

Technical Specification Group Services and System Aspects **TSGS#18(02)0768**

Meeting #18, New Orleans, U.S.A., 9-12 December 2002

**Source:** TSG SA WG2  
**Title:** CRs on 23.060 (GPRS Stage 2)  
**Agenda Item:** 7.2.3

The following Change Requests (CRs) have been approved by TSG SA WG2 and are requested to be approved by TSG SA plenary #18.

Tdoc #	Title	Spec	CR #	c a t	Version in	REL	WI
<a href="#">S2-023000</a>	IP version requirements on Iu	23.060	414 r1	F	5.3.0	Rel-5	TEI-5
S2-023004	Handling of preserved PDP contexts	23.060	400 r1	F	3.13.0	Rel-99	TEI
S2-023005	Handling of preserved PDP contexts	23.060	401 r1	A	4.6.0	Rel-4	TEI4
S2-023006	Handling of preserved PDP contexts	23.060	402 r1	A	5.3.0	Rel-5	TEI5
S2-023007	QoS negotiation	23.060	417	A	5.3.0	Rel-5	TEI5
<a href="#">S2-023321</a>	SMS over PS in Iu mode	23.060	418	F	5.3.0	Rel-5	TEI-5
<a href="#">S2-023525</a>	Re-use of TEID	23.060	419 r1	F	5.3.0	Rel-5	TEI-5
<a href="#">S2-023656</a>	Mobility Management for GPRS (CAMEL) Subscriber	23.060	399 r3	F	5.3.0	Rel-5	CAMEL4

## CHANGE REQUEST

⌘ **23.060 CR 414** ⌘ rev **1** ⌘ Current version: **5.3.0** ⌘

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

<b>Title:</b>	⌘ IP version requirements on lu		
<b>Source:</b>	⌘ Ericsson, Nokia		
<b>Work item code:</b>	⌘ TEI-5	<b>Date:</b>	⌘ 18/10/2002
<b>Category:</b>	⌘ <b>F</b>	<b>Release:</b>	⌘ Rel-5
	<i>Use one of the following categories:</i> <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification)		<i>Use one of the following releases:</i> 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)
	Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		

<b>Reason for change:</b>	⌘ The current text in section 14.12.1 has lead to some confusion as to what the requirement regarding the IP versions to be supported on lu, when the IP transport option is applied, actually is.
	The intention of the text was not to require the use and configuration of both IPv4 and IPv6 addresses in the RNC/BSC (when the IP transport option is applied), but rather that the RNC/BSC shall be able to support both types of addresses. If a particular network configuration do not require one of the address types, then only the one being used needs to be configured in the node, but still the implementation shall be able to support both types of addresses if required.
<b>Summary of change:</b>	⌘ In 14.12.1, the statement "each RNC or BSC <u>shall have</u> both IPv6 addresses and IPv4 addresses" is changed to "each RNC or BSC <u>shall be able to support</u> both IPv6 addresses and IPv4 addresses". Meaning that any RNC/BSC implementation shall provide the possibility to configure both types of addresses, but the actual use of one or the other type of addresses is an operator's choice depending on the particular configuration of the network. A note is also added to further clarify this point.
<b>Consequences if not approved:</b>	⌘ The requirement on which IP versions to support on lu will remain ambiguous.

<b>Clauses affected:</b>	⌘ 14.12.1						
<b>Other specs affected:</b>	⌘	<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 checked="" type="checkbox"/></td> <td style="text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table>	Y	N	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Other core specifications ⌘ Test specifications ⌘ O&M Specifications ⌘
Y	N						
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>						

**Other comments:** ☼

**How to create CRs using this form:**

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- 1) Fill out the above form. The symbols above marked ☼ contain pop-up help information about the field that they are closest to.
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### 14.12.1 RNC/BSC Address

Each RNC or BSC shall have one or more IP addresses for inter-communication over the Iu interface. When the ATM transport option is applied on the Iu interface, ~~these addresses~~ each RNC or BSC shall be able to support addresses of type IPv4 and optionally of type IPv6. When the IP transport option is applied on the Iu interface, each RNC or BSC shall ~~have~~ be able to support both IPv6 addresses and IPv4 addresses.

NOTE: These statements refer to RNC and BSC implementation requirements. When both IP versions are required to be supported in the RNC or BSC, it is still an operational choice whether to configure and use both or only one of the address types in a particular network set-up (i.e. in a network where it is known that all interconnected RNCs and SGSNs support the same IP version, it is legitimate to operate IPv4 only or IPv6 only).

CR-Form-v7	
<b>CHANGE REQUEST</b>	
⌘ <b>23.060 CR 400</b> ⌘ rev <b>1</b> ⌘	Current version: <b>3.13.0</b> ⌘

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

<b>Title:</b>	⌘ Handling of preserved PDP contexts		
<b>Source:</b>	⌘ Siemens		
<b>Work item code:</b>	⌘ TEI	<b>Date:</b>	⌘ 14/10/2002
<b>Category:</b>	⌘ <b>F</b>	<b>Release:</b>	⌘ R99
	Use <u>one</u> of the following categories: <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification) Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		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)

<b>Reason for change:</b>	⌘ In case the MS moves from a R99 SGSN (GTPv1) to a R97/98 SGSN (GTPv0) then the QoS attributes mapping table in 3GPP TS 23.107 section "9.1.2.3 Determining R97/98 attributes from R99 attributes" have to be used. Following the rules of this table, R99 real-time PDP contexts with a maximum bitrate in downlink and uplink of 0 kbit/s will be mapped to R97/98 non-real-time PDP contexts with a peak throughput class of 1. The peak throughput class 1 means the maximum bitrate is set to 8 kbit/s. That means that the preservation is abolished and charging starts again. This would contradict to the current approach defined in TS 23.060 that only the MS decides what happens with preserved PDP contexts.  This CR proposes that the MS and network (old SGSN locally and towards GGSN) shall locally deactivate PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s.
<b>Summary of change:</b>	⌘ PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s shall be deleted locally by the MS and the network once a change to a pre-release 99 network is done.
<b>Consequences if not approved:</b>	⌘ Preservation is not defined for pre-release 99. A change to a pre-release 99 SGSN would contradict to the approved approach in TS 23.060. Charging would start although the MS may not wish to re-establish this PDP context.

<b>Clauses affected:</b>	⌘ 11.1.1						
<b>Other specs</b>	⌘	<table border="1" style="display: inline-table; text-align: center; font-size: x-small;"> <tr> <td>Y</td> <td>N</td> </tr> <tr> <td><input type="checkbox"/></td> <td><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"/>						

<b>affected:</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Test specifications	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O&M Specifications	
<b>Other comments:</b>	⌘			

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### 11.1.1 Interactions Between GTP v0 (R97) and GTP v1 (R99)

When a first GSN receives a GTP PDU from a second GSN using a version not supported, then the first GSN shall return a "version not supported" error message to the second GSN. The second GSN shall then fall back to the most-recent version supported by the first GSN. A GSN shall use its most-recent GTP version when initiating GTP PDU transmission to a new GSN.

When an SGSN that supports GTP v1 establishes a GTP tunnel to a GGSN that supports GTP v0, the SGSN shall convert a release 99 QoS profile to a release 97 QoS profile before transmitting the QoS profile to the GGSN. If the MS supports the R99 QoS profile, the SGSN shall convert the negotiated R97 QoS profile to an R99 QoS profile before transmitting the QoS profile to the MS.

A GGSN shall be able to fall back to GTP v0 during an Update PDP Context procedure. That is, the GGSN shall accept an Update PDP Context Request of GTP v0 even if the established GTP tunnel is of GTP v1.

When an inter-SGSN RA update procedure is performed from a first SGSN that supports GTP v1 to a second SGSN that supports GTP v0, the first SGSN shall convert the R99 QoS profile to an R97 QoS profile before sending the SGSN Context Response message. Furthermore, it fills the Uplink Flow Label Signalling field in the PDP Context information element of the SGSN Context Response message with the lower two octets of the Uplink TEID Control Plane. All PDP contexts that are identified by an extended TI (see 3GPP TS 24.007 [12]) [and all PDP contexts with a maximum bitrate for uplink and downlink of 0 kbit/s](#) shall be deleted locally in the MS and the first SGSN, ~~and~~ ~~+~~ The first SGSN shall initiate the deletion of these PDP contexts in the GGSN after receiving an SGSN Context Acknowledge message from the second SGSN. If several of the remaining PDP contexts have been activated for the same APN and PDP address in the first SGSN (secondary PDP context activation), then all PDP contexts except the PDP context with the highest-quality QoS profile shall be deleted locally in the MS and in the first SGSN, and the first SGSN shall initiate the deletion of these PDP contexts in the GGSN.

MS detects that the new SGSN is supporting only GTPv0 from the Release Indication broadcasted on the GSM radio.

3G TS 23.107 [58] specifies how to determine the highest-quality QoS profile. The second SGSN shall be responsible for updating the remaining PDP context in the GGSN, and the GGSN shall remove the TFT if present when it receives the GTP v0 Update PDP Context Request message.

NOTE: The conversion between an R99 QoS profile and an R97 QoS profile is defined in 3G TS 23.107.

When an inter-SGSN RA update procedure is performed from a first SGSN that supports GTP v0 to a second SGSN that supports GTP v1, the second SGSN shall convert the R97 QoS profile to the R99 QoS profile, ignore the delivered Uplink Flow Label Signalling and use GTP v1 to send the Update PDP Context Request message to the GGSN. The Update PDP Context Request message shall be sent with a header containing a TEID set to all zeros and with an additional IE containing the IMSI for the PDP context.

A GGSN shall be able to change to GTP v1 during an Update PDP Context procedure. That is, the GGSN shall accept an Update PDP Context Request of GTP v1 with a TEID set to all zeros and containing the IMSI in addition to the NSAPI, even if the established GTP tunnel is of GTP v0.

When a GTP v0 tunnel was established between the old SGSN and the GGSN, and both old and new SGSNs support GTPv1, the respective uplink Flow Label signalling shall be inserted in the two lower octets of the Uplink TEID Control Plane field of the SGSN Context Response message; the upper two octets shall be set to all zeros.

When an inter-SGSN RA update procedure is performed from a first SGSN that supports only GTP v0 to a second SGSN that supports GTP v1, and the second SGSN does not have a valid PDP Context Identifier, it shall use value 255 to indicate this.

CR-Form-v7	
<b>CHANGE REQUEST</b>	
# <b>23.060 CR 401</b> # rev <b>1</b> #	Current version: <b>4.6.0</b> #

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

<b>Title:</b>	# Handling of preserved PDP contexts		
<b>Source:</b>	# Siemens		
<b>Work item code:</b>	# TE14	<b>Date:</b>	# 14/10/2002
<b>Category:</b>	# <b>A</b>	<b>Release:</b>	# Rel-4
	<i>Use one of the following categories:</i> <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification) Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		<i>Use one of the following releases:</i> <b>2</b> (GSM Phase 2) <b>R96</b> (Release 1996) <b>R97</b> (Release 1997) <b>R98</b> (Release 1998) <b>R99</b> (Release 1999) <b>Rel-4</b> (Release 4) <b>Rel-5</b> (Release 5) <b>Rel-6</b> (Release 6)

<b>Reason for change:</b>	# In case the MS moves from a R99 SGSN (GTPv1) to a R97/98 SGSN (GTPv0) then the QoS attributes mapping table in 3GPP TS 23.107 section "9.1.2.3 Determining R97/98 attributes from R99 attributes" have to be used. Following the rules of this table, R99 real-time PDP contexts with a maximum bitrate in downlink and uplink of 0 kbit/s will be mapped to R97/98 non-real-time PDP contexts with a peak throughput class of 1. The peak throughput class 1 means the maximum bitrate is set to 8 kbit/s. That means that the preservation is abolished and charging starts again. This would contradict to the current approach defined in TS 23.060 that only the MS decides what happens with preserved PDP contexts.  This CR proposes that the MS and network (old SGSN locally and towards GGSN) shall locally deactivate PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s.
<b>Summary of change:</b>	# PDP contexts with maximum bitrate for uplink and downlink of 0 kbit/s shall be deleted locally by the MS and the network once a change to a pre-release 99 network is done.
<b>Consequences if not approved:</b>	# Preservation is not defined for pre-release 99. A change to a pre-release 99 SGSN would contradict to the approved approach in TS 23.060. Charging would start although the MS may not wish to re-establish this PDP context.

<b>Clauses affected:</b>	# 11.1.1						
<b>Other specs</b>	#	<table border="1" style="display: inline-table; vertical-align: middle;"> <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"/>						



<b>affected:</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Test specifications	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O&M Specifications	
<b>Other comments:</b>	⌘			

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When an SGSN that supports GTP v1 establishes a GTP tunnel to a GGSN that supports GTP v0, the SGSN shall convert a release 99 QoS profile to a release 97 QoS profile before transmitting the QoS profile to the GGSN. If the MS supports the R99 QoS profile, the SGSN shall convert the negotiated R97 QoS profile to an R99 QoS profile before transmitting the QoS profile to the MS.

A GGSN shall be able to fall back to GTP v0 during an Update PDP Context procedure. That is, the GGSN shall accept an Update PDP Context Request of GTP v0 even if the established GTP tunnel is of GTP v1.

When an inter-SGSN RA update procedure is performed from a first SGSN that supports GTP v1 to a second SGSN that supports GTP v0, the first SGSN shall convert the R99 QoS profile to an R97 QoS profile before sending the SGSN Context Response message. Furthermore, it fills the Uplink Flow Label Signalling field in the PDP Context information element of the SGSN Context Response message with the lower two octets of the Uplink TEID Control Plane. All PDP contexts that are identified by an extended TI (see 3GPP TS 24.007 [12]) [and all PDP contexts with a maximum bitrate for uplink and downlink of 0 kbit/s](#) shall be deleted locally in the MS and the first SGSN, ~~and~~ ~~+~~ The first SGSN shall initiate the deletion of these PDP contexts in the GGSN after receiving an SGSN Context Acknowledge message from the second SGSN. If several of the remaining PDP contexts have been activated for the same APN and PDP address in the first SGSN (secondary PDP context activation), then all PDP contexts except the PDP context with the highest-quality QoS profile shall be deleted locally in the MS and in the first SGSN, and the first SGSN shall initiate the deletion of these PDP contexts in the GGSN.

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A GGSN shall be able to change to GTP v1 during an Update PDP Context procedure. That is, the GGSN shall accept an Update PDP Context Request of GTP v1 with a TEID set to all zeros and containing the IMSI in addition to the NSAPI, even if the established GTP tunnel is of GTP v0.

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CR-Form-v7	
<b>CHANGE REQUEST</b>	
# <b>23.060 CR 402</b> # rev <b>1</b> #	Current version: <b>5.3.0</b> #

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

<b>Title:</b>	# Handling of preserved PDP contexts		
<b>Source:</b>	# Siemens		
<b>Work item code:</b>	# TE15	<b>Date:</b>	# 14/10/2002
<b>Category:</b>	# <b>A</b>	<b>Release:</b>	# Rel-5
	<i>Use one of the following categories:</i> <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification) Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		<i>Use one of the following releases:</i> <b>2</b> (GSM Phase 2) <b>R96</b> (Release 1996) <b>R97</b> (Release 1997) <b>R98</b> (Release 1998) <b>R99</b> (Release 1999) <b>Rel-4</b> (Release 4) <b>Rel-5</b> (Release 5) <b>Rel-6</b> (Release 6)

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<b>Clauses affected:</b>	# 11.1.1						
<b>Other specs</b>	#	<table border="1" style="display: inline-table; vertical-align: middle;"> <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"/>						

<b>affected:</b>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Test specifications	
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	O&M Specifications	
<b>Other comments:</b>	⌘			

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When an SGSN that supports GTP v1 establishes a GTP tunnel to a GGSN that supports GTP v0, the SGSN shall convert a release 99 QoS profile to a release 97 QoS profile before transmitting the QoS profile to the GGSN. If the MS supports the R99 QoS profile, the SGSN shall convert the negotiated R97 QoS profile to an R99 QoS profile before transmitting the QoS profile to the MS.

A GGSN shall be able to fall back to GTP v0 during an Update PDP Context procedure. That is, the GGSN shall accept an Update PDP Context Request of GTP v0 even if the established GTP tunnel is of GTP v1.

When an inter-SGSN RA update procedure is performed from a first SGSN that supports GTP v1 to a second SGSN that supports GTP v0, the first SGSN shall convert the R99 QoS profile to an R97 QoS profile before sending the SGSN Context Response message. Furthermore, it fills the Uplink Flow Label Signalling field in the PDP Context information element of the SGSN Context Response message with the lower two octets of the Uplink TEID Control Plane. All PDP contexts that are identified by an extended TI (see 3GPP TS 24.007 [12]) [and all PDP contexts with a maximum bitrate for uplink and downlink of 0 kbit/s](#) shall be deleted locally in the MS and the first SGSN, ~~and~~ ~~+~~ The first SGSN shall initiate the deletion of these PDP contexts in the GGSN after receiving an SGSN Context Acknowledge message from the second SGSN. If several of the remaining PDP contexts have been activated for the same APN and PDP address in the first SGSN (secondary PDP context activation), then all PDP contexts except the PDP context with the highest-quality QoS profile shall be deleted locally in the MS and in the first SGSN, and the first SGSN shall initiate the deletion of these PDP contexts in the GGSN.

The MS detects that the new SGSN is supporting only GTPv0 from the Release Indication broadcasted by the RAN.

3GPP TS 23.107 [58] specifies how to determine the highest-quality QoS profile. The second SGSN shall be responsible for updating the remaining PDP context in the GGSN, and the GGSN shall remove the TFT if present when it receives the GTP v0 Update PDP Context Request message.

NOTE: The conversion between an R99 QoS profile and an R97 QoS profile is defined in 3GPP TS 23.107.

When an inter-SGSN RA update procedure is performed from a first SGSN that supports GTP v0 to a second SGSN that supports GTP v1, the second SGSN shall convert the R97 QoS profile to the R99 QoS profile, ignore the delivered Uplink Flow Label Signalling and use GTP v1 to send the Update PDP Context Request message to the GGSN. The Update PDP Context Request message shall be sent with a header containing a TEID set to all zeros and with an additional IE containing the IMSI for the PDP context.

A GGSN shall be able to change to GTP v1 during an Update PDP Context procedure. That is, the GGSN shall accept an Update PDP Context Request of GTP v1 with a TEID set to all zeros and containing the IMSI in addition to the NSAPI, even if the established GTP tunnel is of GTP v0.

When a GTP v0 tunnel was established between the old SGSN and the GGSN, and both old and new SGSNs support GTPv1 the respective uplink Flow Label signalling shall be inserted in the two lower octets of the Uplink TEID Control Plane field of the SGSN Context Response message; the upper two octets shall be set to all zeros.

When an inter-SGSN RA update procedure is performed from a first SGSN that supports only GTP v0 to a second SGSN that supports GTP v1, and the second SGSN does not have a valid PDP Context Identifier, it shall use value 255 to indicate this.

CR-Form-v7	
<b>CHANGE REQUEST</b>	
# <b>23.060 CR 417</b> # rev <b>1</b> #	Current version: <b>5.3.0</b> #

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

<b>Title:</b>	#	QoS negotiation	
<b>Source:</b>	#	Siemens AG	
<b>Work item code:</b>	#	TEI5	<b>Date:</b> # 14/10/2002
<b>Category:</b>	#	<b>F</b>	<b>Release:</b> # Rel-5
		<i>Use one of the following categories:</i>	<i>Use one of the following releases:</i>
		<b>F</b> (correction)	2 (GSM Phase 2)
		<b>A</b> (corresponds to a correction in an earlier release)	R96 (Release 1996)
		<b>B</b> (addition of feature),	R97 (Release 1997)
		<b>C</b> (functional modification of feature)	R98 (Release 1998)
		<b>D</b> (editorial modification)	R99 (Release 1999)
		Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .	Rel-4 (Release 4)
			Rel-5 (Release 5)
			Rel-6 (Release 6)

<b>Reason for change:</b>	#	<p>The “PDP Context Activation Procedure” describes the negotiation of the QoS profile between the UE, the SGSN and the GGSN. While it is clearly stated that “the SGSN may restrict the requested QoS attributes given its capabilities and the current load” it is nothing said specifically about the QoS negotiation in the GGSN. Since there is a statement on QoS negotiation in the “PDP Context Modification Procedure”, we think it is necessary to explicitly describe the QoS negotiation in the GGSN for the “PDP Context Activation Procedure”, too.</p> <p>Furthermore, this statement is still in the Release 98 TS 03.60 and seems to be accidentally removed from TS 23.060 during incorporation of CRs (from version 3.3.0 to 3.4.0).</p>
<b>Summary of change:</b>	#	A statement is added to step 4 of the “PDP Context Activation Procedure” saying that the GGSN may restrict QoS Negotiated given its capabilities and the current load.
<b>Consequences if not approved:</b>	#	Without the description of the QoS negotiation in the GGSN for the “PDP Context Activation Procedure” implementations are thinkable which negotiate the QoS profile to a better QoS than requested. This could lead to an undefined situation in case the SGSN is not able to guarantee the increased QoS due to current load or to authorize the increased QoS due to the subscribed QoS profile.

<b>Clauses affected:</b>	#	9.2.2.1									
<b>Other specs affected:</b>		<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="padding: 2px;">#</td> <td style="padding: 2px;">X</td> </tr> <tr> <td style="padding: 2px;">#</td> <td style="padding: 2px;">X</td> </tr> <tr> <td style="padding: 2px;">#</td> <td style="padding: 2px;">X</td> </tr> </table>	Y	N	#	X	#	X	#	X	Other core specifications # Test specifications # O&M Specifications #
	Y	N									
	#	X									
#	X										
#	X										

**Other comments:** ☼

**How to create CRs using this form:**

Comprehensive information and tips about how to create CRs can be found at <http://www.3gpp.org/specs/CR.htm>. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked ☼ contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under <ftp://ftp.3gpp.org/specs/> For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

Start of modified section

9.2.2.1 PDP Context Activation Procedure

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

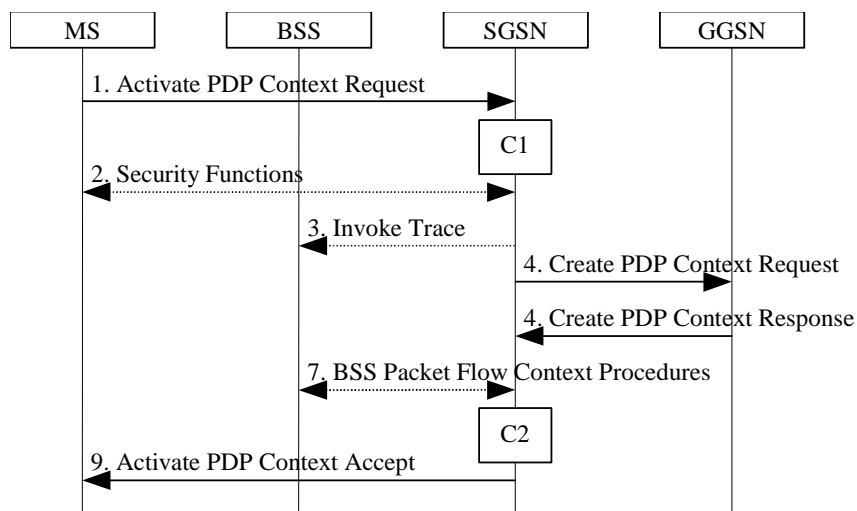


Figure 63: PDP Context Activation Procedure for A/Gb mode

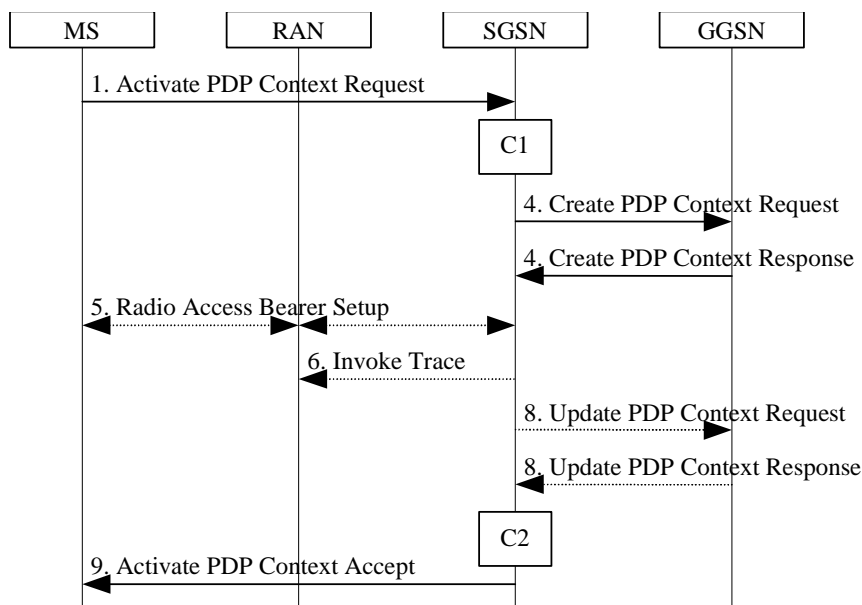


Figure 64: PDP Context Activation Procedure for Iu mode

- 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 packet data network and/or to select a service. Access Point Name is a logical name referring to the 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 transfer optional PDP parameters and/or request to the GGSN (see GSM 29.060 [26] and 24.229 [75]). 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) message to the affected 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 a packet data 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 packet data 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 may restrict QoS Negotiated given its capabilities and the current load.](#) 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 RAN. 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. PDP Configuration Options may be used to transfer optional PDP parameters to the UE (see GSM 29.060 [26] and 24.229 [75]). PDP Configuration Options is sent transparently through the SGSN. 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.

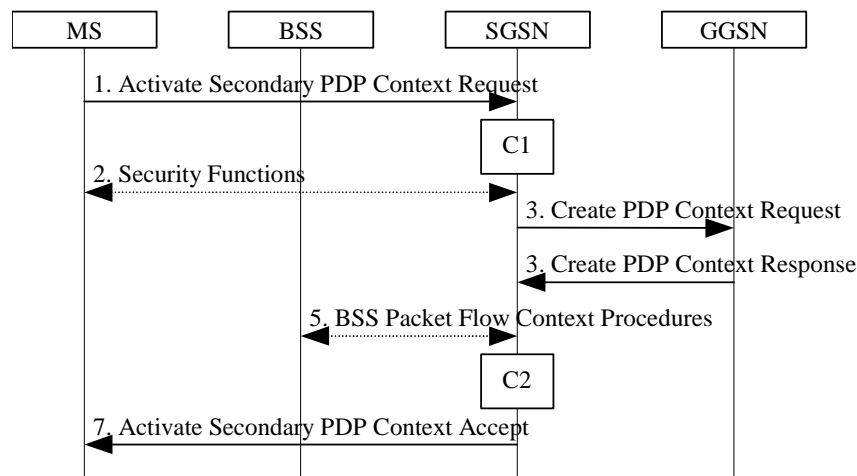
In Figure 63 and Figure 64, procedures return as result "Continue".

#### 9.2.2.1.1 Secondary PDP Context Activation Procedure

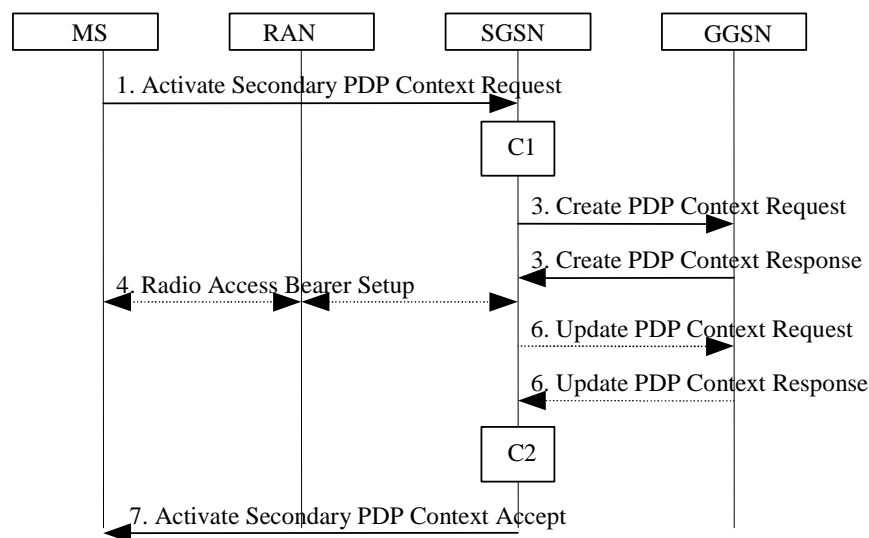
The Secondary PDP Context Activation procedure may be used to activate a PDP context while reusing the PDP address and other PDP context information from an already active PDP context, but with a different QoS profile. Procedures for APN selection and PDP address negotiation are not executed. A unique 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 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 A/Gb mode**



**Figure 66: Secondary PDP Context Activation Procedure for Iu mode**

- 1) The MS sends an Activate Secondary PDP Context Request (Linked TI, NSAPI, TI, QoS Requested, TFT, PDP Configuration Options) 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. PDP Configuration Options may be used to transfer optional PDP parameters and/or requests to the GGSN (see GSM 29.060 [26] and 24.229 [75]). 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) 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, PDP Configuration Options) message to the affected 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. PDP Configuration Options is sent transparently through the SGSN if received in the Activate secondary PDP Context Request message.

The GGSN uses the same packet data 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 packet data network. The GGSN returns a Create PDP Context Response (TEID, QoS Negotiated, Cause, PDP Configuration Options) message to the SGSN. PDP Configuration Options may be used to transfer optional PDP parameters to the UE (see GSM 29.060 [26] and 24.229 [75]).

- 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, PDP Configuration Options) message to the MS. PDP Configuration Options is sent transparently through the SGSN if received in the Create PDP Context Response message. 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, PDP Configuration Options) 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".

<b>End of modified section</b>
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## CHANGE REQUEST

⌘ **23.060 CR 418** ⌘ rev **-** ⌘ Current version: **5.3.0** ⌘

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

<b>Title:</b>	⌘ SMS over PS in lu mode		
<b>Source:</b>	⌘ Ericsson		
<b>Work item code:</b>	⌘ TEI-5	<b>Date:</b>	⌘ 6/11/2002
<b>Category:</b>	⌘ <b>F</b>	<b>Release:</b>	⌘ Rel-5
	Use <u>one</u> of the following categories: <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification) Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		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)

<b>Reason for change:</b>	⌘ In section 16.1, the Point-to-point Short Message Service is described in some detail for the A/Gb mode but only refers to 23.040 in lu mode. However, only 23.060 shows the CAMEL procedure calls, while 23.040 does not describe any CAMEL interaction at all. As a result, the standards are currently ambiguous regarding the implementation of the CAMEL procedure calls associated with the SMS procedures over the PS domain in lu mode.  Since the SMS support over the PS domain is very similar in lu and A/Gb mode, and 23.060 already describes the CAMEL procedure calls in A/Gb mode, this CR generalises the description in section 16.1 to also cover the lu mode to the same level of detail.
<b>Summary of change:</b>	⌘ Subclause 16.1 is generalised to cover both the lu and A/Gb mode in its description of the Point-to-Point Short Message Service over the PS domain. Further, a reference to 24.011 is added in clause 2.
<b>Consequences if not approved:</b>	⌘ The CAMEL procedure calls for SMS over the PS domain in lu mode will not be described anywhere, making their implementation ambiguous.

<b>Clauses affected:</b>	⌘ 2, 16.1										
<b>Other specs affected:</b>	<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;">X</td> <td style="text-align: center;">X</td> </tr> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">X</td> </tr> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">X</td> </tr> </table> Other core specifications ⌘ Test specifications ⌘ O&M Specifications ⌘	Y	N	X	X	X	X	X	X		
Y	N										
X	X										
X	X										
X	X										
<b>Other comments:</b>	⌘										

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- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under <ftp://ftp.3gpp.org/specs/> For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

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## 2 References

The following documents contain provisions, which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".
- [2] GSM 01.61: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); GPRS ciphering algorithm requirements".
- [3] 3GPP TS 22.060: "General Packet Radio Service (GPRS); Service description; Stage 1".
- [4] 3GPP TS 23.003: "Numbering, addressing and identification".
- [5] 3GPP TS 23.007: "Restoration procedures".
- [5b] 3GPP TS 23.016: "Subscriber data management; Stage 2".
- [6] GSM 03.20: "Digital cellular telecommunications system (Phase 2+); Security related network functions".
- [7] GSM 03.22: "Digital cellular telecommunications system (Phase 2+); Functions related to Mobile Station (MS) in idle mode and group receive mode".
- [7b] 3GPP TS 23.122: "Non-Access Stratum functions related to Mobile Station (MS) in idle mode".
- [8] 3GPP TS 23.040: "Technical realization of the Short Message Service (SMS)".
- [8b] 3GPP TS 23.078: "Customised Applications for Mobile network Enhanced Logic (CAMEL) Phase 3 - Stage 2".
- [9] 3GPP TS 21.905: "Vocabulary for 3GPP Specifications", (Release 4).
- [10] Void.
- [11] GSM 03.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS radio interface; Stage 2".
- [12] 3GPP TS 24.007: "Mobile radio interface signalling layer 3; General aspects".
- [13] 3GPP TS 24.008: "Mobile Radio Interface Layer 3 specification; Core Network Protocols; Stage 3".
- [13b] [3GPP TS 24.011: "Point to Point \(PP\) Short Message Service \(SMS\) support on mobile radio interface"](#).
- [14] GSM 04.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) - Base Station System (BSS) interface; Radio Link Control/Medium Access Control (RLC/MAC) protocol".
- [15] GSM 04.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station – Serving GPRS Support Node (MS-SGSN) Logical Link Control (LLC) layer specification".

- [16] GSM 04.65: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station (MS) – Serving GPRS Support Node (SGSN); Subnetwork Dependent Convergence Protocol (SNDCP)".
- [16b] GSM 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".
- [17] 3GPP TS 27.060: "Packet Domain; Mobile Station (MS) supporting Packet Switched services".
- [18] GSM 08.08: "Digital cellular telecommunications system (Phase 2+); Mobile-services Switching Centre - Base Station System (MSC-BSS) interface; Layer 3 specification".
- [19] GSM 08.14: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) interface; Gb interface layer 1".
- [20] GSM 08.16: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN) interface; Network Service".
- [21] GSM 08.18: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN); BSS GPRS Protocol (BSSGP)".
- [22] GSM 08.60: "Digital cellular telecommunications system (Phase 2+); In-band control of remote transcoders and rate adaptors for Enhanced Full Rate (EFR) and full rate traffic channels".
- [23] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".
- [24] 3GPP TS 29.016: "General Packet Radio Service (GPRS); Serving GPRS Support Node (SGSN) - Visitors Location Register (VLR); Gs interface network service specification".
- [25] 3GPP TS 29.018: "General Packet Radio Service (GPRS); Serving GPRS Support Node (SGSN) - Visitors Location Register (VLR); Gs interface layer 3 specification".
- [26] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp Interface".
- [27] 3GPP TS 29.061: "Interworking between the Public Land Mobile Network (PLMN) supporting Packet Based services and Packet Data Networks (PDN)".
- [27b] 3GPP TS 29.078: "Customised Applications for Mobile network Enhanced Logic (CAMEL) Phase 3; CAMEL Application Part (CAP) Specification".
- [28] GSM 11.11: "Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module - Mobile Equipment (SIM-ME) interface".
- [29] ITU-T Recommendations I.130: "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".
- [30] ITU-T Recommendation E.164: "The international public telecommunication numbering plan".
- [31] ITU-T Recommendation Q.65: "The unified functional methodology for the characterization of services and network capabilities".
- [32] ITU-T Recommendation V.42bis: "Data compression procedures for data circuit-terminating equipment (DCE) using error correction procedures".
- [33] ITU-T Recommendation X.3: "Packet assembly/disassembly facility (PAD) in a public data network".
- [34] ITU-T Recommendation X.25: "Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit".
- [39] RFC 768 (1980): "User Datagram Protocol" (STD 6).



- [40] RFC 791 (1981): "Internet Protocol" (STD 5).
- [41] RFC 792 (1981): "Internet Control Message Protocol" (STD 5).
- [42] RFC 793 (1981): "Transmission Control Protocol" (STD 7).
- [43] RFC 1034 (1987): "Domain names – concepts and facilities" (STD 13).
- [44] RFC 1661 (1994): "The Point-to-Point Protocol (PPP)" (STD 51).
- [45] RFC 1542 (1993): "Clarifications and Extensions for the Bootstrap Protocol".
- [46] RFC 2002 (1996): "IP Mobility Support".
- [47] RFC 2131 (1997): "Dynamic Host Configuration Protocol".
- [48] RFC 2460 (1998): "Internet Protocol, Version 6 (IPv6) Specification".
- [49] TIA/EIA-136 (1999): "TDMA Cellular / PCS"; Arlington: Telecommunications Industry Association.
- [50] 3GPP TS 25.301: "Radio Interface Protocol Architecture".
- [51] 3GPP TS 25.303: "Interlayer procedures in Connected Mode".
- [51b] 3GPP TS 25.304: "UE Procedures in Idle Mode and Procedures for Call Reselection in Connected Mode".
- [52] 3GPP TS 25.331: "RRC Protocol Specification".
- [53] 3GPP TS 25.401: "UTRAN Overall Description".
- [54] 3GPP TS 23.121: "Architectural Requirements for Release 1999".
- [55] 3GPP TS 25.322: "RLC protocol specification".
- [56] 3GPP TS 25.412: "UTRAN Iu Interface Signalling Transport".
- [56b] 3GPP TS 25.413: "UTRAN Iu Interface RANAP Signalling".
- [57] 3GPP TS 25.323: "Packet Data Convergence Protocol (PDCP) specification".
- [58] 3GPP TS 23.107: "Quality of Service (QoS) concept and architecture".
- [59] ITU-T Recommendation I.361: "B-ISDN ATM layer specification".
- [60] 3GPP TS 25.321: "Medium Access Control (MAC) protocol specification".
- [61] 3GPP TS 33.102: "3G Security; Security architecture".
- [62] 3GPP TS 22.002: "Circuit Bearer Services (BS) supported by a Public Land Mobile Network (PLMN)".
- [63] 3GPP TS 25.411: "UTRAN Iu interface Layer 1".

- [64] 3GPP TS 25.414: "UTRAN Iu interface data transport & transport signalling".
- [65] 3GPP TS 23.271: "Functional stage 2 description of LCS".
- [66] 3GPP TS 23.015: "Technical realization of Operator Determined Barring (ODB)".
- [67] ITU-T Recommendation I.363.5: "B-ISDN ATM Adaptation Layer (AAL) specification: Type 5 AAL".
- [68] RFC 2373 (1998): "IP Version 6 Addressing Architecture".
- [69] RFC 2462 (1998): "IPv6 Stateless Address Autoconfiguration".
- [70] 3GPP TS 32.215: "3G Telecom Management; Charging management; Charging data description for the Packet Switched (PS) domain".
- [71] RFC 2461 (1998): "Neighbor Discovery for IP Version 6 (IPv6)".
- [72] 3GPP TS 29.202: "Signalling System No. 7 (SS7) signalling transport in core network; Stage 3".
- [73] 3GPP TS 23.236: "Intra Domain Connection of RAN Nodes to Multiple CN Nodes".
- [74] 3GPP TS 43.051: "Radio Access Network; Overall description – Stage 2".
- [75] 3GPP TS 24.229: IP Multimedia Call Control Protocol based on SIP and SDP.

**Next modified section**

## 16.1 Point-to-point Short Message Service

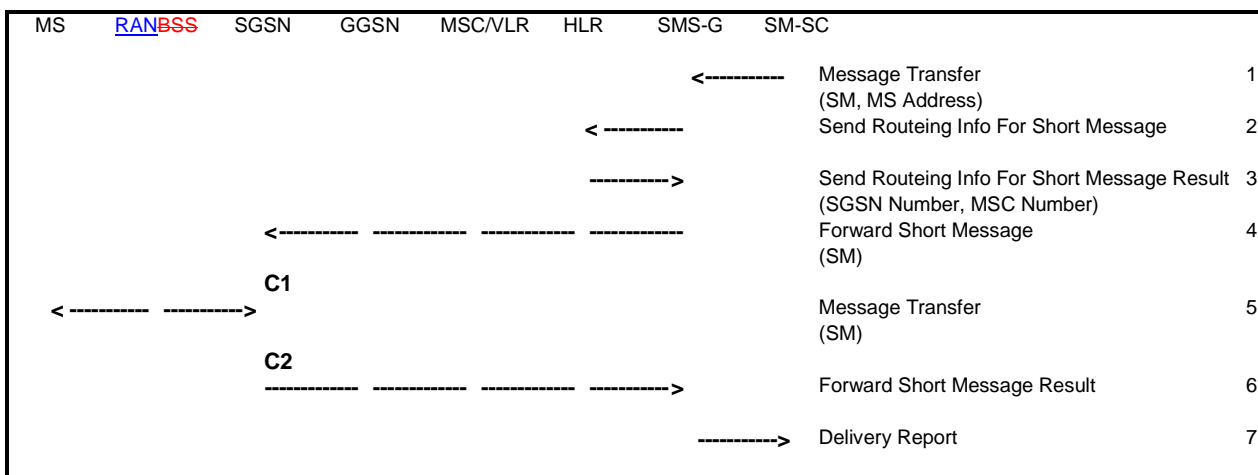
### 16.1.1 ~~Point-to-point Short Message Service (A/Gb mode)~~

It shall be possible for a GPRS-attached MS to send and receive short messages over ~~GPRS radio channels~~the PS domain. An MS that is GPRS-attached and not IMSI-attached shall transfer SMs over ~~GPRS channels~~the PS domain. MSs that are both GPRS-attached and IMSI-attached shall transfer SMs over ~~GPRS channels~~the PS domain or over ~~non-GPRS control channels~~the CS domain (if ~~non-GPRS control channels are~~the CS domain is used, then paging for MT SMS may go through the SGSN).

The following two clauses define the operation of mobile-terminated and mobile-originated SMS routing and transfer over ~~GPRS radio channels~~the PS domain. More detailed definitions are contained in ~~GSM 03.40~~3G TS 23.040 [8].

### 16.1.1.1.4 Mobile-terminated SMS Transfer

Figure 96 and the description below show an example of a successful delivery of an SM to an MS over a ~~GPRS radio channel~~ the PS domain.



**Figure 96: MT SMS Transfer, Successful**

- 1) The short message service centre determines it shall send an SM to an MS. SM-SC forwards the SM to an SMS gateway MSC (SMS-GMSC).
- 2) SMS-GMSC examines the destination MS Address, and sends a Send Routeing Info For Short Message message to the relevant HLR.
- 3) HLR returns a Send Routeing Info For Short Message Result message to the SMS-GMSC. The result may contain the MS's current SGSN Number, the MSC Number, or both. If the result does not contain an SGSN Number (i.e., the HLR knows that the MS is not reachable via an SGSN), and if the result does contain an MSC Number, non-GPRS SMS delivery procedures are followed. If the result contains an SGSN Number, the SMS transfer proceeds according to the following events.

NOTE: SMS delivery via the SGSN is normally more radio resource efficient than SMS delivery via the MSC/VLR. The preferred delivery path is selected by SMS-GMSC operator-specific action.

- 4) SMS-GMSC forwards the SM to the SGSN.
- 5) SGSN transfers the SM to the MS on the RP, ~~and CP, LLC~~ layers, as defined in 3G TS 24.011 ~~GSM 04.11 and GSM 04.64~~.
- 6) SGSN returns a Forward Short Message Result message to the SMS-GMSC indicating successful delivery of the SM.
- 7) SMS-GMSC returns a Delivery Report to the SM-SC indicating successful delivery of the SM.

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

C1) CAMEL\_T\_SMS\_INIT.

The procedure returns as result "Continue".

C2) CAMEL\_T\_SMS\_DELIVERED.

This procedure does not return a result.

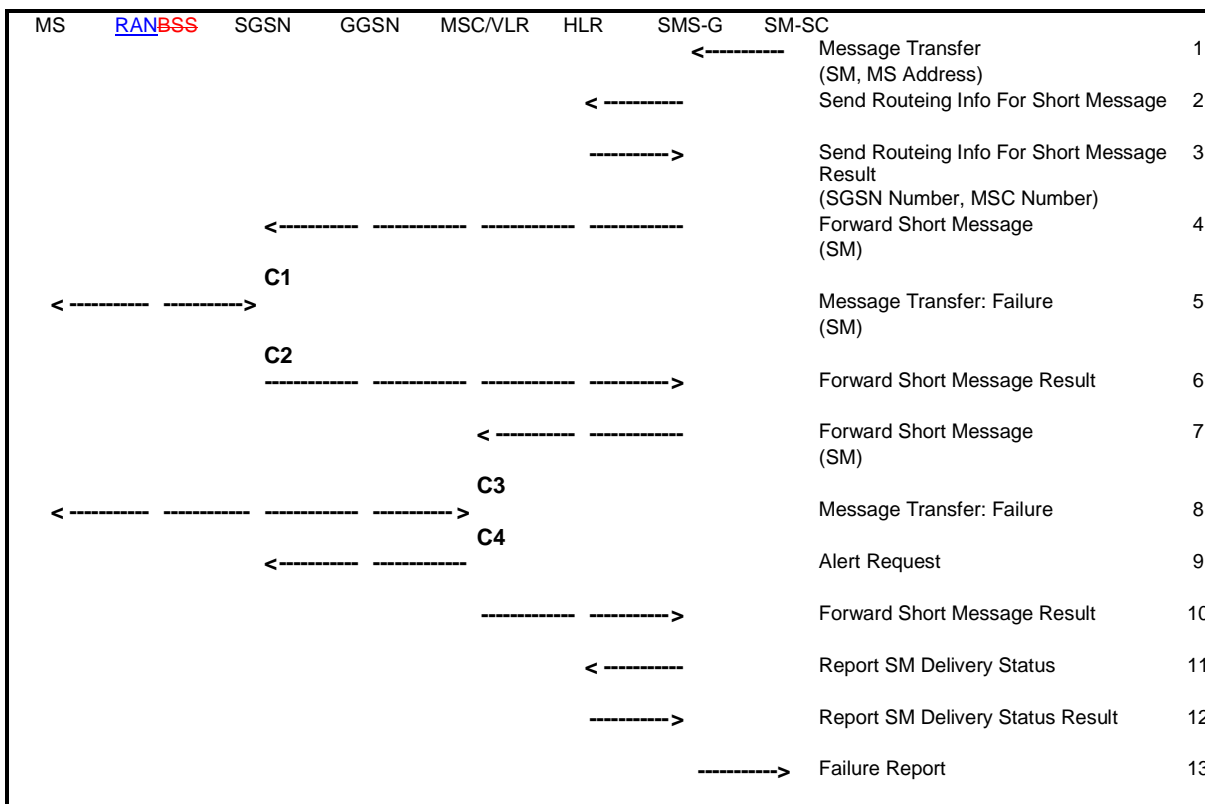
#### 16.1.1.1.1.4 Unsuccessful Mobile-terminated SMS Transfer

The SGSN may not be able to deliver the SM to the MS. This may for example happen when the MS is not attached to GPRS, or when the radio channel conditions are bad.

When the SGSN cannot deliver the SM to the MS, the SGSN sets the Mobile station Not Reachable for GPRS flag (MNRG), and returns a failure report to the SMS-GMSC. Based on the routing information received from the HLR, the SMS-GMSC shall do one of the following:

- If an MSC/VLR is available for the MS, the SM is forwarded to the MS via the MSC/VLR. A successful delivery report shall be returned to the SM-SC.
- If an MSC/VLR is not available for the MS, the Message Waiting Indication information in the HLR shall be updated and an unsuccessful delivery report shall be returned to the SM-SC.

Figure 97 illustrates one possible traffic scenario when neither the SGSN nor the MSC is able to deliver the SM.



**Figure 97: MT SMS Transfer, Unsuccessful**

- 1) The short message service centre determines it shall send an SM to an MS. SM-SC forwards the SM to a SMS-GMSC.
- 2) SMS-GMSC examines the destination MS Address, and sends a Send Routeing Info For Short Message message to the relevant HLR.
- 3) HLR returns a Send Routeing Info For Short Message Result message to the SMS-GMSC. The Result contains an SGSN Number and an MSC Number.
- 4) SMS-GMSC forwards the SM to the SGSN.
- 5) SGSN attempts to transfer the SM to the MS, but fails.
- 6) SGSN sets MNRG and returns a Forward Short Message Result message to SMS-GMSC indicating unsuccessful delivery of the SM.
- 7) SMS-GMSC selects an alternative route for the SMS, and forwards the SM to the MSC/VLR.
- 8) MSC/VLR attempts to transfer the SM to the MS, but fails.

- 9) The MSC/VLR requests the setting of the NGAF at the SGSN.
- 10) VLR sets MNRF and returns a Forward Short Message Result message to the SMS-GMSC indicating unsuccessful delivery of the SM.
- 11) SMS-GMSC sends a Report SM Delivery message to the HLR.
- 12) HLR updates its Message Waiting Indication fields and returns a Report SM Delivery Result message to the SMS-GMSC.
- 13) SMS-GMSC returns a Failure Report to the SM-SC indicating unsuccessful delivery of the SM.

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

C1) CAMEL\_T\_SMS\_INIT.

The procedure returns as result "Continue".

C2) CAMEL\_T\_SMS\_FAILURE.

This procedure does not return a result.

C3) CAMEL\_T\_SMS\_INIT.

The procedure returns as result "Continue".

C4) CAMEL\_T\_SMS\_FAILURE.

This procedure does not return a result.

Figure 69 shows that the SGSN sends a Ready for SM (MS Reachable) message to the HLR when the MS becomes reachable and MNRF is set in the SGSN. The SGSN indicates also to the MSC/VLR when the MS becomes reachable and NGAF is set in the SGSN. If the MNRF is set at the MSC/VLR, the MSC/VLR sends a Ready for SM (MS Reachable) message to the HLR. Reception of a Ready for SM message or Update Location message when MNRF is set in the HLR shall trigger the SMS alert procedure as defined in [GSM-03-40 3G TS 23.040](#).

MNRG remains set in the SGSN independently of whether the MSC/VLR was successful in delivering the SM or not. This means that the SGSN in certain cases sends a Ready for SM message to the HLR when an MS becomes reachable via the SGSN, even if no SM is waiting. This causes a small amount of duplicate signalling between the SGSN and the HLR only.

### 16.1.4.2 Mobile-originated SMS Transfer

Figure 98 and the description below explain the steps involved in sending an SM from an MS over ~~a GPRS radio channel~~ the PS domain.

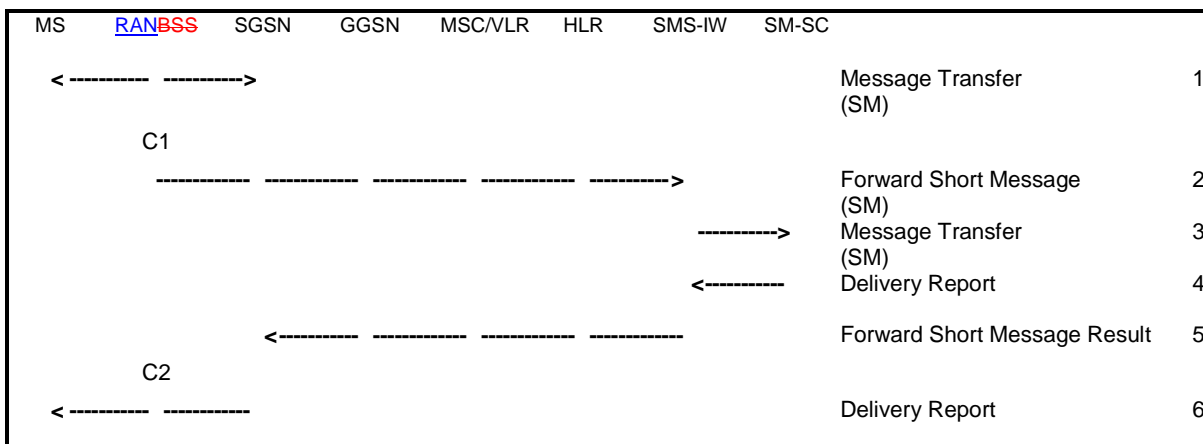


Figure 98: MO SMS Transfer, Successful

- 1) The MS has an SM to send, and transfers the SM to the SGSN via RP, ~~and CP, and LLC.~~
- 2) SGSN checks the MS subscription data, and determines that the MS is allowed to originate the SMS. SGSN forwards the SM to a SMS interworking MSC (SMS-IWMSC).
- 3) SMS-IWMSC passes the SM to the addressed SM-SC.
- 4) SM-SC returns a Delivery Report to the SMS-IWMSC indicating successful delivery of the SM.
- 5) SMS-IWMSC returns a Forward Short Message Result message to the SGSN indicating successful delivery of the SM.
- 6) SGSN returns a Delivery Report to the MS indicating successful delivery of the SM.

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

C1) CAMEL\_O\_SMS\_INIT.

The procedure returns as result "Continue".

C2) CAMEL\_O\_SMS\_SUBMITTED

This procedure does not return a result.

### ~~16.1.2 Point-to-point Short Message Service (Iu mode)~~

~~SMS shall be supported via the control plane in the packet domain. The Iu mode SMS service is described in 3GPP TS 23.040.~~

## CHANGE REQUEST

⌘ **23.060 CR 419** ⌘ rev **1** ⌘ Current version: **5.3.0** ⌘

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

<b>Title:</b>	⌘ Re-use of TEID		
<b>Source:</b>	⌘ Ericsson		
<b>Work item code:</b>	⌘ TEI-5	<b>Date:</b>	⌘ 14/11/2002
<b>Category:</b>	⌘ <b>F</b>	<b>Release:</b>	⌘ Rel-5
	<i>Use one of the following categories:</i> <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification) Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		<i>Use one of the following releases:</i> <b>2</b> (GSM Phase 2) <b>R96</b> (Release 1996) <b>R97</b> (Release 1997) <b>R98</b> (Release 1998) <b>R99</b> (Release 1999) <b>Rel-4</b> (Release 4) <b>Rel-5</b> (Release 5) <b>Rel-6</b> (Release 6)

<b>Reason for change:</b>	⌘ When a path failure on the Gn/Gp interface is detected by a GSN it is optional whether to locally release all the PDP contexts using this path or to keep them active. As a result, in a multivendor environment it is possible that one node releases a PDP context after a path failure while the other end considers the PDP context still active. If the node that releases the PDP context re-uses the corresponding TEID for a new PDP context shortly after the first one has been released, problems may arise due to that the other node will have two PDP contexts associated with the same remote TEID. Potential problems are that the wrong PDP context may be released when data is transferred over the failed PDP context, or packets may not reach their intended recipient.
<b>Summary of change:</b>	⌘ Add a statement in clause 14.6 clearly requiring not to re-use TEIDs within a significant period of time. How long this period should be is however left as an implementation choice.
<b>Consequences if not approved:</b>	⌘ Unexpected behaviour leading to a bad user experience may arise if two GSNs reacting differently in case of Gn path failure re-use the TEID of a released PDP context too quickly.

<b>Clauses affected:</b>	⌘ 14.6										
<b>Other specs affected:</b>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Y</td> <td style="padding: 2px;">N</td> </tr> <tr> <td style="padding: 2px;">?</td> <td style="padding: 2px;"></td> </tr> <tr> <td style="padding: 2px;"></td> <td style="padding: 2px;">X</td> </tr> <tr> <td style="padding: 2px;"></td> <td style="padding: 2px;">X</td> </tr> </table>	Y	N	?			X		X	Other core specifications	⌘
	Y	N									
	?										
	X										
	X										
		Test specifications									
		O&M Specifications									
<b>Other comments:</b>	⌘										

### **How to create CRs using this form:**

Comprehensive information and tips about how to create CRs can be found at <http://www.3gpp.org/specs/CR.htm>. Below is a brief summary:

- 1) Fill out the above form. The symbols above marked ¶ contain pop-up help information about the field that they are closest to.
- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under <ftp://ftp.3gpp.org/specs/> For the latest version, look for the directory name with the latest date e.g. 2001-03 contains the specifications resulting from the March 2001 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.



## 14.6 TEID

A Tunnel Endpoint Identifier (TEID) is used by the GPRS tunnelling protocol between GSNs, and between RNCs/BSCs and SGSNs, to identify a tunnel endpoint in the receiving GTP-C or GTP-U protocol entity and to identify a PDP context (or in the Iu case a Radio Access Bearer). The receiving end side of a GTP-U tunnel locally assigns the TEID value that the transmitting side has to use. The TEID values are exchanged between tunnel endpoints using GTP-C (or RANAP in the Iu case) messages.

The TEID is a unique identifier within one IP address of a logical node, i.e. RNC, BSC, SGSN, or GGSN, which has meaning only within the GTP protocol. For the user plane, i.e. GTP-U, each PDP context has a one-to-one relationship between the TEID on one hand and NSAPI and IMSI on the other hand, or in the Iu reference point case, between the TEID and RAB ID and IMSI. [When a node releases a PDP context, the corresponding TEID shall not be re-used within a significant period of time to ensure a low probability of the TEID being still assigned to an existing PDP context in a peer node.](#) However, the algorithm for computing the value of the TEID [and the period of time until the re-use of a TEID are](#) implementation dependent.

The TEID is forwarded to the GGSN upon PDP Context Activation and it is used in subsequent tunnelling of user data between the GGSN and the SGSN to identify the MS's PDP contexts in the SGSN and GGSN. The TEID is also used to forward N-PDUs from the old SGSN to the new SGSN at and after an inter-SGSN routing area update. In Iu mode, the TEID is also forwarded to the RNC upon RAB assignment and it is used in subsequent tunnelling of user data between the SGSN and the RNC/BSC in order to identify the MS's PDP contexts in the SGSN and the MS's RAB contexts in the RNC/BSC. It is also used to forward N-PDUs from the SRNC/SBSC to the target RNC/BSC at SRNS/SBSS relocation.

## CHANGE REQUEST

# **23.060 CR 399** # rev **3** # Current version: **5.3.0** #

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

<b>Title:</b>	# Mobility Management for GPRS (CAMEL) Subscriber		
<b>Source:</b>	# Siemens		
<b>Work item code:</b>	# CAMEL4	<b>Date:</b>	# 13/11/2002
<b>Category:</b>	# <b>F</b>	<b>Release:</b>	# Rel-5
	Use <u>one</u> of the following categories: <b>F</b> (correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (addition of feature), <b>C</b> (functional modification of feature) <b>D</b> (editorial modification)		Use <u>one</u> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999)
	Detailed explanations of the above categories can be found in 3GPP <a href="#">TR 21.900</a> .		Rel-4 (Release 4) Rel-5 (Release 5) Rel-6 (Release 6)

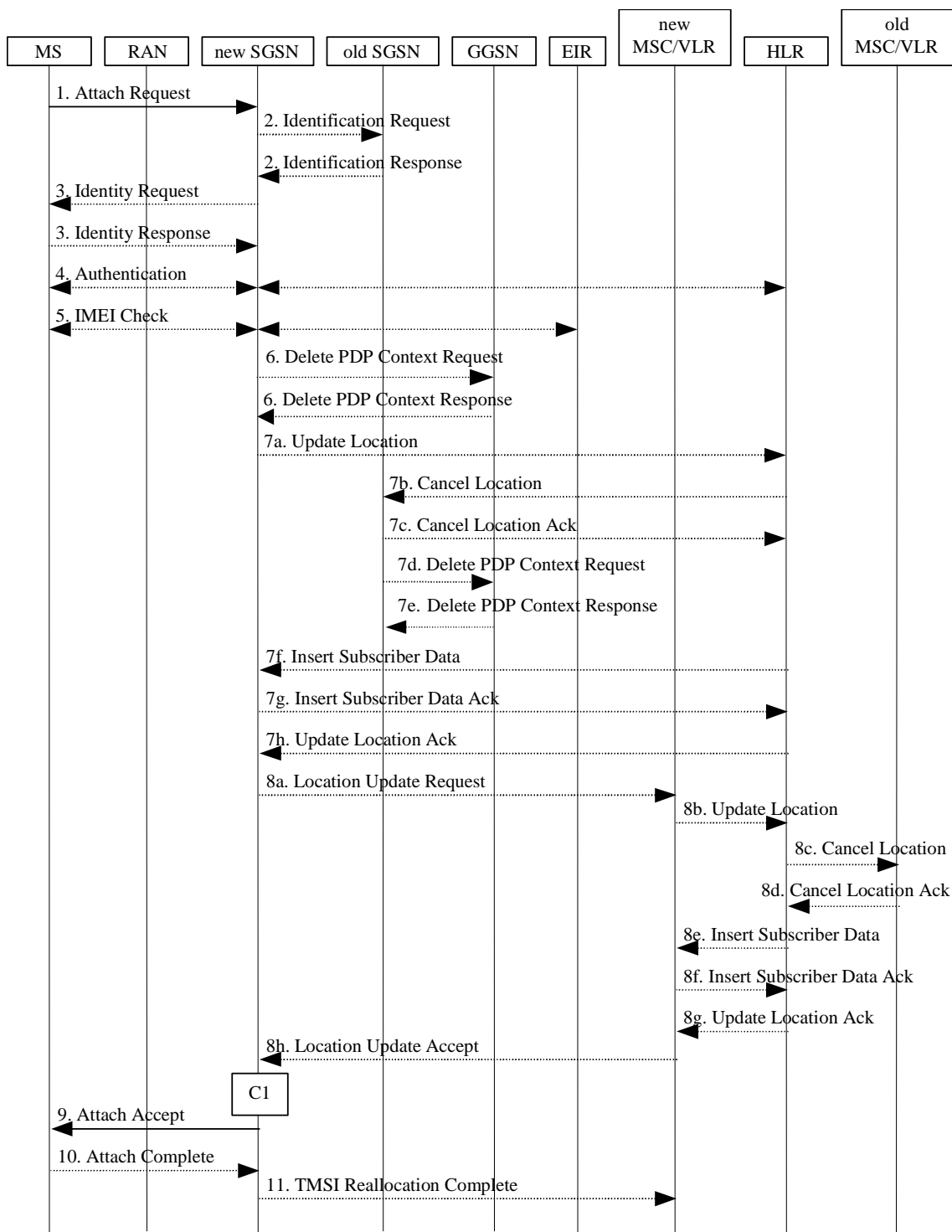
<b>Reason for change:</b>	# Mobility Management for GPRS subscriber has been added in CAMEL Phase 4. This feature enables the notification to the CSE (gsmSCF) of one or more of the following events; - Routeing area update of MS; - GPRS attach; - GPRS detach. This feature is already described in the stage 2 and 3 specifications (e.g. TS 23.078). This CR aligns TS 23.060 with stage 3 specifications.		
<b>Summary of change:</b>	# Addition of the procedure call (CAMEL_PS_Notification in TS 23.078) in Mobility Management procedures. Addition of MG-CSI in the information storage of HLR and SGSN.		
<b>Consequences if not approved:</b>	# TS 23.060 would be inconsistent to stage 3 specifications and CAMEL Phase 4 feature would not be completed.		

<b>Clauses affected:</b>	# 6, 13						
<b>Other specs affected:</b>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; text-align: center;">Y</td> <td style="width: 20px; 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						
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	<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"/>						
<b>Other comments:</b>	# Stage 2 and 3 specifications (TS 23.078, TS 23.016, TS 29.002) already include this feature.						

**\*\*\* First Modified Part \*\*\***

### 6.5.3 Combined GPRS / IMSI Attach procedure

The Combined GPRS / IMSI Attach procedure is illustrated in Figure 22.



**Figure 22: Combined GPRS / IMSI Attach Procedure**

- 1) In A/Gb mode, the MS initiates the attach procedure by the transmission of an Attach Request (IMSI or P-TMSI and old RAI, Classmark, CKSN, Attach Type, DRX Parameters, old P-TMSI Signature) message to the SGSN. IMSI shall be included if the MS does not have a valid P-TMSI available. If the MS has a valid P-TMSI, then P-TMSI and the old RAI associated with P-TMSI shall be included. Classmark contains the MS's GPRS multislot capabilities and supported GPRS ciphering algorithms in addition to the existing classmark parameters defined in GSM 04.08. Attach Type indicates which type of attach is to be performed, i.e. GPRS attach only, GPRS Attach while already IMSI attached, or combined GPRS / IMSI attach. DRX Parameters indicates whether the MS uses discontinuous reception or not. If the MS uses discontinuous reception, then DRX Parameters also indicate when the MS is in a non-sleep mode able to receive paging requests and channel assignments. If the MS uses P-TMSI for identifying itself and if it has also stored its old P-TMSI Signature, then the MS shall include the old P-TMSI Signature in the Attach Request message.

For Iu mode, the MS initiates the attach procedure by the transmission of an Attach Request (IMSI or P-TMSI and old RAI, Core Network Classmark, KSI, Attach Type, old P-TMSI Signature, Follow On Request, DRX Parameters) message to the SGSN. IMSI shall be included if the MS does not have a valid P-TMSI available. If the MS uses P-TMSI for identifying itself and if it has also stored its old P-TMSI Signature, then the MS shall include the old P-TMSI Signature in the Attach Request message. If the MS has a valid P-TMSI, then P-TMSI and the old RAI associated with P-TMSI shall be included. KSI shall be included if the MS has valid security parameters. Core Network Classmark is described in clause "MS Network Capability". The MS shall set "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 GPRS Attach procedure. Attach Type indicates which type of attach is to be performed, i.e. GPRS attach only, GPRS Attach while already IMSI attached, or combined GPRS / IMSI attach. DRX Parameters indicates whether or not the MS uses discontinuous reception and the DRX cycle length.

- 2) If the MS identifies itself with P-TMSI and the SGSN has changed since detach, the new SGSN sends an Identification Request (P-TMSI, old RAI, old P-TMSI Signature) to the old SGSN to request the IMSI. If the new SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the new SGSN may derive the old SGSN from the old RAI and the old P-TMSI and send the Identification Request message to this old SGSN. Otherwise, the new SGSN derives the old SGSN from the old RAI. In any case the new SGSN will derive an SGSN that it believes is the old SGSN. This derived SGSN is itself the old SGSN, or it is associated with the same pool area as the actual old SGSN and it will determine the correct old SGSN from the P-TMSI and relay the message to that actual old SGSN. The old SGSN responds with Identification Response (IMSI, Authentication Triplets or Authentication Quintets). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN also 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.
- 3) If the MS is unknown in both the old and new SGSN, the SGSN sends an Identity Request (Identity Type = IMSI) to the MS. The MS responds with Identity Response (IMSI).
- 4) The authentication functions are defined in the clause "Security Function". If no MM context for the MS exists anywhere in the network, then authentication is mandatory. Ciphering procedures are described in clause "Security Function". If P-TMSI allocation is going to be done and the network supports ciphering, the network shall set the ciphering mode.
- 5) The equipment checking functions are defined in the clause "Identity Check Procedures". Equipment checking is optional.
- 6) If there are active PDP contexts in the new SGSN for this particular MS (i.e. the MS re-attaches to the same SGSN without having properly detached before), the new SGSN deletes these PDP contexts by sending Delete PDP Context Request (TEID) messages to the GGSNs involved. The GGSNs acknowledge with Delete PDP Context Response (TEID) messages.
- 7) If the SGSN number has changed since the GPRS detach, or if it is the very first attach, then the SGSN informs the HLR:
  - a) The SGSN sends an Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.
  - b) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure.
  - c) The old SGSN acknowledges with Cancel Location Ack (IMSI). If there are any ongoing procedures for that MS, the old SGSN shall wait until these procedures are finished before removing the MM and PDP contexts.
  - d) If there are active PDP contexts in the old SGSN for this particular MS, the old SGSN deletes these PDP contexts by sending Delete PDP Context Request (TEID) messages to the GGSNs involved.

- e) The GGSNs acknowledge with Delete PDP Context Response (TEID) messages.
  - f) The HLR sends Insert Subscriber Data (IMSI, GPRS Subscription Data) to the new SGSN.
  - g) The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription restrictions the MS is not allowed to attach in the RA, the SGSN rejects the Attach Request with an appropriate cause, and may return an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted) message to the HLR. If subscription checking fails for other reasons, the SGSN rejects the Attach Request with an appropriate cause and returns an Insert Subscriber Data Ack (IMSI, Cause) 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.
  - h) The HLR acknowledges the Update Location message by sending an Update Location Ack to the SGSN after the cancelling of old MM context and insertion of new MM context are finished. If the Update Location is rejected by the HLR, the SGSN rejects the Attach Request from the MS with an appropriate cause.
- 8) If Attach Type in step 1 indicated GPRS Attach while already IMSI attached, or combined GPRS / IMSI attached, then the VLR shall be updated if the Gs interface is installed. When the SGSN does not provide functionality for the Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the VLR number is derived from the RAI. When the SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the SGSN uses the RAI and a hash value from the IMSI to determine the VLR number. 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 6d). This operation marks the MS as GPRS-attached in the VLR.
- a) The SGSN sends a Location Update Request (new LAI, IMSI, SGSN Number, Location Update Type) message to the VLR. Location Update Type shall indicate IMSI attach if Attach Type indicated combined GPRS / IMSI attach. Otherwise, Location Update Type shall indicate normal location update. The VLR creates an association with the SGSN by storing SGSN Number.
  - b) If the LA update is inter-MSC, the new VLR sends Update Location (IMSI, new VLR) to the HLR.
  - c) If the LA update is inter-MSC, the HLR sends a Cancel Location (IMSI) to the old VLR.
  - d) The old VLR acknowledges with Cancel Location Ack (IMSI).
  - e) If the LA update is inter-MSC, the HLR sends Insert Subscriber Data (IMSI, subscriber data) to the new VLR.
  - f) The VLR acknowledges with Insert Subscriber Data Ack (IMSI).
  - g) After finishing the inter-MSC location update procedures, the HLR responds with Update Location Ack (IMSI) to the new VLR.
  - h) The VLR responds with Location Update Accept (VLR TMSI) to the SGSN.
- 9) The SGSN selects Radio Priority SMS, and sends an Attach Accept (P-TMSI, VLR TMSI, P-TMSI Signature, Radio Priority SMS) message to the MS. P-TMSI is included if the SGSN allocates a new P-TMSI.
- 10) If P-TMSI or VLR TMSI was changed, the MS acknowledges the received TMSI(s) by returning an Attach Complete message to the SGSN.
- 11) If VLR TMSI was changed, the SGSN confirms the VLR TMSI re-allocation by sending a TMSI Reallocation Complete message to the VLR.

If the Attach Request cannot be accepted, the SGSN returns an Attach Reject (IMSI, Cause) message to the MS.

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

C1) CAMEL\_GPRS\_Attach and CAMEL\_PS\_Notification.

They are called in the following order:

- The procedure CAMEL\_GPRS\_Attach is called. In Figure 22, the procedure returns as result "Continue".
- Then the procedure CAMEL\_PS\_Notification is called. The procedure returns as result "Continue".

~~In Figure 22, the procedure returns as result "Continue".~~

## 6.6 Detach Function

The GPRS Detach procedure allows:

- an MS to inform the network that it does not want to access the SGSN-based services any longer; and
- the network to inform an MS that it does not have access to the SGSN-based services any more.

The Detach function allows an MS to inform the network that it wants to make a GPRS and/or IMSI detach, and it allows the network to inform an MS that it has been GPRS-detached or IMSI-detached by the network.

The different types of detach are:

- IMSI detach;
- GPRS detach; and
- combined GPRS / IMSI detach (MS-initiated only).

The MS is detached either explicitly or implicitly:

- Explicit detach: The network or the MS explicitly requests detach.
- Implicit detach: The network detaches the MS, without notifying the MS, a configuration-dependent time after the mobile reachable timer expired, or after an irrecoverable radio error causes disconnection of the logical link.

In the explicit detach case, a Detach Request (Cause) is sent by the SGSN to the MS, or by the MS to the SGSN.

The MS can make an IMSI detach in one of two ways depending on whether it is GPRS-attached or not:

- A GPRS-attached MS sends a Detach Request message to the SGSN, indicating an IMSI detach. This can be made in combination with GPRS detach.
- An MS that is not GPRS-attached makes the IMSI detach as already defined in A/Gb mode or Iu mode.

In the MO Detach Request message there is an indication to tell if the detach is due to switch off or not. The indication is needed to know whether a Detach Accept message should be returned or not.

In the network-originated Detach Request message there may be an indication to tell the MS that it is requested to initiate GPRS Attach and PDP Context Activation procedures for the previously activated PDP contexts.

### 6.6.1 MS-Initiated Detach Procedure

The MS-Initiated Detach procedure when initiated by the MS is illustrated in Figure 23.

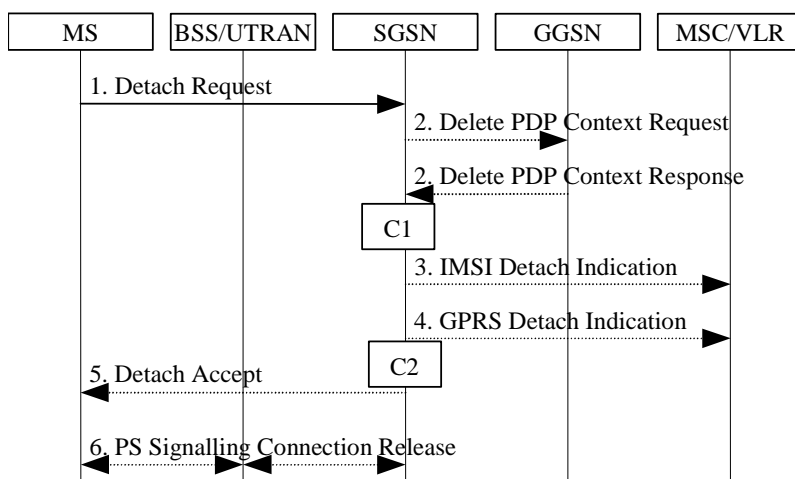


Figure 23: MS-Initiated Combined GPRS / IMSI Detach Procedure

- 1) The MS detaches by sending Detach Request (Detach Type, P-TMSI, P-TMSI Signature, Switch Off) to the SGSN. Detach Type indicates which type of detach is to be performed, i.e., GPRS Detach only, IMSI Detach only or combined GPRS and IMSI Detach. Switch Off indicates whether detach is due to a switch off situation or not. The Detach Request message includes P-TMSI and P-TMSI Signature. P-TMSI Signature is used to check the validity of the Detach Request message. If P-TMSI Signature is not valid or is not included, the authentication procedure should be performed.
- 2) If GPRS detach, the active PDP contexts in the GGSNs regarding this particular MS are deactivated by the SGSN sending Delete PDP Context Request (TEID) to the GGSNs. The GGSNs acknowledge with Delete PDP Context Response (TEID).
- 3) If IMSI detach, the SGSN sends an IMSI Detach Indication (IMSI) message to the VLR.
- 4) If the MS wants to remain IMSI-attached and is doing a GPRS detach, the SGSN sends a GPRS Detach Indication (IMSI) message to the VLR. The VLR removes the association with the SGSN and handles paging and location update without going via the SGSN.
- 5) If Switch Off indicates that detach is not due to a switch off situation, the SGSN sends a Detach Accept to the MS.
- 6) If the MS was GPRS detached, then the 3G-SGSN releases the PS signalling connection.

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

C1) CAMEL\_GPRS\_PDP\_Context\_Disconnection.

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

C2) CAMEL\_GPRS\_Detach [and CAMEL\\_PS\\_Notification](#).

[They are called in the following order:](#)

- [The procedure CAMEL\\_GPRS\\_Detach is called. The procedure returns as result "Continue".](#)

- [Then the procedure CAMEL\\_PS\\_Notification is called. The procedure returns as result "Continue".](#)

~~The procedure returns as result "Continue".~~

## 6.6.2 Network-Initiated Detach Procedure

### 6.6.2.1 SGSN-Initiated Detach Procedure

The SGSN-Initiated Detach procedure when initiated by the SGSN is illustrated in Figure 24.

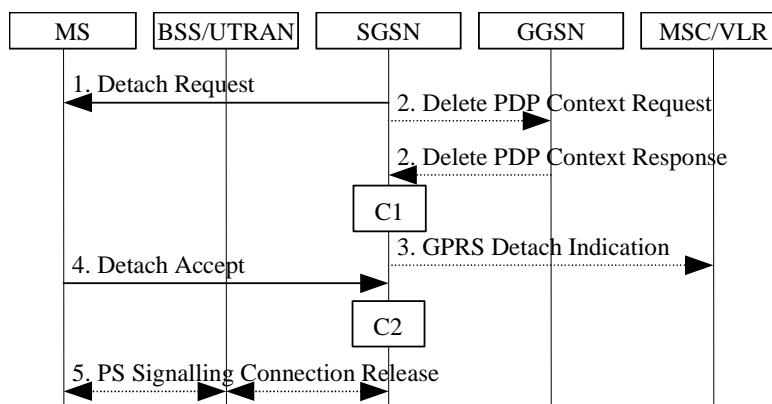


Figure 24: SGSN-Initiated GPRS Detach Procedure

- 1) The SGSN informs the MS that it has been detached, by sending Detach Request (Detach Type) to the MS. Detach Type indicates if the MS is requested to make a new attach and PDP context activation for the previously activated PDP contexts. If so, the attach procedure shall be initiated when the detach procedure is completed.
- 2) The active PDP contexts in the GGSNs regarding this particular MS are deactivated by the SGSN sending Delete PDP Context Request (TEID) messages to the GGSNs. The GGSNs acknowledge with Delete PDP Context Response (TEID) messages.
- 3) If the MS was both IMSI- and GPRS-attached, the SGSN sends a GPRS Detach Indication (IMSI) message to the VLR. The VLR removes the association with the SGSN and handles paging and location update without going via the SGSN.
- 4) The MS sends a Detach Accept message to the SGSN any time after step 1.
- 5) After receiving the Detach Accept message, if Detach Type did not request the MS to make a new attach, then the 3G SGSN releases the PS signalling connection.

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

- C1) [CAMEL\\_GPRS\\_PDP\\_Context\\_Disconnection](#).

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

- C2) [CAMEL\\_GPRS\\_Detach](#) and [CAMEL\\_PS\\_Notification](#).

They are called in the following order:

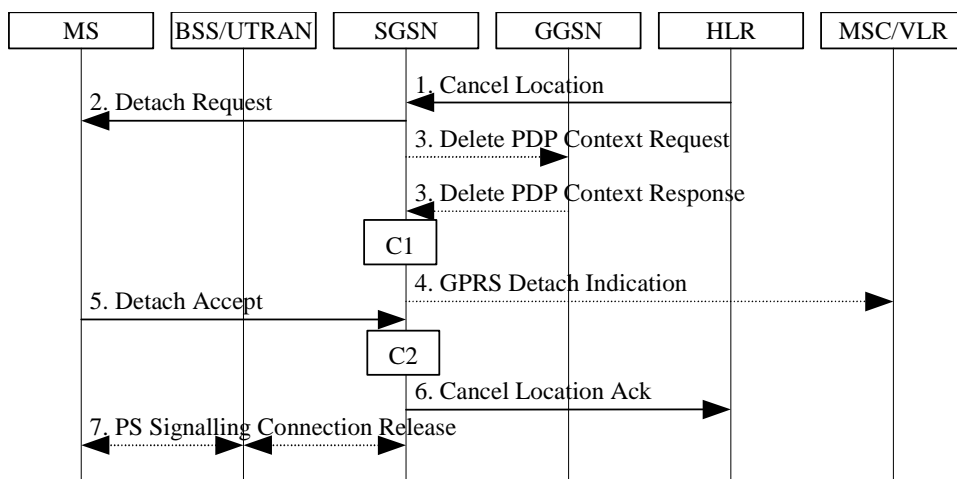
- The procedure CAMEL\_GPRS\_Detach is called. The procedure returns as result "Continue".

- Then the procedure CAMEL\_PS\_Notification is called. The procedure returns as result "Continue".

~~The procedure returns as result "Continue".~~

### 6.6.2.2 HLR-Initiated Detach Procedure

The HLR-Initiated Detach procedure is initiated by the HLR. The HLR uses this procedure for operator-determined purposes to request the removal of a subscriber's MM and PDP contexts at the SGSN. The HLR-Initiated Detach Procedure is illustrated in Figure 25.



**Figure 25: HLR-Initiated GPRS Detach Procedure**

- 1) If the HLR wants to request the immediate deletion of a subscriber's MM and PDP contexts from the SGSN, the HLR shall send a Cancel Location (IMSI, Cancellation Type) message to the SGSN with Cancellation Type set to Subscription Withdrawn.
- 2) The SGSN informs the MS that it has been detached by sending Detach Request (Detach Type) to the MS. Detach Type shall indicate that the MS is not requested to make a new attach and PDP context activation.



- 3) The active PDP contexts in the GGSNs regarding this particular MS are deactivated by the SGSN sending Delete PDP Context Request (TEID) messages to the GGSNs. The GGSNs acknowledge with Delete PDP Context Response (TEID) messages.
- 4) If the MS was both IMSI- and GPRS-attached, the SGSN sends a GPRS Detach Indication (IMSI) message to the VLR. The VLR removes the association with the SGSN and handles paging and location update without going via the SGSN.
- 5) The MS sends a Detach Accept message to the SGSN any time after step 2.
- 6) The SGSN confirms the deletion of the MM and PDP contexts with a Cancel Location Ack (IMSI) message.
- 7) After receiving the Detach Accept message, if Detach Type did not request the MS to make a new attach, then the 3G-SGSN releases the PS signalling connection.

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

- C1) CAMEL\_GPRS\_PDP\_Context\_Disconnection.

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

- C2) CAMEL\_GPRS\_Detach and CAMEL\_PS\_Notification.

They are called in the following order:

- The procedure CAMEL\_GPRS\_Detach is called. The procedure returns as result "Continue".
- Then the procedure CAMEL\_PS\_Notification is called. The procedure returns as result "Continue".

~~The procedure returns as result "Continue".~~

\*\*\* Next Modified Part \*\*\*

### 6.9.1.2 Routing Area Update Procedure

A routing area update takes place when a GPRS-attached MS detects that it has entered a new RA, when the periodic RA update timer has expired, or when the MS has to indicate new access capabilities to the network or, for A/Gb mode, when a suspended MS is not resumed by the BSS (see clause "Suspension of GPRS Services"). 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 GGSNs or the HLR about the new MS location. A periodic RA update is always an intra SGSN routing area update.

#### 6.9.1.2.1 Intra SGSN Routing Area Update

The Intra SGSN Routing Area Update procedure is illustrated in Figure 32.

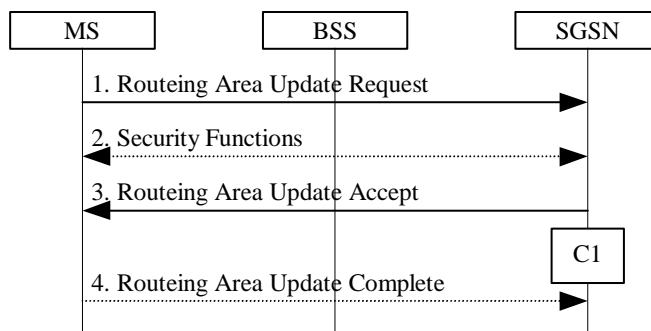


Figure 32: Intra SGSN Routing Area Update Procedure

- 1) The MS sends a Routing Area Update Request (P-TMSI, old RAI, old P-TMSI Signature, Update Type) to the 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, see GSM 08.18 [21].
- 2) Security functions may be executed. These procedures are defined in subclause "Security Function".
- 3) The 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, or if subscription checking fails, the SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the SGSN updates the MM context for the MS. A new P-TMSI may be allocated. A Routing Area Update Accept (P-TMSI, P-TMSI Signature) is returned to the MS.
- 4) If P-TMSI was reallocated, the MS acknowledges the new P-TMSI by returning a Routing Area Update Complete message to the 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:

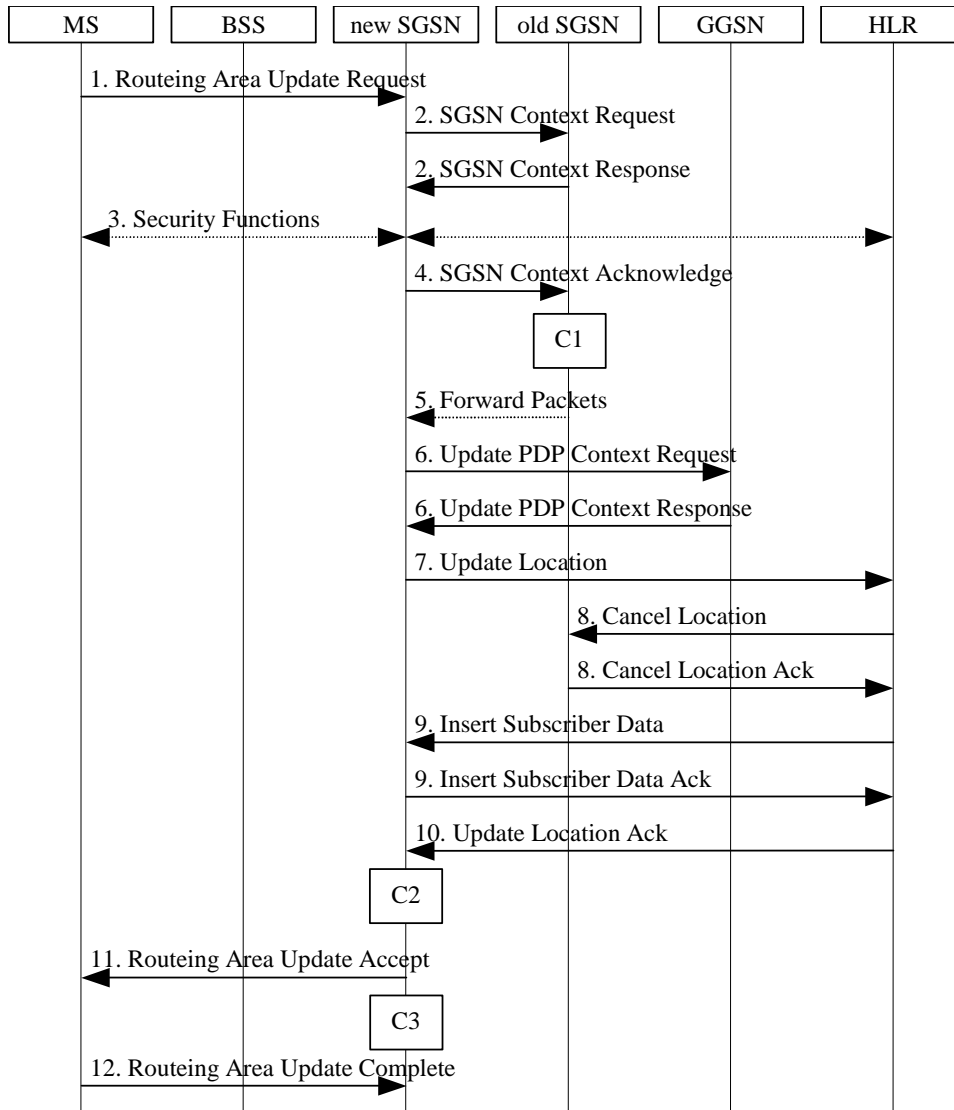
~~C1~~ CAMEL\_GPRS\_Routing\_Area\_Update\_Session, [CAMEL\\_PS\\_Notification](#) and CAMEL\_GPRS\_Routing\_Area\_Update\_Context.

[They are called in the following order:](#)

- The procedure CAMEL\_GPRS\_Routing\_Area\_Update\_Session is called once per session. It returns as a result "Continue".
- [Then the procedure CAMEL\\_PS\\_Notification is called once per session. It returns as a result "Continue".](#)
- Then the procedure CAMEL\_GPRS\_Routing\_Area\_Update\_Context is called once per PDP context. It returns as a result "Continue".

### 6.9.1.2.2 Inter SGSN Routing Area Update

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



**Figure 33: 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. If the new SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the new SGSN may derive the old SGSN from the old RAI and the old P-TMSI (or TLLI) and send the SGSN Context Request message to this old SGSN. Otherwise, the new SGSN derives the old SGSN from the old RAI. In any case the new SGSN will derive an SGSN that it believes is the old SGSN. This derived SGSN is itself the old SGSN, or it is associated with the same pool area as the actual old SGSN and it will determine the correct old SGSN from the P-TMSI (or TLLI) and relay the message to that actual old SGSN. 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) to the GGSNs concerned. 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.

The PDP Contexts shall be sent from old to new SGSN in a prioritized order, i.e. the most important PDP Context first in the SGSN Context Response message. (The prioritization method is implementation dependent, but should be based on the current activity.)

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN should use the prioritisation sent by old SGSN as input when deciding which PDP contexts to maintain active and which ones to delete. In any case, 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 and CAMEL\_PS\_Notification.

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".
- Then the CAMEL\_PS\_Notification procedure is called once. The procedure return as result "Continue".

C2) CAMEL\_GPRS\_Routeing\_Area\_Update\_Session and CAMEL\_PS\_Notification.

They are called in the following order:

- The CAMEL\_GPRS\_Routeing\_Area\_Update\_Session procedure is called. The procedure returns as result "Continue".
- Then the CAMEL\_PS\_Notification procedure is called. The procedure returns as result "Continue".

~~The procedure returns as result "Continue".~~

C3) CAMEL\_GPRS\_Routeing\_Area\_Update\_Context.

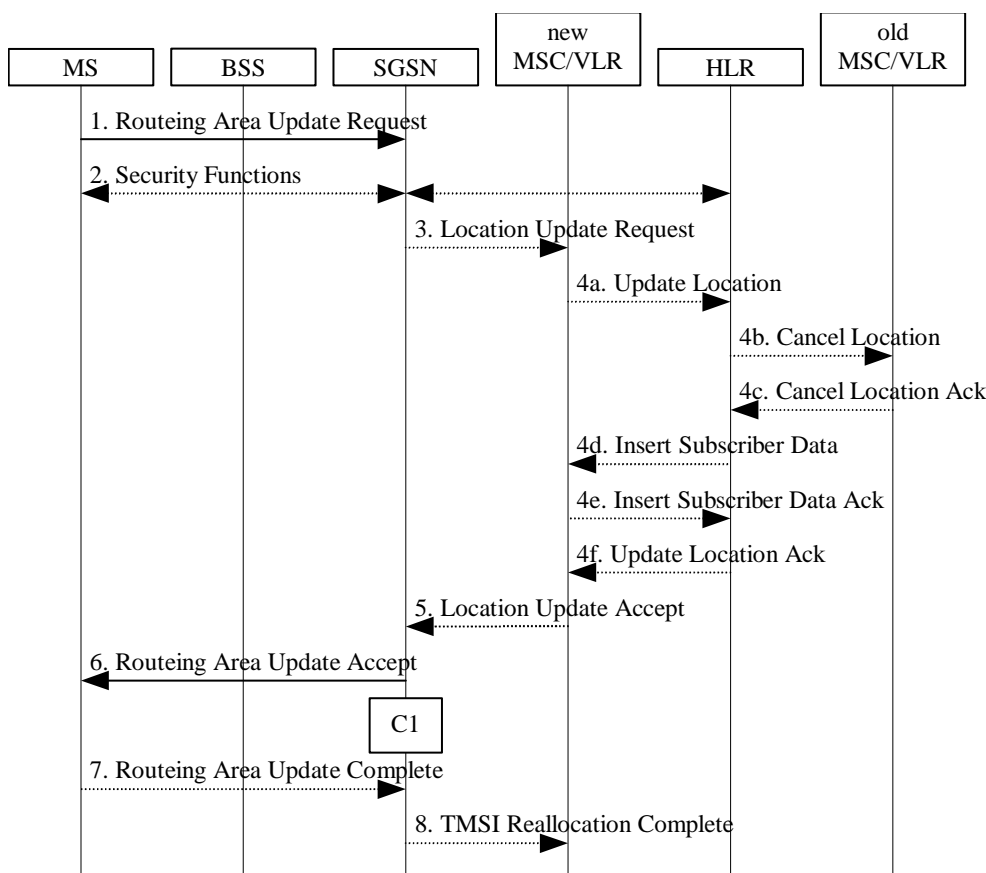
This procedure is called several times: once per PDP context. It returns as result "Continue".

### 6.9.1.3 Combined RA / LA Update Procedure

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 an IMSI attach or when the MS has to indicate new access capabilities to the network, or when a suspended MS is not resumed by the BSS (see subclause "Suspension of GPRS Services"). 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 GSM 03.22), as no combined RA / LA updates are performed during a CS connection.

#### 6.9.1.3.1 Combined Intra SGSN RA / LA Update

The Combined RA / LA Update (intra SGSN) procedure is illustrated in Figure 34.



**Figure 34: Combined RA / LA Update in the Case of Intra SGSN RA Update Procedure**

- 1) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type) to the 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) Security functions may be executed. This procedure is defined in clause "Security Function". 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.
- 3) 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 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. When the SGSN does not provide functionality for the Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the VLR number is derived from the RAI. When the SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the SGSN uses the RAI and a hash value from the IMSI to determine the VLR number. The VLR creates or updates the association with the SGSN by storing SGSN Number.

- 4) 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 data in the old VLR and inserts subscriber data in the new VLR:
  - 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, 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.
- 5) The new VLR allocates a new VLR TMSI and responds with Location Update Accept (VLR TMSI) to the SGSN. VLR TMSI is optional if the VLR has not changed.
- 6) The 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, or if subscription checking fails, the SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the SGSN updates the MM context for the MS. A new P-TMSI may be allocated. The SGSN responds to the MS with Routing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature).
- 7) If a new P-TMSI or VLR TMSI was received, the MS confirms the reallocation of the TMSIs by returning a Routing Area Update Complete message to the SGSN.
- 8) The SGSN sends a TMSI Reallocation Complete message to the VLR if the MS confirms the VLR TMSI

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 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~~:

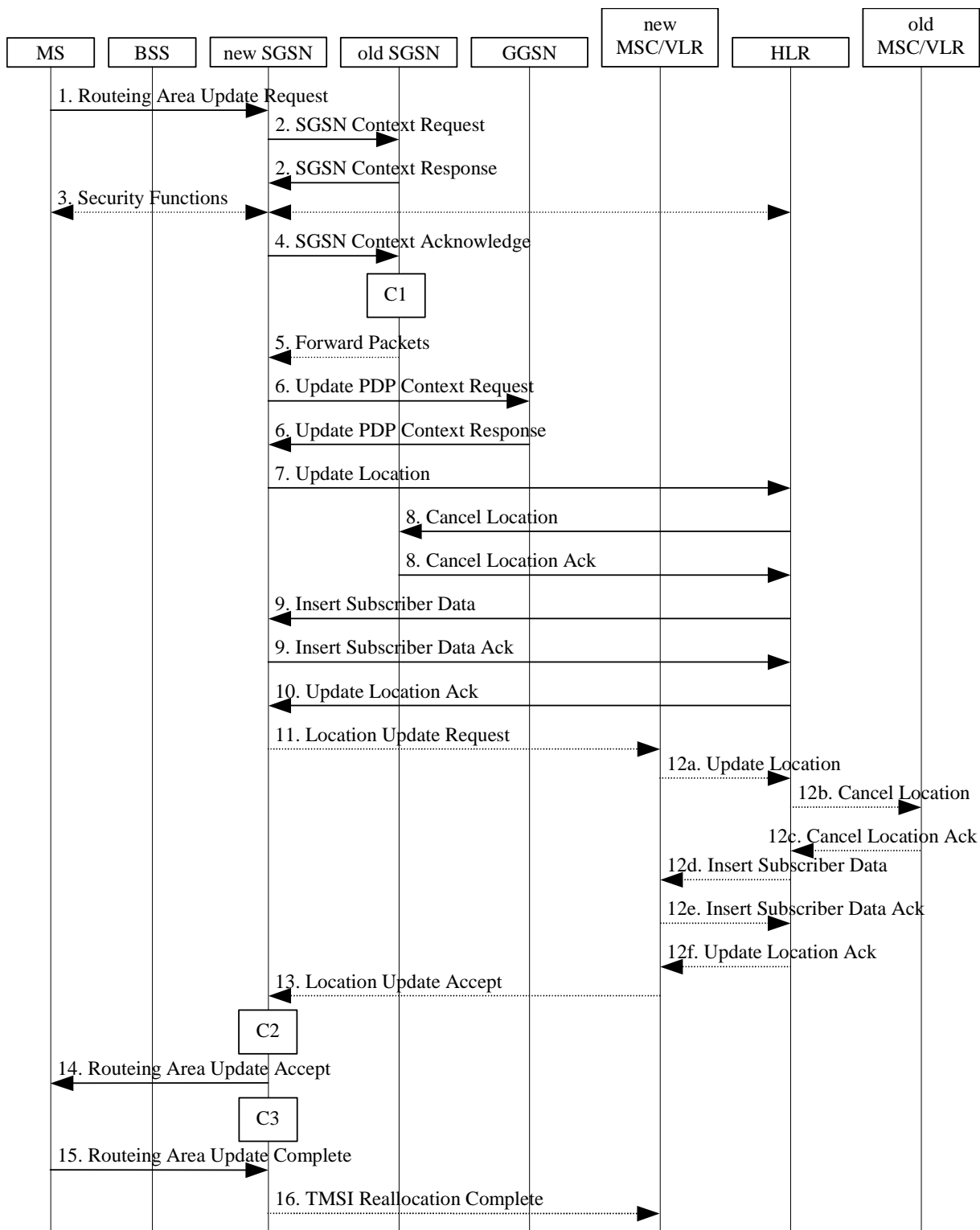
~~C1~~ CAMEL\_GPRS\_Routeing\_Area\_Update\_Session, [CAMEL\\_PS\\_Notification](#) and CAMEL\_GPRS\_Routeing\_Area\_Update\_Context.

[They are called in the following order:](#)

- The procedure CAMEL\_GPRS\_Routeing\_Area\_Update\_Session is called once per session. In Figure 34, the procedure returns as result "Continue".
- [Then the procedure CAMEL\\_PS\\_Notification is called. The procedure returns as result "Continue".](#)
- Then the procedure CAMEL\_GPRS\_Routeing\_Area\_Update\_Context is called once per PDP context. In Figure 34, the procedure returns as result "Continue".

## 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 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 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. If the new SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the new SGSN may derive the old SGSN from the old RAI and the old P-TMSI (or TLLI) and send the SGSN Context Request message to this old SGSN. Otherwise, the new SGSN derives the old SGSN from the old RAI. In any case the new SGSN will derive an SGSN that it believes is the old SGSN. This derived SGSN is itself the old SGSN, or it is associated with the same pool area as the actual old SGSN and it will determine the correct old SGSN from the P-TMSI (or TLLI) and relay the message to that actual old SGSN. 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 SDCP 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 SDCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode to the MS, the SDCP 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 SDCP 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) to the GGSNs concerned. 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 routeing 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. When the SGSN does not provide functionality for the Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the VLR number is derived from the RAI. When the SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the SGSN uses the RAI and a hash value from the IMSI to determine the VLR number. 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:
    - 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, 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 routeing 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 Routeing 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 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.
  - 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 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, 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 routeing area update.

The PDP Contexts shall be sent from old to new SGSN in a prioritized order, i.e. the most important PDP Context first in the SGSN Context Response message. (The prioritization method is implementation dependent, but should be based on the current activity.)

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN should use the prioritisation sent by old SGSN as input when deciding which PDP contexts to maintain active and which ones to delete. In any case, 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 and CAMEL\_PS\_Notification.

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".

- Then the CAMEL\_PS\_Notification procedure is called once. The procedure returns as result "Continue".

C2) CAMEL\_GPRS\_Routing\_Area\_Update\_Session and CAMEL\_PS\_Notification.

They are called in the following order:

- The CAMEL\_GPRS\_Routing\_Area\_Update\_Session procedure is called. The procedure returns as result "Continue".

- Then the CAMEL\_PS\_Notification procedure is called. The procedure returns as result "Continue".

~~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".

## 6.9.2 Location Management Procedures (Iu-mode)

In the context of this specification, the terms RNS or RNC refer also to a GERAN BSS or BSC (respectively) when serving an MS in Iu mode.

Refer to 3GPP TS 25.301 for further information on the location management procedures for the UTRAN.

The PLMN shall provide information for the MS to be able to:

- detect when it has entered a new cell or a new RA; and
- determine when to perform periodic RA updates.

In this specification, only the Location Management procedures related to the CN are described. These procedures are:

- a routing area update procedure; and
- Serving RNC relocation procedure.

An MS detects entering a new cell by comparing the cell's identity with the cell identity stored in the MS. By comparing the RAI stored in the MS's MM context with the RAI received from the network, the MS detects that an RA update shall be performed. In RRC-CONNECTED mode (PMM-CONNECTED state or CS MM CONNECTED state), the MS is informed of RAI and Cell Identity by the serving RNC via an "MM information" message at the RRC layer. In RRC-IDLE state, the MS is informed of RAI and Cell Identity by the broadcast system information at the RRC layer.

If the MS enters a new PLMN, the MS shall perform a routeing area update, unless it is not allowed to do so for the reasons specified in TS 24.008 [13] and TS 23.122 [7b].

In network mode of operation II, whenever an MS determines that it shall perform both an LA update and an RA update, the MS shall start the LA update first. The MS should start the RA update procedure before the LA update is completed.

### 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 in CS/PS mode of operation shall perform the Combined RA / LA Update procedures except this CS/PS mode MS is engaged in a CS connection, then it shall perform (non combined) RA 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).

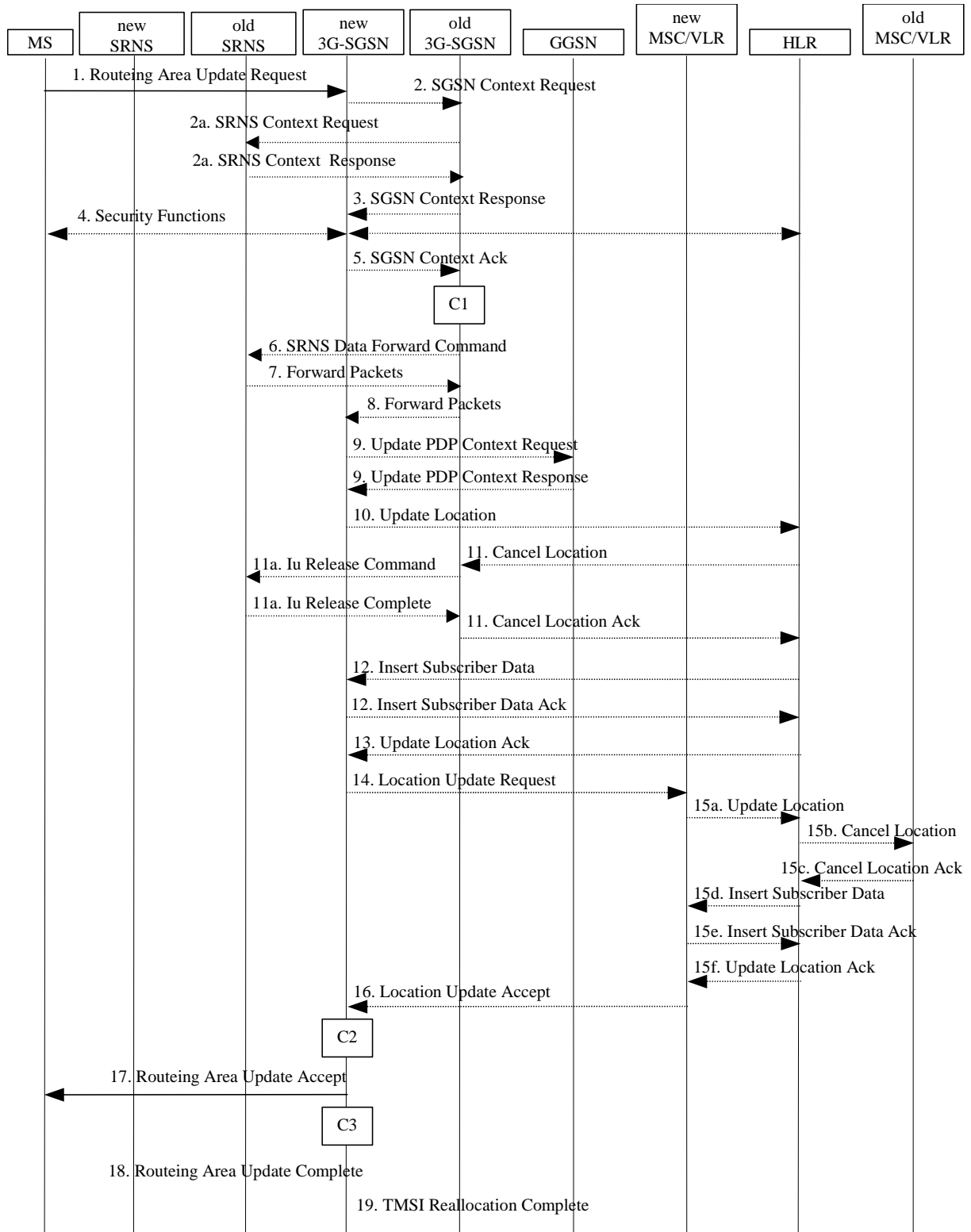


Figure 36: Iu mode RA Update Procedure

- 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 RAN 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. If the new SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the new SGSN may derive the old SGSN from the old RAI and the old P-TMSI and send the SGSN Context Request message to this old SGSN. Otherwise, the new SGSN derives the old SGSN from the old RAI. In any case the new SGSN will derive an SGSN that it believes is the old SGSN. This derived SGSN is itself the old SGSN, or it is associated with the same pool area as the actual old SGSN and it will determine the correct old SGSN from the P-TMSI and relay the message to that actual old SGSN. 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 Routing 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 routing area update procedure back to the old SGSN before completing the ongoing routing 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,) to the GGSNs concerned. 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. When the SGSN does not provide functionality for the Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the VLR number is derived from the RAI. When the SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the SGSN uses the RAI and a hash value from the IMSI to determine the VLR number. 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:

- 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, 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 routeing 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 Routeing Area Update Accept (P-TMSI, VLR TMSI, P-TMSI Signature).
  - 18) The MS confirms the reallocation of the TMSIs by returning a Routeing 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.

NOTE: The new SGSN may initiate RAB establishment after execution of the security functions (step 4), or wait until completion of the RA update procedure. For the MS, RAB establishment may occur anytime after the RA update request is sent (step 1).

In the case of a rejected routeing 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 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, 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 routeing area update.

The PDP Contexts shall be sent from old to new SGSN in a prioritized order, i.e. the most important PDP Context first in the SGSN Context Response message. (The prioritization method is implementation dependent, but should be based on the current activity.)

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN should use the prioritisation sent by old SGSN as input when deciding which PDP contexts to maintain active and which ones to delete. In any case, 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 routeing 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 routeing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routeing 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 calls shall be performed, see referenced procedures in 3GPP TS 23.078:

C1) CAMEL\_GPRS\_PDP\_Context\_Disconnection, ~~and~~ CAMEL\_GPRS\_Detach [and CAMEL PS Notification](#).

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".
- Then the CAMEL\_PS\_Notification procedure is called once. The procedure returns as result "Continue".

C2) CAMEL\_GPRS\_Routeing\_Area\_Update\_Session and CAMEL\_PS\_Notification.

They are called in the following order:

- The CAMEL\_GPRS\_Routeing\_Area\_Update\_Session procedure is called. The procedure returns as result "Continue".
- Then the CAMEL\_PS\_Notification procedure is called. The procedure returns as result "Continue".

~~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".

### 6.9.2.2 Serving RNS Relocation Procedures

In the context of this specification, the terms RNS or RNC refer also to a GERAN BSS or BSC (respectively) when serving an MS in Iu mode.

Serving RNS relocation procedures move the RAN to CN connection point at the RAN side of the source RNC to the target RNC. The Serving RNS Relocation Procedures, described in the following sub-clauses, may be performed as "Lossless SRNS Relocation", which means packet loss during the SRNS change is eliminated. For this purpose, the RNS and the MS have to provide PDCP layer functionality, which in the subsequent description is referred as the lossless PDCP. The source RNC decides to perform the Serving RNS Relocation Procedure as "Lossless SRNS Relocation" based on capabilities of the UE and the RNS and based on QoS parameters (e.g. SDU error ratio).

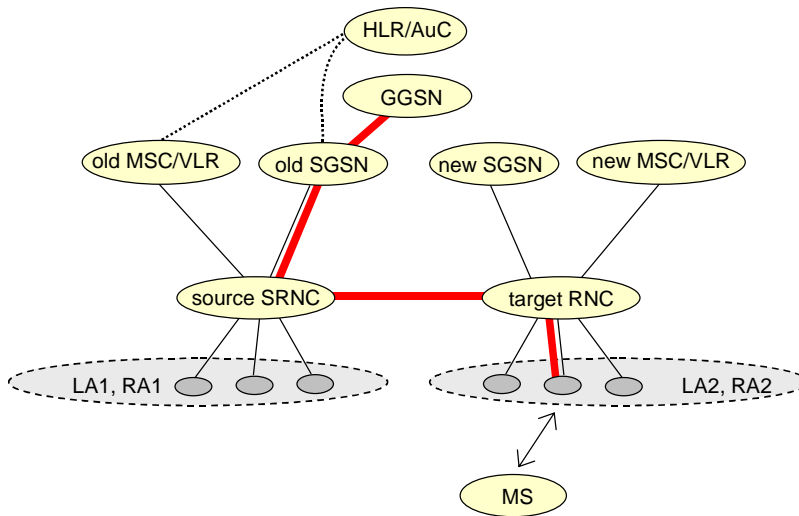
For "Lossless SRNS Relocation", both the MS and the source RNS have to support and to use the lossless PDCP. When the SRNS changes, the old RNS forwards all received and not yet transferred downlink GTP-PDUs to the target RNS. GTP-PDUs forwarded to the target RNS indicate a PDCP sequence number if the contained N-PDUs were sent to the MS as a PDCP-SDUs, but are not yet acknowledged by lossless PDCP. The target RNS and the MS exchange respective sequence numbers of next expected PDCP-PDUs. This process indicates PDCP-PDUs that were already successfully transferred between the MS and the source RNS for downlink and uplink directions, respectively. This also confirms all N-PDUs (PDCP-SDUs) successfully transferred before the change of the SRNS. These N-PDUs are discarded by the MS and the target RNS, respectively. The target RNS identifies the forwarded GTP-PDUs containing confirmed N-PDUs by the PDCP sequence number in the GTP-PDU. All other N-PDUs have to be transmitted via the new MS – RNS link.

#### 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. This procedure is not applicable for GERAN.

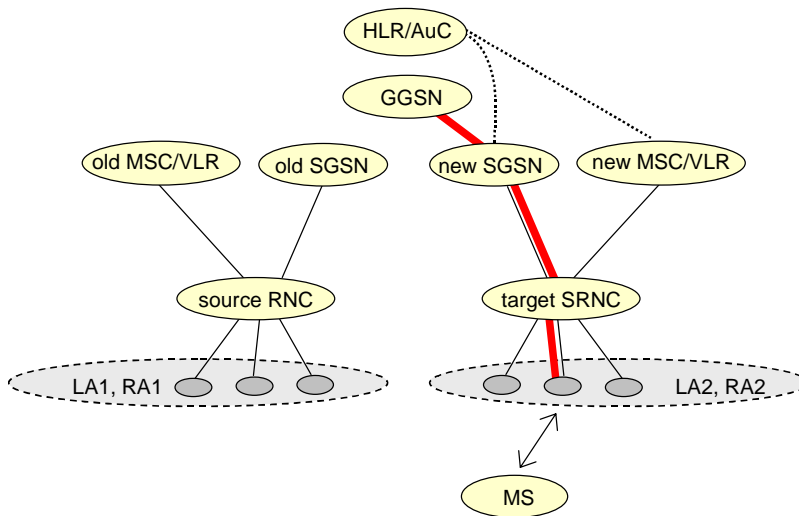
The Serving SRNS Relocation procedure is used to move the RAN to CN connection point at the RAN side from the source SRNC to the target RNC, from a "standing still position". In the procedure, the Iu links are relocated. If the target RNC is connected to the same SGSN as the source SRNC, an Intra-SGSN SRNS Relocation procedure is performed. If the routeing area is changed, this procedure is followed by an Intra-SGSN Routeing Area Update procedure. The SGSN detects 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 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 Routeing 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 Routeing Area Update**

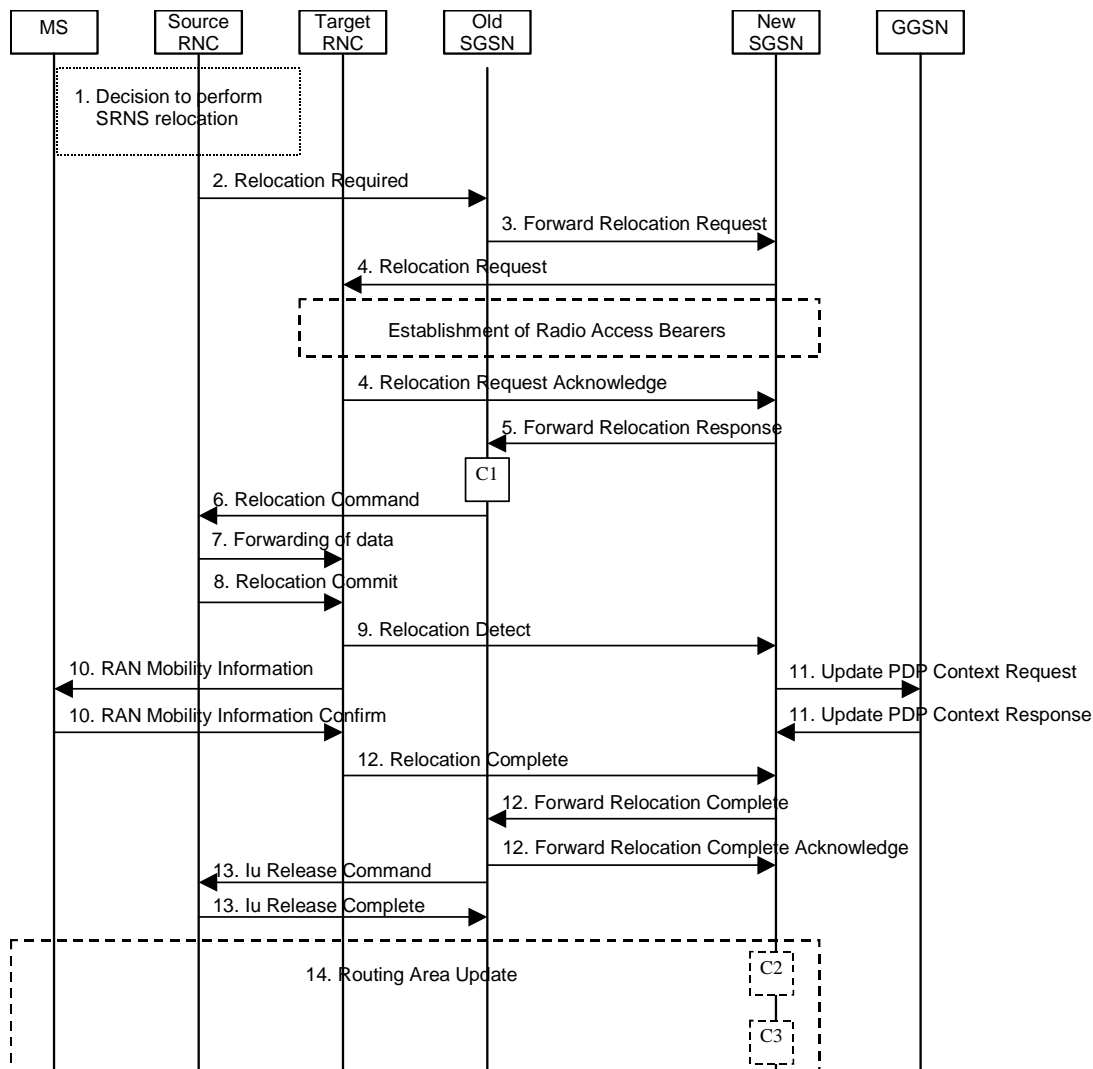
Before the SRNS Relocation procedure and RA update, the MS is registered in the old SGSN. The source RNC is acting as a serving RNC (SRNC).



**Figure 38: After SRNS Relocation and Routeing 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, RAN transparent container, RANAP Cause) to the new SGSN. For relocation to an area where Intra Domain Connection of RAN Nodes to Multiple CN Nodes is used, the old SGSN may – if it provides Intra Domain Connection of RAN Nodes to Multiple CN Nodes -have multiple target SGSNs for each relocation target in a pool area, in which case the old SGSN will select one of them to become the new SGSN, as specified in 3GPP TS 23.236 [73]. 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 (Iu mode)"). 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 RAN Mobility Information message (step 10) at the same time. Hence, target RNC may receive RAN 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 RAN 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 RAN Mobility Information message the MS may start sending uplink user data to the target SRNC. When the MS has reconfigured itself, it sends the RAN 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) to the GGSNs concerned. 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 RAN 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 (Iu mode)". 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 and CAMEL\_PS\_Notification.

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".
- Then the CAMEL\_PS\_Notification 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 and CAMEL\_PS\_Notification.

They are called in the following order:

- The CAMEL\_GPRS\_Routing\_Area\_Update\_Session procedure is called. The procedure returns as result "Continue".
- Then, the CAMEL\_PS\_Notification procedure is called. The procedure returns as result "Continue".

~~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.

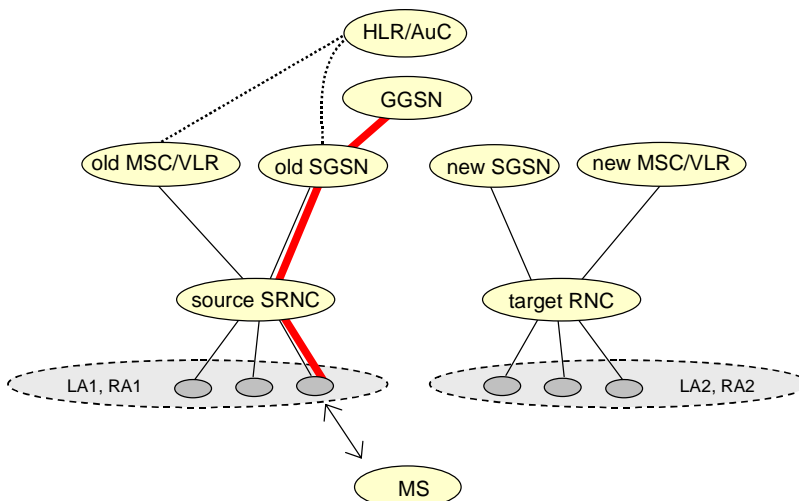
### 6.9.2.2.2 Combined Hard Handover and SRNS Relocation Procedure

This procedure is only performed for an MS in PMM-CONNECTED state in case the Iur interface is not available. In the context of this specification, the terms RNS or RNC refer also to a GERAN BSS or BSC (respectively) when serving a mobile in Iu mode.

The Combined Hard Handover and SRNS Relocation procedure is used to move the RAN to CN connection point at the RAN side from the source SRNC to the target RNC, while performing a hard handover decided by the RAN. 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.

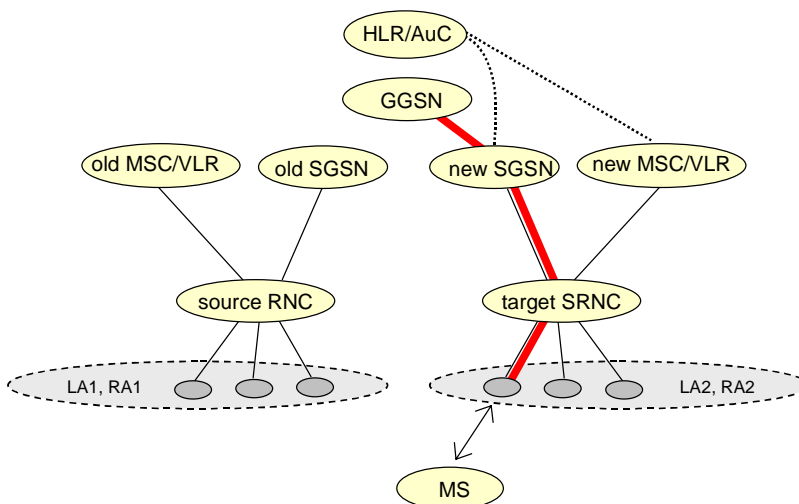
If the target RNC is connected to a different SGSN than the source SRNC, an Inter-SGSN SRNS Relocation procedure is performed. This procedure is followed by an Inter-SGSN Routing Area Update procedure.

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. Both figures are also applicable to BSS to RNS relocation and vice-versa, as well as for BSS to BSS relocation.



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

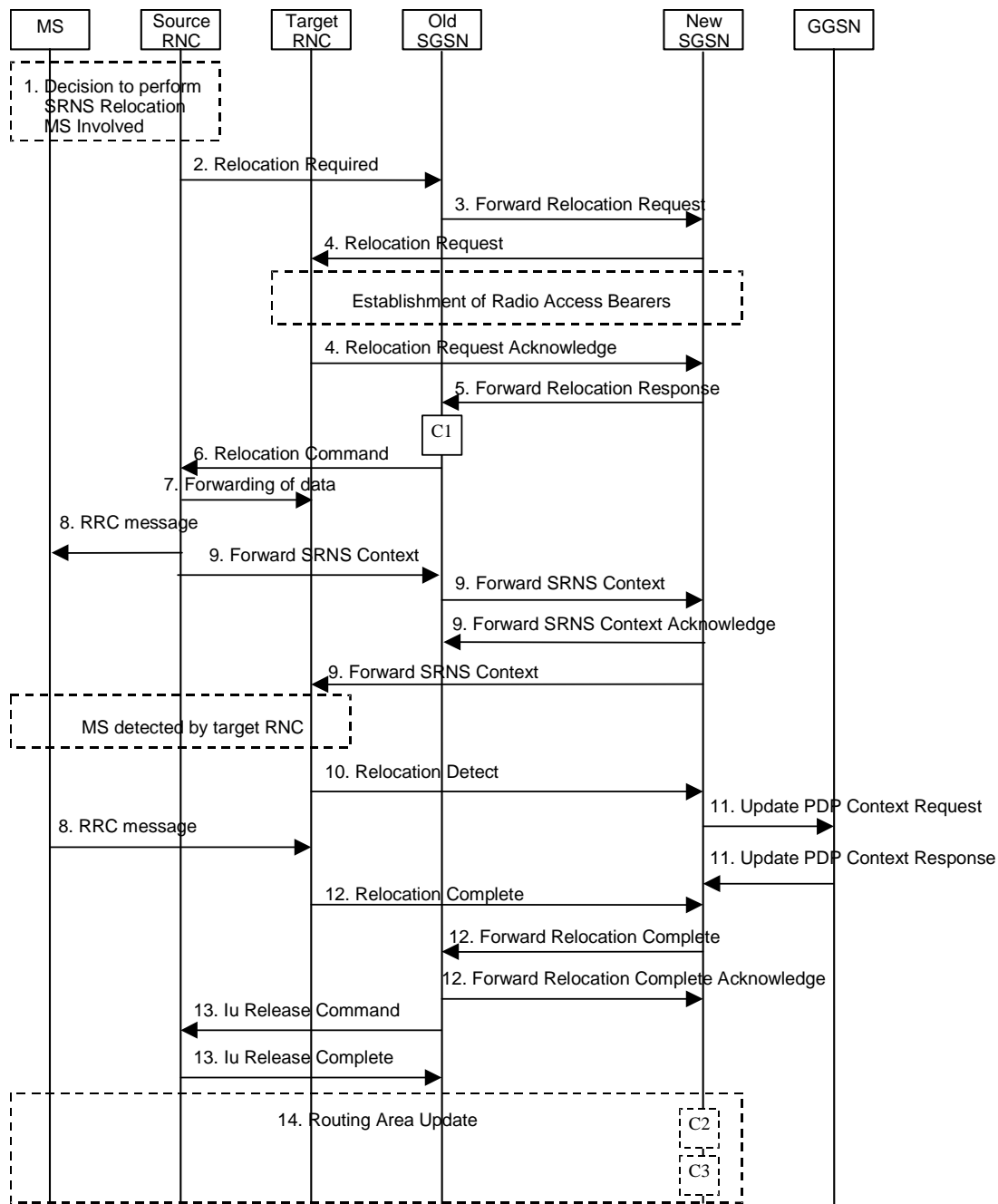
Before the SRNS Relocation and Routeing Area Update the MS is registered in the old SGSN and in the old MSC/VLR. The source RNC is acting as serving RNC.



**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. Furthermore, this signalling flow is also applicable for BSS to RNS relocation and vice-versa, as well as BSS to BSS relocation.



**Figure 42: Combined Hard Handover and SRNS Relocation Procedure**

- 1) Based on measurement results and knowledge of the RAN 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, RAN Transparent Container, RANAP Cause) to the new SGSN. For relocation to an area where Intra Domain Connection of RAN Nodes to Multiple CN Nodes is used, the old SGSN may – if it provides Intra Domain Connection of RAN Nodes to Multiple CN Nodes -have multiple target SGSNs for each relocation target in a pool area, in which case the old SGSN will select one of them to become the new SGSN, as specified in 3GPP TS 23.236 [73]. 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 (Iu mode)"). 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 in UTRAN case, or Handover From UTRAN, or Handover Command in GERAN Iu mode case) 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, RAN 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. RAN 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, begins 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 the RRC message to MS (step 8) and forward SRNS Context message to the old SGSN (step 9) 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 RRC message the uplink and downlink data transfer shall be suspended in the source SRNC for RABs, which require delivery order. The RRC message is for example Physical Channel Reconfiguration for RNS to RNS relocation, or Intersystem to UTRAN Handover for BSS to RNS relocation, or Handover from UTRAN Command for BSS relocation, or Handover Command for BSS to BSS relocation. 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.

When the MS has reconfigured itself, it sends an RRC message 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 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 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) message to the GGSNs concerned. 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 appropriate RRC message, e.g. Physical Channel Reconfiguration Complete message or the Radio Bearer Release Complete message in UTRAN case, or the Handover To UTRAN Complete message or Handover Complete message in GERAN case, 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 (Iu mode)". 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 and CAMEL\_PS\_Notification.

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".
- Then the CAMEL\_PS\_Notification 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 and CAMEL\_PS\_Notification.

They are called in the following order:

- The CAMEL\_GPRS\_Routing\_Area\_Update\_Session procedure is called. In Figure 42, the procedure returns as result "Continue".
- Then the CAMEL\_PS\_Notification procedure is called. The procedure returns as result "Continue".

~~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

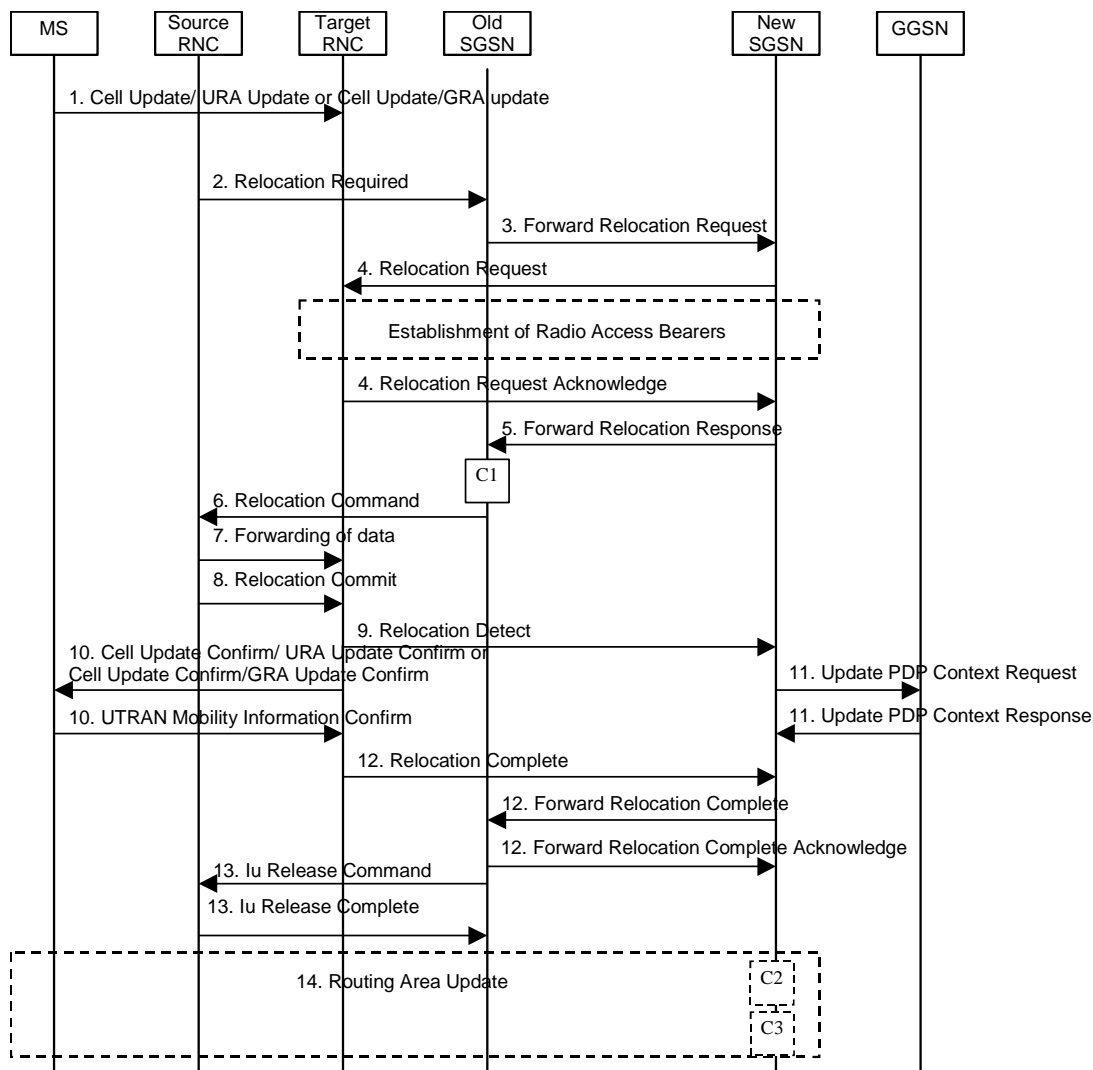
This procedure is only performed for an MS in PMM-CONNECTED state, where the Iur/Iur-g interface carries control signalling but no user data. In the context of this specification, the terms RNS or RNC refer also to a GERAN BSS or BSC (respectively) when serving an MS in Iu mode.

The Combined Cell / URA Update and SRNS Relocation or Combined Cell/GRA Update and SBSS Relocation procedure is used to move the RAN to CN connection point at the RAN side from the source SRNC to the target RNC, while performing a cell re-selection in the RAN. 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 or Combined Cell/GRA Update and SBSS Relocation and before the Routing Area Update, the MS is registered in the old SGSN. The source RNC is acting as serving RNC or serving BSS.

After the Combined Cell / URA Update and SRNS Relocation or Combined Cell/GRA Update and SBSS Relocation and after 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 or Combined Cell/GRA Update and SBSS 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. This signalling flow is also applicable to BSS to RNS relocation and vice-versa, as well as for BSS to BSS relocation.



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

- 1) The MS sends a Cell Update / URA Update or a Cell Update / GRA 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, RAN Transparent Container, RANAP Cause) message to the new SGSN. For relocation to an area where Intra Domain Connection of RAN Nodes to Multiple CN Nodes is used, the old SGSN may – if it provides Intra Domain Connection of RAN Nodes to Multiple CN Nodes -have multiple target SGSNs for each relocation target in a pool area, in which case the old SGSN will select one of them to become the new SGSN, as specified in 3GPP TS 23.236 [73]. 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 (Iu mode)". 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.

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

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.

- 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 (or Cell Update Confirm/GRA Update Confirm) message (step 10) at the same time. Hence, target RNC may receive the UTRAN or GERAN 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 UTRAN Iur interface or over the GERAN Iur-g interface, respectively. 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 or Cell Update Confirm / GRA 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 coordinated in all Iu signalling connections existing for the MS.

Upon reception of the Cell Update Confirm / URA Update Confirm or Cell Update Confirm / GRA Update Confirm message the MS may start sending uplink user data to the target SRNC. When the MS has reconfigured itself, it sends the RAN 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) to the GGSNs concerned. 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 RAN 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 or the Cell / GRA 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 (Iu mode)". 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 and CAMEL\_PS\_Notification.

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".
- Then the CAMEL\_PS\_Notification 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 and CAMEL\_PS\_Notification.

They are called in the following order:

- The CAMEL\_GPRS\_Routing\_Area\_Update\_Session procedure is called. The procedure returns as result "Continue".
- Then, the CAMEL\_PS\_Notification procedure is called. The procedure returns as result "Continue".

~~The procedure returns as result "Continue".~~

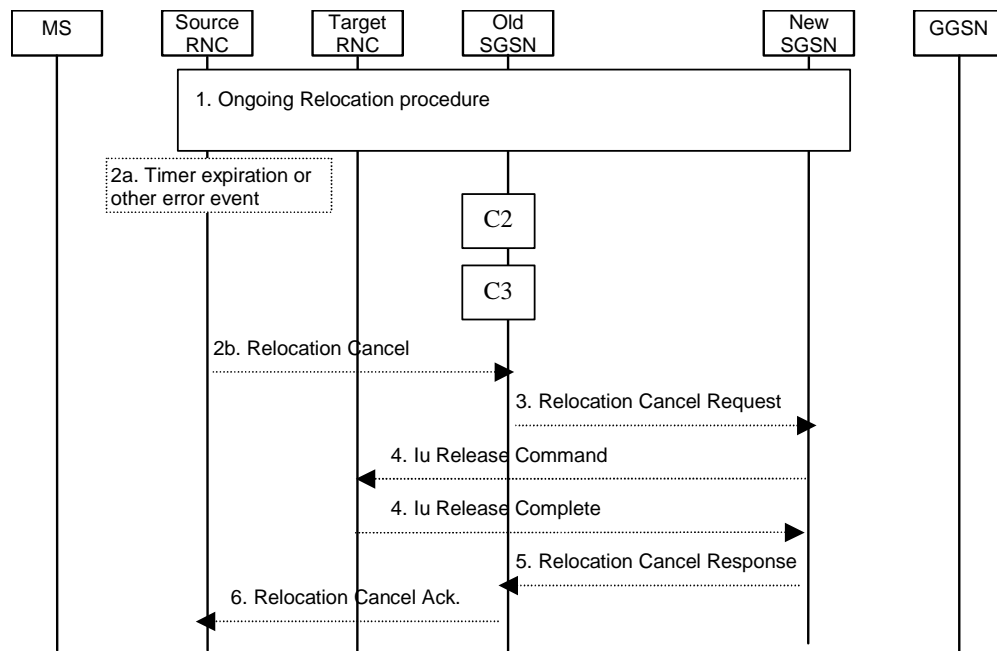
C3) CAMEL\_GPRS\_Routing\_Area\_Update\_Context.

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.

#### 6.9.2.2.4 SRNS Relocation Cancel Procedure

The purpose of the SRNS Relocation Cancel procedure is to cancel an ongoing SRNS relocation. The SRNS Relocation Cancel procedure may be initiated during or after the Relocation Preparation procedure and may be initiated by the source RNC.

The SRNS Relocation Cancel procedure is illustrated in Figure 44. The sequence is valid for cancelling both an intra-SGSN SRNS relocation and an inter-SGSN SRNS relocation.



**Figure 44: SRNS Cancel Relocation Procedure**

- 1) An SRNS Relocation procedure has started, as specified in section 6.9.2.2.1.
- 2a) The SRNS Cancel Relocation may be initiated by a timer expiry or by an error event in the source RNC.
- 2b) When one of conditions in 2a is satisfied, the source RNC sends a Relocation Cancel (Cause) to the old SGSN. Cause indicates the reason for cancelling the ongoing SRNS relocation.
- 3) The old SGSN sends a Relocation Cancel Request (IMSI, RANAP Cause) to the new SGSN to indicate that the ongoing SRNS relocation should be cancelled. RANAP Cause contains the cause value received by the source RNC in the Relocation Cancel message.
- 4) The new SGSN sends an Iu Release Command (Cause) to request from the target RNC to release the Iu resources already allocated for the SRNS relocation, or to cancel the ongoing allocation of Iu resources for the SRNS relocation. Cause is set equal to RANAP Cause, i.e. to whatever cause value was included in the Relocation Cancel Request received from old SGSN. The target RNC releases the requested Iu resources and responds with an Iu Release Complete.
- 5) The new SGSN acknowledges the cancellation of the ongoing SRNS Relocation by sending a Relocation Cancel Response to the old SGSN.
- 6) The old SGSN responds to the source RNC with a Relocation Cancel Ack message.

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

C2) [CAMEL\\_GPRS\\_Routeing\\_Area\\_Update\\_Session](#) and [CAMEL\\_PS\\_Notification](#).

They are called in the following order:

- [The procedure CAMEL GPRS Routeing Area Update Session is called. The procedure returns as result "Continue".](#)
- [Then the procedure CAMEL PS Notification is called. The procedure returns as result "Continue".](#)

~~The procedure returns as result "Continue".~~



C3) CAMEL\_GPRS\_Routeing\_Area\_Update\_Context.

The 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 Modified Part \*\*\***

## 6.13 Intersystem Change

An intersystem change takes place when an MS changes between Iu mode and A/Gb mode of operation. A prerequisite for an intersystem change is that the MS is GPRS-attached. The transition of the mobility management states is as specified for the corresponding mobility management procedures.

There is no transition of the session management states at an intersystem change.

### 6.13.1 Intra SGSN Intersystem Change

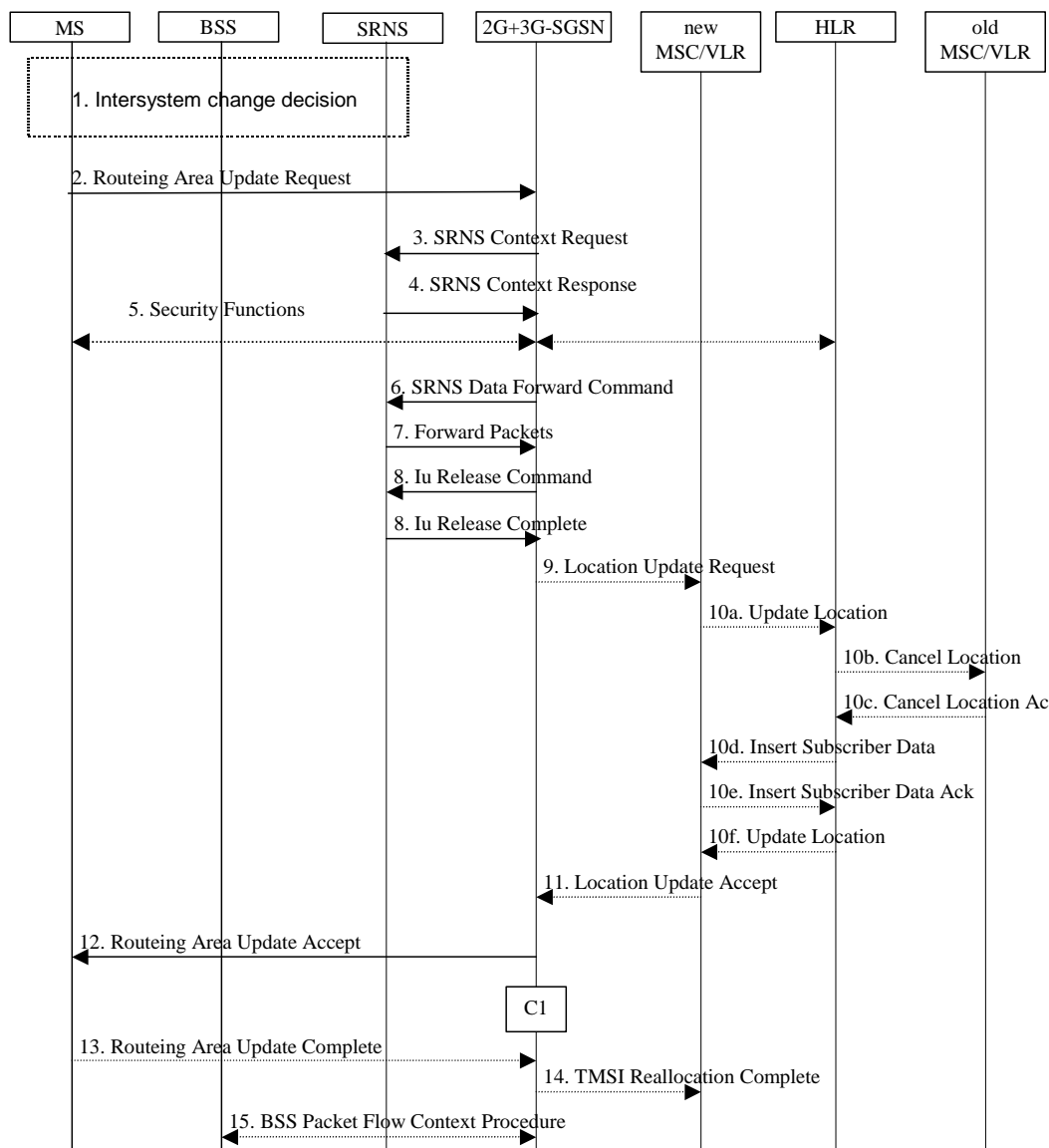
An SGSN that supports both the Gb and Iu-PS interfaces may support an intra-SGSN intersystem change if the radio access technology nodes serving the MS before and after the intersystem change are both served by this SGSN.

#### 6.13.1.1 Iu mode to A/Gb mode Intra SGSN Change

The intersystem change from Iu mode to A/Gb mode takes place when an MS changes from UTRAN or GERAN Iu mode to A/Gb mode. Depending on the PMM state before the intersystem change and whether the RA is changed or not, one of the following procedures is initiated by the MS:

- When an MS in PMM-IDLE state changes to the A/Gb mode without changing the RA, the MS shall follow the selective RA update procedures, see clause "Selective RA Update".
- When an MS in PMM-IDLE state changes to the A/Gb mode and the RA changes, the MS shall initiate the GPRS RA update procedure, see clause "Intra SGSN Routeing Area Update".
- When an MS in PMM-CONNECTED state changes to the A/Gb mode, the MS shall initiate the GPRS RA update procedure independent of whether the RA has changed or not. The RA update procedure is either combined RA / LA update or only RA update.

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 Routeing Area Update Request message 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. In the context of this specification, the terms RNS or RNC refer also to a GERAN BSS or BSC (respectively) when serving an MS in Iu mode.



**Figure 52: Iu mode to A/Gb mode Intra SGSN Change**

- 1) The MS or RAN decides to perform an intersystem change which makes the MS switch to a new cell where A/Gb mode has to be used, and stops transmission to the network.
- 2) The MS sends a Routing Area Update Request (old RAI, old P-TMSI Signature, Update Type) message to the 2G+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 attached 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 2G+3G-SGSN.
- 3) If the MS is PMM-CONNECTED state, the 2G+3G-SGSN sends an SRNS Context Request (IMSI) message to the SRNS.

Upon reception of the SRNS Context Request message, the SRNS starts buffering and stops sending downlink PDUs to the MS. The SRNS responds with an SRNS Context Response (GTP-SNDs, GTP-SNUs, PDCP-SNDs, PDCP-SNUs) message. The GTP sequence numbers are included for each PDP context indicating the next in-sequence downlink GTP-PDU to be sent to the MS and the next in-sequence GTP 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) and the downlink PDCP sequence number (PDCP-SND). PDCP-SNU is the PDCP sequence number for the next expected in-sequence uplink packet to be received from the MS. PDCP-SND is the PDCP sequence number for the first downlink packet for which successful transmission has not been

- confirmed. The 2G+3G-SGSN shall strip off the eight most significant bits of the passed PDCP sequence numbers, thus converting them to SNDCP N-PDU numbers of the respective 2G GPRS PDP contexts.
- 5) Security functions may be executed.
  - 6) If the MS is PMM-CONNECTED, the 2G+3G-SGSN sends an SRNS Data Forward Command (RAB ID, Transport Layer Address, Iu Transport Association) message to the SRNS. This informs the SRNS that the 2G+3G-SGSN is ready to receive data packets. Upon reception of SRNS Data Forward Command message from the 2G+3G-SGSN the SRNS shall start the data-forwarding timer.
  - 7) For each RAB indicated by the SRNS Data Forward Command the SRNS starts duplicating and tunnelling the buffered GTP-PDUs back to the 2G+3G-SGSN. For each radio bearer which uses lossless PDCP the GTP-PDUs related to transmitted but not yet acknowledged PDCP-PDUs are duplicated and tunnelled back to the 2G+3G-SGSN together with their related downlink PDCP sequence numbers. The 2G+3G-SGSN converts the PDCP sequence numbers to SNDCP sequence number (by stripping off the eight most significant bits of the PDCP sequence numbers).
  - 8) The 2G+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.
  - 9) 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, then the 2G+3G-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. When the SGSN does not provide functionality for the Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the VLR number is derived from the RAI. When the SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the SGSN uses the RAI and a hash value from the IMSI to determine the VLR number. The VLR creates or updates the association with the 2G+3G-SGSN by storing the SGSN Number.
  - 10) 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 data in the old VLR and inserts subscriber data in the new VLR:
    - 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, 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.
  - 11) The new VLR allocates a new VLR TMSI and responds with Location Update Accept (VLR TMSI) to the 2G+3G-SGSN. VLR TMSI is optional if the VLR has not changed.

- 12) The 2G+3G-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 2G+3G-SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the 2G+3G-SGSN updates MM and PDP contexts for the MS. A new P-TMSI may be allocated. A logical link is established between the new 2G+3G-SGSN and the MS. 2G+3G-SGSN initiates the establishment procedure. A Routing Area Update Accept (P-TMSI, P-TMSI Signature, Receive N-PDU Number (= converted PDCP-SNU)) message is returned to the MS. 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, these N-PDUs shall be discarded by the MS. 13) 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 (= converted PDCP-SND) contains the acknowledgements for each NSAPI which used lossless PDCP 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, these N-PDUs shall be discarded by the 2G+3G-SGSN. 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.
- 14) The 2G+3G-SGSN sends a TMSI Reallocation Complete message to the VLR if the MS confirms the VLR TMSI.
- 15) The 2G+3G-SGSN and the BSS may execute the BSS Packet Flow Context procedure.

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

C1) CAMEL\_GPRS\_Routeing\_Area\_Update\_Session, [CAMEL\\_PS\\_Notification](#) and CAMEL\_GPRS\_Routeing\_Area\_Update\_Context.

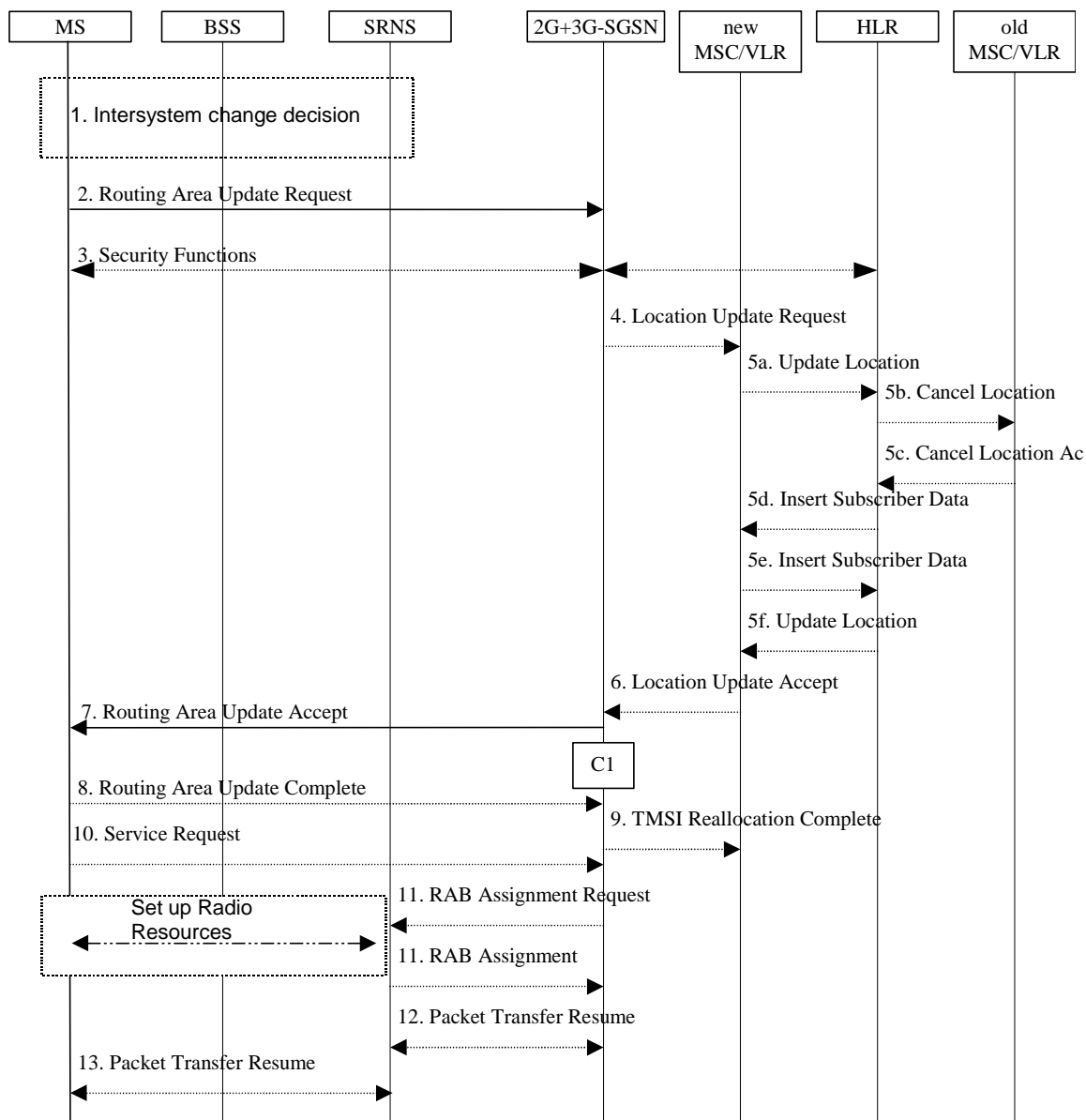
- The procedure CAMEL\_GPRS\_Routeing\_Area\_Update\_Session is called once per session. In Figure 52, the procedure returns as result "Continue".
- [Then the procedure CAMEL\\_PS\\_Notification is called once per session. The procedure returns as result "Continue".](#)
- Then, the procedure CAMEL\_GPRS\_Routeing\_Area\_Update\_Context is called once per PDP context. In Figure 52, the procedure returns as result "Continue".

### 6.13.1.2 A/Gb mode to Iu mode Intra-SGSN Change

The intersystem change from A/Gb mode to Iu mode takes place when a GPRS-attached MS changes from A/Gb mode to GERAN or UTRAN Iu mode. Depending on the GPRS mobility management state before the intersystem change and whether the RA is changed or not, one of the following procedures is initiated by the MS:

- When an MS in STANDBY state changes to Iu mode inside the current RA, the MS shall follow the selective RA update procedures, see clause "Selective RA Update".
- When an MS in STANDBY state changes to Iu mode and the RA changes, the MS shall initiate the Iu mode RA update procedure, see clause "Routing Area Update Procedure".
- When an MS in READY state changes to Iu mode independent of whether the RA has changed or not, the MS shall initiate the Iu mode RA update procedure and afterwards initiate the RABs by the Service Request procedure, see clause "MS Initiated Service Request Procedure". The RA update procedure is either combined RA / LA update or only RA update.

If the network operates in mode I, an MS that is both PS-attached and CS-attached shall perform the Combined RA / LA Update procedure. This concerns only idle mode (see 3GPP TS 23.122), as no combined RA / LA updates are performed during a CS connection. In the context of this specification, the terms RNS or RNC refer also to a GERAN BSS or BSC (respectively) when serving an MS in Iu mode.



**Figure 53: A/Gb mode to Iu mode Intra SGSN Change**

- 1) The MS or the RAN decides to perform an intersystem change which makes the MS switch to a new cell where Iu mode has to be used, and stops transmission to the network.
- 2) The MS initiates an RRC connection establishment and sends a Routing Area Update Request (P-TMSI, Old RA, Old P-TMSI Signature, Update Type, CM) message to the combined 2G+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 SRNS shall add an identifier of the area where the message was received before passing the message to the 2G+3G-SGSN. The 2G+3G-SGSN stops transmission of N-PDUs to the MS.
- 3) Security functions may be executed.

- 4) 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 2G+3G-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. When the SGSN does not provide functionality for the Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the VLR number is derived from the RAI. When the SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the SGSN uses the RAI and a hash value from the IMSI to determine the VLR number. The VLR creates or updates the association with the 2G+3G-SGSN by storing SGSN Number.
- 5) 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 data in the old VLR and inserts subscriber data in the new VLR:
  - 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, 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.
- 6) The new VLR allocates a new VLR TMSI and responds with Location Update Accept (VLR TMSI) to the 2G+3G-SGSN. VLR TMSI is optional if the VLR has not changed.
- 7) The 2G+3G-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 2G+3G-SGSN rejects the routing area update with an appropriate cause. If all checks are successful, the 2G+3G-SGSN updates MM and PDP contexts for the MS. A new P-TMSI may be allocated. A Routing Area Update Accept (P-TMSI, P-TMSI Signature) message is returned to the MS. The 2G+3G-SGSN derives for this intersystem change the corresponding PDCP sequence numbers from the N-PDU sequence numbers stored in the SGSN PDP contexts by adding eight most significant bits "1". These PDCP sequence numbers are stored in the SGSN PDP contexts.
- 8) The MS acknowledges the new P-TMSI by returning a Routing Area Update Complete message to the SGSN.
- 9) The 2G+3G-SGSN sends a TMSI Reallocation Complete message to the VLR if the MS confirms the VLR TMSI.
- 10) If the MS has pending uplink data or signalling, 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.
- 11) The 2G+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-SNUs, PDCP-SNUs) message to the SRNS. The PDCP sequence numbers are derived from the N-PDU sequence numbers and stored in the PDP contexts in step 7). The SRNS sends a Radio Bearer Setup Request (PDCP-SNUs) message to the MS. The MS responds with a Radio Bearer Setup Complete (PDCP-SNDs) message. The SRNS responds with a RAB Assignment Response message.

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

- 12) Traffic flow is resumed between the 2G+3G-SGSN and the SRNS. N-PDUs that were already sent to the MS in acknowledged mode SMDCP and that are not yet acknowledged by the MS are tunnelled by the 2G+3G-SGSN to the SRNS together with their related N-PDU number (SMDCP sequence number). No PDCP sequence numbers shall be indicated for these N-PDUs. The SRNS shall discard all N-PDUs with N-PDU sequence numbers older than the eight least significant bits of PDCP-SND received from the MS. Other N-PDUs shall be transmitted to the MS. The MS shall discard all N-PDUs with sequence numbers older than the eight least significant bits of the PDCP-SNU received from the SRNS. All 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 SMDCP for the related NSAPI or not.
- 13) The traffic flow is resumed between the SRNS and the MS.

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

- C1) CAMEL\_GPRS\_Routeing\_Area\_Update\_Session, [CAMEL\\_PS\\_Notification](#) and CAMEL\_GPRS\_Routeing\_Area\_Update\_Context.
- The procedure CAMEL\_GPRS\_Routeing\_Area\_Update\_Session is called once relative to the session. In Figure 53, the procedure returns as result "Continue".
  - [Then the procedures CAMEL\\_PS\\_Notification is called once relative to the session. The procedure returns as result "Continue".](#)
  - Then the procedure CAMEL\_GPRS\_Routeing\_Area\_Update\_Context is called once per PDP context. In Figure 53, the procedure returns as result "Continue".

### 6.13.1.3 Selective RA Update

The MS shall use the following procedures when in STANDBY or PMM-IDLE state.

Note that upon expiry of the periodic RA update timer, the MS shall carry out the periodic routeing area update procedure.

#### 6.13.1.3.1 Uplink Signalling or Data Transmission

In STANDBY or PMM-IDLE state the MS shall not perform an RA update procedure until uplink data or signalling information is to be sent from the MS.

If the MS is in the same mode (A/Gb mode or Iu mode) as when it last sent data or signalling, the procedures defined for that mode shall be followed. This shall be the sending of an LLC PDU in A/Gb mode, or for example sending of a Service Request message in Iu mode.

If the MS is in a different mode (A/Gb mode or Iu mode) as when it last sent data or signalling, the RA update procedure shall be performed before the sending of data or signalling. The RA update procedure needs not be performed if the signalling message is a power-off detach.

#### 6.13.1.3.2 Downlink Signalling or Data Transmission

If the SGSN receives data for an MS in STANDBY or PMM-IDLE state, the SGSN shall page in the RA where the MS is located. This may include both A/Gb mode and Iu mode cells.

If the MS receives this page in the same mode (A/Gb mode or Iu mode) as when it last sent data or signalling, the procedures defined for that mode shall be followed. This shall be the sending of an LLC PDU in a cell where the MS has to use A/Gb mode or, for example, sending of a Service Request message in a cell where the MS has to use Iu mode.

If the MS receives this page in a different mode (A/Gb mode or Iu mode) as when it last sent data or signalling, the RA update procedure shall be performed. The SGSN shall accept this RAU as a valid response.

## 6.13.2 Inter-SGSN Inter-system Change

### 6.13.2.1 Iu mode to A/Gb mode Inter-SGSN Change

An inter-SGSN inter-system change from Iu mode to A/Gb mode takes place when an MS in PMM-IDLE or PMM-CONNECTED state changes from UTRAN or GERAN Iu mode to A/Gb mode and the A/Gb mode radio access node serving the MS is served by a different SGSN. In this case, the RA changes. Therefore, the MS shall initiate a A/Gb mode 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. In the context of this specification, the terms RNS or RNC refer also to a GERAN BSS or BSC (respectively) when serving an MS in Iu mode.

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 Routeing 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.

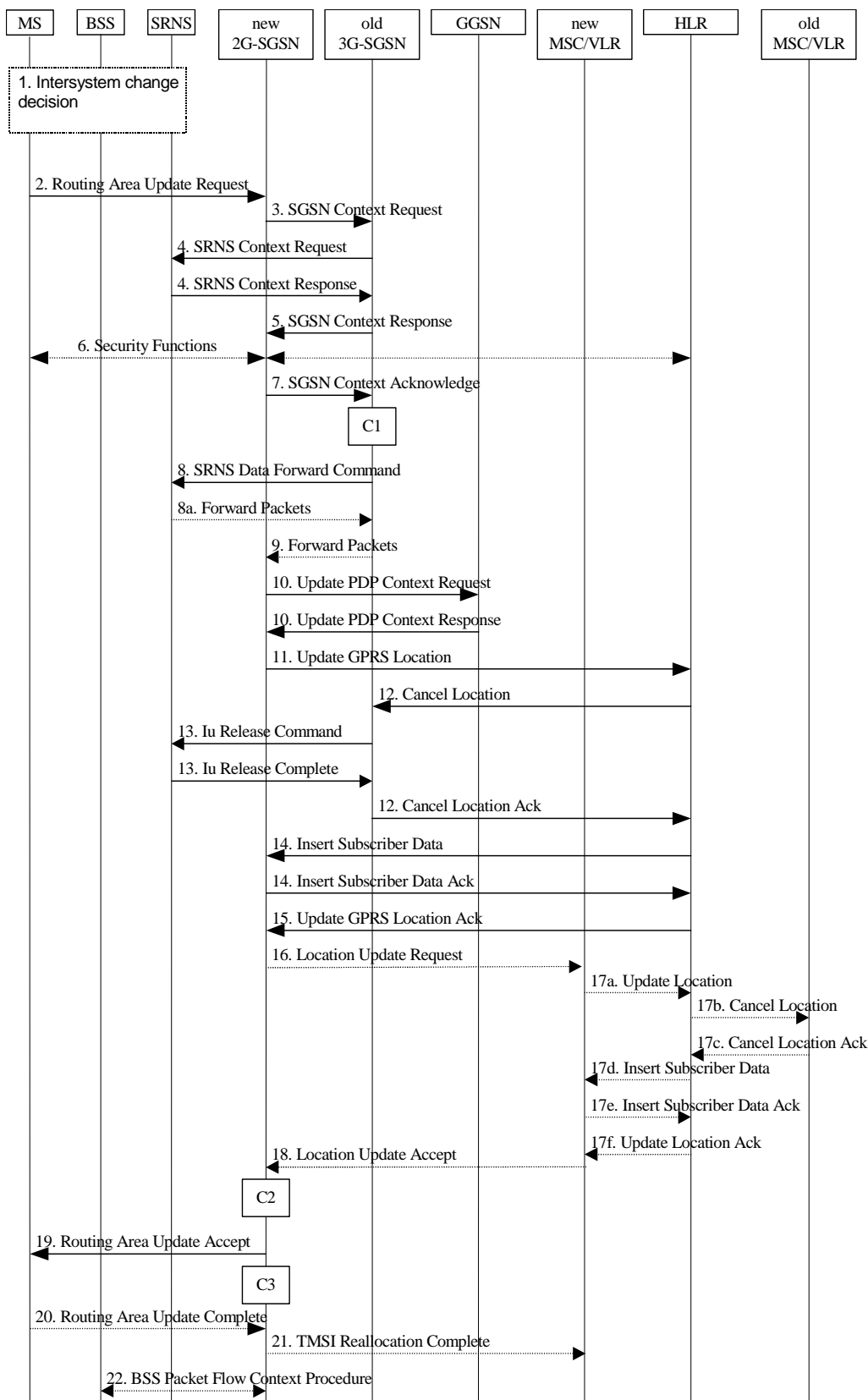


Figure 54: Iu mode to A/Gb mode Inter-SGSN Change

- 1) The MS or RAN decides to perform an inter-system change, which makes the MS switch to a new cell where A/Gb mode has to be used, 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. If the new SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the new SGSN may derive the old SGSN from the old RAI and the old P-TMSI (or TLLI) and send the SGSN Context Request message to this old SGSN. Otherwise, the new SGSN derives the old SGSN from the old RAI. In any case the new SGSN will derive an SGSN that it believes is the old SGSN. This derived SGSN is itself the old SGSN, or it is associated with the same pool area as the actual old SGSN and it will determine the correct old SGSN from the P-TMSI (or TLLI) and relay the message to that actual old SGSN. 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) message to each GGSN concerned. 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. When the SGSN does not provide functionality for the Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the VLR number is derived from the RAI. When the SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the SGSN uses the RAI and a hash value from the IMSI to determine the VLR number. 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:
  - 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, 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.

The PDP Contexts shall be sent from old to new SGSN in a prioritized order, i.e. the most important PDP Context first in the SGSN Context Response message. (The prioritization method is implementation dependent, but should be based on the current activity.)

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN should use the prioritisation sent by old SGSN as input when deciding which PDP contexts to maintain active and which ones to delete. In any case, 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 and CAMEL\_PS\_Notification.

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".
- Then the CAMEL\_PS\_Notification procedure is called once. The procedure returns as result "Continue".

- C2) CAMEL\_GPRS\_Routing\_Area\_Update\_Session and CAMEL\_PS\_Notification.

They are called in the following order:

- The CAMEL\_GPRS\_Routing\_Area\_Update\_Session procedure is called. The procedure returns as result "Continue".
- Then the CAMEL\_PS\_Notification procedure is called. The procedure returns as result "Continue".

~~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 A/Gb mode to Iu mode Inter-SGSN Change

The inter-system change from A/Gb mode to Iu mode takes place when a GPRS-attached MS changes from A/Gb mode to UTRAN or GERAN Iu mode and the new RAN node serving the MS is served by a different SGSN. In this case the RA changes. Therefore, the MS shall initiate a Iu mode 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. In the context of this specification, the terms RNS or RNC refer also to a GERAN BSS or BSC (respectively) when serving an MS in Iu mode.

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.

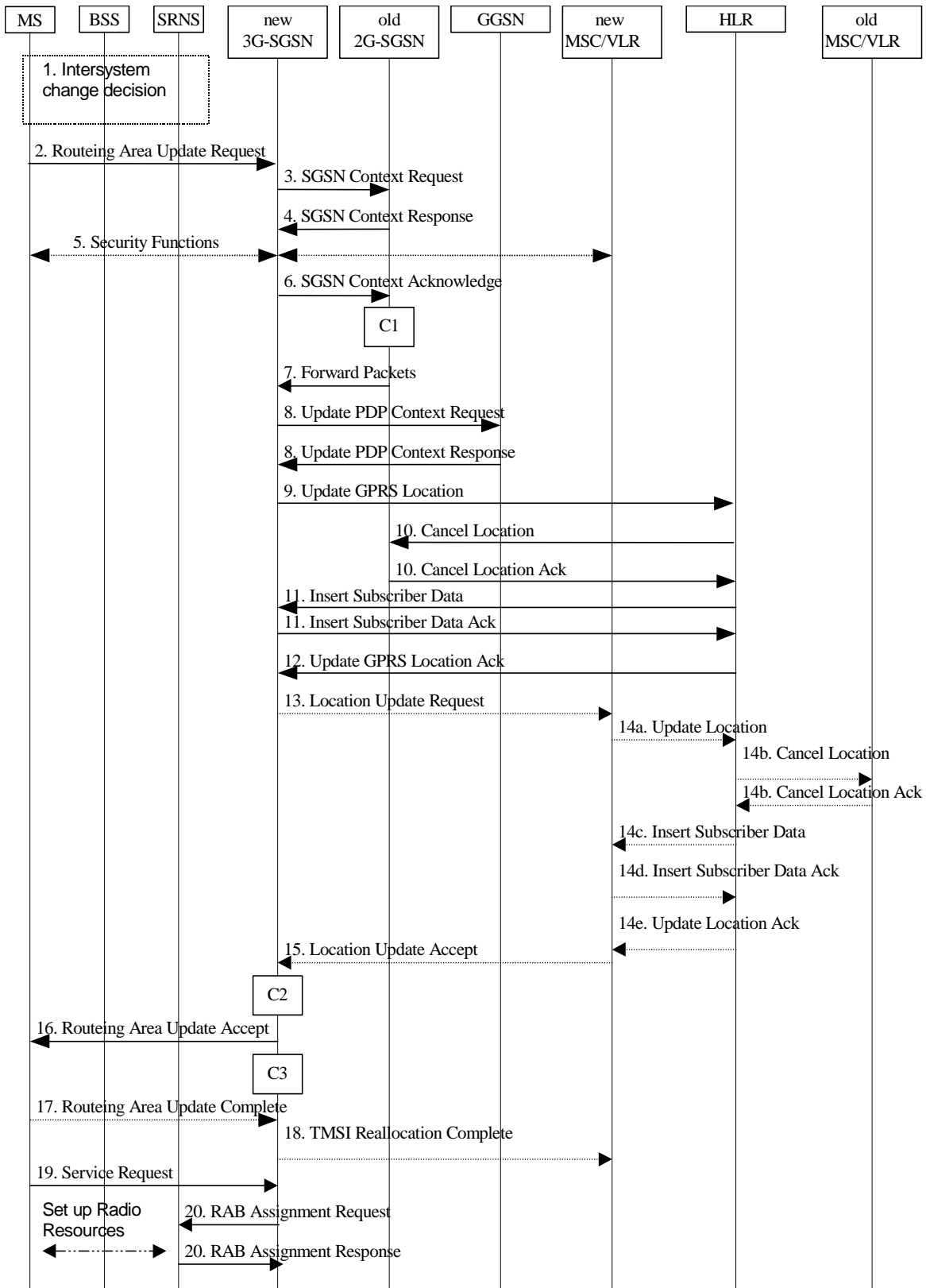


Figure 55: A/Gb mode to Iu mode Inter SGSN Change

- 1) The MS or RAN decides to perform an inter-system change, which makes the MS switch to a new cell where Iu mode has to be used, 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. If the new SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the new SGSN may derive the old SGSN from the old RAI and the old P-TMSI and send the SGSN Context Request message to this old SGSN. Otherwise, the new SGSN derives the old SGSN from the old RAI. In any case the new SGSN will derive an SGSN that it believes is the old SGSN. This derived SGSN is itself the old SGSN, or it is associated with the same pool area as the actual old SGSN and it will determine the correct old SGSN from the P-TMSI and relay the message to that actual old SGSN. 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 SNDCCP Send N-PDU Number for the next downlink N-PDU to be sent in acknowledged mode SNDCCP to the MS and the SNDCCP Receive N-PDU Number for the next uplink N-PDU to be received in acknowledged mode SNDCCP 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 SNDCCP and that are not yet acknowledged by the MS are tunnelled together with their related SNDCCP 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) message to each GGSN concerned. 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. When the SGSN does not provide functionality for the Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the VLR number is derived from the RAI. When the SGSN provides functionality for Intra Domain Connection of RAN Nodes to Multiple CN Nodes, the SGSN uses the RAI and a hash value from the IMSI to determine the VLR number. 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:
  - 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, 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-SNUs, PDCP-SNUs) 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-SNUs) message to the MS. The MS responds with a Radio Bearer Setup Complete (PDCP-SNDs) 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-SNUs 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.

NOTE: The new SGSN may initiate RAB establishment after execution of the security functions (step 5), or wait until completion of the RA update procedure. For the MS, RAB establishment may occur anytime after the RA update request is sent (step 2).

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 routeing area update.

The PDP Contexts shall be sent from old to new SGSN in a prioritized order, i.e. the most important PDP Context first in the SGSN Context Response message. (The prioritization method is implementation dependent, but should be based on the current activity.)

If the new SGSN is unable to support the same number of active PDP contexts as received from old SGSN, the new SGSN should use the prioritisation sent by old SGSN as input when deciding which PDP contexts to maintain active and which ones to delete. In any case, 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 routeing 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 and CAMEL\_PS\_Notification.

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".
- Then the CAMEL\_PS\_Notification procedure is called once. It returns as result "Continue".

C2) CAMEL\_GPRS\_Routeing\_Area\_Update\_Session and CAMEL\_PS\_Notification.

They are called in the following order:

- The CAMEL\_GPRS\_Routeing\_Area\_Update\_Session procedure is called. The procedure returns as result "Continue".
- Then the CAMEL\_PS\_Notification procedure is called. The procedure returns as result "Continue".

~~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".

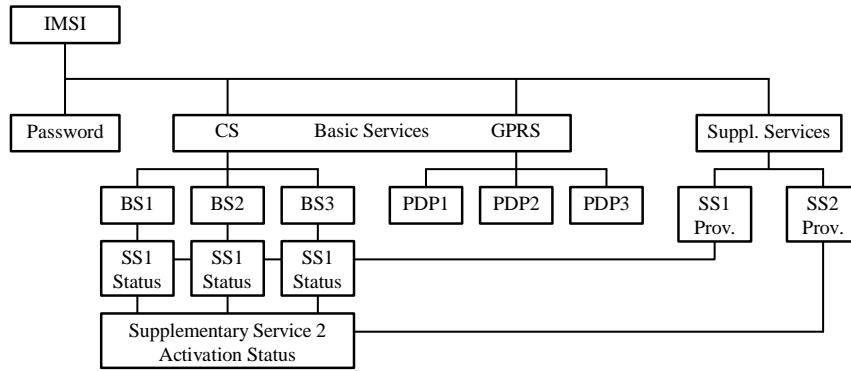
**\*\*\* Next Modified Part \*\*\***

## 13 Information Storage

This clause describes information storage structures required for GPRS, and the recovery and restoration procedures needed to maintain service if inconsistencies in databases and lost or invalid database information occur.

### 13.1 HLR

IMSI is the prime key to the subscription data stored in the HLR. There may be several sets of GPRS subscription data per IMSI. This is illustrated in Figure 93.



**Figure 93: Subscription Data**

As Figure 93 indicates, the GPRS subscription data is at the same level as basic services. Each PDP subscription is seen as a basic service. Supplementary services are provisioned as part of the overall subscription. Activation of SSs is either at the basic service level (SS1) or at the overall subscription level (SS2).

Table 5 shows the GPRS subscription data contained in the HLR.



Table 5: HLR GPRS Subscription Data

Field	Description
IMSI	IMSI is the main reference key.
MSISDN	The basic MSISDN of the MS.
SGSN Number	The SS7 number of the SGSN currently serving this MS.
SGSN Address	The IP address of the SGSN currently serving this MS.
Subscribed Charging Characteristics	The charging characteristics for the MS, e.g. normal, prepaid, flat-rate, and/or hot billing subscription.
Trace Reference	Identifies a record or a collection of records for a particular trace.
Trace Type	Indicates the type of trace, e.g. MSC/BSS trace, HLR trace, and/or SGSN/GGSN/BSS trace.
OMC Identity	Identifies the OMC that shall receive the trace record(s).
SMS Parameters	SMS-related parameters, e.g. operator-determined barring.
MS PS Purged for GPRS	Indicates that the MM and PDP contexts of the MS are deleted from the SGSN.
MNRG	Indicates that the MS is not reachable through an SGSN, and that the MS is marked as not reachable at the SGSN and possibly at the GGSN.
GGSN-list	The GSN number and optional IP address pair related to the GGSN that shall be contacted when activity from the MS is detected and MNRG is set. The GSN number shall be either the number of the GGSN or the protocol-converting GSN as described in the clauses "MAP-based GGSN - HLR Signalling" and "GTP and MAP-based GGSN - HLR Signalling".
GPRS-CSI	Optional GPRS CAMEL subscription information, see 3GPP TS 23.016
<a href="#">MG-CSI</a>	<a href="#">Optional Mobility Management for GPRS CAMEL subscription information, see 3GPP TS 23.016.</a>
PDP Context Identifier	Index of the PDP context.
PDP Type	PDP type, e.g. PPP or IP.
PDP Address	PDP address, e.g., an IP address. This field shall be empty if dynamic addressing is allowed.
Access Point Name	A label according to DNS naming conventions describing the access point to the packet data network.
QoS Profile Subscribed	The quality of service profile subscribed. QoS Profile Subscribed is the default level if a particular QoS profile is not requested. . QoS Profile Subscribed is also the maximum QoS per PDP context to the associated APN.
VPLMN Address Allowed	Specifies whether the MS is allowed to use the APN in the domain of the HPLMN only, or additionally the APN in the domain of the VPLMN.
PDP context Charging Characteristics	The charging characteristics of this PDP context, e.g. normal, prepaid, flat-rate, and/or hot billing.
ODB for PS parameters	Indicates that the status of the operator determined barring for packet oriented services.

## 13.2 SGSN

SGSN maintains MM context and PDP context information for MSs in the STANDBY, READY, PMM-IDLE, and PMM-CONNECTED states. Table 6 shows the context fields for one MS.

During the Intersystem Change, when new Authentication and Key Agreement is not performed, the KSI in the new 3G-SGSN shall be assigned the value of the CKSN, which has been sent by the MS. Similarly, in the new 2G-SGSN, when AKA does not take place, the CKSN shall be assigned the value of the KSI, which has been sent by the MS.

Table 6: SGSN MM and PDP Contexts

Field	Description	A/Gb mode	Iu mode
IMSI	IMSI is the main reference key.	X	X
MM State	Mobility management state, IDLE, STANDBY, READY, PMM-DETACHED, PMM-IDLE, or PMM-CONNECTED.	X	X
P-TMSI	Packet Temporary Mobile Subscriber Identity.	X	X
P-TMSI Signature	A signature used for identification checking purposes.	X	X
IMEI	International Mobile Equipment Identity	X	X
MSISDN	The basic MSISDN of the MS.	X	X
Routeing Area	Current routeing area.	X	X
Cell Identity	Current cell in READY state, last known cell in STANDBY or IDLE state.	X	
Cell Identity Age	Time elapsed since the last LLC PDU was received from the MS at the SGSN.	X	
Service Area Code	Last known SAC when initial UE message was received or Location Reporting procedure was executed.		X
Service Area Code Age	Time elapsed since the last SAC was received at the 3G-SGSN.		X
VLR Number	The VLR number of the MSC/VLR currently serving this MS.	X	X
New SGSN Address	The IP address of the new SGSN where buffered and not sent N-PDUs should be forwarded to.	X	X
Authentication Vectors	Authentication and ciphering parameters (authentication triplets or quintets)..	X	X
Kc	Currently used A/Gb mode ciphering key.	X	2)
CKSN	Ciphering key sequence number of Kc.	X	2)
Ciphering algorithm	Selected ciphering algorithm.	X	X
CK	Currently used Iu mode ciphering key.	1)	X
IK	Currently used Iu mode integrity key.	1)	X
KSI	Key Set Identifier.	1)	X
MS Radio Access Capability	MS radio access capabilities.	X	
MS Network Capability	MS network capabilities.	X	X
DRX Parameters	Discontinuous reception parameters.	X	X
MNRG	Indicates whether activity from the MS shall be reported to the HLR.	X	X
NGAF	Indicates whether activity from the MS shall be reported to the MSC/VLR.	X	X
PPF	Indicates whether paging for PS and CS services can be initiated.	X	X
Subscribed Charging Characteristics	The charging characteristics for the MS, e.g. normal, prepaid, flat-rate, and/or hot billing subscription.	X	X
Trace Reference	Identifies a record or a collection of records for a particular trace.	X	X
Trace Type	Indicates the type of trace.	X	X
Trigger Id	Identifies the entity that initiated the trace.	X	X
OMC Identity	Identifies the OMC that shall receive the trace record(s).	X	X
SMS Parameters	SMS-related parameters, e.g. operator-determined barring.	X	X
Recovery	Indicates if HLR or VLR is performing database recovery.	X	X
Radio Priority SMS	The RLC/MAC radio priority level for uplink SMS transmission.	X	
GPRS-CSI	Optional GPRS CAMEL subscription information, see 3GPP TS 23.016	X	X
<u>MG-CSI</u>	<u>Optional Mobility Management for GPRS CAMEL subscription information, see 3GPP TS 23.016.</u>	<u>X</u>	<u>X</u>
ODB for PS parameters	Indicates that the status of the operator determined barring for packet oriented services.	X	X
Each MM context contains zero or more of the following PDP contexts:			
PDP Context Identifier	Index of the PDP context.	X	X
PDP State	Packet data protocol state, INACTIVE or ACTIVE.	X	X
PDP Type	PDP type, e.g. PPP or IP.	X	X
PDP Address	PDP address, e.g. an IP address.	X	X
APN Subscribed	The APN received from the HLR.	X	X
APN in Use	The APN currently used. This APN shall be composed of the APN Network Identifier and the APN Operator Identifier.	X	X
NSAPI	Network layer Service Access Point Identifier.	X	X
TI	Transaction Identifier.	X	X
TEID for Gn/Gp	Tunnel Endpoint Identifier for the Gn and Gp interfaces.	X	X
TEID for Iu	Tunnel Endpoint Identifier for the Iu interface.		X
GGSN Address in Use	The IP address of the GGSN currently used.	X	X
VPLMN Address Allowed	Specifies whether the MS is allowed to use the APN in the domain of the HPLMN only, or additionally the APN in the domain of the VPLMN.	X	X
QoS Profile Subscribed	The quality of service profile subscribed.	X	X

Field	Description	A/Gb mode	Iu mode
QoS Profile Requested	The quality of service profile requested.	X	X
QoS Profile Negotiated	The quality of service profile negotiated.	X	X
Radio Priority	The RLC/MAC radio priority level for uplink user data transmission.	X	
Packet Flow Id	Packet flow identifier.	X	
Aggregate BSS QoS Profile Negotiated	The aggregate BSS quality of service profile negotiated for the packet flow that this PDP context belongs to.	X	
Send N-PDU Number	SNDCP sequence number of the next downlink N-PDU to be sent to the MS.	X	
Receive N-PDU Number	SNDCP sequence number of the next uplink N-PDU expected from the MS.	X	
GTP-SND	GTP-U sequence number of the next downlink N-PDU to be sent to the MS.	X	X
GTP-SNU	GTP-U sequence number of the next uplink N-PDU to be sent to the GGSN.	X	X
PDCP-SND	Sequence number of the next downlink in-sequence PDCP-PDU to be sent to the MS.		X
PDCP-SNU	Sequence number of the next uplink in-sequence PDCP-PDU expected from the MS.		X
Charging Id	Charging identifier, identifies charging records generated by SGSN and GGSN.	X	X
PDP Context Charging Characteristics	The charging characteristics of this PDP context, e.g. normal, prepaid, flat-rate, and/or hot billing.	X	X
RNC Address in Use	The IP address of the RNC/BSC currently used.		X

The information marked with a "1)" in table 6 may be maintained if authentication is performed by the UMTS authentication procedure.

The information marked with a "2)" in table 6 may be maintained if authentication is performed by the GSM authentication procedure.

**\*\*\* Next Modified Part \*\*\***