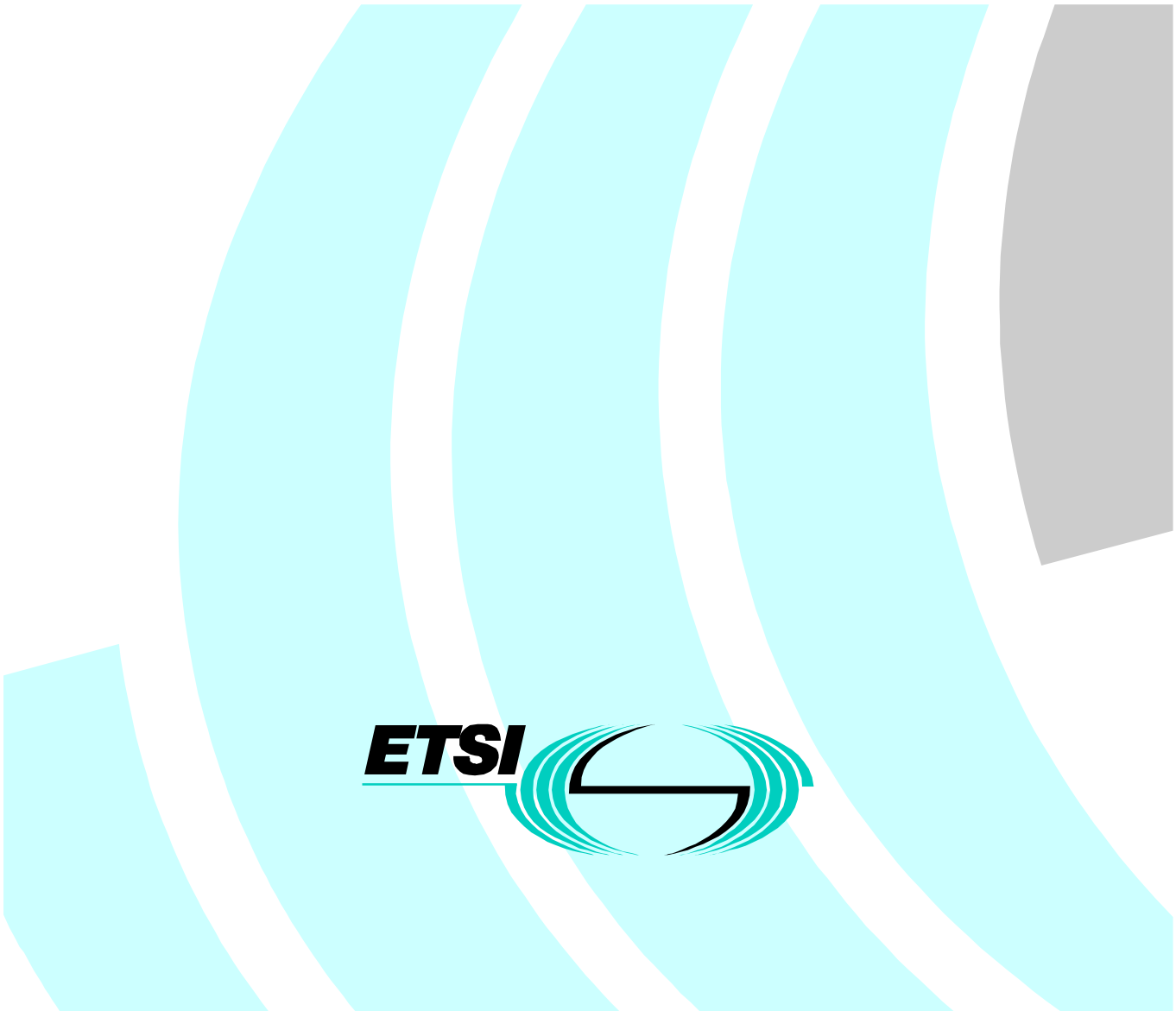
ETSI TS 101 376-3-18 V1.1.1 (2001-03)

Technical Specification

GEO-Mobile Radio Interface Specifications;
Part 3: Network specifications;
Sub-part 18: Terminal-to-Terminal Call (TtT);
GMR-1 03.296



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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Contents

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IPRs:

Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,226,084	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,715,365	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,826,222	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,754,974	US
TS 101 376 V1.1.1	Digital Voice Systems Inc		US	US 5,701,390	US

IPR Owner: Digital Voice Systems Inc
One Van de Graaff Drive Burlington,
MA 01803
USA

Contact: John C. Hardwick
Tel.: +1 781 270 1030
Fax: +1 781 270 0166

Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Ericsson Mobile Communication	Improvements in, or in relation to, equalisers	GB	GB 2 215 567	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Power Booster	GB	GB 2 251 768	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Receiver Gain	GB	GB 2 233 846	GB
TS 101 376 V1.1.1	Ericsson Mobile Communication	Transmitter Power Control for Radio Telephone System	GB	GB 2 233 517	GB

IPR Owner: Ericsson Mobile Communications (UK) Limited
The Keytech Centre, Ashwood Way
Basingstoke
Hampshire RG23 8BG
United Kingdom

Contact: John Watson
Tel.: +44 1256 864 821

Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Hughes Network Systems		US	Pending	US

IPR Owner: Hughes Network Systems
11717 Exploration Lane
Germantown, Maryland 20876
USA

Contact: John T. Whelan
Tel: +1 301 428 7172
Fax: +1 301 428 2802

Project	Company	Title	Country of Origin	Patent n°	Countries Applicable
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	2.4-to-3 KBPS Rate Adaptation Apparatus for Use in Narrowband Data and Facsimile Communication Systems	US	US 6,108,348	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Cellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic ThroughputCellular Spacecraft TDMA Communications System with Call Interrupt Coding System for Maximizing Traffic Throughput	US	US 5,717,686	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Enhanced Access Burst for Random Access Channels in TDMA Mobile Satellite System	US	US 5,875,182	
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,314	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System	US	US 5,974,315	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Mutual Offset High-argin Forward Control Signals	US	US 6,072,985	US
TS 101 376 V1.1.1	Lockheed Martin Global Telecommunic. Inc	Spacecraft Cellular Communication System with Spot Beam Pairing for Reduced Updates	US	US 6,118,998	US

IPR Owner: Lockheed Martin Global Telecommunications, Inc.
900 Forge Road
Norristown, PA. 19403
USA

Contact: R.F. Franciose
Tel.: +1 610 354 2535
Fax: +1 610 354 7244

Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

The contents of the present document are subject to continuing work within TC-SES and may change following formal TC-SES approval. Should TC-SES modify the contents of the present document it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 1.m.n

where:

- the third digit (n) is incremented when editorial only changes have been incorporated in the specification;
- the second digit (m) is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The present document is part 3, sub-part 18 of a multi-part deliverable covering the GEO-Mobile Radio Interface Specifications, as identified below:

Part 1: "General specifications";

Part 2: "Service specifications";

Part 3: "Network specifications";

Sub-part 1: "Network Functions; GMR-1 03.001";

Sub-part 2: "Network Architecture; GMR-1 03.002";

Sub-part 3: "Numbering, Addressing and identification; GMR-1 03.003";

Sub-part 4: "Organization of Subscriber Data; GMR-1 03.008";

Sub-part 5: "Technical realization of Supplementary Services; GMR-1 03.011";

Sub-part 6: "Location Registration and Position Identification Procedures; GMR-1 03.012";

Sub-part 7: "Discontinuous Reception (DRX); GMR-1 03.013";

Sub-part 8: "Support of Dual-Tone Multifrequency Signalling (DTMF); GMR-1 03.014";

Sub-part 9: "Security related Network Functions; GMR-1 03.020";

Sub-part 10: "Functions related to Mobile Earth station (MES) in idle mode; GMR-1 03.022";

Sub-part 11: "Technical realization of the Short Message Service (SMS) Point-to-Point (PP); GMR-1 03.040";

Sub-part 12: "Technical realization of the Short Message Service Cell Broadcast (SMSCB); GMR-1 03.041";

Sub-part 13: "Technical realization of group 3 facsimile using transparent mode of transmission; GMR-1 03.045";

Sub-part 14: "Transmission Planning Aspects of the Speech Service in the GMR-1 system; GMR-1 03.050";

Sub-part 15: "Line Identification supplementary service - Stage 2; GMR-1 03.081";

Sub-part 16: "Call Barring (CB) supplementary services - Stage 2; GMR-1 03.088";

Sub-part 17: "Unstructured Supplementary Service Data (USSD) - Stage 2; GMR-1 03.290";

Sub-part 18: "Terminal-to-Terminal Call (TtT); GMR-1 03.296";

Sub-part 19: "Optimal Routing technical realization; GMR-1 03.297";

Sub-part 20: "Technical realization of High-Penetration Alerting; GMR-1 03.298";

Sub-part 21: "Position Reporting services; Stage 2 Service description; GMR-1 03.299";

Part 4: "Radio interface protocol specifications";

Part 5: "Radio interface physical layer specifications";

Part 6: "Speech coding specifications";

Part 7: "Terminal adaptor specifications".

Introduction

GMR stands for GEO (Geostationary Earth Orbit) Mobile Radio interface, which is used for mobile satellite services (MSS) utilizing geostationary satellite(s). GMR is derived from the terrestrial digital cellular standard GSM and supports access to GSM core networks.

Due to the differences between terrestrial and satellite channels, some modifications to the GSM standard are necessary. Some GSM specifications are directly applicable, whereas others are applicable with modifications. Similarly, some GSM specifications do not apply, while some GMR specifications have no corresponding GSM specification.

Since GMR is derived from GSM, the organization of the GMR specifications closely follows that of GSM. The GMR numbers have been designed to correspond to the GSM numbering system. All GMR specifications are allocated a unique GMR number as follows:

GMR-n xx.zyy

where:

- xx.0yy (z = 0) is used for GMR specifications that have a corresponding GSM specification. In this case, the numbers xx and yy correspond to the GSM numbering scheme.
- xx.2yy (z = 2) is used for GMR specifications that do not correspond to a GSM specification. In this case, only the number xx corresponds to the GSM numbering scheme and the number yy is allocated by GMR.
- N denotes the first (n = 1) or second (n = 2) family of GMR specifications.

A GMR system is defined by the combination of a family of GMR specifications and GSM specifications as follows:

- If a GMR specification exists it takes precedence over the corresponding GSM specification (if any). This precedence rule applies to any references in the corresponding GSM specifications.

NOTE: Any references to GSM specifications within the GMR specifications are not subject to this precedence rule. For example, a GMR specification may contain specific references to the corresponding GSM specification.

- If a GMR specification does not exist, the corresponding GSM specification may or may not apply. The applicability of the GSM specifications is defined in GMR-1 01.201 [2].

1 Scope

The present document describes the process of call establishment and call termination in the GMR-1 Mobile Satellite System, where the call is a Terminal-to-Terminal (TtT) call. The present document presents a unified view of all the processes that are involved in TtT call establishment, and identifies the impacts on the call establishment that are due specifically to the TtT nature of the call.

The TtT call can be established in either single-hop mode or double-hop mode.

In the single-hop mode two MESs engaged in a call communicate directly via satellite on a circuit switched L-L channel at the satellite.

The single-hop mode call is established only for a voice call. The TtT double-hop mode call is established between two MESs for data, fax, and some voice calls when MESs are in geographically restricted positions.

The GMR-1 network supports two types of TtT double-hop calls:

- Where only one Gateway Station (GS) is in use and both Mobile Earth Stations (MESs) are registered at a common GS.
- Where two GSs are in use and each MES is registered at a different GS.

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 and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] GMR-1 01.004 (ETSI TS 101 376-1-1): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 1: Abbreviations and acronyms; GMR-1 01.004".

[2] GMR-1 01.201 (ETSI TS 101 376-1-2): "GEO-Mobile Radio Interface Specifications; Part 1: General specifications; Sub-part 2: Introduction to the GMR-1 Family; GMR-1 01.201".

[3] GMR-1 03.014 (ETSI TS 101 376-3-8): "GEO-Mobile Radio Interface Specifications; Part 3: Network specifications; Sub-part 8: Support of Dual-Tone Multifrequency Signalling (DTMF); GMR-1 03.014".

[4] GMR-1 03.020 (ETSI TS 101 376-3-9): "GEO-Mobile Radio Interface Specifications; Part 3: Network specifications; Sub-part 9: Security related Network Functions; GMR-1 03.020".

[5] GMR-1 03.297 (ETSI TS 101 376-3-19): "GEO-Mobile Radio Interface Specifications; Part 3: Network specifications; Sub-part 19: Optimal Routing technical realization; GMR -1 03.297".

[6] GMR-1 04.008 (ETSI TS 101 376-4-8): "GEO-Mobile Radio Interface Specifications; Part 4: Radio interface protocol specifications; Sub-part 8: Mobile Radio Interface Layer 3 Specifications; GMR-1 04.008".

[7] GMR-1 05.008 (ETSI TS 101 376-5-6): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 6: Radio Subsystem Link Control; GMR-1 05.008".

[8] GMR-1 05.010 (ETSI TS 101 376-5-7): "GEO-Mobile Radio Interface Specifications; Part 5: Radio interface physical layer specifications; Sub-part 7: Radio Subsystem Synchronisation; GMR-1 05.010".

3 Definitions

For the purposes of the present document, the terms and definitions given in GMR-1 01.004 [1] and the following apply.

MES(o): originating MES in the TtT call

MES(t): terminating MES terminal in the TtT call

Call Reference Id(o): unique value assigned by Traffic Control System (TCS) to identify the originating side of a TtT call

Call Reference Id(t): unique value assigned by TCS to identify the terminating side of the TtT call

GS(o): originating GS

GS(t): terminating GS

GSC(o1): Gateway Station Controller (GSC) within the originating GS(o) and initially associated with MES(o)

GSC(o2): GSC within the originating GS(o) and associated with the MES(t) for a single-hop call with a single GS only. It is not used when two GSs are used for a single-hop TtT call.

GSC(t1): GSC within the terminating GS(t) and associated with the MES(o)

GSC(t2): GSC within the terminating GS(t) and associated with the MES(t)

MSC(o): MSC within the originating GS

MSC(t): MSC within the terminating GS

TCS(o): TCS within the originating GS

TCS(t): TCS within the terminating GS

TtT channel: pair of L-L channels connected at the satellite, while MESs are performing signalling procedures on the assigned channel

TtT container: information element carried by COMPLETE L3 message with value User_Ref_ID(o)

TtT parameters: common ciphering key (Ktt), Terminal-to-Terminal Channel (TTCH), frame number operation, use of S1, S2, Keep-Alive Burst (KAB), etc

4 Main concepts

The GMR-1 network supports single-hop voice calls between two MESs on the same satellite network. The MES types involved in the call can be GMR-1 MESs or GMR-1/GSM (dual-mode) MESs. It does not matter whether the MESs are in their Home Public Land Mobile Network (HPLMN) or roaming. TtT calls are managed by the terminating GS. MESs accessing different GSs or different satellites are connected by first moving the originating MES to the terminating GS using the Optimal Routing procedure (see GMR-1 03.297 [5]).

During TtT call processing, the GS establishes a single-hop call between two MESs when circumstances permit. Otherwise the GS connects the MESs in a double-hop mode. The main steps in establishing a single-hop call are:

- The originating TCS recognizes the TtT call during the gateway selection procedure described in GMR -1 03.297 [5].

Optimal routing is performed when necessary to move the originating MES to the GS on which the terminating MES is registered. The terminating TCS is notified that the call is TtT.

The terminating GS establishes separate connections with each MES using independent ciphering keys (Kc1, Kc2).

The terminating GSC(t2) initiates a procedure for early assignment of traffic channels to MESs. In this procedure GSC(t2) and TCS(t) request the Advanced Operations Center (AOC) to cross-connect a new pair of L-L channels at the satellite.

On completion of the L-L connection procedure, GSC(t1) and GSC(t) initiate TTCH assignment procedure, which includes the transfer of the common ciphering key (Ktt) to both MESs and assignment of the TTCH and L-L channels connected at the satellite.

On successful completion of the TTCH assignment procedure, a single-hop voice call is established. The MES/network begin to perform the signalling, power control, and timing correction for the call over the TTCH.

5 Call processing

5.1 Call establishment

The following clauses describe the information flow during signalling as well as establishment of a voice path between two MESs for a single-hop TtT call in the GMR-1 system. In this scenario a GMR-1 subscriber MES(o) visiting at GS(o) calls a Global System for Mobile (GSM) subscriber MES(t) visiting the GMR-1 network at GS(t).

5.1.1 Network to originating MES

5.1.1.1 Gateway selection and radio resource allocation

Figure 5.1 shows the Immediate Assignment procedure on the originating side during a TtT call.

1) The MES(o) initiates an IMMEDIATE ASSIGNMENT procedure. In this procedure, the MES shall send a CHANNEL REQUEST on the Random Access Channel (RACH) with the called party number and shall wait for the IMMEDIATE ASSIGNMENT on the Access Grant Channel (AGCH) of the corresponding Common Control Channel (CCCH).

2) Upon receipt of the CHANNEL REQUEST message, the TCS(o) shall determine whether or not the called party number is GMR-1/GSM or a dual number of the cooperating network by analyzing the received called party number. In this case the TCS(o) shall send an IMMEDIATE ASSIGNMENT with a (PAUSE = True) indication to the MES(o).

3) The TCS(o) shall interrogate the called party Home Location Register (HLR) to determine the current location of the called MES(t), i.e., the Mobile Switching Center Identification (MSC ID) and Location Area Identifier (LAI) (optional) of the MES(t).

4) The TCS(o) shall perform the gateway selection procedure as described in GMR-1 03.297 [5]. If there are no restrictions, the TCS(o) identifies the call as TtT, allocates a traffic channel and additional TtT parameters (TTCH channel and additional TCH channel used in establishment of a single-hop call, TT_id), and transfers to the TCS(t) via the Intra-Network Communication Subsystem (INCS) messages.

5) The TCS(t) shall validate and assign the loaned resources to GSC(t1). The GSC(t1) shall activate the resources and acknowledge to the TCS(t). The TCS(t) in turn shall acknowledge to the TCS(o). The TCS(o), on receipt of acknowledgment of the transferred resources, shall compute timing, frequency, and power correction for the MES(o) and assign the allocated traffic channel (as described in step 2) to the MES(o) by sending the IMMEDIATE ASSIGNMENT (PAUSE = False) on the corresponding CCCH with an indication to initiate a location update. At the GS(t), the TCS(t) shall assign the resources and transfers the "*Call reference ID(o)*" to the selected GSC(t1) to identify the originating side of the TtT call.

6) The MES(o), on receipt of the IMMEDIATE ASSIGNMENT (PAUSE = FALSE), shall initiate a link establishment procedure on the assigned Traffic Channel (TCH) channel. In this procedure the MES(o) sends a Set Asynchronous Balanced Mode (SABM) and the GSC(t1) sends an Unnumbered Acknowledgment (UA) in response to the SABM message. On successful completion of the link establishment, the Radio Resource (RR) connection is known to be established between the MES(o) and the GS(t).

7) For the details of TtT call procedure with two satellites, please refer clause "MES-MES call with two satellite".

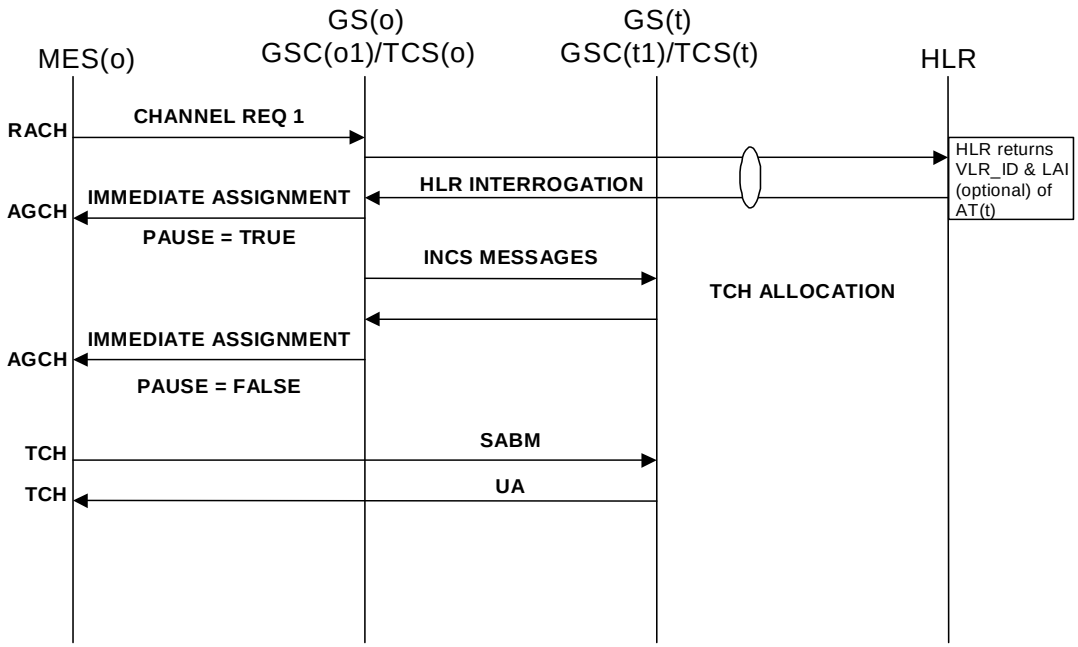

Figure 5.1: Channel assignment procedure (originating side)

5.1.1.2 Mobility management procedure

On successful establishment of the radio link, the MES(o) shall initiate the location update procedure (GMR-1 04.008 [6]) to get registered at the selected gateway GS(t). On successful completion of the registration procedure, the MES(o) shall establish a mobility management connection with the GS(t). In this procedure, the GSC(t1) shall mark the established RR connection as a TtT call type connection and start to intercept Direct Transfer Application Part (DTAP) messages, until the LOCATION UPDATE message is not received.

On receipt of the LOCATION UPDATE REQUEST (FOR = TRUE) message, the GSC(t1) shall fill the TtT container with the "*call reference ID(o)*" and deliver to the MSC during Signalling Connection Control Part (SCCP) connection establishment procedure. During this phase the GSC(t1) shall also transfer the GPS position in the Cell Identification (CI) field. The process requires that the MSC shall not release the SCCP connection at the end of the location update. The MES shall inform the MSC of this condition via the "Follow-on Request Pending" information element in the LOCATION UPDATING REQUEST message.

The following procedure and the diagram in figure 5.2 describe the location update procedure for an MES subscriber when initiating a call to a destination that requires the MES subscriber to be reregistered.

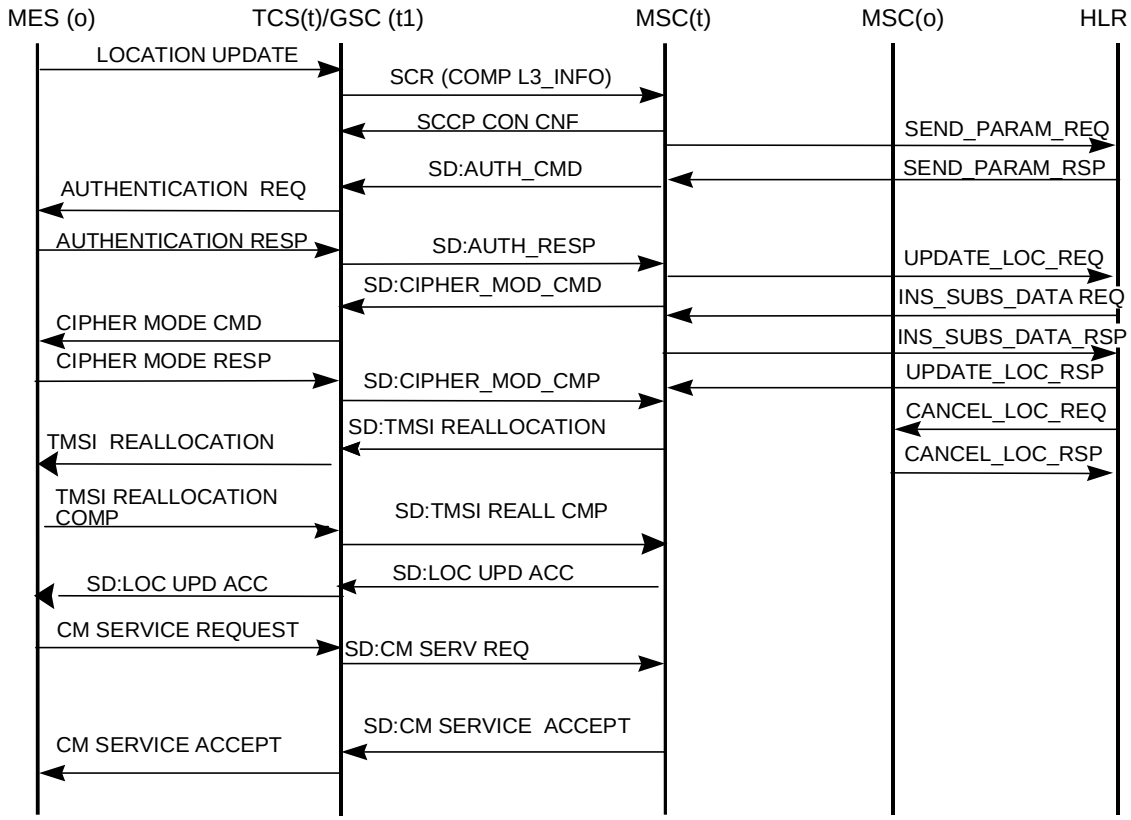

Figure 5.2: MM connection establishment (originating side)

1) The MES(o) shall send a LOCATION UPDATE message with (FOR = true) to the MSC of the selected gateway.

2) The GSC(t1) shall establish a SCCP connection request. In this procedure the GSC(t1) transfers the COMPLETE LAYER 3 message to the MSC (see figure 5.2). The main parameters of the COMPLETE LAYER 3 message are the L3 message (LOCATION UPDATE), the TtT container with call reference Id(o)and the Global Positioning System (GPS) position, (region in which MES is located).

3) The MSC shall initiate the authentication procedure by sending the AUTHENTICATION REQ message, which is a DTAP message that passes transparently through the GSC. The MES(o) responds with the AUTHENTICATION RESPONSE, which again is a DTAP message and passes transparently via the GSC to the MSC.

4) The MSC shall then initiate the ciphering procedure by sending a CIPHER MODE COMMAND to the GSC(t1). After the procedure is completed, the GSC(t1) shall inform the MSC about the completion of the procedure.

5) The MSC shall transfer the Temporary Mobile Station Identity (TMSI) upon LAI in a TMSI reallocation procedure. The MES(o), upon receipt of the TMSI and LAI (Location Area Code IE of the LAI shall carry the new value of the MSC(t) assigned by the GSC(t1), and the spot beam ID remains unchanged), shall update its Subscriber Identity Module (SIM) card with the new value of the TMSI and LAI. The MSC shall send the Location Update Accept with FOP = True.

6) In a Location Update procedure (with FOR = TRUE), the MSC shall defer the link release procedures after completion of the location update procedure. The MES(o) shall issue the CM SERV REQ message. The GSC(t1) shall transfer the message to the MSC upon the same SCCP connection used for the location update. The MSC, on receipt of the CM SERVICE REQUEST, shall send the CM SERVICE ACCEPT message to the MES(o). On the MES(o) side, an Mobility Management (MM) connection is established upon receipt of the CM SERVICE ACCEPT message.

7) Finally, the processing continues into the call set-up procedures with the SET-UP message.

5.1.1.3 Call control procedure

In this procedure, the GSC(t1) shall transfer the MES-originated DTAP (SET-UP, etc.) message to the MSC over the established SCCP connection without any modification. The MSC, on receipt of the Call Control message (SET-UP), shall analyze the Country Code/National Destination Code (CC/NDC) part of the called party number and shall interrogate the HLR to determine the location of the called subscriber MES(t) currently roaming in the GMR-1 network. The MSC shall indicate the progress of the call by issuing a CALL PROCEEDING message to the originating MES(o).

Upon transferring the CALL PROCEEDING message, the MSC shall initiate an assignment of traffic channels to the MES(o). Upon receipt of the ASSIGNMENT message, the GSC(t1) shall examine the assignment request to initiate a channel mode modify procedure or assignment procedure.

If TCH is assigned for signalling (very early assignment), then GSC(t1) shall initiate a channel mode modify procedure to the MES(o).

The GSC(t1) shall initiate this procedure by issuing the CHANNEL MODE MODIFY message to the MES(o). The originating MES(o), on receipt of the CHANNEL MODE MODIFY message, shall change the mode of the existing channel and acknowledge to the GSC(t1) by transferring a CHANNEL MODE COMPLETE message to the GSC(t1). Upon receipt of the CHANNEL MODE COMPLETE message, GSC(t1) shall send the ASSIGNMENT COMPLETE to the MSC (see figure 5.3).

If the MES is at the SDDCH channel at the time the ASSIGNMENT is received by the MSC, the GSC(t1) shall initiate an assignment procedure and assign a TCH to the MES(o).

5.1.2 Network to terminating MES

Upon receipt of the SET-UP message from the MES(o), the MSC shall analyze CC/NDC of the called party number, determine the HLR, and initiate the HLR interrogation to get Mobile Station Routing Number (MSRN) and International Mobile Subscriber Identity (IMSI). The MSC shall verify for the TtT container during the SCCP connection request, shall disable certain SS and SMS services, shall save the TtT container, and shall transfer to the terminating side during ciphering phase via CIPHER MODE COMMAND message if the bearer capability of the SET-UP message indicates a voice call only. Upon completion of the assignment procedure on the originating side, i.e., on receipt of the ASSIGNMENT COMPLETE message from the GSC(t1), the MSC shall perform the following actions:

1) Issue a PAGING message to the terminating MES, with a TtT indicator. The MES(t) on receipt of the PAGING REQUEST message, shall initiate a radio link establishment procedure with the GS. The GS shall validate the position provided by the MES(t). If the GPS position of the MES(t) is valid, it shall allow the MES(t) to establish a connection with the GS. Upon successful completion of the radio link, the MES(t) shall send the Page Response message to the GS. The GSC performs the establishment of the SCCP connection with the MSC and shall transfer the GPS position in the CI field for the billing and call interception purposes.

2) Issue a PROGRESS message (with an indication for the generation of CIP tones) and also apply Call In Progress (CIP) tones to the MES(o) on the assigned TCH.

Upon receipt of the PROGRESS message (with an indication to generate CIP tones), the MES(o) shall generate the CIP tones and provides them to the user. See figure 5.3.

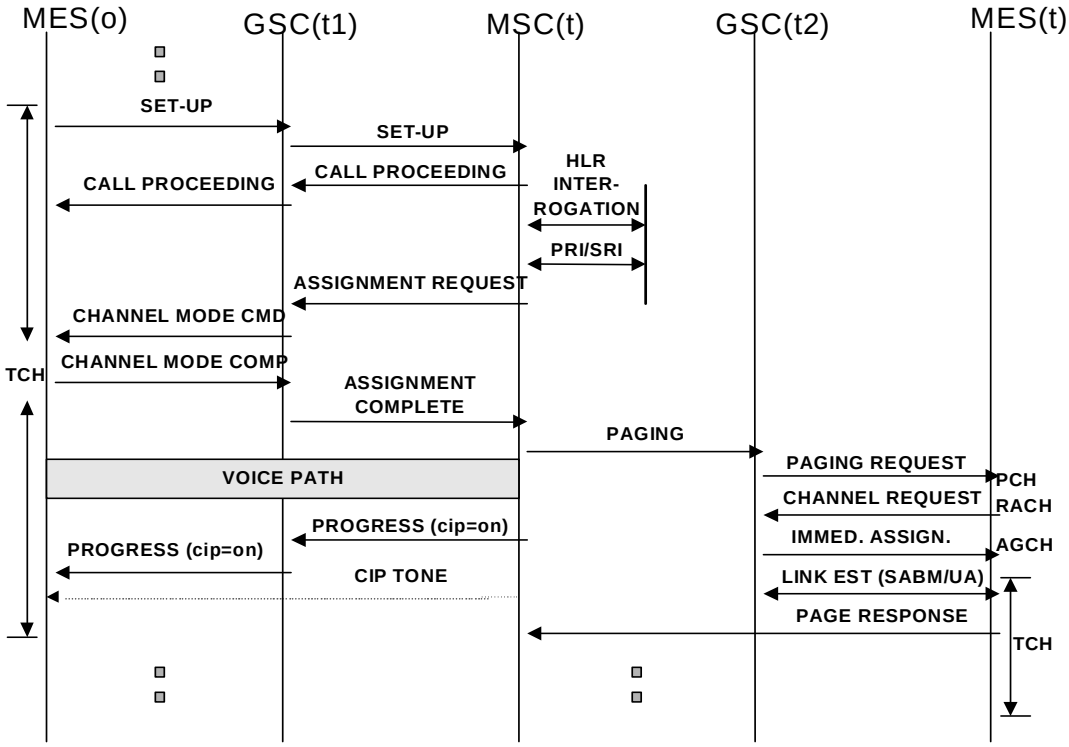

Figure 5.3: RR establishment procedure on terminating side

5.1.2.1 Radio resource allocation procedure

Figure 5.3 shows the RR establishment procedure on the MES-terminating side.

- On getting a page request from the MSC(t), the GSC(t2)/TCS(t) shall determine the CCCH ID and page group ID and transmit the page message over the air on the selected CCCH. The terminating MES, listening to the page in the CCCH, shall respond to the page by initiating the Channel Request procedure on the RACH.
- The MES shall send a Channel Request message in the RACH and wait for the Immediate Assignment on the AGCH of the corresponding CCCH.
- The RR connection set-up is exactly like the case of the originating MES with the following differences:
  - HLR interrogation shall not be performed;
  - the first Layer 3 message shall be Page Response with MES identity (IMSI/TMSI).

5.1.2.2 MM procedures (terminating side) and L-L connection

Figure 5.4 shows the MM procedure between the terminating MES(t) and the MSC.

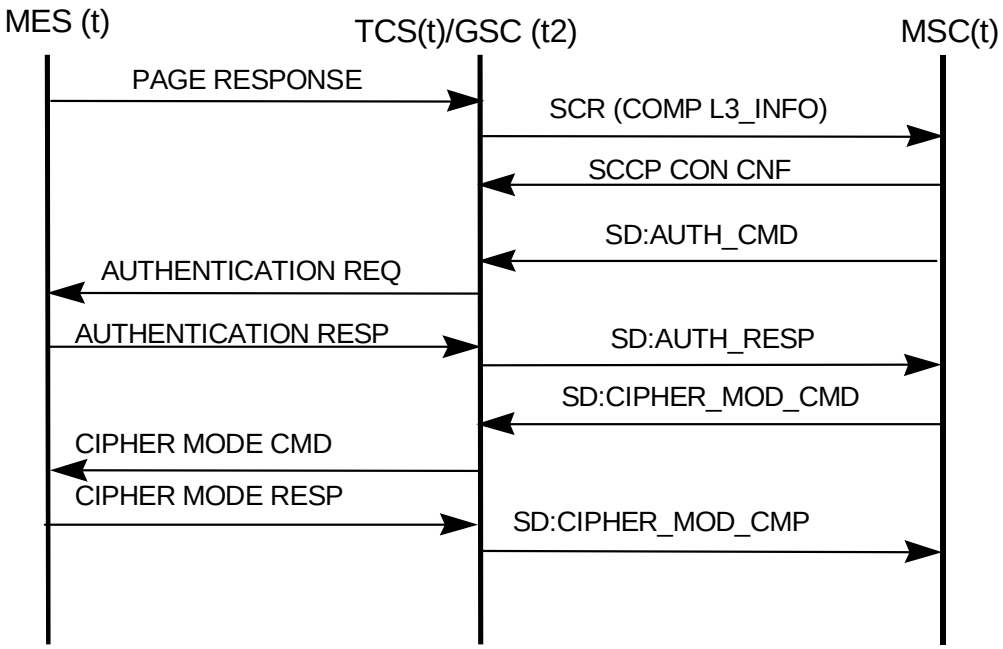

Figure 5.4: MM procedure on terminating side

This case is also similar to the originating MES(o) procedures with the following differences:

1) The MSC shall initiate the Authentication/Ciphering process on receipt of the PAGE RESPONSE as described in clause 5.1.1.2.

2) In the Ciphering Command message, the GSC(t2) shall check for the indication of the TtT container. Upon detecting the container, the GSC(t2) shall transfer the call reference Id(o) to the TCS(t). Upon receipt of the call reference Id(o), the TCS shall initiate the procedures for establishment of a single-hop TtT call. In this procedure the TCS(t) shall assign a call reference Id(t) to identify the terminating session of the TtT call, shall transfer it to the GSC(t2), generate a common ciphering key, Ktt, to be employed in the call by using the GMR-1 Random Number Generator; and request that the AOC perform an L-L connection at the satellite. In this procedure the TCS(t) shall provide two separate (L-C) carriers to the AOC with a request to connect at the satellite, and at the same time, it shall allow both the MESs and the network to continue the signalling procedure on the existing channel without any interruption (see figure 5.5).

3) The L-L connection procedure can be described as follows: The TCS shall transfer this request to the AOC and wait for the AOC response. The AOC shall examine the request. If the AOC is able to perform a connection of the requested L-L channel at the satellite, it shall issue a command to the satellite payload procedure and shall notify the TCS that the L-L connection can be established at the satellite. Upon receipt of the AOC response with an indication of the L-L channel connection at the satellite, the TCS shall signal to the GSC(t1) to initiate an Assignment procedure (TTCH) on the originating MES(o). Upon successful completion of the TTCH channel, the MES(o) shall become aware that this is a single-hop TtT call. Upon successful completion of the TTCH assignment on the originating side, the TCS shall signal the GSC(t2) to initiate a TTCH channel assignment procedure on the terminating MES(t) (see figure 5.5).

4) In the TTCH assignment procedure, the network shall transfer the required information to both MESs such as Ktt, TCH, or TTCH channels; MES mode of operation, etc. Details are described by ASSIGNMENT COMMAND2 message in the GMR-1 04.008 [6].

5) If the AOC fails to connect to the L-L channel at the satellite, the AOC shall notify the TCS and the TCS shall not initiate a TTCH assignment procedure on the originating side as well as on the terminating side of the MESs. In this case both MESs shall stay at the assigned channel and the call will be a double hop, but the MSC shall treat it as a single-hop call.

6) If the L-L channels are connected at the satellite but the assignment of this channel fails at the originating side, the TCS shall not initiate a request for assignment of a new channel connected at the satellite on the terminating side. The call shall be in a double-hop mode, but the MSC shall treat it as a single-hop call.

7) During steps 2, 3, 4, and 5, the signalling procedure between the MES(t) and the MSC runs in a normal way on the existing channel without any interruptions. The GSC(t2), upon receipt of the CIPHERMODE COMMAND with the TtT container, shall transfer the CIPHERING message to the MES(t) without the TtT container and continues to communicate with the MES(t) on an existing channel.

8) At the end of the ciphering procedure, the MSC shall perform the Call Control (CC) procedures on existing and newly assigned channels.

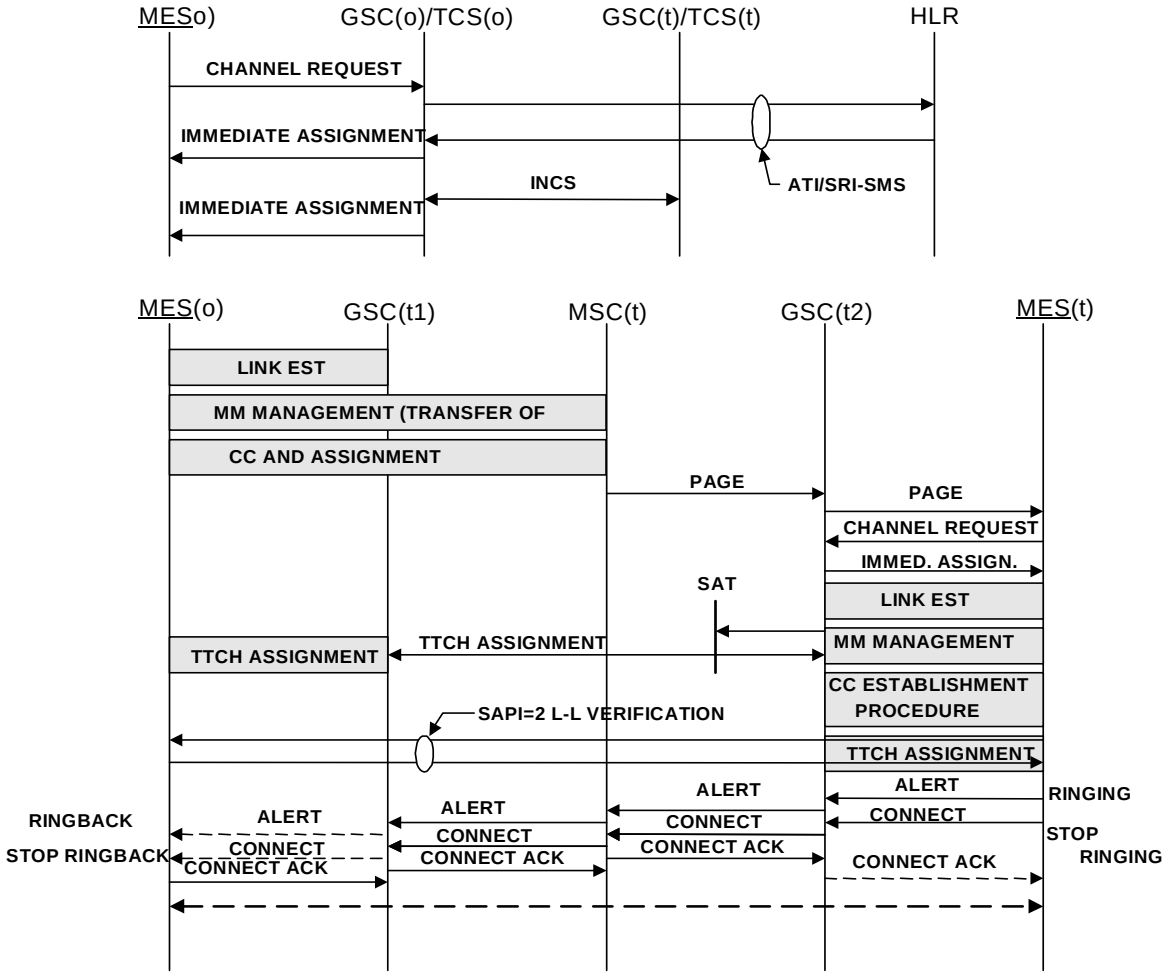

Figure 5.5: CC establishment/TCH assignment (on terminating side)

5.1.2.3 Call control procedure

In this procedure, the MSC shall perform late traffic channel assignment. The MSC indicates, this procedure to the MES(t) by not including the SIGNAL IE in the set-up message.

1) The MSC shall transfer the SET-UP (without the SIGNAL IE) message to the GSC (t2) over the established SCCP connection (see figure 5.5). The GSC(t2) shall transfer the message to the MES(t) over the air without modifications.

2) The MES(t) shall send a CALL CONFIRM message in response to the SET-UP message to the GSC(t2). The GSC(t2) shall transfer the received CALL CONFIRM message to the MSC on the established SCCP connection.

3) The MSC, upon receipt of the CALL CONFIRM message, shall issue the ASSIGNMENT message to the GSC(t2). The GSC(t2) shall examine the request and performs either assignment or channel mode modify procedure, depending upon the type of channel the MES(t) is on for signalling.

a) If the MES(t) is on the TCH/SDDCH channel and the originating MES(o) is communicating with the network via TTCH, then GSC(t2) shall perform a TTCH assignment procedure at the terminating side.

b) If the MES(t) is on a TCH channel and the originating side TTCH assignment fails, then GSC(t2) shall perform a CHANNEL MODE MODIFY procedure at the terminating side.

c) If the MES(t) is on the SDCCH channel and the originating TTCH assignment fails, then GSC(t2) shall perform an assignment procedure for the assignment of TCH at the terminating side.

4) During TTCH assignment procedure on the terminating side, the direct communication between two MESs shall be verified.

In this procedure both MESs shall be able to establish a link on the L-L channel at SAPI = 2 during the TTCH assignment phase with the new ciphering key, Ktt, and by using frame delay operation for ciphering/deciphering purpose. The GS shall designate the terminating MES(t) as terminal and the originating MES(o) as network in the respective ASSIGNMENT COMMAND 2 messages. The MESs shall act according to their designated roles for link establishment, ciphering, DL, power control, and all other purposes.

In case the MESs fail to communicate with each other with Ktt, the MES(t) will report an assignment failure of the TTCH channel, via ASSIGNMENT FAIL, to the network. The network, upon receipt of the ASSIGNMENT, shall fail with a cause (fails to communicate with MESs. In such an instance, the MES(t) shall revert back to the old TCH channel with the old ciphering key. Upon receipt of the ASSIGNMENT FAIL, the network shall assign old TCH to the MES(o), as described in clause 5.3.4, and the call remains in a double-hop mode only.

In case the MES fails to communicate via SAPI = 2, the MES(t) shall inform the network and stay on the old TCH channel with the old ciphering key. The call shall be in double-hop mode as described in clause 5.3.4.

If the MESs are able to communicate on the L-L channel, i.e., establishment of a link at SAPI = 2, the MES(t) shall generate an alerting signal to the user, generate an ALERT message, and transfer to the network on the SAPI = 0 link

5.1.3 End-to-end voice path

1) Upon assignment of the traffic channel to the MES(t), the MES(t) shall generate the ringing indication to the user and send the ALERTING message to the MSC. The MSC shall forward an ALERTING message to the originating MES(o) to indicate the far end is ringing.

2) Upon receipt of the ALERT message, the MES(o) shall generate a local ring back. The ringback tone shall be generated locally as described in GMR-1 04.008 [6].

3) If the terminating MES's user picks up the phone (offhook), and accepts the call, the MES shall send a CONNECT message to the MSC. Upon detection of an offhook condition, the MES(t) shall stop ringing.

4) Upon receipt of the CONNECT message, the MSC shall send CONNECT ACK to the MES(t) and forward the CONNECT message to the MES(o).

5) Upon receipt of the CONNECT message, the GSC(t2), GSC(t1) shall release the unused (old) resources, and the MSC shall send CONNECT ACK to the MES(t) and forward the connect message to the MES(o).

6) The MES(o), upon receipt of the CONNECT message, shall stop the ringback tone and enables a direct communication with the MES(t) via a single hop on the assigned traffic channel (see figure 5.5).

7) In the established single-hop call, if the SAPI = 2 link fails, e.g., during transfer of Dual Tone Multiple Frequency (DTMF) signalling message, the MES shall deactivate SAPI = 2 link and inform the network as described in GMR-1 04.008 [6]. The network shall take appropriate action to the call, either releasing it or keeping it in a double-hop mode.

5.2 TtT call - both MESs are registered at the same GS

Most of the procedures are the same as those described in the previous clause. The main difference in this procedure as compared to the previous case is as follows:

1) In this procedure the TTCH channel is supported by the same GS.
2) There is no need for INCS communication.
3) There is no need for MES(o) to perform Location Update Procedure.
4) There is no need to verify radio resource and roaming agreements.
5) The same GS uses one TCH3/SDDCH for signalling and reserves one TCH3 on each side to connect at the satellite at the appropriate time of the signalling, as described in previous clause.

5.3 Abnormal conditions

5.3.1 No response from the terminating side

If the terminating side does not respond to PAGE and the High Penetration Alerting (HPA), the MSC shall play the announcement to the MES(o) and forward the call to the forwarding number (see figure 5.6). If the forwarding number is not available, the MSC shall release the call and play an announcement to MES(o).

If the called party MES(t) is busy with the Public Switched Telephone Network (PSTN) user and subscribed with "call wait" SS services, the MSC shall establish a call between the MES(o) and the MES(t) in a double-hop mode instead of a single-hop mode.

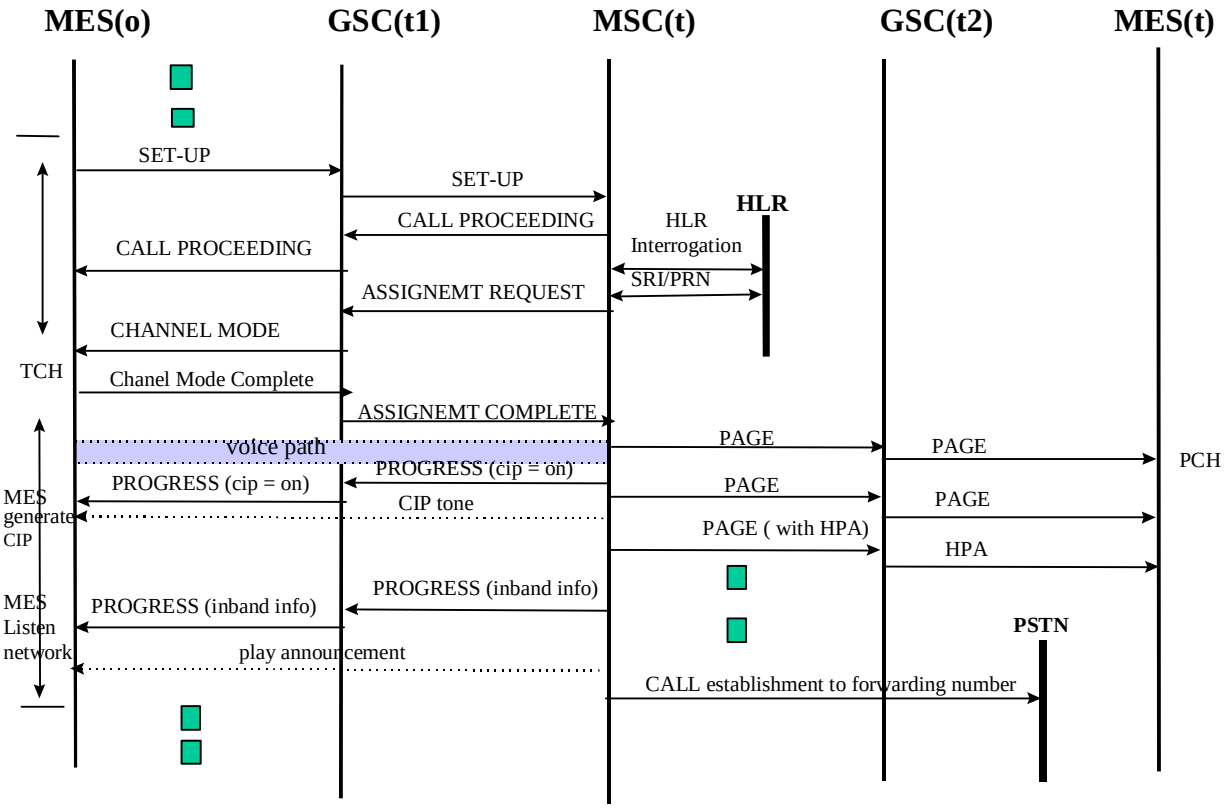

Figure 5.6: No response from MES(t)

5.3.2 Terminating side busy

If the terminating side is engaged in a call, the MSC shall send a SET-UP message to the MES(t), and the rest of the processing is based on the response of the MES(t).

1) On receipt of the SET-UP message, the MES(t) shall generate the WAIT tone.

2) If the user accepts the call, the call is established between two MESs, i.e., MES(o) and MES(t), via double hop.

3) If the user declines the call, the MSC shall provide appropriate treatment (see figure 5.7).

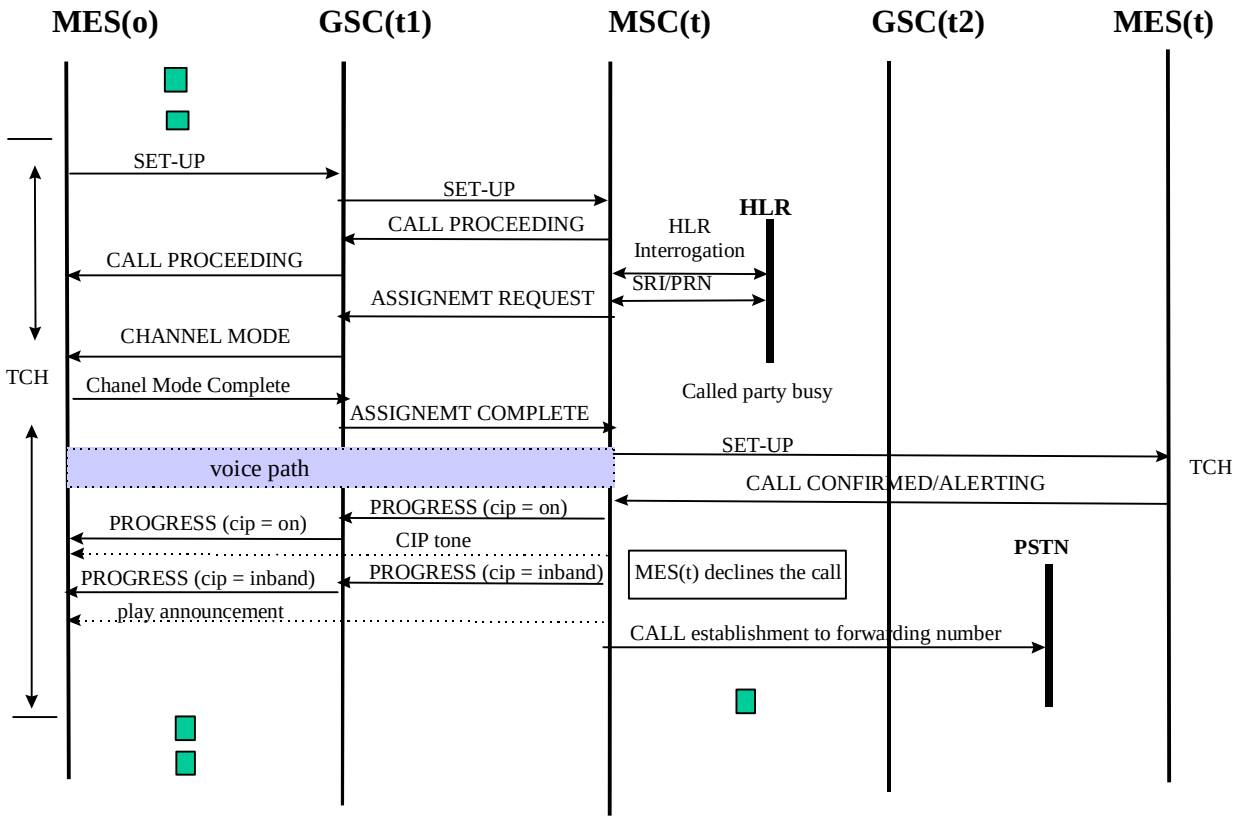

Figure 5.7: MES(t) busy

5.3.3 Terminating party does not answer

Upon receipt of the ALERT, the MSC shall start a timer (Connect Wait Timer); if the terminating party does not answer the call, the Connect Wait Timer expires, and the MSC shall perform the following actions:

1) Disconnect the terminating side connection.

2) At the same time the MSC shall request the GSC(t1) to assign the normal traffic channel to the MES(o), and the MSC shall initiate channel assignment (TCH) procedure. The GSC(t1) shall receive an ASSIGNMENT message from the MSC and perform the assigning of the TCH channel to the MES(o). Upon the successful completion of the TCH assignment, the GSC(t1) shall send the ASSIGNMENT COMPLETE message to the MSC. The existing TTCH channels are released, and the MES(o) shall communicate with the MSC via the TCH channel with the previous ciphering key Kc_1.

3) Upon receipt of the ASSIGNMENT COMPLETE message, the MSC shall play the announcement to the MES(o) and initiates the SS services (see figure 5.8).

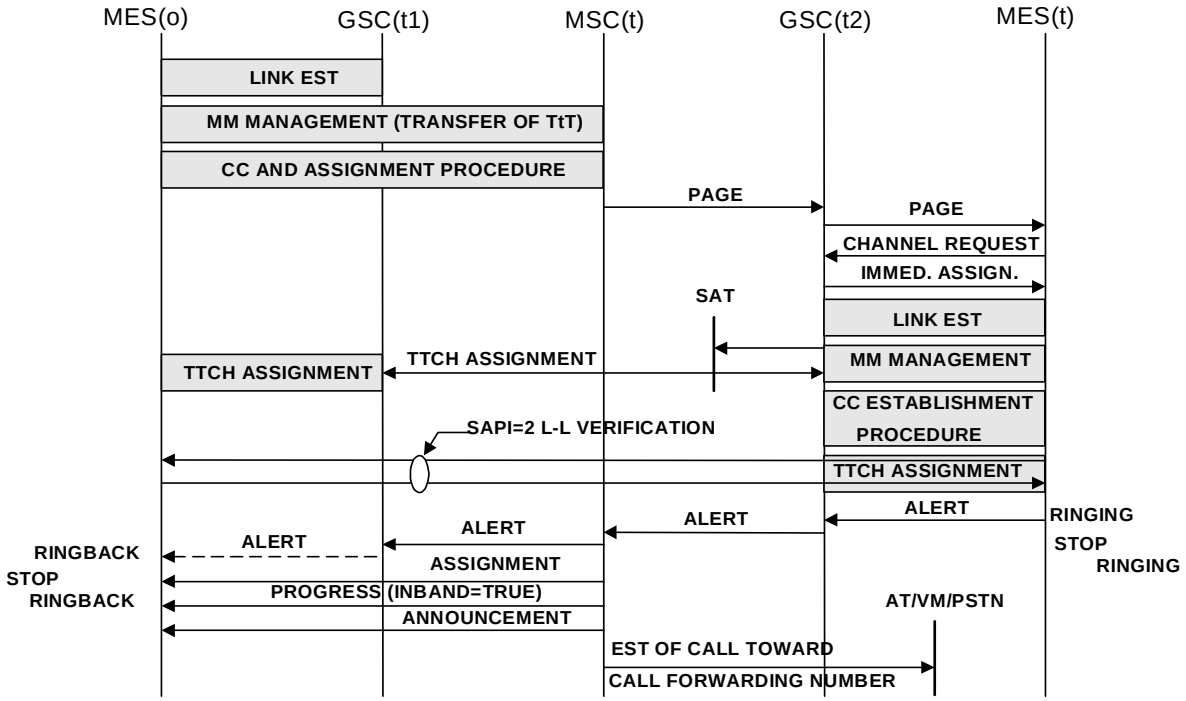

Figure 5.8: No answer from MES(t)

In the abnormal cases, the network shall perform the following actions:

If a TtT call is attempted and the optimal MSC decides for whatever reason to apply forwarding or treatment instead of connecting the call to the dialled number, the call becomes a TtG call. If the call is forwarded to an MES, a double-hop call will result.

In the event of a TtT call becoming a TtG call, blocked supplementary services are not restored to the originating MES(o) until the call is ended. An MES that receives a double-hop call through call forwarding retains all of its normal supplementary services.

5.3.4 Assignment failure on TtT segment

If for any reason the TTCH assignment procedure fails, then the affected GSC shall use the existing TCH resources, and the call will remain in double-hop mode.

5.3.4.1 Assignment (TTCH) failure on terminating side

If any one of the operations described in clause 5.3 fails, the GSC(t2) shall initiate the subsequent channel assignment procedure on the originating side and channel mode modification procedure on the terminating side, and the call shall remain in a double-hop mode (see figure 5.9). At some time TCS informs the AOC to deallocate the TtT channels connected at the satellite.

In the channel mode modify procedure, the GSC(t2) shall issue a Channel Mode Modify message to the terminating MES(t). The terminating MES(t) shall change the mode of the channel, and, on completion, the MES(t) shall send acknowledgment of the channel mode modification to the GSC(t) by transferring the CHANNEL MODE MODIFY ACK message. Upon receipt of the CHANNEL MODE MODIFY ACK message, the GSC(t2) shall send the Assignment Complete message to the MSC in response to the Assignment message issued by the MSC.

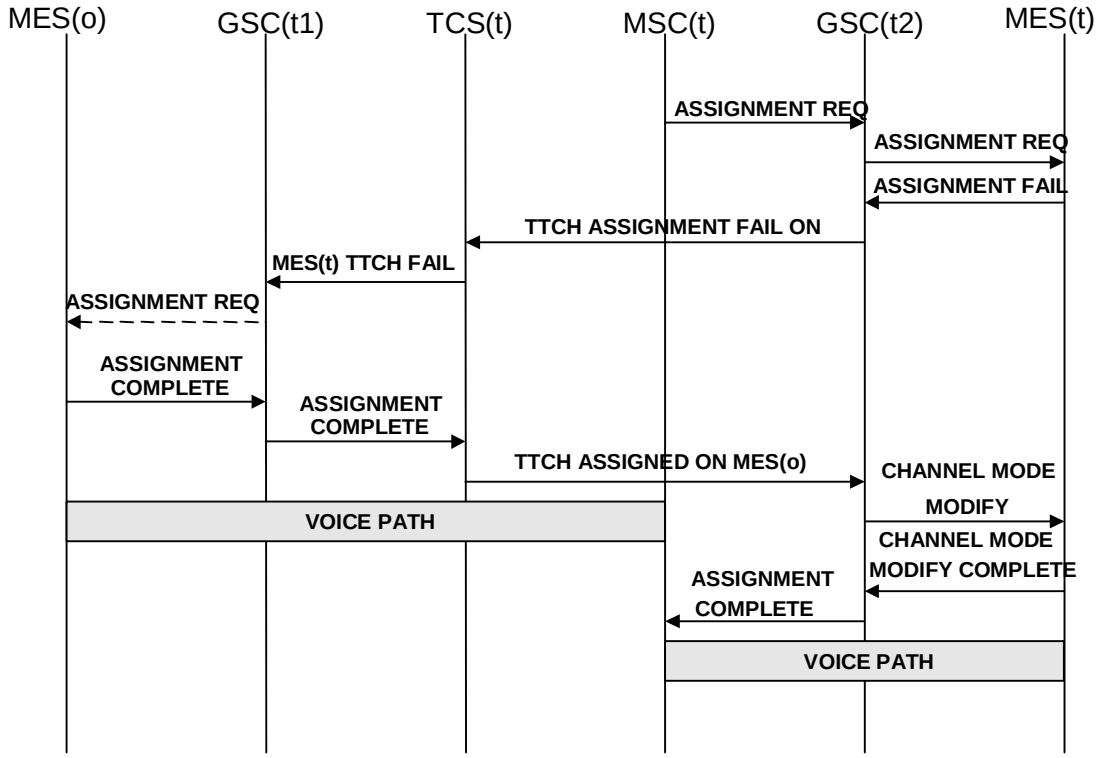

Figure 5.9: Reassignment of the TCH

5.3.4.2 Assignment (TTCH) failure on originating side

If the assignment of the TTCH fails on the originating side, the originating GSC(t1) shall inform the TCS of the result of the TTCH assignment. The TCS(t) shall inform the GSC(t2) about the status of the assignment. In case it indicates failure, the terminating GSC(t2) shall not perform the TTCH assignment upon receipt of the Assignment message from the MSC(t), and the call will go as double hop.

5.3.5 TtT resources not available

In the case where no TtT resources are available, this event will trigger the establishment of a double-hop call, and it shall be handled in a similar manner to an Assignment Failure of the TtT segment.

5.3.6 AOC fails to connect L-L channel

The call will be treated as a double hop. The TCS(t) shall deallocate the TtT single-hop radio resources. The MES(o) and MES(t) shall remain connected with the GS(t) via the original TCH channel, with original ciphering keys, Kc_1 and Kc_2 respectively.

5.3.7 MSC fails to indicate TtT indication

The MSC shall verify the Bearer Capability (BC) in the SET-UP message. If the BC parameters do not indicate a voice call, the MSC shall not provide a TtT indication as well as a TtT container to the terminating Gateway Station Subsystem (GSS), and the call will be treated as a double hop.

5.3.8 Satellite fails to connect L-L channels

This error is determined by the terminating MES(t). At the time of TTCH, TCH assignment to the MES(t), it shall attempt to communicate with MES(o) and shall establish a link with the MES(o) on SAPI = 2. If the MESs cannot communicate, the MES(t) will report to the network for establishment of a double-hop call instead of single-hop call.

5.3.9 AOC failure

In this case, if both MESs are already at the same GS, the call will remain in double-hop mode, and supplementary and Short Message Services (SMS) services shall remain disabled.

5.4 Ciphering

Cipher protection shall be provided for single-hop calls. During call set-up the GS shall establish independent ciphering sessions with the originating and terminating MESs. A separate common ciphering key (Ktt) shall be generated by the network and used by both MESs and the GS following channel reassignment to the TTCH. A full discussion of TtT ciphering procedures can be found in GMR-1 03.020 [4].

5.5 Power control operation

In a single-hop call, MESs shall control each other's power level over the L-L channel. For details, see specification GMR-1 05.008 [7].

5.6 Timing control operation

Similar to a TtG/GtT call, open loop synchronization is employed for MES receivers while close loop control is applied to the MES transmitter. The control loop for the MES(o) is an MES(o) transmitter-[L-C link]-GTS(t1)-[INCS]-GTS(o)-[TTCH]-MES(o) transmitter and the control loop for MES(t) transmitter is an MES(t) transmitter-[L-C link]-GTS(t2)-[TTCH]-MES(t) transmitter. The TTCH reception is used to control the MES perspective of timing. This basis is used for the transmission of the TCH. The received TCH is separately tracked using offsets from the TTCH-based observation. In addition, any timing drift of an MES transmitter is corrected by Timing Correction messages from GS(t) through TTCH channel. The GTS(t1) and GTS(t2) shall monitor the actual time of TCH burst arrival through the L-C link. If the timing error is found to be over the prespecified threshold, a timing correction message shall be transmitted to the MES on the TTCH (see figure 5.10).

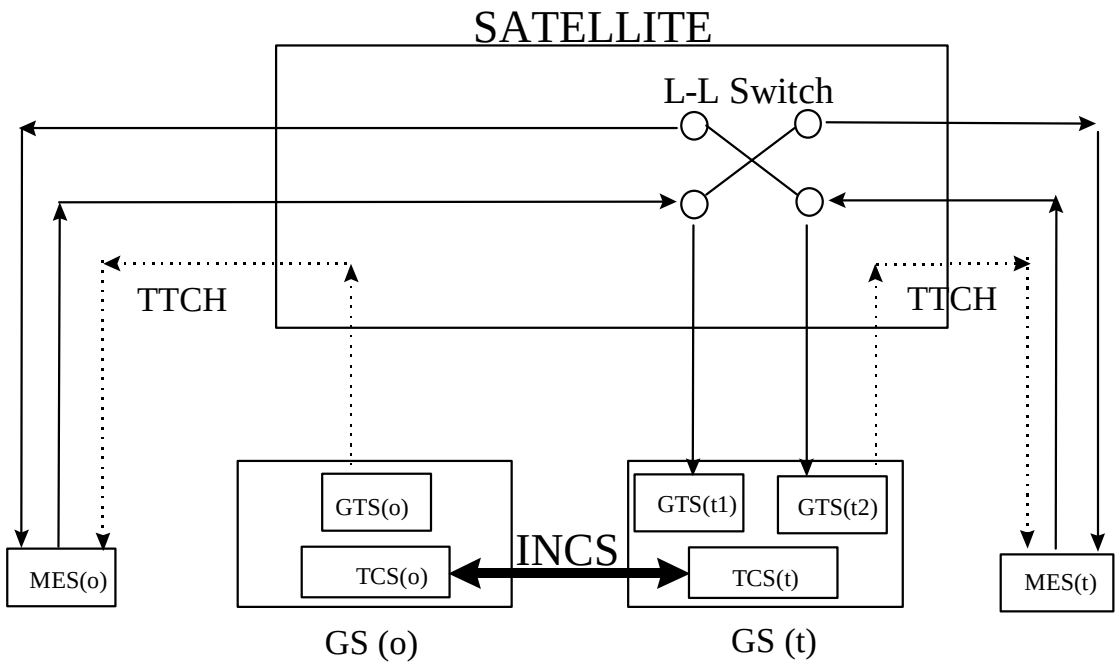

Figure 5.10: System configuration during the TtT call

5.7 Frequency synchronization

The whole system is synchronized with the nominal frequency at the satellite. Frequency errors arise from the oscillators of MESs, the satellite and a GS, and the Doppler shift. As in time synchronization, the MES frequency alignment at a transmitter is done by using the factors provided by a GS and frequency synchronization at a receiver is achieved by the use of its internal frequency reference and by tracking the received signal.

As in time synchronization, open loop synchronization is employed for MES receivers while closed loop control is applied to MES transmitters. The TTCH reception is used to control the MES perspective of frequency. This basis is used for the transmission of the TCH. The received TCH is separately tracked using offsets from the TTCH-based observation. Any frequency drift of an MES transmitter is corrected by frequency correction messages from the corresponding GS(t) through TTCH channel. For details, see GMR-1 05.010 [8].

5.8 DTMF

DTMF is supported for TtT calls, including single-hop calls. Refer to GMR-1 03.014 [3] for details.

5.9 SS services during single-hop call

The implementation of supplementary services in the GMR-1 system will be affected by the TtT calls connected single hop. In this case, certain supplementary services will not be available and, therefore, shall be disabled. For an MES engaged in an MES-MES call via a single-hop L-L connection, the HOLD, Call Waiting, and Multiparty services shall be blocked by the MSC.

5.10 SMS services during single-hop call

SMS services, including MES-originated and MES-terminated, shall not be available during single-hop TtT calls.

5.11 Call performance reporting

Call performance reporting shall not be available during single-hop TtT calls.

5.12 Class mark update

The GMR-1 system shall support class mark change procedure during TtT calls.

5.13 Interception

The GMR-1 network performs the standard legal interception procedure for single-hop calls in the same way as is performed for TtG calls. In single-hop calls the MES/network connectivity is configured in such a way that voice activity initiated by MES(o) and MES(t) is available to the MSC via two point-to-point feeder links. The MSC receives the voice activity of MES(o) and transfers it to the MES(t) via GSC(t2). The GSC(t2), on receipt of the voice activity, ignores it. Similarly the MSC receives the voice activity from the MES(t) and transfers it to the MES(o) via GSC(t1). Upon receipt of voice activity for the MES(o), the GSC(t1) also ignores it. In addition, the MSC also transfers the voice activity received from both the parties (MES(s)) and transfers the voice traffic to the Interception Controller. The Interception Controller delivers the intercept product to respective countries, as configured by the Interception controller (see figure 5.11).

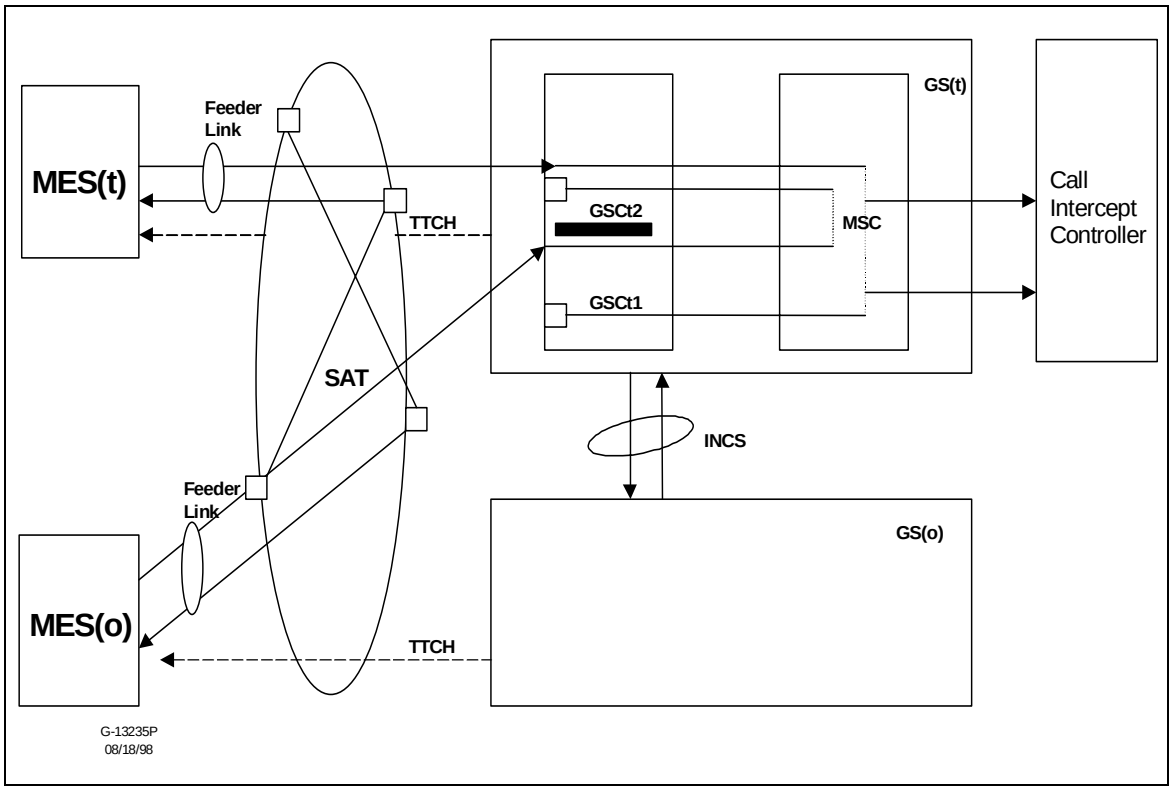

Figure 5.11: TtT call interception

5.14 Active call disconnection

The GMR-1 network does not support active call disconnection of single-hop TtT calls.

5.15 Handover

Handover during single-hop TtT calls shall not be supported.

5.16 Call release procedures

5.16.1 MES-to-MES call release (MES-originated call release)

The procedure for call release initiated from an MES engaged in an MES-to-MES call is demonstrated in figure 5.12. The procedure is outlined in two parts, one for call release procedure with one GS and the second for call release procedure with two GSs.

5.16.2 Call release procedure with one GS

The call procedure initiated by MES(o) issues Disconnect (DTAP) message. The MSC receives the message, and the call gets release in the same way as it takes place in an MES/PSTN call but initiated by MES.

On the terminating side, call release procedure is initiated by the MSC on receipt of the DISCONNECT (DTAP) message received by the MSC from the MES(o). This side release procedure is carried out as it is performed in the PSTN/MES call by the MSC, as if the call release were initiated by a PSTN user, in this case, the MES(o).

The three main phases of the procedure as listed below.

- CC call release procedure: This procedure is carried out in the same way as it is performed in GSM, described in GMR-1 04.008 [6].
- RR radio release procedure: This procedure is carried out in the same way as it is performed in GSM, described in GMR-1 04.008 [6].
- In both procedures the messages from the network to the MES is carried by the TTCH channel, as shown in diagram.
- Deallocation of radio resources: upon completion of the RR procedure, the TCS disconnects from the L-L channel and deallocates it.

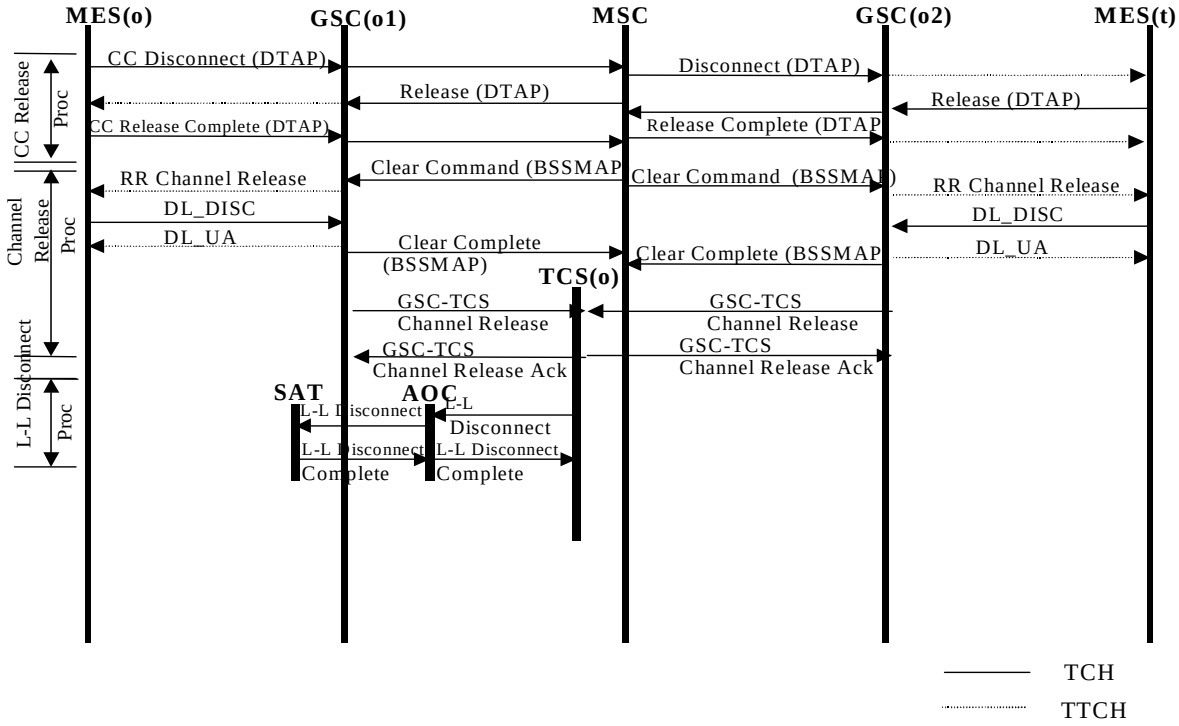

Figure 5.12: TtT call release procedure with single GSs

5.16.3 Call release procedure with two GSs

The signalling procedure is the same as described in clause 5.16.2. The signalling messages for the originating MES(o) from the network are carried out on TTCH channel, but it involves two GSs as the originating MES(o) listens to the TTCH from the originating GS(o). The terminating GS(t) transfers the Signalling Messages to the originating GS(o) via INCS, and the originating GS(o) delivers it to the originating GS(o) via TTCH (see figure 5.13).

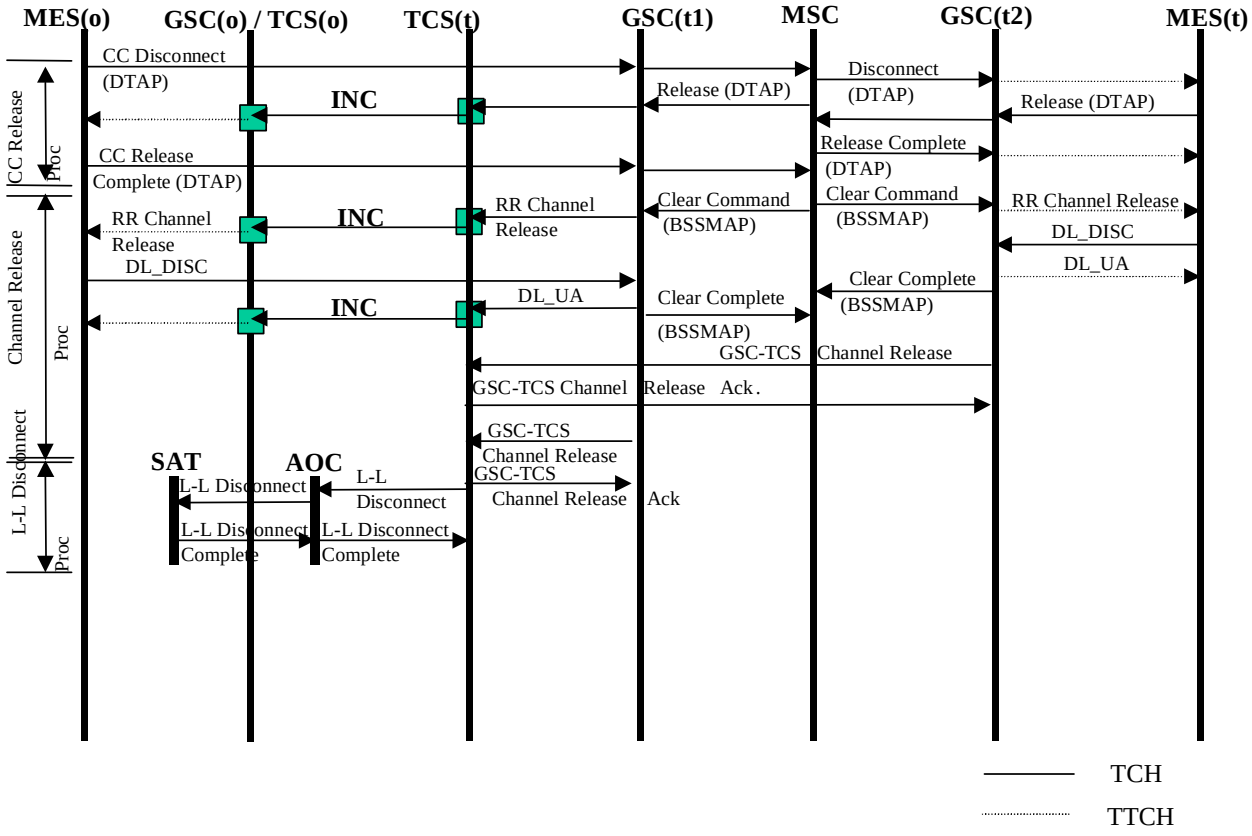

Figure 5.13: TtT call release procedure with two GS

5.16.4 MES-MES call release by operator

In this case the signalling procedure works in the same way as it works in GSM. In this mode the call initiation is started by the MSC at the request of the operator. The MSC issues a DISCONNECT (DTAP) message to both MESs on the established CC connection and performs the call release procedure as described in previous clauses.

5.17 MES-MES call with two satellites

A GMR-1 network with multiple satellites may establish single-hop TtT calls when the originating and terminating mobiles are on different satellites within the same system. The procedure is as follows:

1) The originating TCS determines through the gateway selection procedure that the MES(t) is registered on a different satellite. In cases where a single Visitor Location Register (VLR) is supporting multiple satellites, the LAI is used to determine on which satellite MES(t) is registered.

2) MES(o) is optimally routed to the terminating satellite (see GMR-1 03.297 [5]) where it repeats its Channel Request.

3) The call now proceeds as in the single satellite case.

History

Document history		
V1.1.1	March 2001	Publication