sent to the MS. Each PDP Context also includes the PDCP sequence numbers if PDCP sequence numbers are received from the old SRNS. The new 3G-SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routeing Area Request. The GTP sequence numbers received from the old 3G-SGSN are only relevant if delivery order is required for the PDP context (QoS profile).
- 4) Security functions may be executed. These procedures are defined in clause "Security Function". If the security functions do not authenticate the MS correctly, the routeing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.
- 5) If the RA update is an Inter-SGSN Routeing area update, the new SGSN sends an SGSN Context Acknowledge message to the old SGSN. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure.

- 6) If the MS is in PMM-CONNECTED state in the old 3G-SGSN or, in case of an intra-SGSN RA update, if the MS is PMM connected and the RAU was received over another Iu connection than the established one, the old 3G-SGSN sends an SRNS Data Forward Command (RAB ID, Transport Layer Address, Iu Transport Association) message to the SRNS. Upon receipt of the SRNS Data Forward Command message from the 3G-SGSN, the SRNS shall start the data-forwarding timer.
- 7) For each indicated RAB the SRNS starts duplicating and tunnelling the buffered GTP PDUs to the old 3G-SGSN. For each radio bearer which uses lossless PDCP the SRNS shall start tunnelling the partly transmitted and the transmitted but not acknowledged PDCP-PDUs together with their related PDCP sequence numbers and start duplicating and tunnelling the buffered GTP PDUs to the old 3G-SGSN. Upon receipt of the SRNS Data Forward Command message from the 3G-SGSN, the SRNS shall start the data-forwarding timer.
- 8) If the RA update is an Inter-SGSN RA Update, the old 3G-SGSN tunnels the GTP PDUs to the new 3G-SGSN. No conversion of PDCP sequence numbers to SMDCP sequence numbers shall be done in the 3G-SGSN.
- 9) If the RA update is an Inter-SGSN RA Update and if the MS was not in PMM-CONNECTED state in the new 3G-SGSN, the new SGSN sends Update PDP Context Request (new SGSN Address, QoS Negotiated, Tunnel Endpoint Identifier, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN](#). The GGSNs update their PDP context fields and return an Update PDP Context Response (Tunnel Endpoint Identifier). Note: If the RA update is an Inter-SGSN routing area update initiated by an MS in PMM-CONNECTED state in the new 3G-SGSN, the Update PDP Context Request message is sent as described in subclause "Serving RNS Relocation Procedures".
- 10) If the RA update is an Inter-SGSN RA Update, the new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
- 11) If the RA update is an Inter-SGSN RA Update, the HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, the old SGSN removes the MM context. Otherwise, the contexts are removed only when the timer expires. It also ensures that the MM context is kept in the old SGSN in case the MS initiates another inter SGSN routing area update before completing the ongoing routing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).
- 11a) On receipt of Cancel Location, if the MS is PMM-CONNECTED in the old 3G-SGSN, the old 3G-SGSN sends an Iu Release Command message to the old SRNC. When the data-forwarding timer has expired, the SRNS responds with an Iu Release Complete message.
- 12) If the RA update is an inter-SGSN RA Update, the HLR sends Insert Subscriber Data (IMSI, subscription data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to be attached in the RA, the SGSN rejects the Routing Area Update Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If all checks are successful, the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 13) If the RA update is an Inter-SGSN RA Update, the HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.
- 14) If Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routing area update, the association has to be established, and the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with ISI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI via a table in the SGSN. The SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 8). The VLR creates or updates the association with the SGSN by storing SGSN Number.
- 15) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.

- e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
- 16) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the SGSN. VLR TMSI is optional if the VLR has not changed.
- 17) The new SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the RA, or if subscription checking fails, the SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new SGSN establishes MM context for the MS. The new SGSN responds to the MS with Routing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature).
- 18) The MS confirms the reallocation of the TMSIs by returning a Routing Area Update Complete message to the SGSN.
- 19) The new SGSN sends a TMSI Reallocation Complete message to the new VLR if the MS confirms the VLR TMSI.

NOTE 3: Steps 15, 16, and 19 are performed only if step 14 is performed.

In the case of a rejected routing area update operation, due to regional subscription or roaming restrictions, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routing area update to that RA. The RAI value shall be deleted when the MS is powered up.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

NOTE: In case MS was in PMM-CONNECTED state the PDP Contexts are sent already in the Forward Relocation Request message as described in subclause "Serving RNS relocation procedures".

If the routing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routing Area Update Reject (Cause) message, the MS shall enter PMM-DETACHED state.

If the Location Update Accept message indicates a reject, this should be indicated to the MS, and the MS shall not access non-PS services until a successful location update is performed.

The CAMEL procedure call shall be performed, see referenced procedures in 3GPP TS 23.078:

C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach.

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

C2) CAMEL_GPRS_Routing_Area_Update_Session.

The procedure returns as result "Continue".

C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

Next change

6.9.2.2.1 Serving RNS Relocation Procedure

This procedure is only performed for an MS in PMM-CONNECTED state where the Iur interface carries both the control signalling and the user data.

The Serving SRNS Relocation procedure is used to move the UTRAN to CN connection point at the UTRAN side from the source SRNC to the target RNC, from a "standing still position". In the procedure, the Iu links are relocated. If the target RNC is connected to the same SGSN as the source SRNC, an Intra-SGSN SRNS Relocation procedure is performed. If the routing area is changed, this procedure is followed by an Intra-SGSN Routing Area Update procedure. The SGSN detects an Intra-SGSN routing area update by noticing that it also handles the old RA. In this case, the SGSN has the necessary information about the MS and there is no need to inform the HLR about new location of the MS.

Figure 37 shows user data routing before SRNS relocation when source SRNC and target RNC are connected to different SGSNs. Figure 38 shows the user data routing after SRNS Relocation procedure and Routing Area Update procedure is completed. In case depicted in Figure 37 and Figure 38, the MS is in state PMM-CONNECTED.

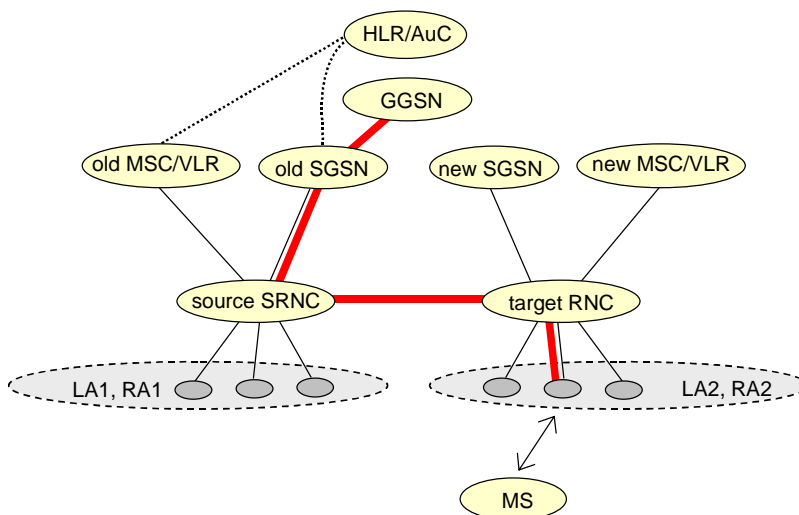


Figure 37: Before SRNS Relocation and Routing Area Update

Before the SRNS Relocation procedure and RA update, the MS is registered in the old SGSN. The source RNC is acting as a serving RNC (SRNC).

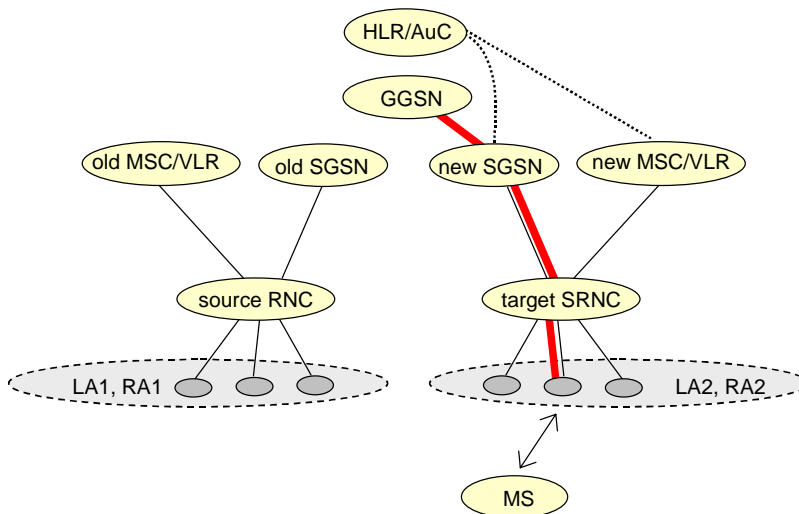


Figure 38: After SRNS Relocation and Routing Area Update

After the SRNS Relocation procedure and RA update, the MS is registered in the new SGSN. The MS is in the state PMM-CONNECTED towards the new SGSN, and the target RNC is acting as the serving RNC.

The Serving SRNS Relocation procedure is illustrated in Figure 39. The sequence is valid for both intra-SGSN SRNS relocation and inter-SGSN SRNS relocation.

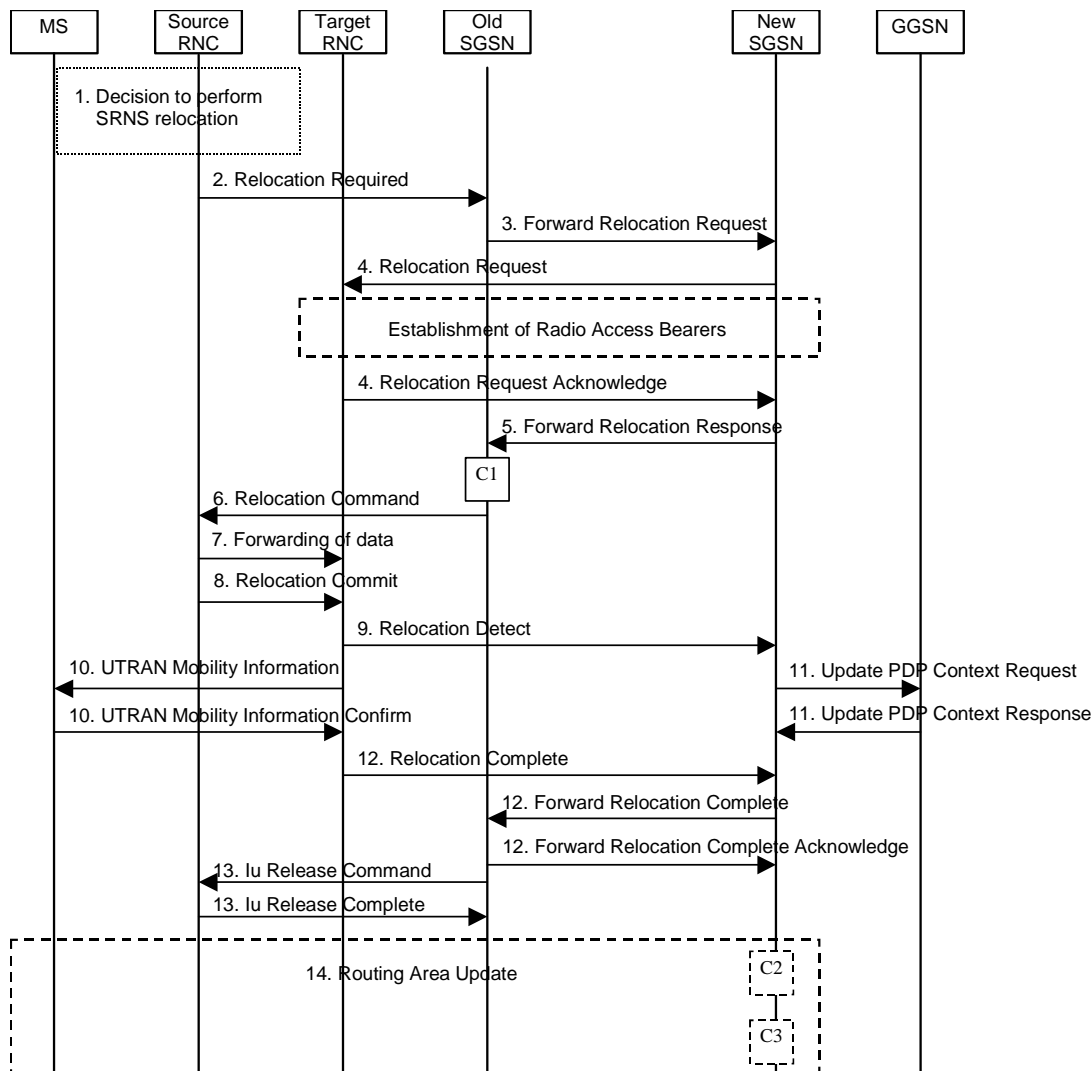


Figure 39: SRNS Relocation Procedure

- 1) The source SRNC decides to perform/initiate SRNS relocation. At this point both uplink and downlink user data flows via the following tunnel(s): Radio Bearer between MS and source SRNC (data flows via the target RNC, which acts as a drift RNC); GTP-U tunnel(s) between source SRNC and old-SGSN; GTP-U tunnel(s) between old-SGSN and GGSN.
- 2) The source SRNC sends a Relocation Required message (Relocation Type, Cause, Source ID, Target ID, Source RNC to target RNC transparent container) to the old SGSN. The source SRNC shall set the Relocation Type to "UE not involved". The Source SRNC to Target RNC Transparent Container includes the necessary information for Relocation co-ordination, security functionality and RRC protocol context information (including MS Capabilities).
- 3) The old SGSN determines from the Target ID if the SRNS Relocation is intra-SGSN SRNS relocation or inter-SGSN SRNS relocation. In case of inter-SGSN SRNS relocation, the old SGSN initiates the relocation resource allocation procedure by sending a Forward Relocation Request message (IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, UTRAN transparent container, RANAP Cause) to the new SGSN. The PDP context contains GGSN Address for User Plane and Uplink TEID for Data (to this GGSN Address and Uplink TEID for Data the old SGSN and the new SGSN send uplink packets). At the same time a timer is started on the MM and PDP contexts in the old SGSN (see the Routing Area Update procedure in subclause "Location Management Procedures (UMTS only)"). The Forward Relocation Request message is applicable only in the case of inter-SGSN SRNS relocation.

- 4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source-RNC to target RNC transparent container, RABs to be setup) to the target RNC. Only the Iu Bearers of the RABs are setup between the target RNC and the new-SGSN as the existing Radio Bearers will be reallocated between the MS and the target RNC when the target RNC takes the role of the serving RNC. For each requested RAB, the RABs to be setup information elements shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. SGSN shall not establish RABs for PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to the uplink Tunnel Endpoint Identifier Data. After all necessary resources for accepted RABs including the Iu user plane are successfully allocated; the target RNC shall send the Relocation Request Acknowledge message (RABs setup, RABs failed to setup) to the new SGSN. Each RAB to be setup is defined by a Transport Layer Address, which is the target RNC Address for user data, and an Iu Transport Association, which corresponds to the downlink Tunnel Endpoint Identifier for user data. For each RAB to be set up, the target RNC may receive simultaneously downlink user packets both from the source SRNC and from the new SGSN.
- 5) When resources for the transmission of user data between the target RNC and the new SGSN have been allocated and the new SGSN is ready for relocation of SRNS, the Forward Relocation Response message (Cause, RANAP Cause, and RAB Setup Information) is sent from the new SGSN to old SGSN. This message indicates that the target RNC is ready to receive from source SRNC the forwarded downlink PDUs, i.e. the relocation resource allocation procedure is terminated successfully. RANAP Cause is information from the target RNC to be forwarded to the source SRNC. The RAB Setup Information, one information element for each RAB, contains the RNC Tunnel Endpoint Identifier and the RNC IP address for data forwarding from the source SRNC to the target RNC. If the target RNC or the new SGSN failed to allocate resources, the RAB Setup Information element contains only NSAPI indicating that the source SRNC shall release the resources associated with the NSAPI. The Forward Relocation Response message is applicable only in case of inter-SGSN SRNS relocation.
- 6) The old SGSN continues the relocation of SRNS by sending a Relocation Command message (RABs to be released, and RABs subject to data forwarding) to the source SRNC. The old SGSN decides the RABs to be subject for data forwarding based on QoS, and those RABs shall be contained in RABs subject to data forwarding. For each RAB subject to data forwarding, the information element shall contain RAB ID, Transport Layer Address, and Iu Transport Association. These are the same Transport Layer Address and Iu Transport Association that the target RNC had sent to new SGSN in Relocation Request Acknowledge message, and these are used for forwarding of downlink N-PDU from source SRNC to target RNC. The source SRNC is now ready to forward downlink user data directly to the target RNC over the Iu interface. This forwarding is performed for downlink user data only.
- 7) The source SRNC may, according to the QoS profile, begin the forwarding of data for the RABs to be subject for data forwarding. The data forwarding at SRNS relocation shall be carried out through the Iu interface, meaning that the data exchanged between the source SRNC and the target RNC are duplicated in the source SRNC and routed at IP layer towards the target RNC. For each radio bearer which uses lossless PDCP the GTP-PDUs related to transmitted but not yet acknowledged PDCP-PDUs are duplicated and routed at IP layer towards the target RNC together with their related downlink PDCP sequence numbers. The source RNC continues transmitting duplicates of downlink data and receiving uplink data. Before the serving RNC role is not yet taken over by target RNC and when downlink user plane data starts to arrive to target RNC, the target RNC may buffer or discard arriving downlink GTP-PDUs according to the related QoS profile.

Note: The order of steps, starting from step 7 onwards, does not necessarily reflect the order of events. For instance, source RNC may start data forwarding (step 7) and send Relocation Commit message (step 8) almost simultaneously except in the delivery order required case where step 7 triggers step 8. Target RNC may send Relocation Detect message (step 9) and UTRAN Mobility Information message (step 10) at the same time. Hence, target RNC may receive UTRAN Mobility Information Confirm message (step 10) while data forwarding (step 7) is still underway, and before the new SGSN receives Update PDP Context Response message (step 11).

- 8) Before sending the Relocation Commit the uplink and downlink data transfer in the source, SRNC shall be suspended for RABs, which require delivery order. The source RNC shall start the data-forwarding timer. When the source SRNC is ready, the source SRNC shall trigger the execution of relocation of SRNS by sending a Relocation Commit message (SRNS Contexts) to the target RNC over the Iur interface. The purpose of this procedure is to transfer SRNS contexts from the source RNC to the target RNC, and to move the SRNS role from the source RNC to the target RNC. SRNS contexts are sent for each concerned RAB and contain the sequence numbers of the GTP PDUs next to be transmitted in the uplink and downlink directions and the next PDCP sequence numbers that would have been used to send and receive data from the MS. For PDP context(s) using delivery order not required (QoS profile), the sequence numbers of the GTP-PDUs next to be transmitted are not used by the target RNC. PDCP sequence numbers are only sent by the source RNC for radio bearers,

which used lossless PDCP [57]. The use of lossless PDCP is selected by the RNC when the radio bearer is set up or reconfigured.

If delivery order is required (QoS profile), consecutive GTP-PDU sequence numbering shall be maintained throughout the lifetime of the PDP context(s). Therefore, during the entire SRNS relocation procedure for the PDP context(s) using delivery order required (QoS profile), the responsible GTP-U entities (RNCs and GGSN) shall assign consecutive GTP-PDU sequence numbers to user packets belonging to the same PDP context for uplink and downlink, respectively.

- 9) The target RNC shall send a Relocation Detect message to the new SGSN when the relocation execution trigger is received. For SRNS relocation type "UE not involved", the relocation execution trigger is the reception of the Relocation Commit message from the Iur interface. When the Relocation Detect message is sent, the target RNC shall start SRNC operation.
- 10) The target SRNC sends a UTRAN Mobility Information message. This message contains UE information elements and CN information elements. The UE information elements include among others new SRNC identity and S-RNTI. The CN information elements contain among others Location Area Identification and Routing Area Identification. The procedure shall be co-ordinated in all Iu signalling connections existing for the MS.

The target SRNC establishes and/or restarts the RLC, and exchanges the PDCP sequence numbers (PDCP-SNU, PDCP-SND) between the target SRNC and the MS. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received in the MS per radio bearer, which used lossless PDCP in the source RNC. PDCP-SND confirms all mobile-terminated packets successfully transferred before the SRNC relocation. If PDCP-SND confirms reception of packets that were forwarded from the source SRNC, the target SRNC shall discard these packets. PDCP-SNU is the PDCP sequence number for the next expected in-sequence uplink packet to be received in the RNC per radio bearer, which used lossless PDCP in the source RNC. PDCP-SNU confirms all mobile originated packets successfully transferred before the SRNC relocation. If PDCP-SNU confirms reception of packets that were received in the source SRNC, the MS shall discard these packets.

Upon reception of the UTRAN Mobility Information message the MS may start sending uplink user data to the target SRNC. When the MS has reconfigured itself, it sends the UTRAN Mobility Information Confirm message to the target SRNC. This indicates that the MS is also ready to receive downlink data from the target SRNC.

If new the SGSN has already received the Update PDP Context Response message from the GGSN, it shall forward the uplink user data to GGSN over this new GTP-U tunnel. Otherwise, the new SGSN shall forward the uplink user data to that GGSN IP address and TEID(s), which the new SGSN had received earlier by the Forward Relocation Request message.

For all RABs, the target RNC should:

- start uplink reception of data and start transmission of uplink GTP-PDUs towards the new SGSN;
- start processing the already buffered and the arriving downlink GTP-PDUs and start downlink transmission towards the MS.

- 11) Upon receipt of the Relocation Detect message, the CN may switch the user plane from source RNC to target SRNC. If the SRNS Relocation is an inter SGSN SRNS relocation, the new SGSN sends Update PDP Context Request messages (new SGSN Address, SGSN Tunnel Endpoint Identifier, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (GGSN Tunnel Endpoint Identifier).
- 12) When the target SRNC receives the UTRAN Mobility Information Confirm message, i.e. the new SRNC—ID + S-RNTI are successfully exchanged with the MS by the radio protocols, the target SRNC shall initiate the Relocation Complete procedure by sending the Relocation Complete message to the new SGSN. The purpose of the Relocation Complete procedure is to indicate by the target SRNC the completion of the relocation of the SRNS to the CN. If the user plane has not been switched at Relocation Detect and upon reception of Relocation Complete, the CN shall switch the user plane from source RNC to target SRNC. If the SRNS Relocation is an inter-SGSN SRNS relocation, the new SGSN shall signal to the old SGSN the completion of the SRNS relocation procedure by sending a Forward Relocation Complete message.
- 13) Upon receiving the Relocation Complete message or if it is an inter-SGSN SRNS relocation; the Forward Relocation Complete message, the old SGSN sends an Iu Release Command message to the source RNC. When the RNC data-forwarding timer has expired the source RNC responds with an Iu Release Complete.

- 14) After the MS has finished the RNTI reallocation procedure and if the new Routeing Area Identification is different from the old one, the MS initiates the Routeing Area Update procedure. See subclause "Location Management Procedures (UMTS only)". Note that it is only a subset of the RA update procedure that is performed, since the MS is in PMM-CONNECTED mode.

If the SRNS Relocation is inter-SGSN, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

- C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach.

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

If the SRNS Relocation is intra-SGSN, then the above mentioned CAMEL procedures calls shall not be performed.

If Routeing Area Update occurs, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

- C2) CAMEL_GPRS_Routeing_Area_Update_Session.

The procedure returns as result "Continue".

- C3) CAMEL_GPRS_Routeing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result ""Continue"".

For C2 and C3: refer to Routing Area Update procedure description for detailed message flow.

6.9.2.2.2 Combined Hard Handover and SRNS Relocation Procedure

This procedure is only performed for an MS in PMM-CONNECTED state in case the Iur interface is not available.

The Combined Hard Handover and SRNS Relocation procedure is used to move the UTRAN to CN connection point at the UTRAN side from the source SRNC to the target RNC, while performing a hard handover decided by the UTRAN. In the procedure, the Iu links are relocated. If the target RNC is connected to the same SGSN as the source SRNC, an Intra-SGSN SRNS Relocation procedure is performed. If the routeing area is changed, this procedure is followed by an Intra-SGSN Routeing Area Update procedure. The SGSN detects that it is an intra-SGSN routeing area update by noticing that it also handles the old RA. In this case, the SGSN has the necessary information about the MS and there is no need to inform the HLR about the new MS location.

If the target RNC is connected to a different SGSN than the source SRNC, an Inter-SGSN SRNS Relocation procedure is performed. This procedure is followed by an Inter-SGSN Routeing Area Update procedure.

Figure 40 shows the situation before a Combined Hard Handover and SRNS Relocation procedure when source and target RNC are connected to different SGSNs. Figure 41 shows the situation after the Combined Hard Handover and SRNS Relocation procedure and RA update procedure have been completed. In the case described in Figure 40 and Figure 41 the MS is in PMM-CONNECTED state.

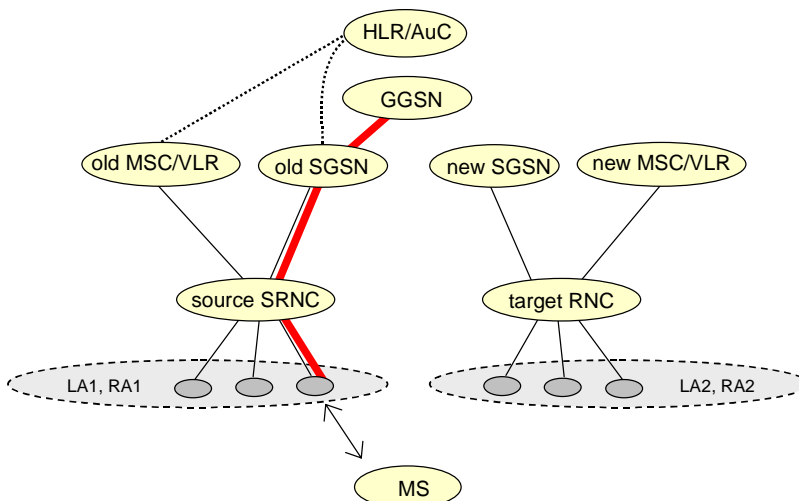


Figure 40: Before Combined Hard Handover and SRNS Relocation and Routeing Area Update

Before the SRNS Relocation and Routeing Area Update the MS is registered in the old SGSN and in the old MSC/VLR. The source RNC is acting as serving RNC.

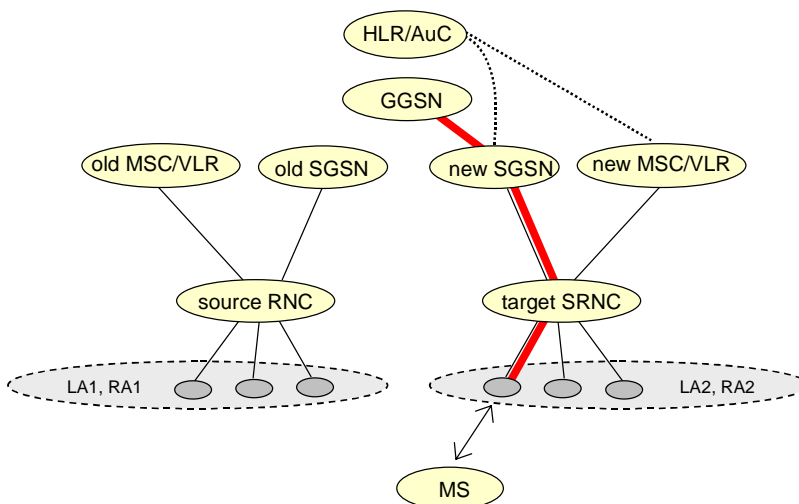


Figure 41: After Combined Hard Handover and SRNS Relocation and Routeing Area Update

After the SRNS relocation and RA update, the MS is registered in the new SGSN and in the new MSC/VLR. The MS is in state PMM-CONNECTED towards the new SGSN and in MM IDLE state towards the new MSC/VLR. The target RNC is acting as serving RNC.

The Combined Hard Handover and SRNS Relocation procedure for the PS domain is illustrated in Figure 42. The sequence is valid for both intra-SGSN SRNS relocation and inter-SGSN SRNS relocation.

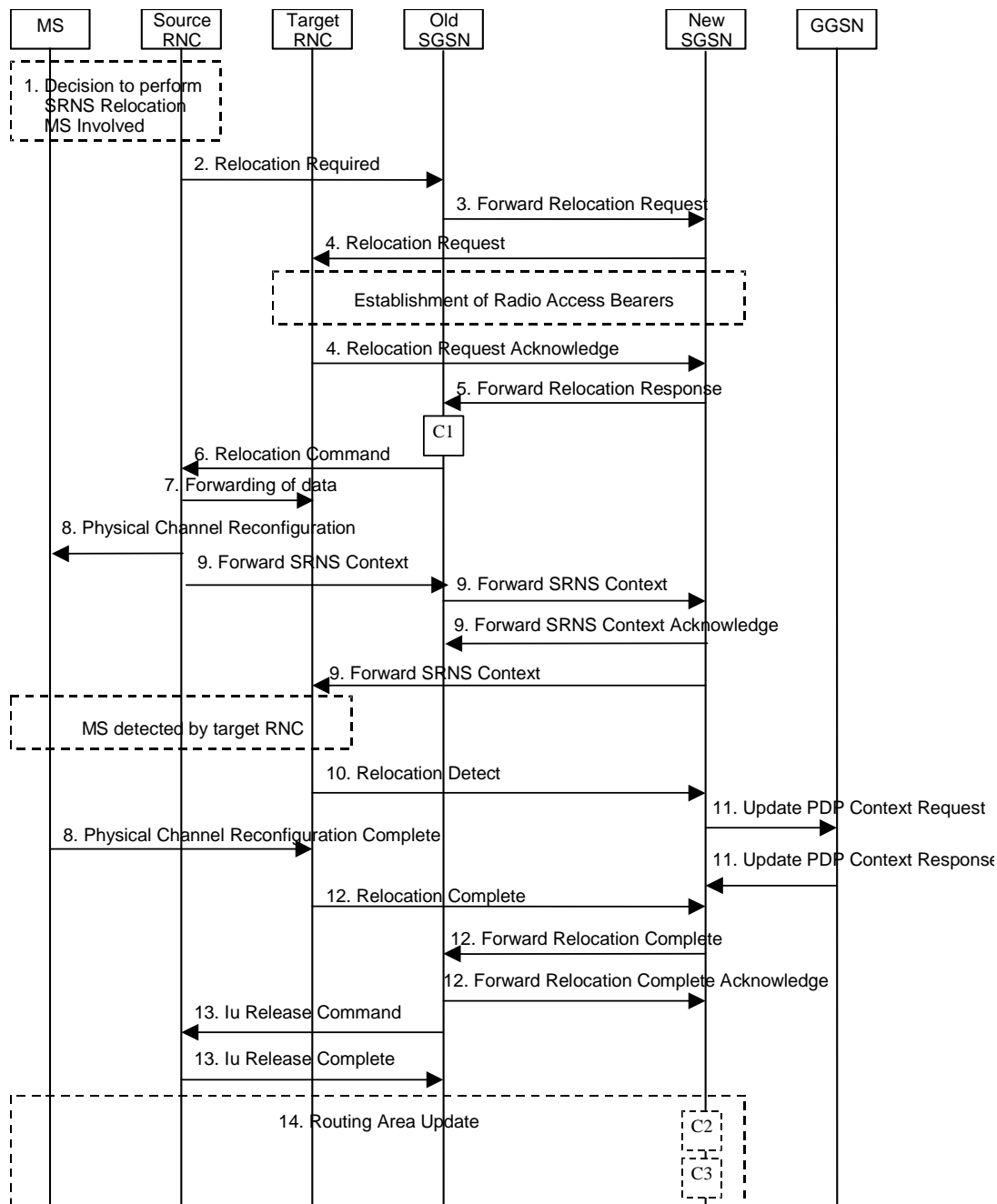


Figure 42: Combined Hard Handover and SRNS Relocation Procedure

- 1) Based on measurement results and knowledge of the UTRAN topology, the source SRNC decides to initiate a combined hard handover and SRNS relocation. At this point both uplink and downlink user data flows via the following tunnel(s): Radio Bearer between the MS and the source SRNC (no drift RNC available); GTP-U tunnel(s) between the source SRNC and the old SGSN; GTP-U tunnel(s) between the old SGSN and the GGSN.
- 2) The source SRNC sends a Relocation Required message (Relocation Type, Cause, Source ID, Target ID, Source RNC To Target RNC Transparent Container) to the old SGSN. The source SRNC shall set Relocation Type to "UE Involved". Source RNC To Target RNC Transparent Container includes the necessary information for relocation co-ordination, security functionality and RRC protocol context information (including MS Capabilities).

- 3) The old SGSN determines from the Target ID if the SRNS relocation is intra-SGSN SRNS relocation or inter-SGSN SRNS relocation. In case of inter-SGSN SRNS relocation the old SGSN initiates the relocation resource allocation procedure by sending a Forward Relocation Request message (IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, UTRAN Transparent Container, RANAP Cause) to the new SGSN. PDP context contains GGSN Address for User Plane and Uplink TEID for Data (to this GGSN Address and Uplink TEID for Data, the old SGSN and the new SGSN send uplink packets). At the same time a timer is started on the MM and PDP contexts in the old SGSN (see Routeing Area Update procedure in subclause "Location Management Procedures (UMTS only)"). The Forward Relocation Request message is applicable only in case of inter-SGSN SRNS relocation.
- 4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source RNC To Target RNC Transparent Container, RAB To Be Setup) to the target RNC. For each RAB requested to be established, RABs To Be Setup shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. SGSN shall not establish RABs for PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to the uplink Tunnel Endpoint Identifier Data.

After all the necessary resources for accepted RABs including the Iu user plane are successfully allocated, the target RNC shall send the Relocation Request Acknowledge message (Target RNC To Source RNC Transparent Container, RABs Setup, RABs Failed To Setup) to the new SGSN. Each RAB to be setup is defined by a Transport Layer Address, which is the target RNC Address for user data, and the Iu Transport Association, which corresponds to the downlink Tunnel Endpoint Identifier for user data. The transparent container contains all radio-related information that the MS needs for the handover, i.e., a complete RRC message (e.g., Physical Channel Reconfiguration) to be sent transparently via CN and source SRNC to the MS. For each RAB to be set up, the target RNC may receive simultaneously downlink user packets both from the source SRNC and from the new SGSN.

- 5) When resources for the transmission of user data between target RNC and new SGSN have been allocated and the new SGSN is ready for relocation of SRNS, the Forward Relocation Response (Cause, UTRAN Transparent Container, RANAP Cause, Target-RNC Information) message is sent from the new SGSN to the old SGSN. This message indicates that the target RNC is ready to receive from source SRNC the forwarded downlink PDUs, i.e., the relocation resource allocation procedure is terminated successfully. UTRAN transparent container and RANAP Cause are information from the target RNC to be forwarded to the source SRNC. The Target RNC Information, one information element for each RAB to be set up, contains the RNC Tunnel Endpoint Identifier and RNC IP address for data forwarding from the source SRNC to the target RNC. The Forward Relocation Response message is applicable only in case of inter-SGSN SRNS relocation.
- 6) The old SGSN continues the relocation of SRNS by sending a Relocation Command message (Target RNC To Source RNC Transparent Container, RABs To Be Released, RABs Subject To Data Forwarding) to the source SRNC. The old SGSN decides the RABs to be subject for data forwarding based on QoS, and those RABs shall be contained in RABs subject to data forwarding. For each RAB subject to data forwarding, the information element shall contain RAB ID, Transport Layer Address, and Iu Transport Association. These are the same Transport Layer Address and Iu Transport Association that the target RNC had sent to new SGSN in Relocation Request Acknowledge message, and these are used for forwarding of downlink N-PDU from the source SRNC to the target RNC. The source SRNC is now ready to forward downlink user data directly to the target RNC over the Iu interface. This forwarding is performed for downlink user data only.
- 7) The source SRNC may, according to the QoS profile, begin the forwarding of data for the RABs to be subject for data forwarding.

Note: The order of steps, starting from step 7 onwards, does not necessarily reflect the order of events. For instance, source RNC may start data forwarding (step 7), send Physical Channel Reconfiguration message to MS (step 8) and forward SRNS Context message to the old SGSN (step 8) almost simultaneously.

The data forwarding at SRNS relocation shall be carried out through the Iu interface, meaning that the GTP-PDUs exchanged between the source SRNC and the target RNC are duplicated in the source SRNC and routed at the IP layer towards the target RNC. For each radio bearer which uses lossless PDCP the GTP-PDUs related to transmitted but not yet acknowledged PDCP-PDUs are duplicated and routed at IP layer towards the target RNC together with their related downlink PDCP sequence numbers. The source RNC continues transmitting duplicates of downlink data and receiving uplink data.

Before the serving RNC role is not yet taken over by target RNC and when downlink user plane data starts to arrive to target RNC, the target RNC may buffer or discard arriving downlink GTP-PDUs according to the related QoS profile.

- 8) Before sending the Physical Channel Reconfiguration the uplink and downlink data transfer shall be suspended in the source SRNC for RABs, which require delivery order. When the source SRNC is ready, the source RNC shall trigger the execution of relocation of SRNS by sending to the MS the RRC message provided in the Target RNC to source RNC transparent container, e.g., a Physical Channel Reconfiguration (UE Information Elements, CN Information Elements) message. UE Information Elements include among others new SRNC identity and S-RNTI. CN Information Elements contain among others Location Area Identification and Routing Area Identification.

Before the RRC message is sent (e.g. Physical Channel Reconfiguration) uplink and downlink data transfer in the source RNC shall be suspended for RABs which require to maintain the delivery order. .

When the MS has reconfigured itself, it sends e.g., a Physical Channel Reconfiguration Complete message to the target SRNC. If the Forward SRNS Context message with the sequence numbers is received, the exchange of packets with the MS may start. If this message is not yet received, the target RNC may start the packet transfer for all RABs, which do not require maintaining the delivery order.

- 9) The source SRNC continues the execution of relocation of SRNS by sending a Forward SRNS Context (RAB Contexts) message to the target RNC via the old and the new SGSN. The Forward SRNS Context message is acknowledged by a Forward SRNS Context Acknowledge message, from new to old SGSN. The purpose of this procedure is to transfer SRNS contexts from the source RNC to the target RNC, and to move the SRNS role from the source RNC to the target RNC. SRNS contexts are sent for each concerned RAB and contain the sequence numbers of the GTP PDUs next to be transmitted in the uplink and downlink directions and the next PDCP sequence numbers that would have been used to send and receive data from the MS. PDCP sequence numbers are only sent by the source RNC for the radio bearers which used losslessPDCP [57]. The use of lossless PDCP is selected by the RNC when the radio bearer is set up or reconfigured. For PDP context(s) using delivery order not required (QoS profile), the sequence numbers of the GTP-PDUs next to be transmitted are not used by the target RNC.

If delivery order is required (QoS profile), consecutive GTP-PDU sequence numbering shall be maintained throughout the lifetime of the PDP context(s). Therefore, during the entire SRNS relocation procedure for the PDP context(s) using delivery order required (QoS profile), the responsible GTP-U entities (RNCs and GGSN) shall assign consecutive GTP-PDU sequence numbers to user packets belonging to the same PDP context uplink and downlink, respectively.

The target RNC establishes and/or restarts the RLC and exchanges the PDCP sequence numbers (PDCP-SNU, PDCP-SND) between the target RNC and the MS. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received by the MS per radio bearer, which used lossless PDCP in the source RNC. PDCP-SND confirms all mobile terminated packets successfully transferred before the SRNC relocation. If PDCP-SND confirms reception of packets that were forwarded from the source SRNC, then the target SRNC shall discard these packets. PDCP-SNU is the PDCP sequence number for the next expected in-sequence uplink packet to be received in the RNC per radio bearer, which used lossless PDCP in the source RNC. PDCP-SNU confirms all mobile originated packets successfully transferred before the SRNC relocation. If PDCP-SNU confirms reception of packets that were received in the source SRNC, the MS shall discard these packets.

- 10) The target RNC shall send a Relocation Detect message to the new SGSN when the relocation execution trigger is received. For SRNS relocation type "UE Involved", the relocation execution trigger may be received from the Uu interface; i.e., when target RNC detects the MS on the lower layers. When the Relocation Detect message is sent, the target RNC shall start SRNC operation.
- 11) Upon reception of the Relocation Detect message, the CN may switch the user plane from the source RNC to the target SRNC. If the SRNS relocation is an inter-SGSN SRNS relocation, the new SGSN sends an Update PDP Context Request (New SGSN Address, SGSN Tunnel Endpoint Identifier, QoS Negotiated, [serving network identity](#)) message to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (GGSN Tunnel Endpoint Identifier) message.
- 12) When the target SRNC receives the Physical Channel Reconfiguration Complete message or the Radio Bearer Release Complete message, i.e. the new SRNC-ID + S-RNTI are successfully exchanged with the MS by the radio protocols, the target SRNC shall initiate a Relocation Complete procedure by sending the Relocation Complete message to the new SGSN. The purpose of the Relocation Complete procedure is to indicate by the target SRNC the completion of the relocation of the SRNS to the CN. If the user plane has not been switched at Relocation Detect, the CN shall upon reception of Relocation Complete switch the user plane from source RNC to target SRNC. If the SRNS Relocation is an inter-SGSN SRNS relocation, the new SGSN signals to the old SGSN the completion of the SRNS relocation procedure by sending a Forward Relocation Complete message.

- 13) Upon receiving the Relocation Complete message or, if it is an inter-SGSN SRNS relocation, the Forward Relocation Complete message, the old SGSN sends an Iu Release Command message to the source RNC. When the RNC data-forwarding timer has expired, the source RNC responds with an Iu Release Complete message.
- 14) After the MS has finished the reconfiguration procedure and if the new Routing Area Identification is different from the old one, the MS initiates the Routing Area Update procedure. See subclause "Location Management Procedures (UMTS only)". Note that it is only a subset of the RA update procedure that is performed, since the MS is in PMM-CONNECTED state.

If the SRNS Relocation is inter-SGSN, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

- C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

If the SRNS Relocation is intra-SGSN, then the above mentioned CAMEL procedures calls shall not be performed.

If Routing Area Update occurs, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

- C2) CAMEL_GPRS_Routing_Area_Update_Session.

In Figure 42, the procedure returns as result "Continue".

- C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue".

For C2 and C3: refer to Routing Area Update procedure description for detailed message flow.

6.9.2.2.3 Combined Cell / URA Update and SRNS Relocation Procedure

This procedure is only performed for an MS in PMM-CONNECTED state, where the Iur interface carries control signalling but no user data.

The Combined Cell / URA Update and SRNS Relocation procedure is used to move the UTRAN to CN connection point at the UTRAN side from the source SRNC to the target RNC, while performing a cell re-selection in the UTRAN. In the procedure, the Iu links are relocated. If the target RNC is connected to the same SGSN as the source SRNC, an Intra-SGSN SRNS Relocation procedure is performed. If the routing area is changed, this procedure is followed by an Intra-SGSN Routing Area Update procedure. The SGSN detects that it is an intra-SGSN routing area update by noticing that it also handles the old RA. In this case, the SGSN has the necessary information about the MS and there is no need to inform the HLR about the new MS location.

Before the Combined Cell / URA Update and SRNS Relocation and the Routing Area Update, the MS is registered in the old SGSN. The source RNC is acting as serving RNC.

After the Combined Cell / URA Update and SRNS Relocation and the Routing Area Update, the MS is registered in the new SGSN. The MS is in state PMM-CONNECTED towards the new SGSN, and the target RNC is acting as serving RNC.

The Combined Cell / URA Update and SRNS Relocation procedure for the PS domain is illustrated in Figure 43. The sequence is valid for both intra-SGSN SRNS relocation and inter-SGSN SRNS relocation.

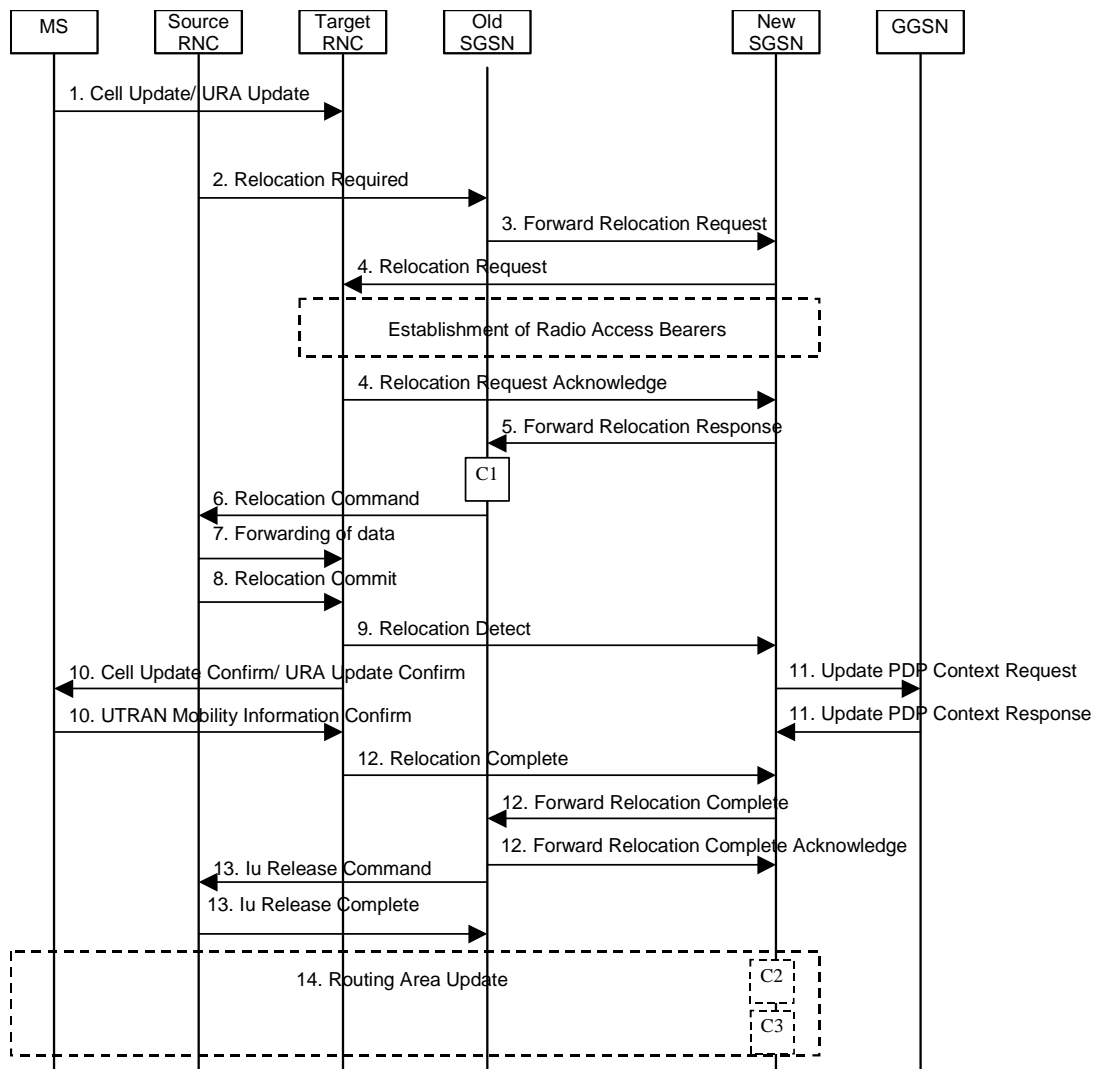


Figure 43: Combined Cell / URA Update and SRNS Relocation Procedure

- 1) The MS sends a Cell Update / URA Update message to the source SRNC (if the cell is located under another RNC the message is routed via the DRNC to SRNC over the Iur). The source SRNC decides whether or not to perform a combined cell / URA update and SRNS relocation towards the target RNC. The rest of this subclause describes the case where a combined cell / URA update and SRNS relocation applies. In this case no radio bearer is established between the source SRNC and the UE. Nonetheless the following tunnel(s) are established: GTP-U tunnel(s) between source SRNC and old-SGSN; GTP-U tunnel(s) between old-SGSN and GGSN.
- 2) The source SRNC sends a Relocation Required message (Relocation Type, Cause, Source ID, Target ID, Source RNC to Target RNC Transparent Container) to the old SGSN. The source SRNC shall set Relocation Type to "UE not involved". Source RNC to Target RNC Transparent Container includes the necessary information for Relocation co-ordination, security functionality, and RRC protocol context information (including MS Capabilities).
- 3) The old SGSN determines from the Target ID if the SRNS Relocation is intra-SGSN SRNS relocation or inter-SGSN SRNS relocation. In the case of inter-SGSN SRNS relocation the old SGSN initiates the relocation resource allocation procedure by sending a Forward Relocation Request (IMSI, Tunnel Endpoint Identifier Signalling, MM Context, PDP Context, Target Identification, UTRAN Transparent Container, RANAP Cause) message to the new SGSN. PDP context contains GGSN Address for User Plane and Uplink TEID for Data (to this GGSN Address and Uplink TEID for Data, the old SGSN and the new SGSN send uplink packets). At the same time a timer is started on the MM and PDP contexts in the old SGSN, see Routing Area Update procedure

in subclause "Location Management Procedures (UMTS only)". The Forward Relocation Request message is applicable only in case of inter-SGSN SRNS relocation.

- 4) The new SGSN sends a Relocation Request message (Permanent NAS UE Identity, Cause, CN Domain Indicator, Source RNC to Target RNC Transparent Container, RABs To Be Setup) to the target RNC. For each requested RAB, RABs To Be Setup shall contain information such as RAB ID, RAB parameters, Transport Layer Address, and Iu Transport Association. SGSN shall not establish RABs for PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s. The RAB ID information element contains the NSAPI value, and the RAB parameters information element gives the QoS profile. The Transport Layer Address is the SGSN Address for user data, and the Iu Transport Association corresponds to the uplink Tunnel Endpoint Identifier Data.

After all necessary resources for accepted RABs including the Iu user plane are successfully allocated, the target RNC shall send the Relocation Request Acknowledge message (RABs setup, RABs failed to setup) to the new SGSN. Each RAB to be setup is defined by a Transport Layer Address, which is the target RNC Address for user data, and a Iu Transport Association which corresponds to the downlink Tunnel Endpoint Identifier for user data. The target-RNC may simultaneously receive for each RAB to be set up downlink user packets both from the source SRNC and from the new SGSN.

After the new SGSN receives the Relocation Request Acknowledge message, the GTP-U tunnels are established between the target RNC and the new-SGSN.

- 5) When resources for the transmission of user data between the target RNC and the new SGSN have been allocated and the new SGSN is ready for relocation of SRNS, the Forward Relocation Response message (Cause, RANAP Cause, and Target RNC Information) is sent from the new SGSN to the old SGSN. This message indicates that the target RNC is ready to receive from the source SRNC the forwarded downlink packets, i.e., the relocation resource allocation procedure is terminated successfully. RANAP Cause is information from the target RNC to be forwarded to the source SRNC. The RAB Setup Information, one information element for each RAB, contains the RNC Tunnel Endpoint Identifier and RNC IP address for data forwarding from the source SRNC to the target RNC. If the target RNC or the new SGSN failed to allocate resources, the RAB Setup Information element contains only NSAPI indicating that the source SRNC shall release the resources associated with the NSAPI. The Forward Relocation Response message is applicable only in case of inter-SGSN SRNS relocation.
- 6) The old SGSN continues the relocation of SRNS by sending a Relocation Command (RABs to be released, and RABs subject to data forwarding) message to the source SRNC. The old SGSN decides the RABs subject to data forwarding based on QoS, and those RABs shall be contained in RABs subject to data forwarding. For each RAB subject to data forwarding, the information element shall contain RAB ID, Transport Layer Address, and Iu Transport Association. These are the same Transport Layer Address and Iu Transport Association that the target RNC had sent to new SGSN in Relocation Request Acknowledge message, and these are used for forwarding of downlink N-PDU from the source SRNC to the target RNC. The source SRNC is now ready to forward downlink data directly to the target RNC over the Iu interface. This forwarding is performed for downlink user data only.
- 7) The source SRNC may, according to the QoS profile, begin the forwarding of data for the RABs subject to data forwarding and starts the data-forwarding timer. The data forwarding at SRNS relocation shall be carried out through the Iu interface, meaning that the data exchanged between the source SRNC and the target RNC are duplicated in the source SRNC and routed at the IP layer towards the target RNC. For each radio bearer which uses lossless PDCP the GTP-PDUs related to transmitted but not yet acknowledged PDCP-PDUs are duplicated and routed at IP layer towards the target RNC together with their related downlink PDCP sequence numbers. The source RNC continues transmitting duplicates of downlink data and receiving uplink data.

Note: The order of steps, starting from step 7 onwards, does not necessarily reflect the order of events. For instance, source RNC may send data forwarding (step 7) and start Relocation Commit message (step 8) almost simultaneously. Target RNC may send Relocation Detect message (step 9) and Cell Update Confirm/URA Update Confirm message (step 10) at the same time. Hence, target RNC may receive the UTRAN Mobility Information Confirm message from MS (step 10) while data forwarding (step 8) is still underway, and before the new SGSN receives Update PDP Context Response message (step 11).

Before the serving RNC role is not yet taken over by target RNC and when downlink user plane data starts to arrive to target RNC, the target RNC may buffer or discard arriving downlink GTP-PDUs according to the related QoS profile.

- 8) Before sending the Relocation Commit the uplink and downlink data transfer in the source, SRNC shall be suspended for RABs, which require delivery order.

When the source SRNC is ready, the source SRNC shall trigger the execution of relocation of SRNS by sending a Relocation Commit message (SRNS Contexts) to the target RNC over the Iur interface. The purpose of this

procedure is to transfer SRNS contexts from the source RNC to the target RNC, and to move the SRNS role from the source RNC to the target RNC. SRNS contexts are sent for each concerned RAB and contain the sequence numbers of the GTP-PDUs next to be transmitted in the uplink and downlink directions and the next PDCP sequence numbers that would have been used to send and receive data from the MS. . PDCP sequence numbers are only sent by the source RNC for radio bearers, which used lossless PDCP [57]. The use of lossless PDCP is selected by the RNC when the radio bearer is set up or reconfigured. For PDP context(s) using delivery order not required (QoS profile), the sequence numbers of the GTP-PDUs next to be transmitted are not used by the target RNC.

If delivery order is required (QoS profile), consecutive GTP-PDU sequence numbering shall be maintained throughout the lifetime of the PDP context(s). Therefore, during the entire SRNS relocation procedure for the PDP context(s) using delivery order required (QoS profile), the responsible GTP-U entities (RNCs and GGSN) shall assign consecutive GTP-PDU sequence numbers to user packets belonging to the same PDP context for uplink and downlink respectively.

- 9) The target RNC shall send a Relocation Detect message to the new SGSN when the relocation execution trigger is received. For SRNS relocation type "UE not involved", the relocation execution trigger is the reception of the Relocation Commit message from the Iur interface. When the Relocation Detect message is sent, the target RNC shall start SRNC operation.
- 10) The target SRNC sends a Cell Update Confirm / URA Update Confirm message. This message contains UE information elements and CN information elements. The UE information elements include among others new SRNC identity and S-RNTI. The CN information elements contain among others Location Area Identification and Routing Area Identification. The procedure shall be co-ordinated in all Iu signalling connections existing for the MS.

Upon reception of the Cell Update Confirm / URA Update Confirm message the MS may start sending uplink user data to the target SRNC. When the MS has reconfigured itself, it sends the UTRAN Mobility Information Confirm message to the target SRNC. This indicates that the MS is also ready to receive downlink data from the target SRNC.

If the new SGSN has already received the Update PDP Context Response message from the GGSN, it shall forward the uplink user data to the GGSN over this new GTP-U tunnel. Otherwise, the new SGSN shall forward the uplink user data to that GGSN IP address and TEID(s), which the new SGSN had received earlier by the Forward Relocation Request message.

The target SRNC and the MS exchange the PDCP sequence numbers; PDCP-SNU and PDCP-SND. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received in the MS per radio bearer, which used lossless PDCP in the source RNC. PDCP-SND confirms all mobile terminated packets successfully transferred before the SRNC relocation procedure. . If PDCP-SND confirms the reception of packets that were forwarded from the source SRNC, the target SRNC shall discard these packets. PDCP-SNU is the PDCP sequence number for the next expected in-sequence uplink packet to be received in the RNC per radio bearer, which used lossless PDCP in the source RNC. PDCP-SNU confirms all mobile originated packets successfully transferred before the SRNC relocation. If PDCP-SNU confirms reception of packets that were received in the source SRNC, the target SRNC shall discard these packets.

- 11) Upon receipt of the Relocation Detect message, the CN may switch the user plane from the source RNC to the target SRNC. If the SRNS Relocation is an inter-SGSN SRNS relocation, the new SGSN sends Update PDP Context Request messages (new SGSN Address, SGSN Tunnel Endpoint Identifier, QoS Negotiated, [serving network identity](#)) to the GGSNs concerned. [The SGSN should send the serving network identity to the GGSN.](#) The GGSNs update their PDP context fields and return an Update PDP Context Response (GGSN Tunnel Endpoint Identifier) message.
- 12) When the target SRNC receives the UTRAN Mobility Information Confirm message, i.e. the new SRNC-ID + S-RNTI are successfully exchanged with the MS by the radio protocols, the target SRNC shall initiate the Relocation Complete procedure by sending the Relocation Complete message to the new SGSN. The purpose of the Relocation Complete procedure is to indicate by the target SRNC the completion of the relocation of the SRNS to the CN. If the user plane has not been switched at Relocation Detect, the CN shall upon reception of Relocation Complete switch the user plane from the source RNC to the target SRNC. If the SRNS Relocation is an inter SGSN SRNS relocation, the new SGSN signals to the old SGSN the completion of the SRNS relocation procedure by sending a Forward Relocation Complete message.
- 13) Upon receiving the Relocation Complete message or if it is an inter-SGSN SRNS relocation, the Forward Relocation Complete message, the old SGSN sends an Iu Release Command message to the source RNC. When the RNC data-forwarding timer has expired the source RNC responds with an Iu Release Complete.

- 14) After the MS has finished the Cell / URA update and RNTI reallocation procedure and if the new Routing Area Identification is different from the old one, the MS initiates the Routing Area Update procedure. See subclause "Location Management Procedures (UMTS only)". Note that it is only a subset of the RA update procedure that is performed, since the MS is in PMM-CONNECTED state.

If the SRNS Relocation is inter-SGSN, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

- C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

If the SRNS Relocation is intra-SGSN, then the above mentioned CAMEL procedures calls shall not be performed.

If Routing Area Update occurs, then the following CAMEL procedure calls shall be performed (see referenced procedures in 3GPP TS 23.078):

- C2) CAMEL GPRS Routing Area Update-Session

The procedure returns as result "Continue".

- C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times: once per PDP context. It returns as result "Continue". For C2 and C3: refer to Routing Area Update procedure description for detailed message flow.

Next change

6.13.2.1 UMTS to GSM Inter-SGSN Change

An inter-SGSN inter-system change from UMTS to GSM takes place when an MS in PMM-IDLE or PMM-CONNECTED state changes from UTRAN to GSM radio access and the GSM radio access node serving the MS is served by a different SGSN. In this case, the RA changes. Therefore, the MS shall initiate a GSM RA update procedure. The RA update procedure is either combined RA / LA update or only RA update. These RA update cases are illustrated in Figure 54.

A combined RA / LA update takes place in network operation mode I when the MS enters a new RA or when a GPRS-attached MS performs IMSI attach. The MS sends a Routing Area Update Request indicating that an LA update may also need to be performed, in which case the SGSN forwards the LA update to the VLR. This concerns only idle mode (see 3GPP TS 23.122), as no combined RA / LA updates are performed during a CS connection.

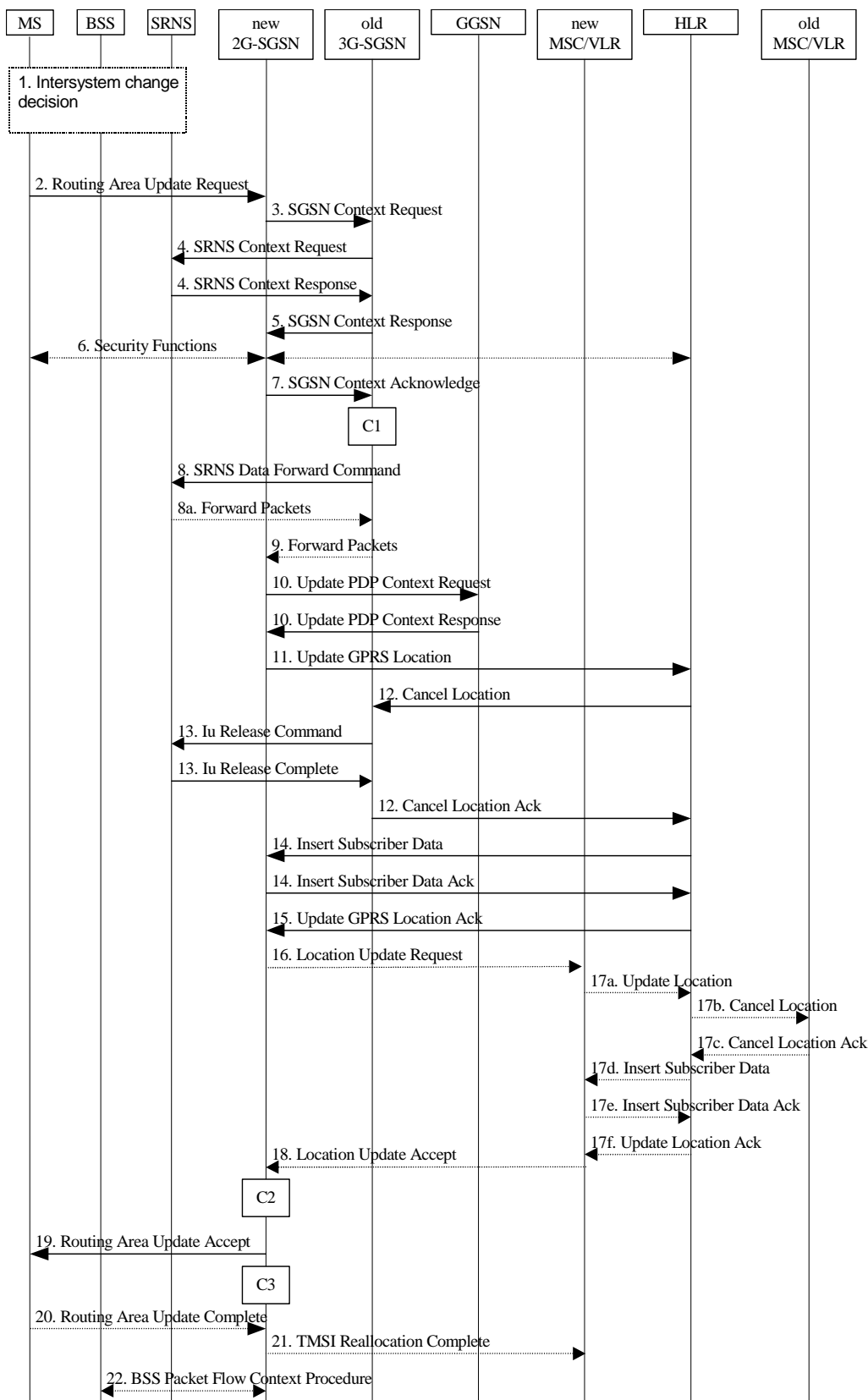


Figure 54: UMTS to GSM Inter-SGSN Change

- 1) The MS or BSS or UTRAN decides to perform an inter-system change, which makes the MS switch to a new cell that supports GSM radio technology, and stops transmission to the network.

- 2) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type, MS Network Capability) message to the new 2G-SGSN. Update Type shall indicate RA update or combined RA / LA update, or, if the MS wants to perform an IMSI attach, combined RA / LA update with IMSI attach requested. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the new 2G-SGSN.
- 3) The new 2G-SGSN sends an SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) message to the old 3G-SGSN to get the MM and PDP contexts for the MS. The old 3G-SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old 3G-SGSN. If the received old P-TMSI Signature does not match the stored value, the security functions in the new 2G-SGSN should be initiated. If the security functions authenticate the MS correctly, the new 2G-SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old 3G-SGSN. MS Validated indicates that the new 2G-SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new 2G-SGSN indicates that it has authenticated the MS correctly, the old 3G-SGSN starts a timer. If the MS is not known in the old 3G-SGSN, the old 3G-SGSN responds with an appropriate error cause.
- 4) If the MS is PMM-CONNECTED the old 3G-SGSN sends an SRNS Context Request (IMSI) message to the SRNS. Upon receipt of this message the SRNS buffers and stops sending downlink PDUs to the MS and returns an SRNS Context Response (GTP-SNDs, GTP-SNUs, PDCP-SNDs, PDCP-SNUs) message. The SRNS shall include for each PDP context the next in-sequence GTP sequence number to be sent to the MS and the GTP sequence number of the next uplink PDU to be tunnelled to the GGSN. For each active PDP context, which uses lossless PDCP, the SRNS also includes the uplink PDCP sequence number (PDCP-SNU) downlink PDCP sequence number (PDCP-SND). PDCP-SNU shall be the next in-sequence PDCP sequence number expected from the MS. PDCP-SND is the PDCP sequence number for the first downlink packet for which successful transmission has not been confirmed. The 3G-SGSN shall strip off the eight most significant bits of the passed PDCP sequence numbers, thus converting them to SMDCP N-PDU numbers and stores the N-PDU numbers in its PDP contexts..
- 5) The old 3G-SGSN responds with an SGSN Context Response (MM Context, PDP Contexts) message. For each PDP context the old 3G-SGSN shall include the GTP sequence number for the next uplink GTP PDU to be tunnelled to the GGSN and the next downlink GTP sequence number for the next in-sequence N-PDU to be sent to the MS. Each PDP Context also includes the SMDCP Send N-PDU Number (the value is 0) for the next in-sequence downlink N-PDU to be sent in SMDCP acknowledged mode to the MS and the SMDCP Receive N-PDU Number (= converted PDCP-SNU) for the next in-sequence uplink N-PDU to be received in SMDCP acknowledged mode from the MS. The new 3G-SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routing Area Request.
- 6) Security functions may be executed.
- 7) The new 2G-SGSN sends an SGSN Context Acknowledge message to the old 3G-SGSN. This informs the old 3G-SGSN that the new 2G-SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a RA update procedure back to the old SGSN before completing the ongoing RA update procedure.
- 8) If the MS is in the PMM-CONNECTED state, the old 3G-SGSN sends an SRNS Data Forward Command (RAB ID, Transport Layer Address, Iu Transport Association) message to the SRNS. For each indicated RAB the SRNS starts duplicating and tunnelling the buffered GTP PDUs to the old 3G-SGSN. For each radio bearer which uses lossless PDCP the SRNS shall start tunnelling the GTP-PDUs related to transmitted but not yet acknowledged PDCP-PDUs to the old 3G-SGSN together with their related downlink PDCP sequence numbers. Upon receipt of the SRNS Data Forward Command message from the 3G-SGSN, the SRNS shall start the data-forwarding timer.
- 9) The old 3G-SGSN tunnels the GTP PDUs to the new 2G-SGSN. In the case of GTPv1, the conversion of PDCP sequence numbers to SMDCP sequence numbers (the eight most significant bits shall be stripped off) shall be done in the new SGSN. No N-PDU sequence numbers shall be indicated for these N-PDUs. If GTPv0 is used between the SGSNs, the conversion of PDCP sequence numbers to SMDCP numbers shall be done in the old 3G-SGSN (by stripping off the eight most significant bits).
- 10) The new 2G-SGSN sends an Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated, [serving network identity](#)) message to each GGSN concerned. [The SGSN should send the serving network identity to the GGSN.](#) Each GGSN updates its PDP context fields and returns an Update PDP Context Response (TEID) message.

- 11) The new 2G-SGSN informs the HLR of the change of SGSN by sending an Update GPRS Location (SGSN Number, SGSN Address, IMSI) message to the HLR.
- 12) The HLR sends a Cancel Location (IMSI) message to the old 3G-SGSN. The old 3G-SGSN acknowledges with a Cancel Location Ack (IMSI) message. The old 3G-SGSN removes the MM and PDP contexts if the timer described in step 3 is not running. If the timer is running, the MM and PDP contexts shall be removed when the timer expires.
- 13) When the MS is PMM-CONNECTED, the old 3G-SGSN sends an Iu Release Command message to the SRNS. When the RNC data-forwarding timer has expired, the SRNS responds with an Iu Release Complete message.
- 14) The HLR sends an Insert Subscriber Data (IMSI, GPRS Subscription Data) message to the new 2G-SGSN. The 2G-SGSN constructs an MM context and PDP contexts for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 15) The HLR acknowledges the Update GPRS Location by returning an Update GPRS Location Ack (IMSI) message to the new 2G-SGSN.
- 16) If the association has to be established i.e. if Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routing area update, the new 2G-SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with IMSI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI by the 2G-SGSN. The 2G-SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 14). The VLR creates or updates the association with the 2G-SGSN by storing SGSN Number.
- 17) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.
 - e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
- 18) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the 2G-SGSN. VLR TMSI is optional if the VLR has not changed.
- 19) The new 2G-SGSN validates the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the RA, or if subscription checking fails, the new 2G-SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new 2G-SGSN constructs MM and PDP contexts for the MS. A logical link is established between the new 2G-SGSN and the MS. 2G-SGSN initiates the establishment procedure. The new 2G-SGSN responds to the MS with a Routing Area Update Accept (P-TMSI, P-TMSI Signature, Receive N-PDU Number (= converted PDCP-SNU) message. Receive N-PDU Number contains the acknowledgements for each NSAPI which used lossless PDCP before the start of the update procedure, thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms the reception of N-PDUs, the MS shall discard these N-PDUs.
- 20) The MS acknowledges the new P-TMSI by returning a Routing Area Update Complete (Receive N-PDU Number (= converted PDCP-SND)) message to the SGSN. Receive N-PDU Number contains the acknowledgements for each lossless PDCP used by the MS before the start of the update procedure, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If Receive N-PDU Number confirms the reception of N-PDUs that were forwarded from the old 3G-SGSN, the new 2G-SGSN shall discard these N-PDUs. The MS deducts Receive N-PDU number from PDCP-SND by stripping off the eight most significant bits. PDCP-SND is the PDCP sequence number for the next expected in-sequence downlink packet to be received in the MS per radio bearer, which used lossless PDCP. The new 2G-SGSN negotiates with the MS for each NSAPI the use of acknowledged or unacknowledged SNDCP regardless whether the SRNS used lossless PDCP or not.

- 21) The new 2G-SGSN sends TMSI Reallocation Complete message to the new VLR if the MS confirms the VLR TMSI.
- 22) The 2G-SGSN and the BSS may execute the BSS Packet Flow Context procedure.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

The CAMEL procedure calls shall be performed, see referenced procedures in 3GPP TS 23.078:

- C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. The procedure returns as result "Continue".

- C2) CAMEL_GPRS_Routing_Area_Update_Session.

The procedure returns as result "Continue".

- C3) CAMEL_GPRS_Routing_Area_Update_Context.

This procedure is called several times once per PDP context. It returns as result "Continue".

6.13.2.2 GSM to UMTS Inter-SGSN Change

The inter-system change from GSM to UMTS takes place when a GPRS-attached MS changes from GSM radio access to UTRAN and the UTRAN node serving the MS is served by a different SGSN. In this case the RA changes. Therefore, the MS shall initiate a UMTS RA update procedure by establishing an RRC connection and initiating the RA update procedure. The RA update procedure is either combined RA / LA update or only RA update, these RA update cases are illustrated in Figure 55.

If the network operates in mode I, then an MS, that is both PS-attached and CS-attached, shall perform the Combined RA / LA Update procedures. This concerns only idle mode (see 3GPP TS 23.122), as no combined RA / LA updates are performed during a CS connection.

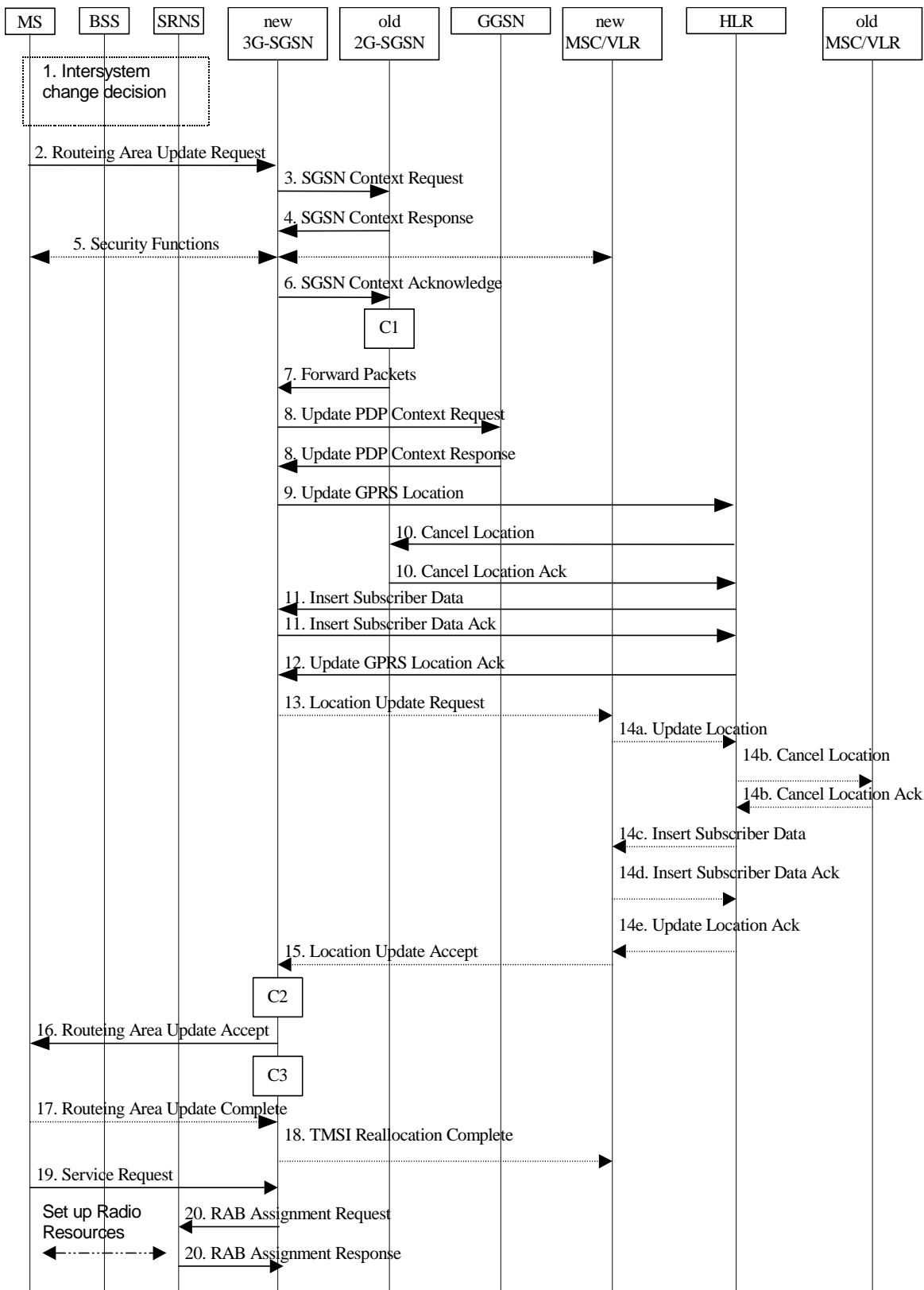


Figure 55: GSM to UMTS Inter SGSN Change

- 1) The MS or BSS or UTRAN decides to perform an inter-system change, which makes the MS switch to a new cell that supports UMTS radio technology, and stops transmission to the network.

- 2) The MS sends a Routing Area Update Request (P-TMSI, old RAI, old P-TMSI Signature, Update Type, CM, MS Network Capability) message to the new 3G-SGSN. Update Type shall indicate RA update or combined RA / LA update, or, if the MS wants to perform an IMSI attach, combined RA / LA update with IMSI attach requested, and also if the MS has a follow-on request, i.e. if there is pending uplink traffic (signalling or data). The SGSN may use, as an implementation option, the follow-on request indication to release or keep the Iu connection after the completion of the RA update procedure. The SRNC shall add the Routing Area Identity including the RAC and LAC of the area where the MS is located before forwarding the message to the 3G-SGSN. This RA identity corresponds to the RAI in the MM system information sent by the SRNC to the MS.
- 3) The new 3G-SGSN uses the old RAI received from the MS to derive the old 2G-SGSN address, and sends an SGSN Context Request (old RAI, old P-TMSI, New SGSN Address) message to the old 2G-SGSN to get the MM and PDP contexts for the MS. The old 2G-SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old 2G-SGSN. If the received old P-TMSI Signature does not match the stored value, the old 2G-SGSN should initiate the security functions in the new 3G-SGSN. If the security functions authenticate the MS correctly, the new 3G-SGSN shall send an SGSN Context Request (old RAI, IMSI, MS Validated, New SGSN Address) message to the old 2G-SGSN. MS Validated indicates that the new 3G-SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new 3G-SGSN indicates that it has authenticated the MS correctly, the old 2G-SGSN starts a timer and stops the transmission of N-PDUs to the MS.
- 4) The old 2G-SGSN responds with an SGSN Context Response (MM Context, PDP Contexts) message. Each PDP Context includes the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled to the GGSN. Each PDP Context also includes the SMDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode SMDCP to the MS and the SMDCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode SMDCP from the MS. The new 3G-SGSN derives the corresponding PDCP sequence numbers from these N-PDU sequence numbers by adding eight most significant bits "1". These PDCP sequence numbers are stored in the 3G-SGSN PDP contexts. The new 3G-SGSN shall ignore the MS Network Capability contained in MM Context of SGSN Context Response only when it has previously received an MS Network Capability in the Routing Area Request.
- 5) Security functions may be executed.
- 6) The new 3G-SGSN sends an SGSN Context Acknowledge message to the old 2G-SGSN. This informs the old 2G-SGSN that the new 3G-SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the GGSNs and the HLR are invalid. This triggers the MSC/VLR, the GGSNs, and the HLR to be updated if the MS initiates a routing area update procedure back to the old SGSN before completing the ongoing routing area update procedure.
- 7) The old 2G-SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new 3G-SGSN. Additional N-PDUs received from the GGSN before the timer described in step 3 expires are also duplicated and tunnelled to the new 3G-SGSN. N-PDUs that were already sent to the MS in acknowledged mode SMDCP and that are not yet acknowledged by the MS are tunnelled together with their related SMDCP N-PDU sequence number. No PDCP sequence numbers shall be indicated for these N-PDUs. No N-PDUs shall be forwarded to the new 3G-SGSN after expiry of the timer described in step 3.
- 8) The new 3G-SGSN sends an Update PDP Context Request (new SGSN Address, TEID, QoS Negotiated, [serving network identity](#)) message to each GGSN concerned. [The SGSN should send the serving network identity to the GGSN.](#) Each GGSN updates its PDP context fields and returns an Update PDP Context Response (TEID) message.
- 9) The new 3G-SGSN informs the HLR of the change of SGSN by sending an Update GPRS Location (SGSN Number, SGSN Address, IMSI) message to the HLR.
- 10) The HLR sends a Cancel Location (IMSI, Cancellation Type) message to the old 2G-SGSN. The old 2G-SGSN removes the MM and PDP contexts if the timer described in step 3 is not running. If the timer is running, the MM and PDP contexts are removed when the timer expires. The old 2G-SGSN acknowledges with a Cancel Location Ack (IMSI) message.
- 11) The HLR sends an Insert Subscriber Data (IMSI, GPRS Subscription Data) message to the new 3G-SGSN. The 3G-SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.
- 12) The HLR acknowledges the Update GPRS Location by returning an Update GPRS Location Ack (IMSI) message to the new 3G-SGSN.

- 13) If the association has to be established, if Update Type indicates combined RA / LA update with IMSI attach requested, or if the LA changed with the routing area update, the new SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) to the VLR. Location Update Type shall indicate IMSI attach if Update Type in step 1 indicated combined RA / LA update with IMSI attach requested. Otherwise, Location Update Type shall indicate normal location update. The VLR number is translated from the RAI by the 3G-SGSN. The 3G-SGSN starts the location update procedure towards the new MSC/VLR upon receipt of the first Insert Subscriber Data message from the HLR in step 12). The VLR creates or updates the association with the 3G-SGSN by storing SGSN Number.
- 14) If the subscriber data in the VLR is marked as not confirmed by the HLR, the new VLR informs the HLR. The HLR cancels the old VLR and inserts subscriber data in the new VLR (this signalling is not modified from existing GSM signalling and is included here for illustrative purposes):
 - a) The new VLR sends an Update Location (new VLR) to the HLR.
 - b) The HLR cancels the data in the old VLR by sending Cancel Location (IMSI) to the old VLR.
 - c) The old VLR acknowledges with Cancel Location Ack (IMSI).
 - d) The HLR sends Insert Subscriber Data (IMSI, GSM subscriber data) to the new VLR.
 - e) The new VLR acknowledges with Insert Subscriber Data Ack (IMSI).
 - f) The HLR responds with Update Location Ack (IMSI) to the new VLR.
- 15) The new VLR allocates a new TMSI and responds with Location Update Accept (VLR TMSI) to the 3G-SGSN. VLR TMSI is optional if the VLR has not changed.
- 16) The new 3G-SGSN validate the MS's presence in the new RA. If due to roaming restrictions the MS is not allowed to be attached in the RA, or if subscription checking fails, the new 3G-SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the new 3G-SGSN constructs MM and PDP contexts for the MS. The new 3G-SGSN responds to the MS with a Routing Area Update Accept (P-TMSI, P-TMSI signature) message.
- 17) The MS acknowledges the new P-TMSI by returning a Routing Area Update Complete message to the SGSN.
- 18) The new 3G-SGSN sends TMSI Reallocation Complete message to the new VLR, if the MS confirms the VLR TMSI.
- 19) If the MS has uplink data or signalling pending it shall send a Service Request (P-TMSI, RAI, CKSN, Service Type) message to the SGSN. Service Type specifies the requested service. Service Type shall indicate one of the following: Data or Signalling.
- 20) If the MS has sent the Service Request, the new 3G-SGSN requests the SRNS to establish a radio access bearer by sending a RAB Assignment Request (RAB ID(s), QoS Profile(s), GTP-SNDs, GTP-SNU(s), PDCP-SNU(s)) message to the SRNS. The PDCP sequence numbers are derived from the N-PDU sequence numbers in step 4) and stored in the SGSN PDP contexts. The SRNS sends a Radio Bearer Setup Request (PDCP-SNU(s)) message to the MS. The MS responds with a Radio Bearer Setup Complete (PDCP-SND(s)) message. The MS deducts PDCP-SND from its Receive N-PDU Number by adding eight most significant bits "1". The SRNS responds with a RAB Assignment Response message. The SRNS shall discard all N-PDUs tunnelled from the SGSN with N-PDU sequence numbers older than the eight least significant bits of the PDCP-SNDs received from the MS. Other N-PDUs shall be transmitted to the MS. The MS shall discard all N-PDUs with SNDCP sequence numbers older than the eight least significant bits of the PDCP-SNU(s) received from the SRNS. Other N-PDUs shall be transmitted to the SRNS. The SRNS negotiates with the MS for each radio bearer the use of lossless PDCP or not regardless whether the old 2G-SGSN used acknowledged or unacknowledged SNDCP for the related NSAPI or not.

NOTE: The NSAPI value is carried in the RAB ID IE.

If the new SGSN is unable to update the PDP context in one or more GGSNs, the new SGSN shall deactivate the corresponding PDP contexts as described in subclause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN shall first update all contexts in one or more GGSNs and then deactivate the context(s) that it cannot maintain as described in subclause "SGSN-initiated PDP Context Deactivation Procedure". This shall not cause the SGSN to reject the routing area update.

The CAMEL procedure calls shall be performed, see referenced procedures in 3GPP TS 23.078:

- C1) CAMEL_GPRS_PDP_Context_Disconnection and CAMEL_GPRS_Detach

They are called in the following order:

- The CAMEL_GPRS_PDP_Context_Disconnection procedure is called several times: once per PDP context. The procedure returns as result "Continue".
- Then the CAMEL_GPRS_Detach procedure is called once. It returns as result "Continue".

- C2) CAMEL_GPRS_Routing_Area_Update_Session

The procedure returns as result "Continue".

- C3) CAMEL_GPRS_Routing_Area_Update_Context

This procedure is called several times: once per PDP context. It returns as result "Continue".

Next change

9.2.2.1 PDP Context Activation Procedure

The PDP Context Activation procedure is illustrated in Figure 63 and Figure 64.

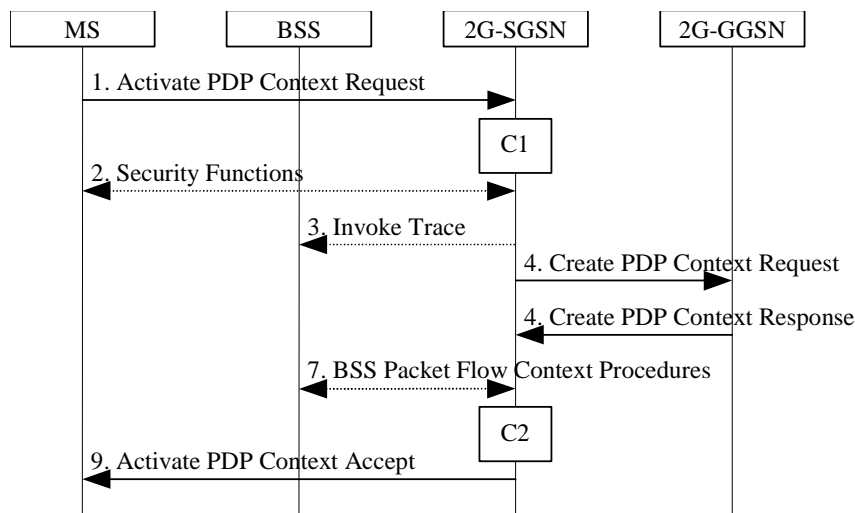


Figure 63: PDP Context Activation Procedure for GSM

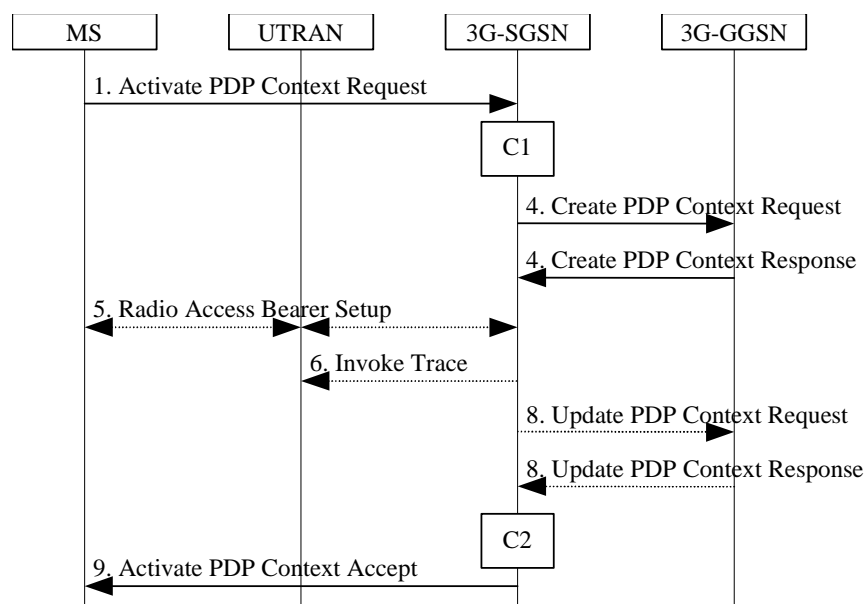


Figure 64: PDP Context Activation Procedure for UMTS

- 1) The MS sends an Activate PDP Context Request (NSAPI, TI, PDP Type, PDP Address, Access Point Name, QoS Requested, PDP Configuration Options) message to the SGSN. The MS shall use PDP Address to indicate whether it requires the use of a static PDP address or whether it requires the use of a dynamic PDP address. The MS shall leave PDP Address empty to request a dynamic PDP address. The MS may use Access Point Name to select a reference point to a certain external network and/or to select a service. Access Point Name is a logical name referring to the external packet data network and/or to a service that the subscriber wishes to connect to. QoS Requested indicates the desired QoS profile. PDP Configuration Options may be used to request optional PDP parameters from the GGSN (see GSM 09.60). PDP Configuration Options is sent transparently through the SGSN.
- 2) In A/Gb mode, security functions may be executed. These procedures are defined in clause "Security Function".
- 3) In A/Gb mode and if BSS trace is activated, the SGSN shall send an Invoke Trace (Trace Reference, Trace Type, Trigger Id, OMC Identity) message to the BSS. Trace Reference, and Trace Type are copied from the trace information received from the HLR or OMC.
- 4) The SGSN validates the Activate PDP Context Request using PDP Type (optional), PDP Address (optional), and Access Point Name (optional) provided by the MS and the PDP context subscription records. The validation criteria, the APN selection criteria, and the mapping from APN to a GGSN are described in annex A.

If no GGSN address can be derived or if the SGSN has determined that the Activate PDP Context Request is not valid according to the rules described in annex A, the SGSN rejects the PDP context activation request.

If a GGSN address can be derived, the SGSN creates a TEID for the requested PDP context. If the MS requests a dynamic address, the SGSN lets a GGSN allocate the dynamic address. The SGSN may restrict the requested QoS attributes given its capabilities and the current load, and it shall restrict the requested QoS attributes according to the subscribed QoS profile.

The SGSN sends a Create PDP Context Request (PDP Type, PDP Address, Access Point Name, QoS Negotiated, TEID, NSAPI, MSISDN, Selection Mode, Charging Characteristics, Trace Reference, Trace Type, Trigger Id, OMC Identity, PDP Configuration Options, [serving network identity](#)) message to the affected GGSN. [The SGSN should send the serving network identity to the GGSN.](#) Access Point Name shall be the APN Network Identifier of the APN selected according to the procedure described in Annex A. PDP Address shall be empty if a dynamic address is requested. The GGSN may use Access Point Name to find an external network and optionally to activate a service for this APN. Selection Mode indicates whether a subscribed APN was selected, or whether a non-subscribed APN sent by an MS or a non-subscribed APN chosen by the SGSN was selected. Selection Mode is set according to Annex A. The GGSN may use Selection Mode when deciding whether to accept or reject the PDP context activation. For example, if an APN requires subscription, the GGSN is configured to accept only the PDP context activation that requests a subscribed APN as indicated by the SGSN with Selection Mode. Charging Characteristics indicates which kind of charging the PDP context is liable for. The charging characteristics on the GPRS subscription and individually subscribed APNs as well as the way the

SGSN handles Charging Characteristics and chooses to send them or not to the GGSN is defined in 3GPP TS 32.215 [70]. The SGSN shall include Trace Reference, Trace Type, Trigger Id, and OMC Identity if GGSN 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 GGSN creates a new entry in its PDP context table and generates a Charging Id. The new entry allows the GGSN to route PDP PDUs between the SGSN and the external PDP network, and to start charging. The way the GGSN handles Charging Characteristics that it may have received from the SGSN is defined in 3GPP TS 32.215 [70]. The GGSN then returns a Create PDP Context Response (TEID, PDP Address, PDP Configuration Options, QoS Negotiated, Charging Id, Cause) message to the SGSN. PDP Address is included if the GGSN allocated a PDP address. If the GGSN has been configured by the operator to use External PDN Address Allocation for the requested APN, PDP Address shall be set to 0.0.0.0, indicating that the PDP address shall be negotiated by the MS with the external PDN after completion of the PDP Context Activation procedure. The GGSN shall relay, modify and monitor these negotiations as long as the PDP context is in ACTIVE state, and use the GGSN-Initiated PDP Context Modification procedure to transfer the currently used PDP address to the SGSN and the MS. PDP Configuration Options contain optional PDP parameters that the GGSN may transfer to the MS. These optional PDP parameters may be requested by the MS in the Activate PDP Context Request message, or may be sent unsolicited by the GGSN. PDP Configuration Options is sent transparently through the SGSN. The Create PDP Context messages are sent over the backbone network.

If QoS Negotiated received from the SGSN is incompatible with the PDP context being activated, the GGSN rejects the Create PDP Context Request message. The GGSN operator configures the compatible QoS profiles.

- 5) In Iu mode, RAB setup is done by the RAB Assignment procedure, see subclause "RAB Assignment Procedure".
- 6) In Iu mode and if BSS trace is activated, the SGSN shall send an Invoke Trace (Trace Reference, Trace Type, Trigger Id, OMC Identity) message to the UTRAN. Trace Reference, and Trace Type are copied from the trace information received from the HLR or OMC.
- 7) In A/Gb mode, BSS packet flow context procedures may be executed. These procedures are defined in clause "BSS Context".
- 8) In Iu mode and in case the QoS attributes have been downgraded in step 5, the SGSN may inform the GGSN about the downgraded QoS attributes by sending an Update PDP Context Request to the affected GGSN. The GGSN confirms the new QoS attributes by sending an Update PDP Context Response to the SGSN.
- 9) The SGSN inserts the NSAPI along with the GGSN address in its PDP context. If the MS has requested a dynamic address, the PDP address received from the GGSN is inserted in the PDP context. The SGSN selects Radio Priority and Packet Flow Id based on QoS Negotiated, and returns an Activate PDP Context Accept (PDP Type, PDP Address, TI, QoS Negotiated, Radio Priority, Packet Flow Id, PDP Configuration Options) message to the MS. The SGSN is now able to route PDP PDUs between the GGSN and the MS, and to start charging.

For each PDP Address a different quality of service (QoS) profile may be requested. For example, some PDP addresses may be associated with E-mail that can tolerate lengthy response times. Other applications cannot tolerate delay and demand a very high level of throughput, interactive applications being one example. These different requirements are reflected in the QoS profile. The QoS profile is defined in clause "Quality of Service Profile". If a QoS requirement is beyond the capabilities of a PLMN, the PLMN negotiates the QoS profile as close as possible to the requested QoS profile. The MS either accepts the negotiated QoS profile, or deactivates the PDP context.

After an SGSN has successfully updated the GGSN, the PDP contexts associated with an MS is distributed as shown in clause "Information Storage".

If the PDP Context Activation Procedure fails or if the SGSN returns an Activate PDP Context Reject (Cause, PDP Configuration Options) message, the MS may attempt another activation to the same APN up to a maximum number of attempts.

The CAMEL procedure calls shall be performed, see referenced procedures in 3GPP TS 23.078:

- C1) CAMEL_GPRS_PDP_Context_Establishment.

In Figure 63 and Figure 64, procedures return as result "Continue".

- C2) CAMEL_GPRS_PDP_Context_Establishment_Acknowledgement.

In Figure 63 and Figure 64, procedures return as result "Continue".

9.2.2.1.1 Secondary PDP Context Activation Procedure

The Secondary PDP Context Activation procedure may be used to activate a PDP context while reusing the PDP address and other PDP context information from an already active PDP context, but with a different QoS profile. Procedures for APN selection and PDP address negotiation are not executed. A unique TI and a unique NSAPI shall identify each PDP context sharing the same PDP address and APN.

The Secondary PDP Context Activation procedure may be executed without providing a Traffic Flow Template (TFT) to the newly activated PDP context if all other active PDP contexts for this PDP address and APN already have an associated TFT. Otherwise a TFT shall be provided. The TFT contains attributes that specify an IP header filter that is used to direct data packets received from the interconnected external packet data network to the newly activated PDP context.

The Secondary PDP Context Activation procedure may only be initiated after a PDP context is already activated for the same PDP address and APN. The procedure is illustrated in Figure 65 and Figure 66.

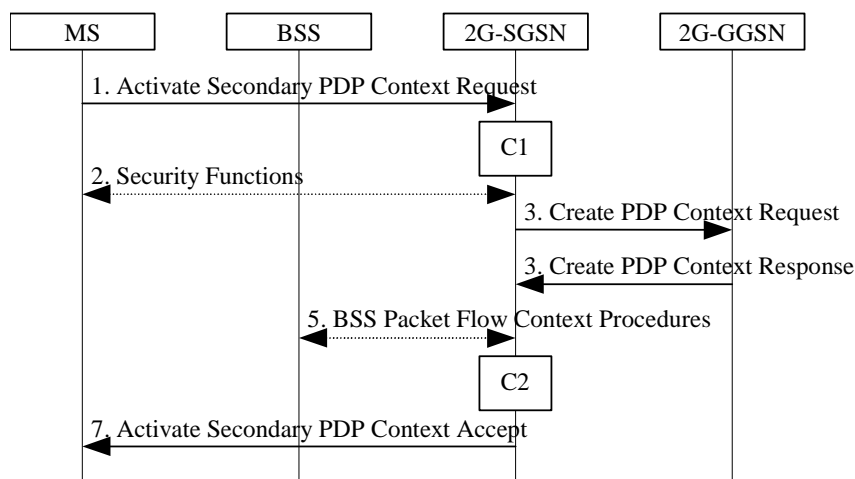


Figure 65: Secondary PDP Context Activation Procedure for GSM

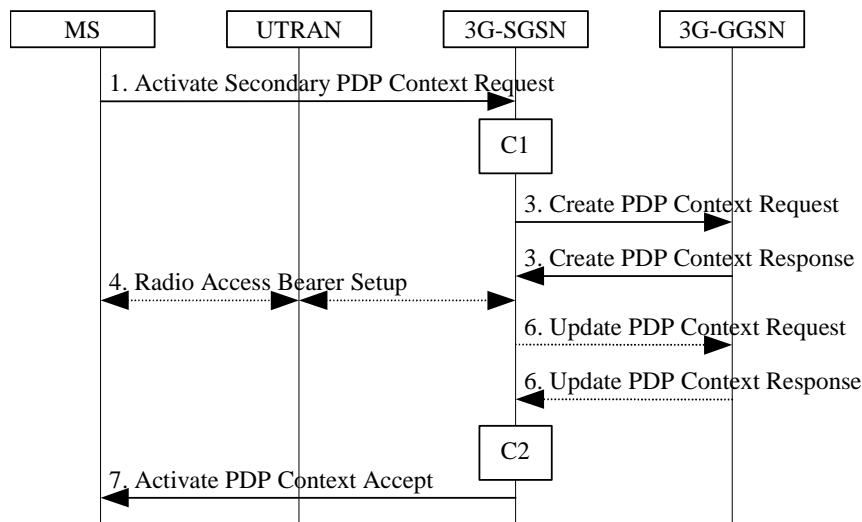


Figure 66: Secondary PDP Context Activation Procedure for UMTS

- 1) The MS sends an Activate Secondary PDP Context Request (Linked TI, NSAPI, TI, QoS Requested, TFT) message to the SGSN. Linked TI indicates the TI value assigned to any one of the already activated PDP contexts for this PDP address and APN. QoS Requested indicates the desired QoS profile. TFT is sent transparently through the SGSN to the GGSN to enable packet classification for downlink data transfer. TI and NSAPI contain values not used by any other activated PDP context.
- 2) In A/Gb mode, security functions may be executed. These procedures are defined in clause "Security Function".

- 3) The SGSN validates the Activate Secondary PDP Context Request using the TI indicated by Linked TI. The same GGSN address is used by the SGSN as for the already-activated PDP context(s) for that TI and PDP address.

The SGSN may restrict the requested QoS attributes given its capabilities and the current load, and it shall restrict the requested QoS attributes according to the subscribed QoS profile, which represents the maximum QoS per PDP context to the associated APN. The GGSN may restrict and negotiate the requested QoS as specified in clause "PDP Context Activation Procedure". The SGSN sends a Create PDP Context Request (QoS Negotiated, TEID, NSAPI, Primary NSAPI, TFT, [serving network identity](#)) message to the affected GGSN. [The SGSN should send the serving network identity to the GGSN.](#) Primary NSAPI indicates the NSAPI value assigned to any one of the already activated PDP contexts for this PDP address and APN. TFT is included only if received in the Activate Secondary PDP Context Request message. The GGSN uses the same external network as used by the already-activated PDP context(s) for that PDP address, generates a new entry in its PDP context table, and stores the TFT. The new entry allows the GGSN to route PDP PDUs via different GTP tunnels between the SGSN and the external PDP network. The GGSN returns a Create PDP Context Response (TEID, QoS Negotiated, Cause) message to the SGSN.

- 4) In Iu mode, RAB setup is done by the RAB Assignment procedure.
- 5) In A/Gb mode, BSS packet flow context procedures may be executed. These procedures are defined in clause "BSS Context".
- 6) In Iu mode and in case the QoS attributes have been downgraded in step 4, the SGSN may inform the GGSN about the downgraded QoS attributes by sending an Update PDP Context Request to the affected GGSN. The GGSN confirms the new QoS attributes by sending an Update PDP Context Response to the SGSN.
- 7) The SGSN selects Radio Priority and Packet Flow Id based on QoS Negotiated, and returns an Activate Secondary PDP Context Accept (TI, QoS Negotiated, Radio Priority, Packet Flow Id) message to the MS. The SGSN is now able to route PDP PDUs between the GGSN and the MS via different GTP tunnels and possibly different LLC links.

For each additionally activated PDP context a QoS profile and TFT may be requested.

If the secondary PDP context activation procedure fails or if the SGSN returns an Activate Secondary PDP Context Reject (Cause) message, the MS may attempt another activation with a different TFT, depending on the cause.

The CAMEL procedure calls shall be performed, see referenced procedures in 3GPP TS 23.078:

- C1) CAMEL_GPRS_PDP_Context_Establishment.

In Figure 65 and in Figure 66, procedures return as result "Continue".

- C2) CAMEL_GPRS_PDP_Context_Establishment_Acknowledgement.

In Figure 65 and in Figure 66, procedures return as result "Continue".

Next change

9.2.3.1 SGSN-Initiated PDP Context Modification Procedure

The SGSN-Initiated PDP Context Modification procedure is illustrated in Figure 70.

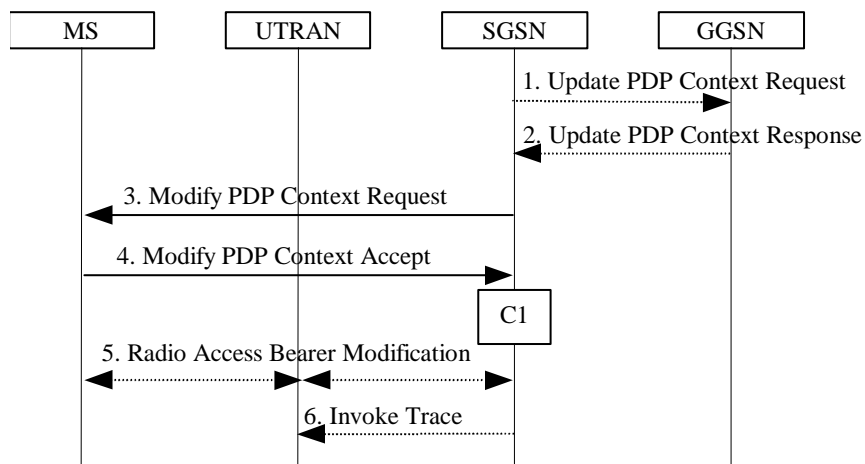


Figure 70: SGSN-Initiated PDP Context Modification Procedure

- 1) The SGSN may send an Update PDP Context Request (TEID, NSAPI, QoS Negotiated, Trace Reference, Trace Type, Trigger Id, OMC Identity, [serving network identity](#)) message to the GGSN. [The SGSN should send the serving network identity to the GGSN.](#) If QoS Negotiated received from the SGSN is incompatible with the PDP context being modified, the GGSN rejects the Update PDP Context Request. The GGSN operator configures the compatible QoS profiles. The SGSN shall include Trace Reference, Trace Type, Trigger Id, and OMC Identity in the message if GGSN trace is activated while the PDP context is active. The SGSN shall copy Trace Reference, Trace Type, and OMC Identity from the trace information received from the HLR or OMC.
- 2) The GGSN may restrict QoS Negotiated given its capabilities and the current load. The GGSN stores QoS Negotiated and returns an Update PDP Context Response (TEID, QoS Negotiated, Cause) message.
- 3) The SGSN selects Radio Priority and Packet Flow Id based on QoS Negotiated, and may send a Modify PDP Context Request (TI, QoS Negotiated, Radio Priority, Packet Flow Id) message to the MS.
- 4) The MS acknowledges by returning a Modify PDP Context Accept message. If the MS does not accept the new QoS Negotiated it shall instead de-activate the PDP context with the PDP Context Deactivation Initiated by the MS procedure.
- 5) In Iu mode, radio access bearer modification may be performed by the RAB Assignment procedure.
- 6) If BSS trace is activated while the PDP context is active, the SGSN shall send an Invoke Trace (Trace Reference, Trace Type, Trigger Id, OMC Identity) message to the BSS or UTRAN. Trace Reference, and Trace Type are copied from the trace information received from the HLR or OMC.

The CAMEL procedure calls shall be performed, see referenced procedure in 3GPP TS 23.078:

C1) CAMEL_GPRS_Change_Of_QoS.

The procedure returns as result "Continue".

Next change

9.2.3.3 MS-Initiated PDP Context Modification Procedure

The MS-Initiated PDP Context Modification procedure is illustrated in Figure 72.

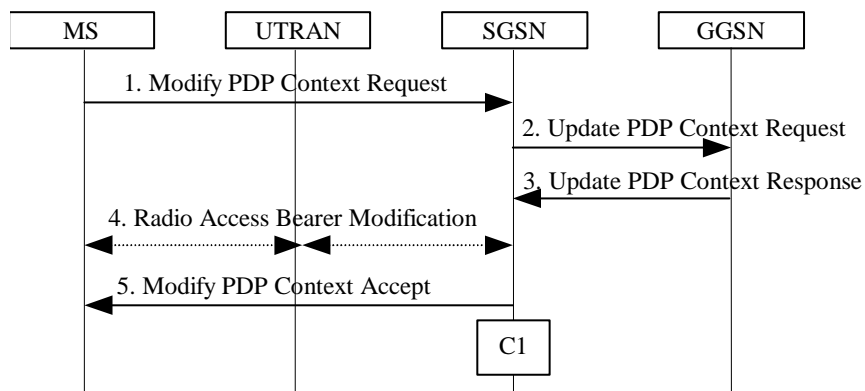


Figure 72: MS-Initiated PDP Context Modification Procedure

- 1) The MS sends a Modify PDP Context Request (TI, QoS Requested, TFT) message to the SGSN. Either QoS Requested or TFT or both may be included. QoS Requested indicates the desired QoS profile, while TFT indicates the TFT that is to be added or modified or deleted from the PDP context.
- 2) The SGSN may restrict the desired QoS profile given its capabilities, the current load, and the subscribed QoS profile. The SGSN sends an Update PDP Context Request (TEID, NSAPI, QoS Negotiated, TFT, [serving network identity](#)) message to the GGSN. [The SGSN should send the serving network identity to the GGSN.](#) If QoS Negotiated and/or TFT received from the SGSN is incompatible with the PDP context being modified (e.g., TFT contains inconsistent packet filters), the GGSN rejects the Update PDP Context Request. The GGSN operator configures the compatible QoS profile.
- 3) The GGSN may further restrict QoS Negotiated given its capabilities and the current load. The GGSN stores QoS Negotiated, stores, modifies, or deletes TFT of that PDP context as indicated in TFT, and returns an Update PDP Context Response (TEID, QoS Negotiated) message.
- 4) In Iu mode, radio access bearer modification may be performed by the RAB Assignment procedure. In case the radio access bearer does not exist the RAB setup is done by the RAB Assignment procedure.
- 5) The SGSN selects Radio Priority and Packet Flow Id based on QoS Negotiated, and returns a Modify PDP Context Accept (TI, QoS Negotiated, Radio Priority, Packet Flow Id) message to the MS.

NOTE: If the SGSN does not accept QoS Requested, then steps 2 and 3 of this procedure are skipped, and the existing QoS Negotiated is returned to the MS in step 4.

The CAMEL procedure calls shall be performed, see referenced procedure in 3GPP TS 23.078:

C1) CAMEL_GPRS_Change_Of_QoS.

The procedure returns as result "Continue".