

GERAN-UTRAN *Iu-mode* handover (final version)

AT&T Wireless

This contribution is available in *Acrobat* and *Word* formats. The *Acrobat* format is smaller and has fewer display artifacts.

For information.

[illegible]

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1. Introduction

This contribution uses sequence diagrams to examine *Iu-mode* handover.

Figures in this document contain the sequence diagrams. A table following each figure describes message events in the sequence, including the values of directly relevant information elements.

In the figures, the following conventions apply:

- Magenta hexagons indicate PMM and MM states. Magenta horizontal arrows indicate PMM and MM messages.
- Cyan hexagons indicate RRC states and modes. Cyan horizontal arrows indicate RRC messages.
- Green hexagons indicate MAC states. Green horizontal arrows indicate MAC or lower-layer messages.
- Rounded-corner blue rectangles indicate a started timer. Vertical blue-shaded arrows indicate timer duration.
- Red horizontal arrows indicate RANAP messages.
- Purple horizontal arrows indicate user-plane traffic.
- Dashed horizontal arrows indicate optional messages.
- Heavy vertical or diagonal lines indicate a stimulus-response relationship between messages.
- Circles indicate an initiating event.

In the descriptive tables and other text, the following conventions apply:

- Questions and comments appear in magenta within angled brackets, *e.g.*, <comment>.
- References to applicable stage-3 standards appear within square brackets in the first line of each message description, *e.g.*, [44.118 §§ 9.2.51 to 9.2.54].
- Blue text indicates optional or conditional information elements.

2. Simplified perspective

The sequences in this contribution correspond to the following scenarios:

- GERAN initiates a circuit handover to UTRAN.
- UTRAN initiates a circuit handover to GERAN.
- GERAN initiates a packet handover to UTRAN.
- UTRAN initiates a packet handover to GERAN.

23.009 § 8.3 provides a stage-2 description for circuit handover; 23.060 §§ 6.9.2.2.2 and 6.9.2.2.3 provide a stage-2 description for packet handover.

In general, GERAN-to-UTRAN handover comprises 5 steps:

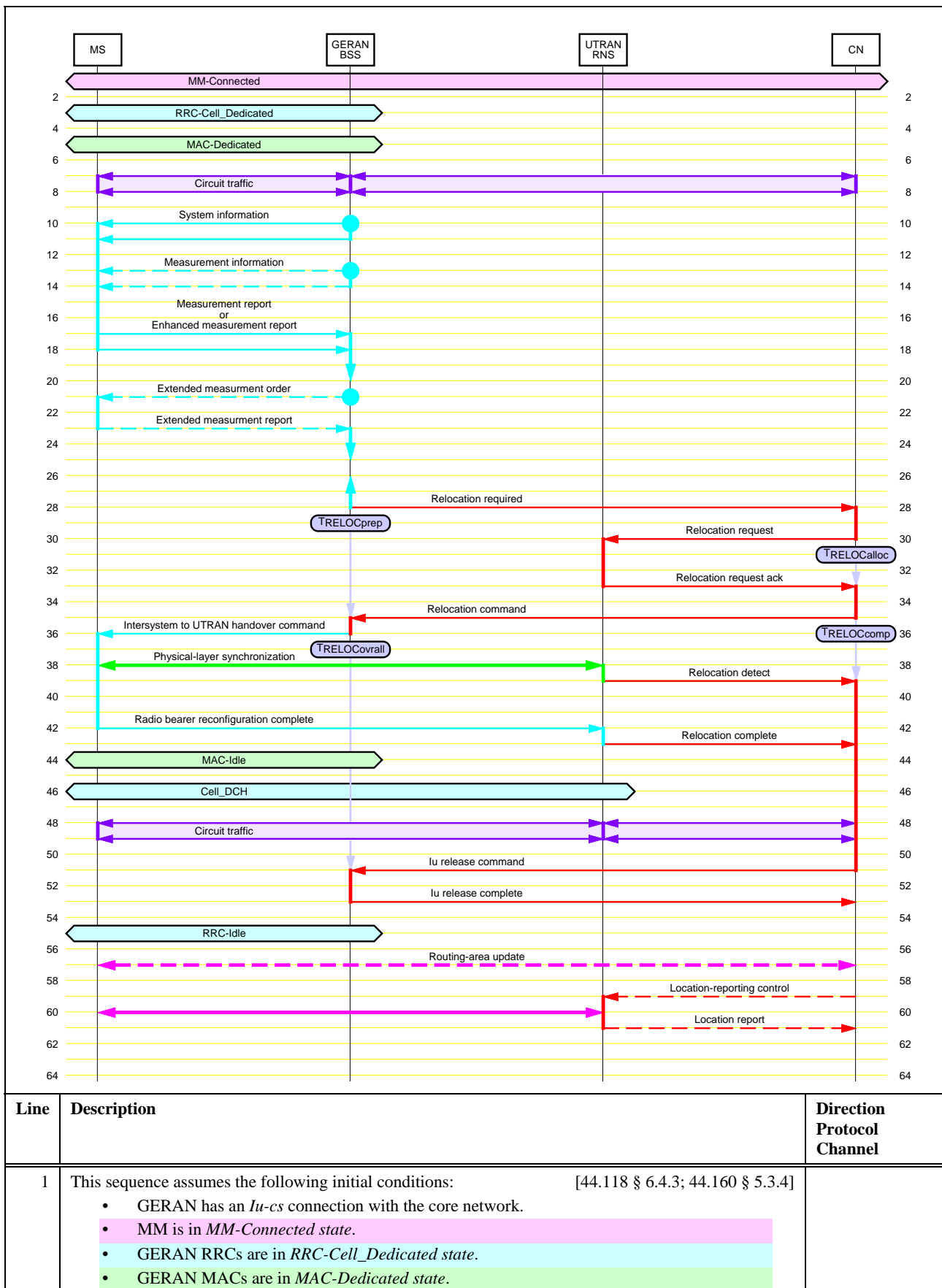
- Measurement control by GERAN.
- Measurement reporting by the mobile station leading to a handover decision by GERAN.
- Relocation preparation.
- Handover of the mobile station from one channel to another, and relocation of the *Iu* connection from GERAN BSS to UTRAN RNS.
- Release of old *Iu* connections to the GERAN BSS.

1 UTRAN-to-GERAN handover comprises 5 similar steps.

2 **3. GERAN circuit handover to UTRAN**

3 Figure 1 shows a GERAN circuit handover to UTRAN.

Figure 1: GERAN circuit handover to UTRAN



7	<p>Circuit traffic</p> <p>The mobile station and the core network exchange user traffic via a dedicated connection between MS and GERAN BSS and a circuit connection between GERAN BSS and CN.</p>	<p>MS↔BSS BSS↔CN null AAL2 TCH</p>
Report normal or enhanced measurements		
10	<p>System information (SI5, SI5bis, SI5ter, SI6) [44.118 §§ 9.2.51 to 9.2.54]</p> <p>The GERAN BSS provides information on the serving cell and neighbouring cells. The GERAN BSS sends SI5 and SI6, and optionally SI5bis and SI5ter, when no other RRC message has to be sent.</p>	<p>MS←BSS GERAN RRC SACCH (SRB1)</p>
13	<p>Measurement information [44.118 §§ 7.9, 9.2.22] {BA ind, 3G BA ind, MP change mark, MI index, MI count, report type, report rate, invalid BSIC reporting, BSIC neighbour description, measurement parameters, 3G neighbour cell description, 3G measurement parameters}</p> <p>The GERAN BSS may configure the mobile station's measurement reporting using one or more <i>measurement information</i> messages.</p> <ul style="list-style-type: none"> • <i>BA ind</i> indicates whether the mobile station shall rebuild the 2G neighbour list. • <i>3G BA ind</i> indicates whether the mobile station shall rebuild the 3G neighbour list. • <i>MP change mark</i> indicates whether the mobile station shall reread important measurement parameters. • <i>MI index</i> indicates the individual message in a sequence of <i>measurement information</i> messages. • <i>MI count</i> indicates the total number of <i>measurement information</i> messages in a sequence. • <i>Report type</i> indicates whether the mobile station shall use enhanced reports or normal reports. • <i>Report rate</i> indicates whether the mobile station shall use SACCH-rate reporting or reduced-rate reporting. • <i>Invalid BSIC reporting</i> indicates whether the mobile station shall report measurements for cells with invalid BSICs. • <i>BSIC neighbour description</i> indicates the 2G neighbour cells to be measured. • <i>Measurement parameters</i> indicates the parameters to be measured for each 2G cell. • <i>3G neighbour description</i> indicates the 3G neighbour cells to be measured. • <i>3G measurement parameters</i> indicates the parameters to be measured for each 3G cell. 	<p>MS←BSS GERAN RRC SACCH (SRB1)</p>
17	<p>Measurement report [44.118 §§ 7.9, 9.2.23] {measurement results}</p> <p>If the <i>measurement information</i> ordered the mobile station to use normal reports, the mobile station sends measurement reports to the GERAN BSS.</p> <ul style="list-style-type: none"> • <i>Measurement results</i> reports the mobile station's measurements of the serving cell and neighbouring cells. 	<p>MS→BSS GERAN RRC SACCH (SRB1)</p>
	<p>Enhanced measurement report [44.118 §§ 7.9, 9.2.7a] {BA used, 3G BA used, BSIC seen, scale, enhanced measurement results}</p> <p>If the <i>measurement information</i> ordered the mobile station to use enhanced reports, the mobile station sends enhanced measurement reports to the GERAN BSS.</p> <ul style="list-style-type: none"> • <i>BA used</i> indicates the value of <i>BA ind</i> that applies to the 2G neighbour list. • <i>3G BA used</i> indicates the value of <i>3G BA ind</i> that applies to the 3G neighbour list. • <i>BSIC seen</i> indicates whether one or more cells with an invalid BSIC is seen. • <i>Scale</i> indicates whether a 10 dB offset was applied to receive-level measurements. • <i>Enhanced measurement results</i> reports the mobile station's measurements of the serving cell and neighbouring cells. 	<p>MS→BSS GERAN RRC SACCH (SRB1)</p>
Report extended measurements		
21	<p>Extended measurement order [44.118 §§ 7.9, 9.2.6] {Extended measurement frequency list}</p> <p>The GERAN BSS orders the mobile station to send one extended measurement report.</p> <ul style="list-style-type: none"> • <i>Extended measurement frequency list</i> indicates the frequencies to be measured. 	<p>MS←BSS GERAN RRC SACCH (SRB1)</p>

23	<p>Extended measurement report [44.118 §§ 7.9, 9.2.7] <i>{Extended measurement results}</i></p> <p>The mobile station reports its extended measurements.</p> <ul style="list-style-type: none"> <i>Extended measurement results</i> reports the mobile station's measurements of the frequencies specified in the <i>extended measurement order</i>. 	MS→BSS GERAN RRC SACCH (SRB1)
Prepare relocation		
28	<p>Relocation required [25.413 §§ 8.6, 9.1.9; 25.331 § 14.12] <i>{relocation type, cause, source ID, target ID, MS classmark 2, MS classmark 3, source-to-target transparent container, GERAN classmark}</i></p> <p>Based on standard mobile-station measurement reports and non-standard internal algorithms, the GERAN BSS decides that handover is needed. The GERAN BSS determines that the handover will also require relocation to a UTRAN RNS. It signals the relocation requirement to the core network. This starts the relocation preparation. If the GERAN BSS also has an <i>Iu-ps</i> connection to the core network, it initiates a simultaneous relocation preparation for the packet domain. The BSS decides whether to initiate an intrasystem or an intersystem relocation.</p> <ul style="list-style-type: none"> <i>Relocation type</i> indicates whether the mobile station is or is not involved in the BSS-to-RNS relocation. Because the mobile station is carrying traffic, it is involved. <i>Cause</i> indicates the reason for the relocation, <i>e.g.</i>, relocation desirable for radio reasons. <i>Source ID</i> identifies the source GERAN BSS. <i>Target ID</i> identifies the target UTRAN RNS. <i>MS classmark 2</i> indicates mobile-station capabilities. It is only required for handover to GERAN A/Gb mode. <i>MS classmark 3</i> indicates additional mobile-station capabilities. It is only required for handover to GERAN A/Gb mode. <i>Source-to-target transparent container</i> contains information the GERAN BSS needs to transfer to the UTRAN RNS, <i>e.g.</i>, RRC information and number of <i>Iu</i> instances. This scenario assumes a single <i>Iu</i> instance to the circuit domain, <i>i.e.</i>, <i>Iu-cs</i>. For intrasystem relocations, this container includes integrity-protection and ciphering information (the selected key and algorithm for each). The RRC information is the <i>RRC information to target RNC container</i>, which contains the <i>SRNS relocation info</i> message. This message includes MS radio-access capabilities. <i>GERAN classmark</i> isn't needed for a relocation to a UTRAN RNS. 	BSS→CN RANAP
29	<p>$T_{\text{RELOCprep}}$ [25.413 §§ 8.6, 9.5]</p> <p>The GERAN BSS starts the relocation-preparation timer. It expects to receive a <i>relocation command</i> or a <i>relocation preparation failure</i> before the timer expires.</p>	BSS RANAP

30	<p>Relocation request [25.413 §§ 8.7, 9.1.10] <i>{UE identity, cause, CN domain indicator, source-to-target transparent container, RABs to be setup, integrity-protection info, encryption info, Iu signalling connection identifier, Global CNid, SNA access info}</i></p> <p>The core network requests the target RNS allocate resources for the handover.</p> <ul style="list-style-type: none"> • <i>UE identity</i> identifies the mobile station. • <i>Cause</i> indicates the reason for the relocation, e.g., relocation desirable for radio reasons. This is the same <i>cause</i> value included in the <i>relocation required</i> message. • <i>CN domain indicator</i> indicates circuit domain. • <i>Source-to-target transparent container</i> contains the <i>source-to-target transparent container</i> from the <i>relocation required</i> message. • <i>RABs to be setup</i> identifies RABs to be established and their attributes. <i><Why does the source-to-target transparent container, which contains the SRNS relocation info message, also include RAB info?></i> • <i>Integrity-protection info</i> identifies the integrity-protection algorithms, in preferred order, that may be used to protect signalling for intersystem relocations. (Intrasystem relocations use integrity-protection info provided in the <i>source-to-target transparent container</i>.) • <i>Encryption info</i> identifies the encryption algorithms, in preferred order, that may be used to cipher signalling for intersystem relocations. (Intrasystem relocations use encryption info provided in the <i>source-to-target transparent container</i>.) This information isn't included if <i>integrity protection info</i> isn't included. • <i>Iu signalling connection identifier</i> identifies the <i>Iu</i> signalling connection to this core-network node. The RNS stores this identifier for the duration of the connection. • <i>Global CNid</i> identifies the core-network node if it is not the default node for the RNS. If not included, the RNS shall assume the default core-network node originated the message. The RNS stores this identifier for the duration of the connection. • <i>SNA access info</i> identifies PLMNs and routing areas the mobile station is allowed to access. 	RNS←CN RANAP
31	<p>$T_{RELOCalloc}$ [25.413 §§ 8.7, 9.5]</p> <p>The core network starts the relocation-allocation timer. It expects to receive a <i>relocation request ack</i> or <i>relocation failure</i> before the timer expires.</p>	CN RANAP
33	<p>Relocation request acknowledge [25.413 §§ 8.7, 9.1.11; 25.331 §§ 10.2.27, 14.12] <i>{target-to-source transparent container, new-BSS-to-old-BSS info, RABs setup, RABs failed setup, chosen integrity-protection algorithm, chosen encryption algorithm}</i></p> <p>The target RNS acknowledges allocation of handover resources. The target RNS coordinates all <i>Iu-cs</i> and <i>Iu-ps</i> connections for the affected mobile station. It returns a <i>relocation request acknowledge</i> message to each core-network domain only after it has received and processed all expected <i>relocation request</i> messages as determined by the number of <i>Iu</i> instances signalled in the <i>source-to-target transparent container</i>.</p> <ul style="list-style-type: none"> • <i>Target-to-source transparent container</i> contains the <i>radio-bearer reconfiguration</i> message that will be sent to the mobile station. If circuit and packet domains are involved in the relocation, the RNS should send the container via one domain: in this case, the circuit domain. If the RNS sends the container via both domains, the containers shall be identical. • <i>New-BSS-to-old BSS info</i> provides information on downlink and uplink cell load. It is used for load-based intersystem handover. • <i>RABs setup</i> identifies RABs that were allocated resources, including any negotiated changes to RAB parameters. • <i>RABs failed setup</i> identifies RABs that were not allocated resources and the cause for the failed allocation. • <i>Chosen integrity-protection algorithm</i> identifies the integrity-protection algorithm chosen by the target RNS. The RNS includes this information if the core network included <i>integrity-protection info</i> in the <i>relocation request</i>. • <i>Chosen encryption algorithm</i> identifies the encryption algorithm chosen by the target RNS. The RNS includes this information if the core network included <i>encryption info</i> in the <i>relocation request</i>. 	RNS→CN RANAP

35	Relocation command [25.413 §§ 8.6, 9.1.12] { <i>target-to-source transparent container</i> , <i>intersystem info transparent container</i> , <i>RABs to be released</i> , <i>RABs subject to data forwarding</i> } The core network orders the source BSS to handover the mobile station to the target RNS. This completes the relocation preparation. If the GERAN BSS also has an <i>Iu-ps</i> connection to the core network, it waits for a <i>relocation command</i> on the <i>Iu-ps</i> interface before executing the handover. <ul style="list-style-type: none"> • <i>Target-to-source transparent container</i> contains the <i>target-to-source transparent container</i> from the <i>relocation request acknowledge</i> message. • <i>Intersystem info transparent container</i> contains uplink and downlink cell-load information. • <i>RABs to be released</i> identifies the RABs not supported by the target RNS. The source BSS may chose to cancel the relocation if this list is not to its liking. • <i>RABs subject to data forwarding</i> only applies to packet services. 	BSS←CN RANAP
36	T _{RELOCcomplete} [25.413 §§ 8.6, 9.5] The core network starts the relocation-complete timer. It expects to receive a <i>relocation complete</i> before the timer expires.	CN RANAP
Handover		
36	Intersystem to UTRAN handover command [25.331 §§ 8.2.2, 10.2.27; 44.118 §§ 7.10, 9.2.19] { <i>RRC transaction identifier</i> , <i>activation time</i> , <i>integrity-check info</i> , <i>integrity-protection-mode info</i> , <i>RAB info</i> , <i>handover to UTRAN command</i> } The GERAN BSS hands the mobile station over to UTRAN. <Check message content. Some information elements seem to duplicate information elements within the radio bearer reconfiguration message issued by the target RNS.> <ul style="list-style-type: none"> • <i>RRC transaction identifier</i> identifies the particular RRC transaction for this message. • <i>Activation time</i> indicates the frame number when the command takes effect. • <i>Integrity-check info</i> contains the <i>message authentication code</i> and <i>RRC message sequence number</i> needed for integrity-protection algorithms. • <i>Integrity-protection-mode info</i> identifies the algorithm, start time, and initialization values. • <i>RAB info</i> identifies each RAB and indicates its CN domain (circuit or packet). • <i>Handover to UTRAN command</i> is the handover command issued by the target RNS and sent via the <i>target-to-source transparent container</i>. The handover command is a <i>radio bearer reconfiguration</i> message. It signals UE info, CN info, mobility info, radio-bearer info, and physical-layer info. The radio-bearer info and physical-layer info signal one of the following: <ul style="list-style-type: none"> • A complete configuration of radio bearers, transport channels, and physical channels. • A predefined configuration identity and physical-channel attributes. • A default configuration identity and physical-channel attributes. 	MS←BSS GERAN RRC FACCH (SRB2)
37	T _{RELOCoverall} [25.413 §§ 8.6, 9.5] The GERAN BSS starts the relocation-overall timer. It expects to receive an <i>Iu release command</i> before the timer expires.	BSS RANAP
38	Physical-layer synchronization [25.331 § 8.2.2.3] The MS and RNS synchronize their physical layers.	MS→RNS
39	Relocation detect [25.413 §§ 8.8, 9.1.13] {} The target RNS indicates it has detected the mobile station. If an <i>Iu-cs</i> connection and an <i>Iu-ps</i> connection will be established, the target RNS sends a <i>relocation detect</i> message to each core-network domain. The core network switches the user plane from the source BSS to the target RNS.	RNS→CN RANAP
42	Radio bearer reconfiguration complete [25.331 §§ 8.2.2, 10.2.28] { <i>UE info</i> , <i>RB info</i> } The mobile station indicates the handover is complete. <ul style="list-style-type: none"> • <i>UE info</i> contains information such as RRC transaction identifier, integrity check info, and integrity protection info. • <i>RB info</i> contains information such as ciphering activation time and uplink counter synchronization. 	MS→RNS UTRAN RRC DCCH (SRB2)

43	Relocation complete {}	[25.413 §§ 8.9, 9.1.14]	RNS→CN RANAP
	The target RNS indicates the relocation is complete. If an <i>Iu-cs</i> connection and an <i>Iu-ps</i> connection will be established, the target RNS sends a <i>relocation complete</i> message to each core-network domain. If the core network has not yet received a relocation detect message, it switches the user plane from the source BSS to the target RNS.		
44	MAC-Idle	[44.160 § 5.3.1]	
	The GERAN MACs enter <i>MAC-Idle state</i> .		
46	Cell_DCH	[25.331 § 7.2.2.3]	
	The UTRAN RRCs enter <i>Cell_DCH state</i> .		
48	Circuit traffic		MS↔RNS RNS↔CN null AAL2 DTCH
	The mobile station and the core network now exchange user traffic via a dedicated connection between MS and UTRAN RNS and a circuit connection between UTRAN RNS and CN.		
Release old connections			
51	<i>Iu</i> release command { <i>cause</i> }	[25.413 §§ 8.5, 9.1.7]	BSS←CN RANAP
	The core network releases the <i>Iu-cs</i> connection to the source BSS. This also releases GERAN resources allocated to the mobile station. Any <i>Iu-ps</i> connection must be released separately. <ul style="list-style-type: none"><i>Cause</i> indicates the reason for the release, <i>e.g.</i>, successful relocation.		
53	<i>Iu</i> release complete { <i>RABs data volume report</i> , <i>RABs released</i> }	[25.413 §§ 8.5, 9.1.8]	BSS→CN RANAP
	The GERAN BSS confirms release of resources allocated to the mobile station. Once the BSS has released, no user data can be transferred over the <i>Iu</i> interface. <ul style="list-style-type: none"><i>RABs data volume report</i> isn't used for circuit services.<i>RABs released</i> isn't used for circuit services.		
55	RRC-Idle	[44.118 § 6.4.1]	
	The GERAN RRCs at BSS and MS enter <i>RRC-Idle mode</i> . The BSS may stop execution of the RRC process for this mobile station.		
57	Routing-area update		MS↔CN MM DCCH (SRB3)
	If MS determines it is in a new routing area, it initiates a routing-area update.		
59	Location reporting control { <i>request type</i> , <i>vertical accuracy code</i> , <i>response time</i> , <i>positioning priority</i> , <i>client type</i> }	[25.413 §§ 8.19, 9.1.29]	RNS←CN RANAP
	If the core network wants to maintain location reporting at change of service area, it sends an appropriate <i>location reporting control</i> message. <ul style="list-style-type: none"><i>Request type</i> indicates whether to start direct reports, stop direct reports, start reports upon change of service area, or stop reports upon change of service area. It indicates the type of location information to report: service-area identifier or geographical area. If geographical area is to be reported, it may also indicate the horizontal accuracy to use.<i>Vertical accuracy code</i> indicates the vertical accuracy to use for geographical reports.<i>Response time</i> applies to direct reporting of geographical area.<i>Positioning priority</i> indicates high or low priority.<i>Client type</i> identifies the client type requesting the location information, <i>e.g.</i>, emergency services, value-added services, PLMN operator services, lawful intercept services.		
60	The mobile station initiates an event that triggers the location report, <i>e.g.</i> , routing-area update upon change of service area.		MS↔RNS

61	Location report <i>{area identity, cause, request type, last known service area}</i> [25.413 §§ 8.20, 9.1.30] The UTRAN RNS signals the mobile station's location to the core network. <ul style="list-style-type: none"> • <i>Area identity</i> indicates the service area or geographic area in which the mobile station is located. • <i>Cause</i> indicates the reason for the report or the reason the location isn't available, <i>e.g.</i>, user restriction start indication, location-reporting congestion. • <i>Request type</i> is the same as the <i>request type</i> from the <i>location reporting control</i> message that instigated the report. • <i>Last known service area</i> is included, if known, and the requested information isn't available. 	RNS→CN RANAP
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4. UTRAN circuit handover to GERAN

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Figure 2 shows a UTRAN circuit handover to GERAN. This handover is similar to the one in § 3, with notable differences described in the table attached to figure 2. Because this section only describes significant differences, § 3 should probably be read first. For easy reference and comparison, line numbers in figure 2 match the line numbers of equivalent messages in figure 1.

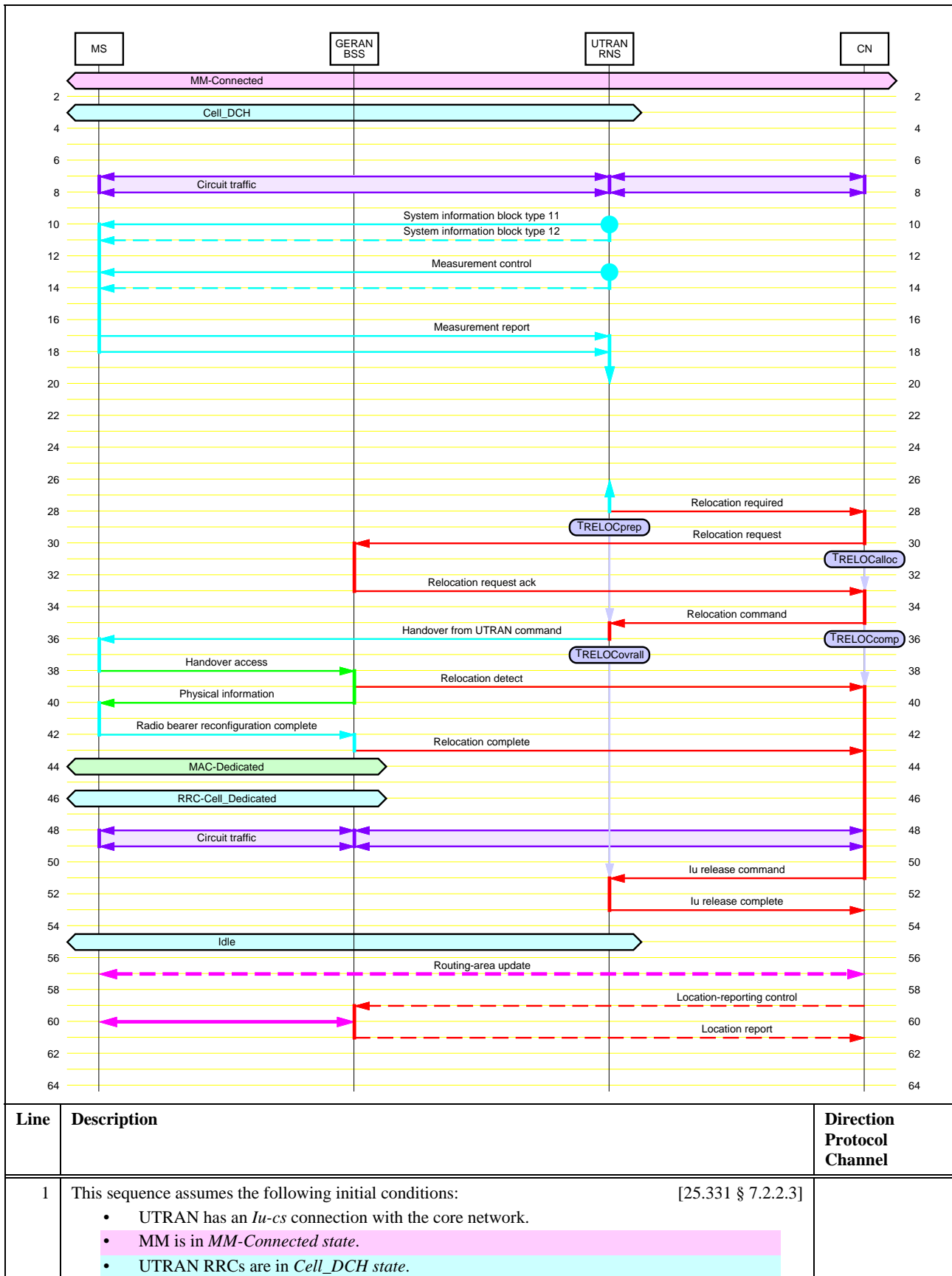
3

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5

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Figure 2: UTRAN circuit handover to GERAN



7	<p>Circuit traffic</p> <p>The mobile station and the core network exchange user traffic via a dedicated connection between MS and UTRAN RNS and a circuit connection between UTRAN RNS and CN.</p>	<p>MS↔RNS RNS↔CN</p> <p>null AAL2 DTCH</p>
Report measurements		
10	<p>System information block type 11 (SIB11) [25.331 §§ 8.1.1.6.11, 10.2.48.8.14] {<i>SIB12 indicator, FACH measurement occasion, measurement control system info</i>}</p> <p>System information block type 12 (SIB12) [25.331 §§ 8.1.1.6.12, 10.2.48.8.15] {<i>FACH measurement occasion, measurement control system info</i>}</p> <p>The UTRAN RNS provides information on the serving cell and neighbouring cells. The UTRAN RNS broadcasts SIB11, and optionally SIB12. If SIB12 is broadcast, SIB11 provides information applicable to <i>idle mode</i> and SIB12 provides information applicable to <i>connected mode</i>. Otherwise, SIB11 provides information applicable to <i>idle mode</i> and <i>connected mode</i>.</p> <ul style="list-style-type: none"> • <i>SIB12 indicator</i> indicates whether the SIB12 message is broadcast. • <i>FACH measurement occasion</i> indicates the radio access technologies on which measurements shall be made. In this case, measurements will be made on GSM. • <i>Measurement control system info</i> provides information needed to perform the measurements. In this case, it includes information on GSM cells, <i>e.g.</i>, BSIC, band, BCCH frequency. 	<p>MS←RNS UTRAN RRC BCCH</p>
13	<p>Measurement control [25.331 § 8.4.1, 10.2.17] {<i>RRC transaction identifier, integrity check info, measurement identity, measurement command, measurement reporting mode, additional measurements list, measurement type</i>}</p> <p>The UTRAN RNS sets up, modifies, or releases mobile-station measurements.</p> <ul style="list-style-type: none"> • <i>RRC transaction identifier</i> identifies the particular RRC transaction for this message. • <i>Integrity check info</i> contains the <i>message authentication code</i> and <i>RRC-message sequence number</i> needed for the integrity-protection algorithm. • <i>Measurement identity</i> identifies the particular measurement for future modification, release, or reporting. • <i>Measurement command</i> indicates whether the message is for setup, modification, or release. • <i>Measurement reporting mode</i> indicates whether acknowledged or unacknowledged RLC shall be used and whether periodical or event-triggered reporting shall be used. • <i>Additional measurements list</i> indicates by <i>measurement identity</i> the additional measurements that shall be reported with this measurement. • <i>Measurement type</i> indicates the type of measurement and its attributes, <i>e.g.</i>, intrafrequency measurement, inter-RAT measurement, positioning measurement, traffic measurement. In this case, an inter-RAT measurement applies. 	<p>MS←RNS UTRAN RRC DCCH (SRB2)</p>
17	<p>Measurement report [25.331 §§ 8.4.2, 10.2.19] {<i>integrity check info, measurement identity, measured results, measured results on RACH, additional measured results, event results, GSM OTD reference cell</i>}</p> <p>The mobile station sends measurement reports to the UTRAN RNS.</p> <ul style="list-style-type: none"> • <i>Integrity check info</i> contains the <i>message authentication code</i> and <i>RRC-message sequence number</i> needed for the integrity-protection algorithm. • <i>Measurement identity</i> identifies the particular measurement. • <i>Measured results</i> reports results for this measurement identity. In this case, it reports inter-RAT measurements. • <i>Measured results on RACH</i> reports results for RACH measurements. • <i>Additional measured results</i> reports results for additional measurements requested by the <i>additional measurements list</i> from the <i>measurement control</i> message. • <i>Event results</i> characterizes the event that triggered the report. • <i>GSM OTD reference cell</i> is used when reporting observed time differences for GSM cells. 	<p>MS→RNS UTRAN RRC DCCH (SRB1 or SRB2)</p>

Prepare relocation		
28	<p>Relocation required [25.413 §§ 8.6, 9.1.9; 44.118 § 11.1] <i>{relocation type, cause, source ID, target ID, MS classmark 2, MS classmark 3, source-to-target transparent container, GERAN classmark}</i></p> <ul style="list-style-type: none"> <i>Source-to-target transparent container</i> contains information the UTRAN RNS needs to transfer to the GERAN BSS, e.g., RRC information and number of <i>Iu</i> instances. This scenario assumes a single <i>Iu</i> instance to the circuit domain, i.e., <i>Iu</i>-cs. For intrasystem relocations, this container includes integrity-protection and ciphering information (the selected key and algorithm for each). The RRC information is the <i>RRC information to target GERAN Iu mode BSS container</i>, which contains the <i>SBSS relocation info</i> message. This message includes MS radio-access capabilities. <44.118 isn't clear which RRC message the RNS sends in the container: <i>inter RAT or mode handover info with MS capabilities or SBSS relocation info</i>.> <i>GERAN classmark</i> indicates the capabilities of the target GERAN BSS. It comprises a list of acceptable codecs, the maximum number of traffic channels, and a list of acceptable channel codings. 	RNS→CN RANAP
29	$T_{\text{RELOCprep}}$ [25.413 §§ 8.6, 9.5]	RNS RANAP
30	<p>Relocation request [25.413 §§ 8.7, 9.1.10] <i>{UE identity, cause, CN domain indicator, source-to-target transparent container, RABs to be setup, integrity-protection info, encryption info, Iu signalling connection identifier, Global CNid, SNA access info}</i></p> <ul style="list-style-type: none"> <i>RABs to be setup</i> identifies RABs to be established and their attributes. For each RAB to be setup, this information element includes a <i>GERAN BSC container</i>. The <i>GERAN BSC container</i> indicates the selected codec type, allowed channel codings, and maximum number of traffic channels. If the target BSS cannot allocate appropriate resources, it returns a <i>relocation failure</i> message containing a <i>GERAN classmark</i>. The CN may initiate another relocation attempt taking into account this <i>GERAN classmark</i>. 	BSS←CN RANAP
31	$T_{\text{RELOCalloc}}$ [25.413 §§ 8.7, 9.5]	CN RANAP
33	<p>Relocation request acknowledge [25.413 §§ 8.7, 9.1.11; 44.118 § 11.1] <i>{target-to-source transparent container, new-BSS-to-old-BSS info, RABs setup, RABs failed setup, chosen integrity-protection algorithm, chosen encryption algorithm}</i></p> <ul style="list-style-type: none"> <i>Target-to-source transparent container</i> is the <i>RRC information target BSS to source BSS container</i>, which contains the <i>radio bearer reconfiguration</i> message that will be sent to the mobile station. 	BSS→CN RANAP
35	<p>Relocation command [25.413 §§ 8.6, 9.1.12] <i>{target-to-source transparent container, intersystem info transparent container, RABs to be released, RABs subject to data forwarding}</i></p>	RNS←CN RANAP
36	$T_{\text{RELOCcomplete}}$ [25.413 §§ 8.6, 9.5]	CN RANAP
Handover		
36	<p>Handover from UTRAN command [25.331 §§ 8.3.7, 10.2.15, 48.118 § 7.14.1] <i>{RRC transaction identifier, integrity check info, activation time, RAB info, system type}</i></p> <p>The UTRAN RNS hands the mobile station over to GERAN.</p> <ul style="list-style-type: none"> <i>RRC transaction identifier</i> identifies the particular RRC transaction for this message. <i>Integrity-check info</i> contains the <i>message authentication code</i> and <i>RRC message sequence number</i> needed for integrity-protection algorithms. <i>Activation time</i> indicates the frame number when the command takes effect. <i>RAB info</i> identifies each RAB and indicates its CN domain (circuit or packet). For handover to GERAN, this information element is not used: the handover command contained within <i>system type</i> provides the RAB info. <i>System type</i> indicates the radio access technology to which the handover is targetted, and it contains the handover command, <i>radio bearer reconfiguration</i>, issued by the target BSS. <25.331 § 8.3.7.3 specifies the <i>inter-RAT message information element contains the radio bearer reconfiguration message</i>. There is no such information element.> 	MS←RNS UTRAN RRC DCCH (SRB2)
37	$T_{\text{RELOCoverall}}$ [25.413 §§ 8.6, 9.5]	RNS RANAP

38	Handover access <i>{handover reference}</i> The mobile station sends <i>handover access</i> messages until the BSS sends timing-advance information. <ul style="list-style-type: none"> <i>Handover reference</i> identifies the handover. 	[44.060 § 11.2.33; 44.118 § 7.18.6; 44.160 § 9.3a]	MS→BSS MAC FACCH, PACCH, or SDCCH
39	Relocation detect <i>{}</i> The GERAN BSS indicates it has detected <i>handover access</i> messages from the mobile station.	[25.413 §§ 8.8, 9.1.13]	BSS→CN RANAP
40	Physical information <i>{timing advance}</i> The GERAN BSS provides timing advance. <ul style="list-style-type: none"> <i>Timing advance</i> indicates the amount of time the mobile station shall advance transmission of its uplink bursts so that the BSS receives these bursts at the proper time. 	[44.060 § 11.2.34; 44.118 § 7.18.6; 44.160 § 9.3a]	MS←BSS MAC FACCH, PACCH, or SDCCH
42	Radio bearer reconfiguration complete <i>(RRC transaction identifier, integrity check info, uplink integrity protection activation info, mobile observed time difference, COUNT-C activation time, RB uplink ciphering activation time info, uplink counter sync info)</i> The mobile station indicates the handover is complete. <ul style="list-style-type: none"> <i>RRC transaction identifier</i> is the same value as the <i>RRC transaction identifier</i> in the <i>handover command</i> contained in the <i>intersystem from UTRAN handover command</i>. <i>Integrity check info</i> contains the <i>message authentication code</i> and <i>RRC message sequence number</i> needed for integrity-protection algorithms. <i>Uplink integrity protection activation info</i> indicates when new integrity protection shall be activated for the signalling radio bearers. <i>Mobile observed time difference</i> reports the synchronization difference between the UTRAN RNS and GERAN BSS. <i>COUNT-C activation time</i> indicates the frame number when the command takes effect. <i>RB uplink ciphering activation time info</i> indicates for each radio bearer when to activate the ciphering configuration. It is expressed in terms of RLC sequence number. <i>Uplink counter sync info</i> provides information for synchronizing the uplink security counters. 	[44.118 §§ 7.14.1, 9.2.29]	MS→BSS GERAN RRC FACCH (SRB2)
43	Relocation complete <i>{}</i>	[25.413 §§ 8.9, 9.1.14]	BSS→CN RANAP
44	MAC-Dedicated The GERAN MACs enter <i>MAC-Dedicated state</i> .	[44.160 § 5.3.4]	
46	RRC-Cell_Dedicated The GERAN RRCs enter <i>RRC-Cell_Dedicated state</i> .	[44.118 § 6.4.3]	
48	Circuit traffic		MS↔BSS BSS↔CN null AAL2 TCH
Release old connections			
51	Iu release command <i>{cause}</i>	[25.413 §§ 8.5, 9.1.7]	RNS←CN RANAP
53	Iu release complete <i>{RABs data volume report, RABs released}</i>	[25.413 §§ 8.5, 9.1.8]	RNS→CN RANAP
55	Idle The UTRAN RRCs enter <i>Idle mode</i> . The RNS may stop execution of the RRC process for this mobile station.	[25.331 § 7.2.1]	
57	Routing-area update If MS determines it is in a new routing area, it initiates a routing-area update.		MS↔CN MM PDTCH (SRB3)

59	Location reporting control <i>{request type, vertical accuracy code, response time, positioning priority, client type}</i>	[25.413 §§ 8.19, 9.1.29]	BSS←CN RANAP
60	The mobile station initiates an event that triggers the location report, <i>e.g.</i> , routing-area update upon change of service area.		MS↔BSS
61	Location report <i>{area identity, cause, request type, last known service area}</i>	[25.413 §§ 8.20, 9.1.30]	BSS→CN RANAP

1

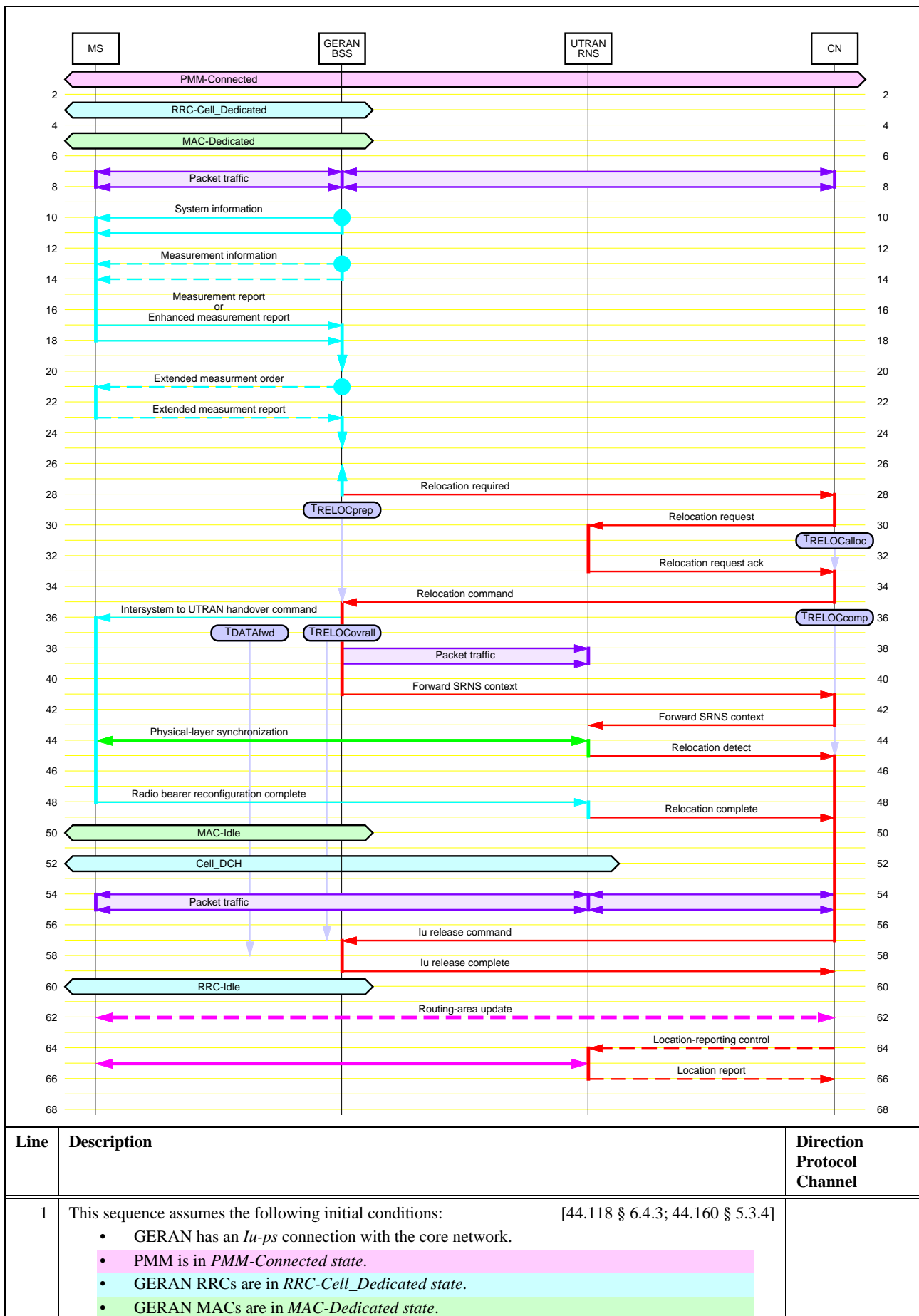
2

5. GERAN packet handover to UTRAN

3

Figure 3 shows a GERAN packet handover to UTRAN.

Figure 3: GERAN packet handover to UTRAN



7	<p>Packet traffic</p> <p>The mobile station and the core network exchange user traffic via a dedicated connection between MS and GERAN BSS and a packet connection between GERAN BSS and CN.</p>	<p>MS↔BSS BSS↔CN PDCP GTP-U PDTCH</p>
Report normal or enhanced measurements		
10	<p>System information (SI5, SI5bis, SI5ter, SI6) [44.118 §§ 9.2.51 to 9.2.54]</p> <p>The GERAN BSS provides information on the serving cell and neighbouring cells. The GERAN BSS sends SI5 and SI6, and optionally SI5bis and SI5ter, when no other RRC message has to be sent.</p>	<p>MS←BSS GERAN RRC SACCH (SRB1)</p>
13	<p>Measurement information [44.118 §§ 7.9, 9.2.22] {BA ind, 3G BA ind, MP change mark, MI index, MI count, report type, report rate, invalid BSIC reporting, BSIC neighbour description, measurement parameters, 3G neighbour cell description, 3G measurement parameters}</p> <p>The GERAN BSS may configure the mobile station's measurement reporting using one or more <i>measurement information</i> messages.</p> <ul style="list-style-type: none"> • <i>BA ind</i> indicates whether the mobile station shall rebuild the 2G neighbour list. • <i>3G BA ind</i> indicates whether the mobile station shall rebuild the 3G neighbour list. • <i>MP change mark</i> indicates whether the mobile station shall reread important measurement parameters. • <i>MI index</i> indicates the individual message in a sequence of <i>measurement information</i> messages. • <i>MI count</i> indicates the total number of <i>measurement information</i> messages in a sequence. • <i>Report type</i> indicates whether the mobile station shall use enhanced reports or normal reports. • <i>Report rate</i> indicates whether the mobile station shall use SACCH-rate reporting or reduced-rate reporting. • <i>Invalid BSIC reporting</i> indicates whether the mobile station shall report measurements for cells with invalid BSICs. • <i>BSIC neighbour description</i> indicates the 2G neighbour cells to be measured. • <i>Measurement parameters</i> indicates the parameters to be measured for each 2G cell. • <i>3G neighbour description</i> indicates the 3G neighbour cells to be measured. • <i>3G measurement parameters</i> indicates the parameters to be measured for each 3G cell. 	<p>MS←BSS GERAN RRC SACCH (SRB1)</p>
17	<p>Measurement report [44.118 §§ 7.9, 9.2.23] {measurement results}</p> <p>If the <i>measurement information</i> ordered the mobile station to use normal reports, the mobile station sends measurement reports to the GERAN BSS.</p> <ul style="list-style-type: none"> • <i>Measurement results</i> reports the mobile station's measurements of the serving cell and neighbouring cells. 	<p>MS→BSS GERAN RRC SACCH (SRB1)</p>
	<p>Enhanced measurement report [44.118 §§ 7.9, 9.2.7a] {BA used, 3G BA used, BSIC seen, scale, enhanced measurement results}</p> <p>If the <i>measurement information</i> ordered the mobile station to use enhanced reports, the mobile station sends enhanced measurement reports to the GERAN BSS.</p> <ul style="list-style-type: none"> • <i>BA used</i> indicates the value of <i>BA ind</i> that applies to the 2G neighbour list. • <i>3G BA used</i> indicates the value of <i>3G BA ind</i> that applies to the 3G neighbour list. • <i>BSIC seen</i> indicates whether one or more cells with an invalid BSIC is seen. • <i>Scale</i> indicates whether a 10 dB offset was applied to receive-level measurements. • <i>Enhanced measurement results</i> reports the mobile station's measurements of the serving cell and neighbouring cells. 	<p>MS→BSS GERAN RRC SACCH (SRB1)</p>
Report extended measurements		
21	<p>Extended measurement order [44.118 §§ 7.9, 9.2.6] {Extended measurement frequency list}</p> <p>The GERAN BSS orders the mobile station to send one extended measurement report.</p> <ul style="list-style-type: none"> • <i>Extended measurement frequency list</i> indicates the frequencies to be measured. 	<p>MS←BSS GERAN RRC SACCH (SRB1)</p>

23	<p>Extended measurement report [44.118 §§ 7.9, 9.2.7] <i>{Extended measurement results}</i></p> <p>The mobile station reports its extended measurements.</p> <ul style="list-style-type: none"> <i>Extended measurement results</i> reports the mobile station's measurements of the frequencies specified in the <i>extended measurement order</i>. 	<p>MS→BSS GERAN RRC SACCH (SRB1)</p>
Prepare relocation		
28	<p>Relocation required [25.413 §§ 8.6, 9.1.9; 25.331 § 14.12] <i>{relocation type, cause, source ID, target ID, MS classmark 2, MS classmark 3, source-to-target transparent container, GERAN classmark}</i></p> <p>Based on standard mobile-station measurement reports and non-standard internal algorithms, the GERAN BSS decides that handover is needed. The GERAN BSS determines that the handover will also require relocation to a UTRAN RNS. It signals the relocation requirement to the core network. This starts the relocation preparation. If the GERAN BSS also has an <i>Iu-cs</i> connection to the core network, it initiates a simultaneous relocation preparation for the circuit domain. The BSS decides whether to initiate an intrasystem or an intersystem relocation.</p> <ul style="list-style-type: none"> <i>Relocation type</i> indicates whether the mobile station is or is not involved in the BSS-to-RNS relocation. Because the mobile station is carrying traffic, it is involved. <i>Cause</i> indicates the reason for the relocation, <i>e.g.</i>, relocation desirable for radio reasons. <i>Source ID</i> identifies the source GERAN BSS. <i>Target ID</i> identifies the target UTRAN RNS. <i>MS classmark 2</i> indicates mobile-station capabilities. It is only required for handover to GERAN A/Gb mode. <i>MS classmark 3</i> indicates additional mobile-station capabilities. It is only required for handover to GERAN A/Gb mode. <i>Source-to-target transparent container</i> contains information the GERAN BSS needs to transfer to the UTRAN RNS, <i>e.g.</i>, RRC information and number of <i>Iu</i> instances. This scenario assumes a single <i>Iu</i> instance to the packet domain, <i>i.e.</i>, <i>Iu-ps</i>. For intrasystem relocations, this container includes integrity-protection and ciphering information (the selected key and algorithm for each). The RRC information is the <i>RRC information to target RNC container</i>, which contains the <i>SRNS relocation info</i> message. This message includes MS radio-access capabilities. <i>GERAN classmark</i> isn't needed for a relocation to a UTRAN RNS. 	<p>BSS→CN RANAP</p>
29	<p>$T_{\text{RELOCprep}}$ [25.413 §§ 8.6, 9.5]</p> <p>The GERAN BSS starts the relocation-preparation timer. It expects to receive a <i>relocation command</i> or a <i>relocation preparation failure</i> before the timer expires.</p>	<p>BSS RANAP</p>

30	<p>Relocation request [25.413 §§ 8.7, 9.1.10] <i>{UE identity, cause, CN domain indicator, source-to-target transparent container, RABs to be setup, integrity-protection info, encryption info, Iu signalling connection identifier, Global CNid, SNA access info}</i></p> <p>The core network requests the target RNS allocate resources for the handover.</p> <ul style="list-style-type: none"> • <i>UE identity</i> identifies the mobile station. • <i>Cause</i> indicates the reason for the relocation, e.g., relocation desirable for radio reasons. This is the same <i>cause</i> value included in the <i>relocation required</i> message. • <i>CN domain indicator</i> indicates packet domain. • <i>Source-to-target transparent container</i> contains the <i>source-to-target transparent container</i> from the <i>relocation required</i> message. • <i>RABs to be setup</i> identifies RABs to be established and their attributes. • <i>Integrity-protection info</i> identifies the integrity-protection algorithms, in preferred order, that may be used to protect signalling for intersystem relocations. (Intrasystem relocations use integrity-protection info provided in the <i>source-to-target transparent container</i>.) • <i>Encryption info</i> identifies the encryption algorithms, in preferred order, that may be used to cipher signalling for intersystem relocations. (Intrasystem relocations use encryption info provided in the <i>source-to-target transparent container</i>.) This information isn't included if <i>integrity protection info</i> isn't included. • <i>Iu signalling connection identifier</i> identifies the <i>Iu</i> signalling connection to this core-network node. The RNS stores this identifier for the duration of the connection. • <i>Global CNid</i> identifies the core-network node if it is not the default node for the RNS. If not included, the RNS shall assume the default core-network node originated the message. The RNS stores this identifier for the duration of the connection. • <i>SNA access info</i> identifies PLMNs and routing areas the mobile station is allowed to access. 	RNS←CN RANAP
31	<p>$T_{RELOCalloc}$ [25.413 §§ 8.7, 9.5] The core network starts the relocation-allocation timer. It expects to receive a <i>relocation request ack</i> or <i>relocation failure</i> before the timer expires.</p>	CN RANAP
33	<p>Relocation request acknowledge [25.413 §§ 8.7, 9.1.11; 25.331 §§ 10.2.27, 14.12] <i>{target-to-source transparent container, new-BSS-to-old-BSS info, RABs setup, RABs failed setup, chosen integrity-protection algorithm, chosen encryption algorithm}</i></p> <p>The target RNS acknowledges allocation of handover resources. The target RNS coordinates all <i>Iu-cs</i> and <i>Iu-ps</i> connections for the affected mobile station. It returns a <i>relocation request acknowledge</i> message to each core-network domain only after it has received and processed all expected <i>relocation request</i> messages as determined by the number of <i>Iu</i> instances signalled in the <i>source-to-target transparent container</i>.</p> <ul style="list-style-type: none"> • <i>Target-to-source transparent container</i> contains the <i>radio bearer reconfiguration</i> message that will be sent to the mobile station. If circuit and packet domains are involved in the relocation, the RNS should send the container via one domain: in this case, the packet domain. If the RNS sends the container via both domains, the containers shall be identical. • <i>New-BSS-to-old BSS info</i> provides information on downlink and uplink cell load. It is used for load-based intersystem handover. • <i>RABs setup</i> identifies RABs that were allocated resources, including any negotiated changes to RAB parameters. • <i>RABs failed setup</i> identifies RABs that were not allocated resources and the cause for the failed allocation. • <i>Chosen integrity-protection algorithm</i> identifies the integrity-protection algorithm chosen by the target RNS. The RNS includes this information if the core network included <i>integrity-protection info</i> in the <i>relocation request</i>. • <i>Chosen encryption algorithm</i> identifies the encryption algorithm chosen by the target RNS. The RNS includes this information if the core network included <i>encryption info</i> in the <i>relocation request</i>. 	RNS→CN RANAP

35	<p>Relocation command [25.413 §§ 8.6, 9.1.12] <i>{target-to-source transparent container, intersystem info transparent container, RABs to be released, RABs subject to data forwarding}</i></p> <p>The core network orders the source BSS to handover the mobile station to the target RNS. This completes the relocation preparation. If the GERAN BSS also has an <i>Iu-cs</i> connection to the core network, it waits for a <i>relocation command</i> on the <i>Iu-cs</i> interface before executing the handover.</p> <ul style="list-style-type: none"> • <i>Target-to-source transparent container</i> contains the <i>target-to-source transparent container</i> from the <i>relocation request acknowledge</i> message. • <i>Intersystem info transparent container</i> contains uplink and downlink cell-load information.. • <i>RABs to be released</i> identifies the RABs not supported by the target RNS. The source BSS may chose to cancel the relocation if this list is not to its liking. • <i>RABs subject to data forwarding</i> identifies RABs for which downlink user data shall be forwarded to the target RNS. It also indicates the RNS address and the tunnel endpoint identifier so the BSS knows where to forward the data. 	BSS←CN RANAP
36	<p>$T_{RELOCcomplete}$ [25.413 §§ 8.6, 9.5] The core network starts the relocation-complete timer. It expects to receive a <i>relocation complete</i> before the timer expires.</p>	CN RANAP
Handover		
36	<p>Intersystem to UTRAN handover command [25.331 §§ 8.2.2, 10.2.27; 44.118 §§ 7.10, 9.2.19] <i>{RRC transaction identifier, activation time, integrity-check info, integrity-protection-mode info, RAB info, handover to UTRAN command}</i></p> <p>The GERAN BSS hands the mobile station over to UTRAN. Prior to handover, it suspends data transfer for RABs that require delivery order.</p> <ul style="list-style-type: none"> • <i>RRC transaction identifier</i> identifies the particular RRC transaction for this message. • <i>Activation time</i> indicates the frame number when the command takes effect. • <i>Integrity-check info</i> contains the <i>message authentication code</i> and <i>RRC message sequence number</i> needed for integrity-protection algorithms. • <i>Integrity-protection-mode info</i> identifies the algorithm, start time, and initialization values. • <i>RAB info</i> identifies each RAB and indicates its CN domain (circuit or packet). • <i>Handover to UTRAN command</i> is the handover command issued by the target RNS and sent via the <i>target-to-source transparent container</i>. The handover command is a <i>radio bearer reconfiguration</i> message. It signals UE info, CN info, mobility info, radio-bearer info, and physical-layer info. The radio-bearer info and physical-layer info signal one of the following: <ul style="list-style-type: none"> • A complete configuration of radio bearers, transport channels, and physical channels. • A predefined configuration identity and physical-channel attributes. • A default configuration identity and physical-channel attributes. 	MS←BSS GERAN RRC PDTCH (SRB2)
37	<p>$T_{RELOCoverall}$ [25.413 §§ 8.6, 9.5] The GERAN BSS starts the relocation-overall timer. It expects to receive an <i>Iu release command</i> before the timer expires.</p> <p>$T_{DATAfwd}$ [25.413 §§ 8.6, 9.5] The GERAN BSS starts the data-forwarding timer. It will continue to forward data until the timer expires.</p>	BSS RANAP
38	<p>Packet traffic</p> <p>For RABS requiring data forwarding, the GERAN BSS forwards downlink packet traffic to the UTRAN RNS.</p>	BSS→RNS GTP-U
41	<p>Forward SRNS context [25.413 §§ 8.13, 9.1.22] <i>{RAB contexts, source RNC PDCP context info}</i></p> <p>The GERAN BSS sends GTP and PDCP contexts to the core network.</p> <ul style="list-style-type: none"> • <i>RAB contexts</i> indicates the next uplink GTP sequence numbers to be sent to the SGSN and the next downlink GTP sequence numbers to be sent to the mobile station. For radio bearers that use lossless PDCP, it also indicates the next uplink PDCP sequence numbers expected from the mobile station and the next downlink PDCP sequence numbers that would have been sent to the mobile station. • <i>Source RNC PDCP context info</i> transfers PDCP context information from source to target. 	BSS→CN RANAP

43	Forward SRNS context { <i>RAB contexts</i> , <i>source RNC PDCP context info</i> } [25.413 §§ 8.14, 9.1.22] The core network forwards GTP and PDCP contexts to the UTRAN RNS. <ul style="list-style-type: none"> <i>RAB contexts</i> indicates the next uplink GTP sequence numbers to be sent to the SGSN and the next downlink GTP sequence numbers to be sent to the mobile station. For radio bearers that use lossless PDCP, it also indicates the next uplink PDCP sequence numbers expected from the mobile station and the next downlink PDCP sequence numbers that would have been sent to the mobile station. <i>Source RNC PDCP context info</i> transfers PDCP context information from source to target. 	RNS←CN RANAP
44	Physical-layer synchronization [25.331 § 8.2.2.3] The MS and RNS synchronize their physical layers.	MS→RNS
45	Relocation detect { } [25.413 §§ 8.8, 9.1.13] The target RNS indicates it has detected the mobile station. If an <i>Iu-cs</i> connection and an <i>Iu-ps</i> connection will be established, the target RNS sends a <i>relocation detect</i> message to each core-network domain. The core network switches the user plane from the source BSS to the target RNS.	RNS→CN RANAP
48	Radio bearer reconfiguration complete { <i>UE info</i> , <i>RB info</i> } [25.331 §§ 8.2.2, 10.2.28] The mobile station indicates the handover is complete. <ul style="list-style-type: none"> <i>UE info</i> contains information such as RRC transaction identifier, integrity check info, and integrity protection info. <i>RB info</i> contains information such as ciphering activation time and uplink counter synchronization. 	MS→RNS UTRAN RRC PDTCH (SRB2)
49	Relocation complete { } [25.413 §§ 8.9, 9.1.14] The target RNS indicates the relocation is complete. If an <i>Iu-cs</i> connection and an <i>Iu-ps</i> connection will be established, the target RNS sends a <i>relocation complete</i> message to each core-network domain. If the core network has not yet received a relocation detect message, it switches the user plane from the source BSS to the target RNS.	RNS→CN RANAP
50	MAC-Idle [44.160 § 5.3.1] The GERAN MACs enter <i>MAC-Idle state</i> .	
52	Cell_DCH [25.331 § 7.2.2.3] The UTRAN RRCs enter <i>Cell_DCH state</i> .	
54	Packet traffic The mobile station and the core network now exchange user traffic via a dedicated connection between MS and UTRAN RNS and a packet connection between UTRAN RNS and CN.	MS↔RNS RNS↔CN PDCP GTP-U DTCH
Release old connections		
57	<i>Iu</i> release command { <i>cause</i> } [25.413 §§ 8.5, 9.1.7] The core network releases the <i>Iu-ps</i> connection to the source BSS. This also releases GERAN resources allocated to the mobile station. Any <i>Iu-cs</i> connection must be released separately. <ul style="list-style-type: none"> <i>Cause</i> indicates the reason for the release, <i>e.g.</i>, successful relocation. 	BSS←CN RANAP
59	<i>Iu</i> release complete { <i>RABs data volume report</i> , <i>RABs released</i> } [25.413 §§ 8.5, 9.1.8] After expiry of T_{DATAfwd} , the GERAN BSS confirms release of resources allocated to the mobile station. The BSS only releases resources needed for data forwarding after T_{DATAfwd} expires. Once the BSS has released, no user data can be transferred over the <i>Iu</i> interface. <ul style="list-style-type: none"> <i>RABs data volume report</i> reports data volume if this was requested during RAB establishment. <i>RABs released</i> isn't used for core-network-initiated releases. 	BSS→CN RANAP
60	RRC-Idle [44.118 § 6.4.1] The GERAN RRCs enter <i>RRC-Idle mode</i> . The BSS may stop execution of the RRC process for this mobile station.	

62	<p>Routing-area update</p> <p>If MS determines it is in a new routing area, it initiates a routing-area update.</p>	<p>MS↔CN</p> <p>PMM</p> <p>DCCH (SRB3)</p>
64	<p>Location reporting control [25.413 §§ 8.19, 9.1.29]</p> <p><i>{request type, vertical accuracy code, response time, positioning priority, client type}</i></p> <p>If the core network wants to maintain location reporting at change of service area, it sends an appropriate <i>location reporting control</i> message.</p> <ul style="list-style-type: none"> • <i>Request type</i> indicates whether to start direct reports, stop direct reports, start reports upon change of service area, or stop reports upon change of service area. It indicates the type of location information to report: service-area identifier or geographical area. If geographical area is to be reported, it may also indicate the horizontal accuracy to use. • <i>Vertical accuracy code</i> indicates the vertical accuracy to use for geographical reports. • <i>Response time</i> applies to direct reporting of geographical area. • <i>Positioning priority</i> indicates high or low priority. • <i>Client type</i> identifies the client type requesting the location information, <i>e.g.</i>, emergency services, value-added services, PLMN operator services, lawful intercept services. 	<p>RNS←CN</p> <p>RANAP</p>
65	<p>The mobile station initiates an event that triggers the location report, <i>e.g.</i>, routing-area update upon change of service area.</p>	<p>MS↔RNS</p>
66	<p>Location report [25.413 §§ 8.20, 9.1.30]</p> <p><i>{area identity, cause, request type, last known service area}</i></p> <p>The UTRAN RNS signals the mobile station's location to the core network.</p> <ul style="list-style-type: none"> • <i>Area identity</i> indicates the service area or geographic area in which the mobile station is located. • <i>Cause</i> indicates the reason for the report or the reason the location isn't available, <i>e.g.</i>, user restriction start indication, location-reporting congestion. • <i>Request type</i> is the same as the <i>request type</i> from the <i>location reporting control</i> message that instigated the report. • <i>Last known service area</i> is included, if known, and the requested information isn't available. 	<p>RNS→CN</p> <p>RANAP</p>

1

6. UTRAN packet handover to GERAN

2

Figure 4 shows a UTRAN packet handover to GERAN. This handover is similar to the one in § 5, with notable differences described in the table attached to figure 4. Because this section only describes significant differences, § 5 should probably be read first. For easy reference and comparison, line numbers in figure 4 match the line numbers of equivalent messages in figure 3.

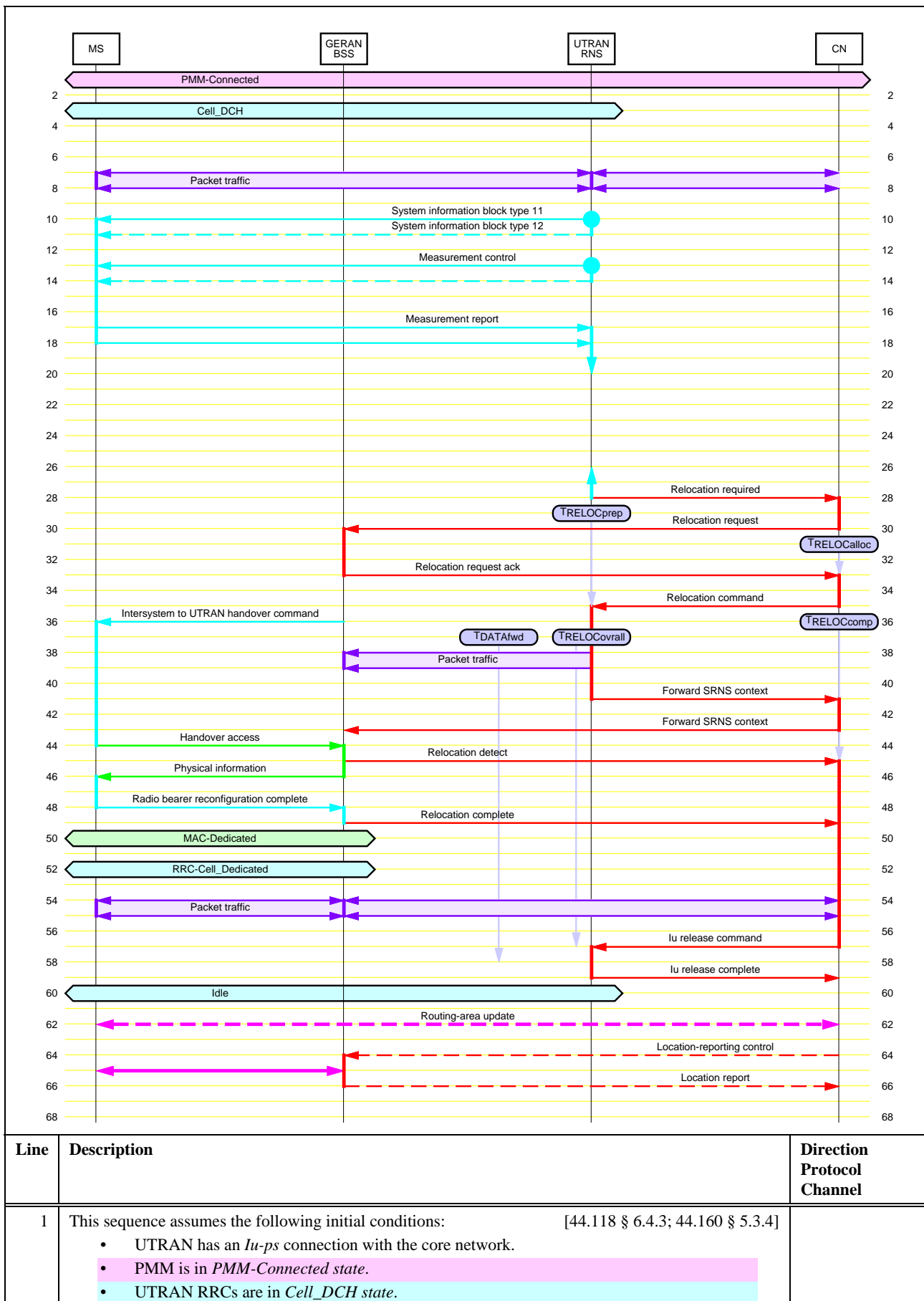
3

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Figure 4: UTRAN packet handover to GERAN



7	<p>Packet traffic</p> <p>The mobile station and the core network exchange user traffic via a dedicated connection between MS and UTRAN RNS and a packet connection between UTRAN RNS and CN.</p>	<p>MS↔RNS RNS↔CN PDCP GTP-U DTCH</p>
Report measurements		
10	<p>System information block type 11 (SIB11) [25.331 §§ 8.1.1.6.11, 10.2.48.8.14] {<i>SIB12 indicator, FACH measurement occasion, measurement control system info</i>}</p> <p>System information block type 12 (SIB12) [25.331 §§ 8.1.1.6.12, 10.2.48.8.15] {<i>FACH measurement occasion, measurement control system info</i>}</p> <p>The UTRAN RNS provides information on the serving cell and neighbouring cells. The UTRAN RNS broadcasts SIB11, and optionally SIB12. If SIB12 is broadcast, SIB11 provides information applicable to <i>idle mode</i> and SIB12 provides information applicable to <i>connected mode</i>. Otherwise, SIB11 provides information applicable to <i>idle mode</i> and <i>connected mode</i>.</p> <ul style="list-style-type: none"> • <i>SIB12 indicator</i> indicates whether the SIB12 message is broadcast. • <i>FACH measurement occasion</i> indicates the radio access technologies on which measurements shall be made. In this case, measurements will be made on GSM. • <i>Measurement control system info</i> provides information needed to perform the measurements. In this case, it includes information on GSM cells, <i>e.g.</i>, BSIC, band, BCCH frequency. 	<p>MS←RNS UTRAN RRC BCCH</p>
13	<p>Measurement control [25.331 § 8.4.1, 10.2.17] {<i>RRC transaction identifier, integrity check info, measurement identity, measurement command, measurement reporting mode, additional measurements list, measurement type</i>}</p> <p>The UTRAN RNS sets up, modifies, or releases mobile-station measurements.</p> <ul style="list-style-type: none"> • <i>RRC transaction identifier</i> identifies the particular RRC transaction for this message. • <i>Integrity check info</i> contains the <i>message authentication code</i> and <i>RRC-message sequence number</i> needed for the integrity-protection algorithm. • <i>Measurement identity</i> identifies the particular measurement for future modification, release, or reporting. • <i>Measurement command</i> indicates whether the message is for setup, modification, or release. • <i>Measurement reporting mode</i> indicates whether acknowledged or unacknowledged RLC shall be used and whether periodical or event-triggered reporting shall be used. • <i>Additional measurements list</i> indicates by <i>measurement identity</i> the additional measurements that shall be reported with this measurement. • <i>Measurement type</i> indicates the type of measurement and its attributes, <i>e.g.</i>, intrafrequency measurement, inter-RAT measurement, positioning measurement, traffic measurement. In this case, an inter-RAT measurement applies. 	<p>MS←RNS UTRAN RRC DCCH (SRB2)</p>
17	<p>Measurement report [25.331 §§ 8.4.2, 10.2.19] {<i>integrity check info, measurement identity, measured results, measured results on RACH, additional measured results, event results, GSM OTD reference cell</i>}</p> <p>The mobile station sends measurement reports to the UTRAN RNS.</p> <ul style="list-style-type: none"> • <i>Integrity check info</i> contains the <i>message authentication code</i> and <i>RRC-message sequence number</i> needed for the integrity-protection algorithm. • <i>Measurement identity</i> identifies the particular measurement. • <i>Measured results</i> reports results for this measurement identity. In this case, it reports inter-RAT measurements. • <i>Measured results on RACH</i> reports results for RACH measurements. • <i>Additional measured results</i> reports results for additional measurements requested by the <i>additional measurements list</i> from the <i>measurement control</i> message. • <i>Event results</i> characterizes the event that triggered the report. • <i>GSM OTD reference cell</i> is used when reporting observed time differences for GSM cells. 	<p>MS→RNS UTRAN RRC DCCH (SRB1 or SRB2)</p>

Prepare relocation		
28	<p>Relocation required [25.413 §§ 8.6, 9.1.9; 44.118 § 11.1] <i>{relocation type, cause, source ID, target ID, MS classmark 2, MS classmark 3, source-to-target transparent container, GERAN classmark}</i></p> <ul style="list-style-type: none"> <i>Source-to-target transparent container</i> contains information the UTRAN RNS needs to transfer to the GERAN BSS, e.g., RRC information and number of <i>Iu</i> instances. This scenario assumes a single <i>Iu</i> instance to the packet domain, i.e., <i>Iu-ps</i>. For intrasystem relocations, this container includes integrity-protection and ciphering information (the selected key and algorithm for each). The RRC information is the <i>RRC information to target GERAN Iu mode BSS container</i>, which contains the <i>SBSS relocation info</i> message. This message includes MS radio-access capabilities. <i>GERAN classmark</i> indicates the capabilities of the target GERAN BSS. It comprises a list of acceptable codecs, the maximum number of traffic channels, and a list of acceptable channel codings. This information isn't needed for packet domain. 	RNS→CN RANAP
29	<p>$T_{\text{RELOCprep}}$ [25.413 §§ 8.6, 9.5]</p>	RNS RANAP
30	<p>Relocation request [25.413 §§ 8.7, 9.1.10] <i>{UE identity, cause, CN domain indicator, source-to-target transparent container, RABs to be setup, integrity-protection info, encryption info, Iu signalling connection identifier, Global CNid, SNA access info}</i></p> <ul style="list-style-type: none"> <i>RABs to be setup</i> identifies RABs to be established and their attributes. For each RAB to be setup in the packet domain, a <i>GERAN BSC container</i> isn't needed. (The <i>GERAN BSC container</i> indicates the selected codec type, allowed channel codings, and maximum number of traffic channels.) If the target BSS cannot allocate appropriate resources, it returns a <i>relocation failure</i> message. 	BSS←CN RANAP
31	<p>$T_{\text{RELOCalloc}}$ [25.413 §§ 8.7, 9.5]</p>	CN RANAP
33	<p>Relocation request acknowledge [25.413 §§ 8.7, 9.1.11; 44.118 § 11.1] <i>{target-to-source transparent container, new-BSS-to-old-BSS info, RABs setup, RABs failed setup, chosen integrity-protection algorithm, chosen encryption algorithm}</i></p> <ul style="list-style-type: none"> <i>Target-to-source transparent container</i> is the <i>RRC information target BSS to source BSS container</i>, which contains the <i>radio bearer reconfiguration</i> message that will be sent to the mobile station. 	BSS→CN RANAP
35	<p>Relocation command [25.413 §§ 8.6, 9.1.12] <i>{target-to-source transparent container, intersystem info transparent container, RABs to be released, RABs subject to data forwarding}</i></p>	RNS←CN RANAP
36	<p>$T_{\text{RELOCcomplete}}$ [25.413 §§ 8.6, 9.5]</p>	CN RANAP
Handover		
36	<p>Handover from UTRAN command [25.331 §§ 8.3.7, 10.2.15, 48.118 § 7.14.1] <i>{RRC transaction identifier, integrity check info, activation time, RAB info, system type}</i></p> <p>The UTRAN RNS hands the mobile station over to GERAN.</p> <ul style="list-style-type: none"> <i>RRC transaction identifier</i> identifies the particular RRC transaction for this message. <i>Integrity-check info</i> contains the <i>message authentication code</i> and <i>RRC message sequence number</i> needed for integrity-protection algorithms. <i>Activation time</i> indicates the frame number when the command takes effect. <i>Integrity-protection-mode info</i> identifies the algorithm, start time, and initialization values. <i>RAB info</i> identifies each RAB and indicates its CN domain (circuit or packet). For handover to GERAN, this information element is not used: the handover command contained within <i>system type</i> provides the RAB info <i>System type</i> indicates the radio access technology to which the handover is targetted, and it contains the handover command, <i>radio bearer reconfiguration</i>, issued by the target BSS. 	MS←RNS UTRAN RRC DCCH (SRB2)
37	<p>$T_{\text{RELOCoverall}}$ [25.413 §§ 8.6, 9.5] T_{DATAfwd} [25.413 §§ 8.6, 9.5]</p>	BSS RANAP
38	<p>Packet traffic</p> <p>For RABS requiring data forwarding, the UTRAN RNS forwards downlink packet traffic to the GERAN BSS.</p>	BSS→RNS GTP-U

41	Forward SRNS context { <i>RAB contexts, source RNC PDCP context info</i> }	[25.413 §§ 8.13, 9.1.22]	RNS→CN RANAP
43	Forward SRNS context { <i>RAB contexts, source RNC PDCP context info</i> }	[25.413 §§ 8.14, 9.1.22]	BSS←CN RANAP
44	Handover access { <i>handover reference</i> } The mobile station sends <i>handover access</i> messages until the BSS sends timing-advance information. • <i>Handover reference</i> identifies the handover.	[44.060 § 11.2.33; 44.118 § 7.18.6; 44.160 § 9.3a]	MS→BSS MAC PACCH or SDCCH
45	Relocation detect {}	[25.413 §§ 8.8, 9.1.13]	BSS→CN RANAP
46	Physical information { <i>timing advance</i> } The GERAN BSS provides timing advance. • <i>Timing advance</i> indicates the amount of time the mobile station shall advance transmission of its uplink bursts so that the BSS receives these bursts at the proper time.	[44.060 § 11.2.34; 44.118 § 7.18.6; 44.160 § 9.3a]	MS←BSS MAC PACCH or SDCCH
48	Radio bearer reconfiguration complete { <i>RRC transaction identifier, integrity check info, uplink integrity protection activation info, mobile observed time difference, COUNT-C activation time, RB uplink ciphering activation time info, uplink counter sync info</i> } The mobile station indicates the handover is complete. • <i>RRC transaction identifier</i> is the same value as the <i>RRC transaction identifier</i> in the <i>handover command</i> contained in the <i>intersystem from UTRAN handover command</i> . • <i>Integrity check info</i> contains the <i>message authentication code</i> and <i>RRC message sequence number</i> needed for integrity-protection algorithms. • <i>Uplink integrity protection activation info</i> indicates when new integrity protection shall be activated for the signalling radio bearers. • <i>Mobile observed time difference</i> reports the synchronization difference between the UTRAN RNS and GERAN BSS. • <i>COUNT-C activation time</i> indicates the frame number when the command takes effect. • <i>RB uplink ciphering activation time info</i> indicates for each radio bearer when to activate the ciphering configuration. It is expressed in terms of RLC sequence number. • <i>Uplink counter sync info</i> provides information for synchronizing the uplink security counters.	[44.118 § 9.2.29]	MS→BSS GERAN RRC PDTCH (SRB2)
49	Relocation complete {}	[25.413 §§ 8.9, 9.1.14]	BSS→CN RANAP
50	MAC-Dedicated The GERAN MACs enter <i>MAC-Dedicated state</i> .	[44.160 § 5.3.4]	
52	RRC-Cell_Dedicated The GERAN RRCs enter <i>RRC-Cell_Dedicated state</i> .	[44.118 § 6.4.3]	
54	Packet traffic		MS↔RNS RNS↔CN PDCP GTP-U DTCH
Release old connections			
57	Iu release command { <i>cause</i> }	[25.413 §§ 8.5, 9.1.7]	RNS←CN RANAP
59	Iu release complete { <i>RABs data volume report, RABs released</i> }	[25.413 §§ 8.5, 9.1.8]	RNS→CN RANAP
60	Idle The UTRAN RRCs enter <i>Idle mode</i> . The RNS may stop execution of the RRC process for this mobile station.	[25.331 § 7.2.1]	

62	Routing-area update	MS↔CN PMM PDTCH (SRB3)
64	Location reporting control <i>{request type, vertical accuracy code, response time, positioning priority, client type}</i>	[25.413 §§ 8.19, 9.1.29] BSS←CN RANAP
65	The mobile station initiates an event that triggers the location report, <i>e.g.</i> , routing-area update upon change of service area.	MS↔BSS
66	Location report <i>{area identity, cause, request type, last known service area}</i>	[25.413 §§ 8.20, 9.1.30] BSS→CN RANAP

7. References

1. 3GPP TS 23.009. *3rd Generation Partnership Project; Technical Specification Group Core Network; Handover procedures.*
2. 3GPP TS 23.060. *3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS); Service description; Stage 2.*
3. 3GPP TS 24.008. *3rd Generation Partnership Project; Technical Specification Group Core Network; Mobile radio interface Layer 3 specification; Core network protocols; Stage 3.*
4. 3GPP TS 25.331. *3rd Generation Partnership Project; Technical Specification Group Radio Access Network; RRC Protocol Specification.*
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6. 3GPP TR 25.931. *3rd Generation Partnership Project; Technical Specification Group RAN; UTRAN Functions, Examples on Signalling Procedures.*
7. 3GPP TS 43.051. *3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Overall description - Stage 2.*
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10. 3GPP TS 44.118. *3rd Generation Partnership Project; Technical Specification Group GSM EDGE Radio Access Network; Mobile radio interface layer 3 specification; Radio Resource Control Protocol; Iu mode.*
11. 3GPP TS 44.160. *3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; General Packet Radio Service (GPRS); Mobile Station (MS) – Base Station System (BSS) interface; Radio Link Control / Medium Access Control (RLC/MAC) protocol Iu mode.*