ETSI/TC SMG
Released by : ETSI/PT 12
Release date: February 1992

RELEASE NOTE

Recommendation GSM 03.04

Signalling Requirements Relating to Routing of Calls to Mobile Subscribers

Previously distributed version : 3.1.0 (Release 1/90)
New Released version February 92 : 3.1.0 (Release 92, Phase 1)

1. Reason for changes

No changes since the previously distributed version.

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ETSI-GSM
Technical
Specification

GSM 03.04

Version 3.1.0

UDC: 621.396.21

Key words: European Digital Cellular Telecommunications System, Global System for Mobile Communications (GSM)

European digital cellular telecommunication system (phase 1);

Signalling Requirements Relating to Routing of Calls to Mobile Subscribers

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PREFATORY NOTE

ETSI has constituted stable and consistent documents which give specifications for the implementation of the European Cellular Telecommunications System. Historically, these documents have been identified as "GSM recommendations".

Some of these recommendations may subsequently become Interim European Telecommunications Standards (I-ETSs) or European Telecommunications Standards (ETSs), whilst some continue with the status of ETSI-GSM Technical Specifications. These ETSI-GSM Technical Specifications are for editorial reasons still referred to as GSM recommendations in some current GSM documents.

The numbering and version control system is the same for ETSI-GSM Technical Specifications as for "GSM recommendations".

RECOMMENDATION T/S 43 - 12

EDINBURGH 1988

NOVEMBER 89 revision 1

SIGNALLING REQUIREMENTS RELATING TO ROUTING OF CALLS TO MOBILE SUBSCRIBERS

RECOMMENDATION PROPOSED BY WORKING GROUP T/ No 11

"SIGNALLING PROTOCOLS AND SWITCHING" (SPS)

The European Conference of Postal and Telecommunications Administrations considering:

- that it is intended to open a pan european mobile service;
- that facilities have to be provided in order to route the calls to the actual location of the mobile subscriber;

recommends that European Administrations who wish to introduce this mobile service apply the following Recommendation.

Note: This Recommendation is also referenced as GSM 03.04 *version* 3.1.0.

Number of pages: 11

1. INTRODUCTION

When a subscriber wants to call a mobile subscriber, the fixed network needs to know the actual location of the MS in order to route the connection to the relevant Mobile Services Switching Centre (see Recommendation GSM 03.12 on location registration). This recommendation presents the requirements the fixed network has to comply with for that purpose. The document considers the different assumptions concerning the capabilities of the fixed exchanges to perform some procedures prior to call set-up.

This Recommendation assumes that the routing analysis requirements specified in CCITT Recommendation Q 107bis are fulfilled.

This Recommendation assumes that the ISDN number of the mobile contains a specific National Destination Code. The cases where the mobile numbering plan is fully integrated in the fixed numbering plan may require additional or different routing features.

2. GENERAL ROUTING RULES

The number dialled by the calling subscriber contains no indication concerning the actual location of the called MS. Therefore, to set-up the complete connection, it is necessary to know the location of the MS and the routing address to be used, i.e. the Mobile Station Roaming Number. The only equipment able to provide this information is the Home Location Register. Therefore to route the call to the Mobile Services Switching Centre where the MS is located, it is necessary to interrogate the HLR.

The preferred procedure with regard to signalling is the following:

1) When a subscriber wants to call a mobile subscriber he dials the ISDN number of this subscriber.

2) The local exchange (or a transit exchange) analyzes the number dialled and recognizes the mobile service National Destination Code indicating that the call is destinated to a mobile subscriber. In general, this complete routing analysis can be made for the national calls only: when the outgoing exchange recognizes that the calling subscriber dialled the international prefix, it routes directly the call to the outgoing International Switching Centre (ISC) without any further analysis. This ISC can then recognize the mobile NDC.

3) If the result of routing analysis shows that it is necessary to get additional information to set-up the complete connection to the MSC where the called MS is located, then this information must be obtained from the HLR in charge of the mobile subscriber. If the interrogation procedure is implemented in an exchange referred in 2) above, this exchange then performs the interrogation of the Home Location Register. The HLR sends back the roaming number of the called MS. This procedure is supported by the Transaction Capabilities of the Signalling system No. 7.

4) Two different principles to allocate a roaming number exist. In alternative one, the roaming number may be allocated at location updating by the VLR and stored in HLR. When it is interrogated,

the HLR may then return the stored roaming number without any further actions.

In the second alternative, the HLR will request the current VLR to allocate a roaming number which will only be allocated on a per call basis, when interrogated by the interrogating exchange.

The details of the two roaming number allocation principles are described in Recommendation GSM 03.02.

54) The connection is then set-up in the fixed network to the MSC according to the roaming number of the MS.

3. GENERAL REQUIREMENTS FOR THE FIXED NETWORK

To route a call up to a mobile subscriber, an interrogation of the HLR must be performed in order to get the roaming number allocated to that MS. This interrogation procedure is supported by the Transaction Capabilities of the signalling system No. 7. The preferred solution is that the local exchanges be adapted to TCAP, and able to perform this interrogation: then, they can route the call directly to the called MS according to the roaming number they obtain from their interrogation of the HLR. The following section of this document shows possible solutions if this assumption is not fulfilled.

As it is described below, in the case where there are no interrogation facilities in the fixed network, on recognition that a call is destinated to a mobile suscriber, the routing is first performed to a Gateway MSC. The interrogation of the HLR is then performed by this MSC and the call proceeds according to the Roaming Number received.

Section 5 deals with the routing of calls to foreign mobile stations: usually, in this case, the local exchange does not analyze the national part of the called address and routes directly to the outgoing International Switching Centre, which then performs the correct routing of the call.

4. ROUTING OF CALL TO A MOBILE STATION MANAGED BY A HOME PLMN SITUATED IN THE SAME COUNTRY

4.1 The originating exchange is adapted to the interrogation procedure (figure 1)

If the originating local exchange is able to perform the interrogation procedure, the call set-up occurs as it is specified in section 2. of this document.

4.2 The originating exchange is not adapted to the interrogation procedure

If the originating exchange is unable to use TCAP, the following cases can be considered:

- the interrogation procedure is performed by a transit exchange
- the call is rerouted by a Gateway MSC.

4.2.1 The interrogation is performed by a transit exchange (figure 2)

If the originating exchange is unable to perform the interrogation of the HLR, the connection is set-up to a transit exchange. This latter analyzes the address received (the ISDN number of the subscriber) and notices that the call is destinated to a mobile subscriber. It performs then the interrogation of the HLR and routes the call as it is described in section 2.

4.2.2 The call is rerouted by a Gateway MSC (figure 3)

If the fixed network is unable to interrogate the HLR in order to route the call to the actual location of the MS, the connection is set-up to the Gateway MSC.

The Gateway MSC interrogates the HLR of the called MS (using MAP in general case). It receives back the roaming number of the subscriber. With this address, the GMSC sets-up a connection via the telephone (or ISDN) network to the MSC where the MS is located. If the called subscriber is abroad, the connection is normally set-up via the international network.

5. ROUTING A CALL TO A FOREIGN MOBILE SUBSCRIBER

As for a normal telephone call, the calling subscriber, when he wants to call a foreign mobile subscriber, dials first the international access prefix. His local exchange, according to this prefix, routes directly the call to the outgoing International Switching Centre without any further analysis of the number dialled.

The routing of the call is then performed by the outgoing International Switching Centre. Two assumptions can be envisaged:

- The outgoing International Switching Centre recognizes that the called party is a mobile subscriber and can perform the interrogation of the HLR;

- the outgoing International Switching Centre is unable to perform the interrogation of the HLR.

5.1 The outgoing ISC can perform the interrogation of the HLR

(figure 4)

When the outgoing International Switching Centre receives the call, it analyzes for routing the country code and the first digits of the national significant number of the called party address. It can then notice that the call is destinated to an MS and needs a preliminary interrogation transaction prior to setting-up the connection.

With the roaming number, the ISC routes then the call to the MSC where the MS is actually located. The connection is set-up via the international network if the MS is not in the same country as the calling subscriber.

5.2 The outgoing ISC is unable to perform the interrogation of the HLR (figure 5)

If the outgoing International Switching Centre is unable to perform the interrogation procedure, it routes the call to the incoming ISC of the country where the Home PLMN of the called mobile is situated according to the telephone (or the ISDN) number dialled by the calling subscriber.

The incoming International Switching Centre receiving the call notices that it is destinated to a mobile. The following assumptions can be envisaged:

- this ISC can perform the interrogation;
- this ISC is unable to perform the interrogation: therefore the interrogation has to be made either by a national transit exchange or by a Gateway MSC.

In this assumption where the actual routing has to be made in the home country of the mobile, the connection may comprise two international links in tandem if the subscriber is roaming abroad. Therefore it would be better that the interrogation is performed in the outgoing country; this method would limit the length of the complete connection. The worst case will appear when the called MS is roaming in the country of the calling subscriber: the complete connection includes two international links in tandem instead of a simple national routing.

5.3 The International Switching Centre recognizes that it is a call to an MS but cannot perform the interrogation

If this case, the International Switching Centre routes the call to a Gateway MSC which performs the interrogation.

i) If the GMSC is accessed by the outgoing ISC: see figure 6.

ii) If the GMSC is accessed by the incoming ISC: see figure 7.

6.ALTERNATIVE SOLUTION: REROUTING OF THE CALL AFTER CLEARING THE PREVIOUS CONNECTION

(figure 8)

The ISUP provides a backward message to indicate that the call should be re-routed and containing the new address. This facility may be used in the case where a foreign MS is called and no interrogation functions are available in the fixed network to get the Roaming Number from the HLR. A long international connection may be established before the location of the MS is determined but this facility could allow the call to be "dropped back" to the suitable MSC.

7. PARTICULAR CASES: IMPACT OF SUPPLEMENTARY SERVICES HANDLING

7.1 Call forwarding services

- call forwarding unconditional: if this service is activated, the address given back by the Home Location Register when it is interrogated will be the forwarded-to number given by the subscriber at the registration of the service. It is not a normal call forwarding but a call diversion from the interrogation exchange.

- other call forwarding services: in the other cases (on no reply, on MS busy...), the call forwarding is performed according to the result of the call set-up in the MSC where the mobile is located. Therefore, the call has to be normally routed according to the roaming number given by the HLR. The call forwarding is then performed by the MSC according to parameters given by its VLR.

- when the roaming number is allocated on a per call basis, the VLR, when it is requested by the HLR for a roaming number, may provide back an indication that the called mobile subscriber is not registered. If the call forwarding service on mobile subscriber not reachable is active, the HLR gives then the forwarded-to-number to the interrogating exchange as described above for call forwarding unconditional.

7.2 Closed user group

The closed user group parameters concerning a mobile subscriber are stored in the HLR. When the interrogation is performed, the HLR can check the closed user group parameters and give the right answer to the originating exchange. If the answer is positive, the HLR gives back the roaming number of the MS. If the compatibility check does not give a positive result, an unsuccessful indication is given to the originating exchange.

7.3. Barring of incoming calls

When this service is activated, the relevant indicator is stored in the HLR. When a call is set-up to this mobile, the HLR will return an unsuccessful indication to the originating network. The indication given to the calling subscriber will discourage the repeat attempts (e.g. sending of Special Information Tone).

7.4 Supplementary Service incompatibility

If an indication given in the interrogation message to the HLR shows an incompatibility with one of the supplementary services activated by the mobile subscriber, an unsuccessful indication is given back to the originating network. The indication given to the subscriber will discourage a repeat attempt in the same conditions.

8. UNSUCCESSFUL CALL SET UP

8.1. Roaming not allowed

If the MS is roaming in an area where is not allowed to have calls, the location is not stored in the HLR and an indicator is set. When a call is set-up to this subscriber, the HLR will return an unsuccessful indication to the originating exchange.

8.2 Restart of the HLR

~~After a restart, the HLR considers that the informations coming from the back up are still valid. If an interrogation is related to a subscriber whose information are not yet restored, the HLR gives back the Roaming Number it has in its tables. If there is a mistake, the restoration procedure specified in Recommendation GSM 03.07 will re-establish the right information.~~

After a restart, the HLR will take certain actions dependent on the roaming number allocation principle used. For subscriber roaming in VLRs where the roaming number is not allocated at location updating, the VLR is requested for a roaming number in the normal way when an interrogation is received in the HLR.

If the HLR receives an interrogation for a subscriber currrently roaming in a VLR which has allocated a roaming number at location updating, the HLR requests the VLR to provide a roaming number using the same procedure as when the roaming number is allocated on a per call basis.

The restoration principles of the location registers are described in Recommendation GSM 03.07.

8.3 Restart of the VLR

A VLR which assigns roaming numbers at location updating will inform all HLRs when it restarts. The HLR then marks all subscribers roaming in this VLR to be checked. At an interrogation, the HLR will request the VLR to provide a roaming number using the same procedure as when the roaming number is allocated on a per call basis.

8.43 Mobile Station Roaming Number unallocated

If the incoming MSC receives a call which roaming number is declared unallocated by the VLR, it sends back an unsuccessful call set up indication to the outgoing exchange. This situation may occur after a restart of the HLR or of the VLR (see Recommendation GSM 03.07).

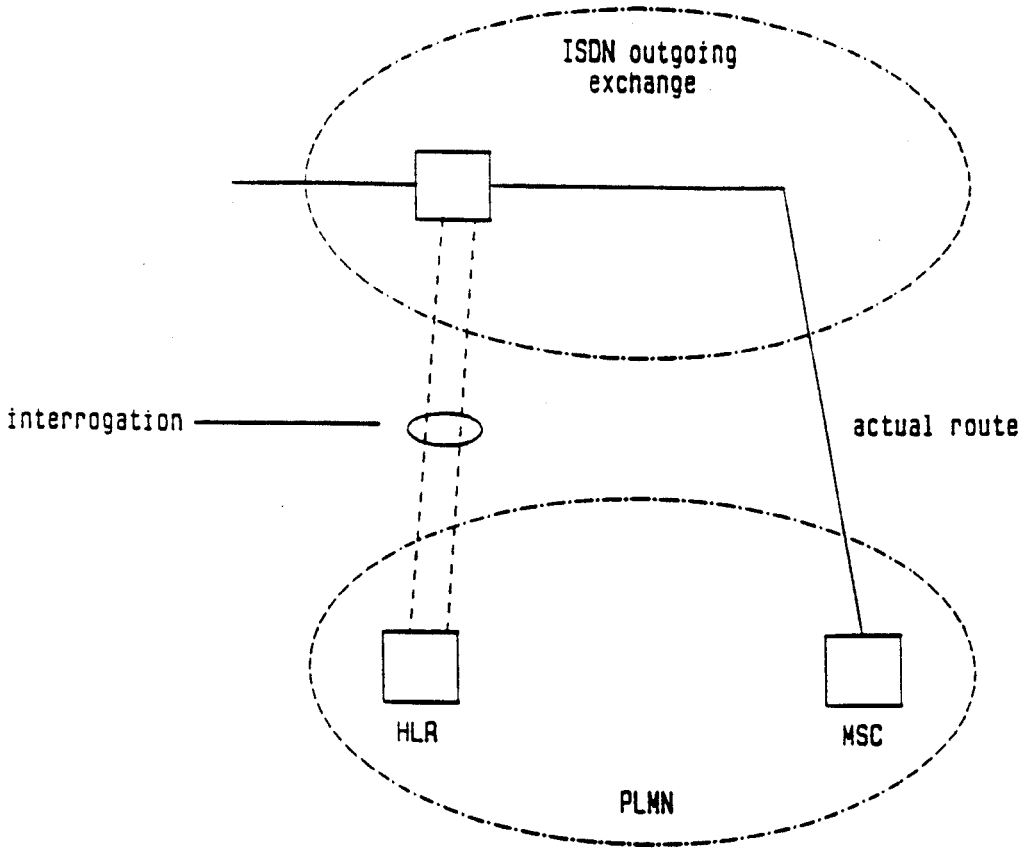

FIGURE 1
General interrogation procedure
Interrogation done by outgoing ISDN exchange

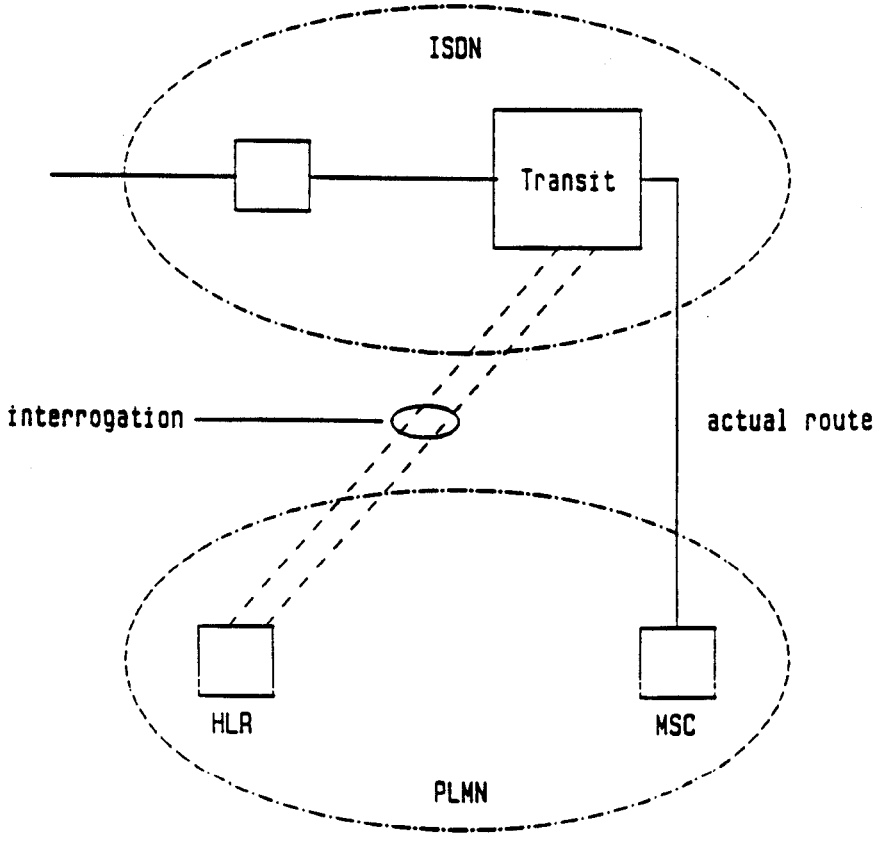

FIGURE 2
Interrogation is done by a transit exchange

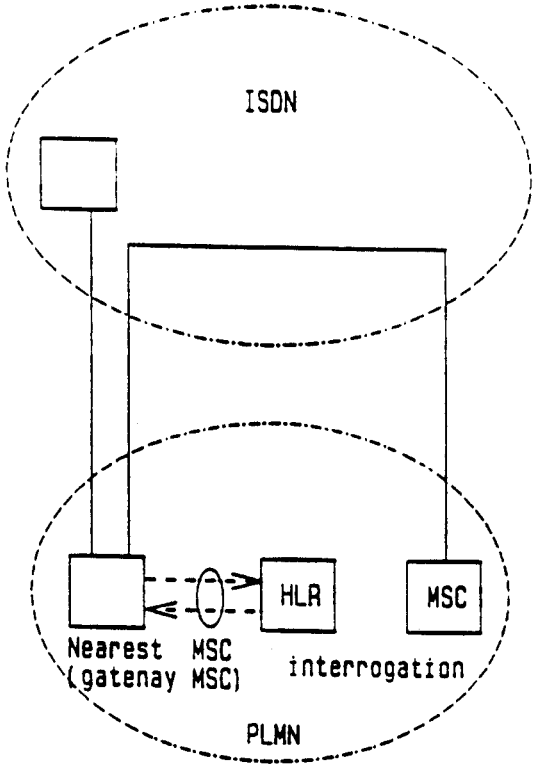

FIGURE 3
Routing to nearest MSC using call forwarding combined with interrogation within the PLMN

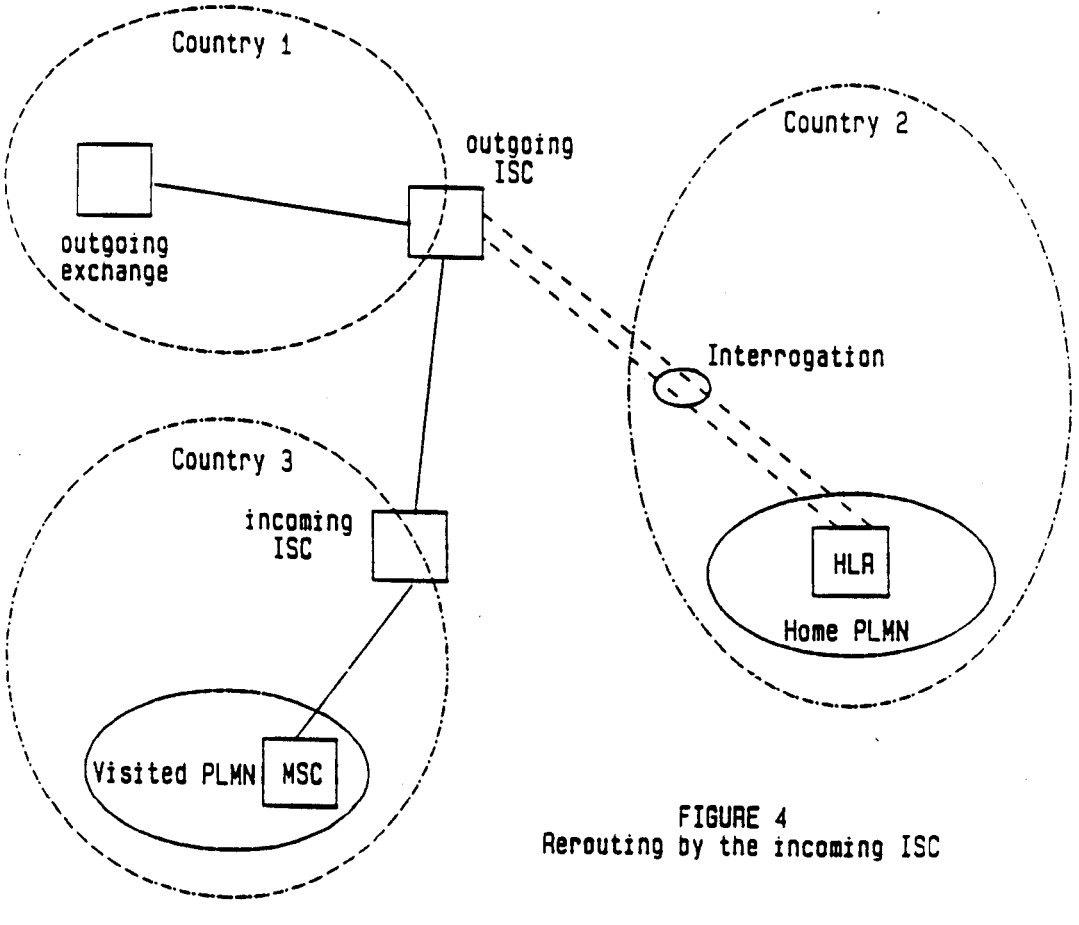

FIGURE 4
Rerouting by the incoming ISC

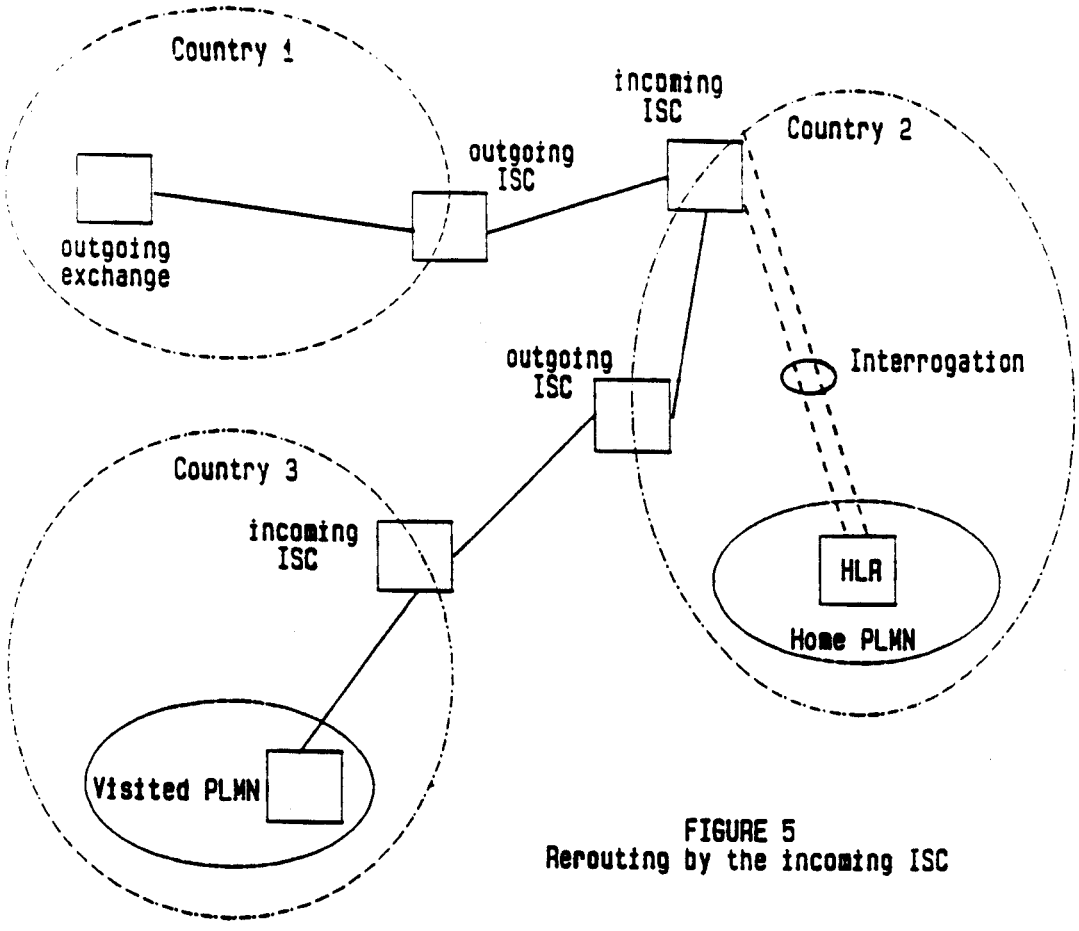

FIGURE 5
Rerouting by the incoming ISC

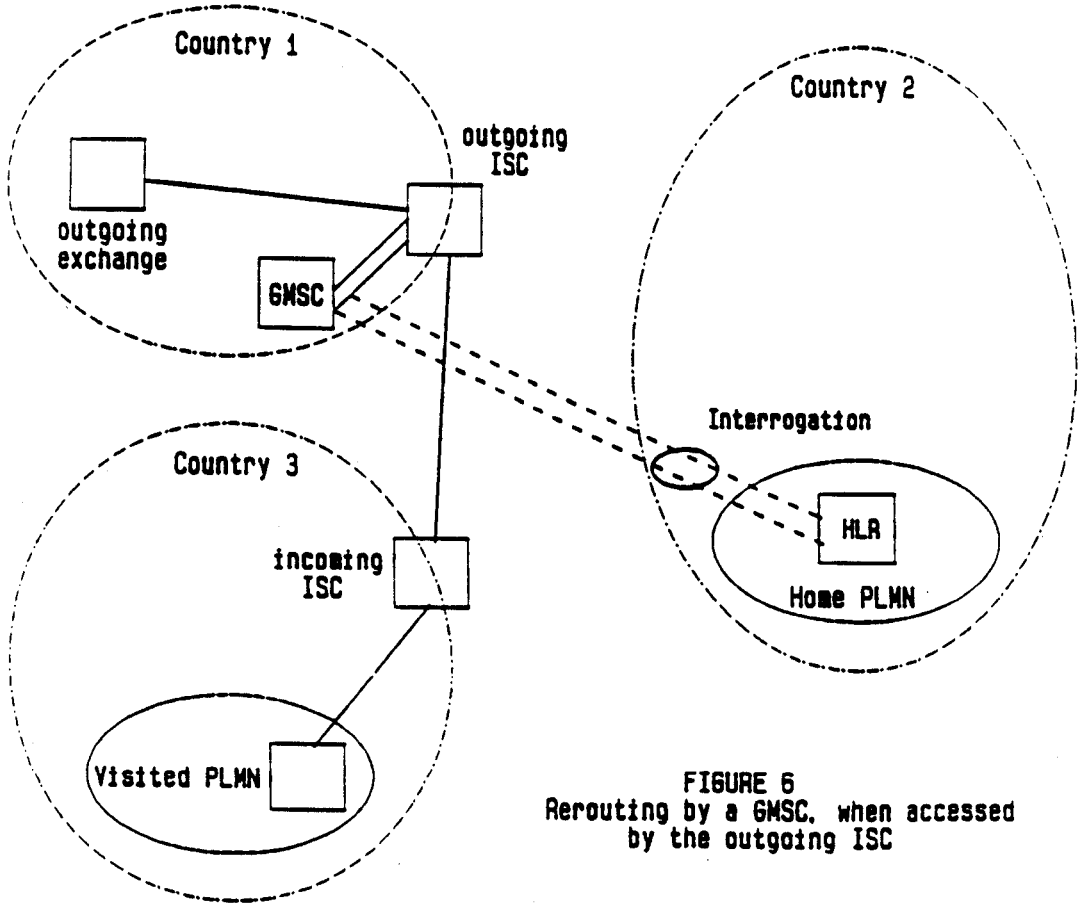

FIGURE 6
Rerouting by a GMSC, when accessed by the outgoing ISC

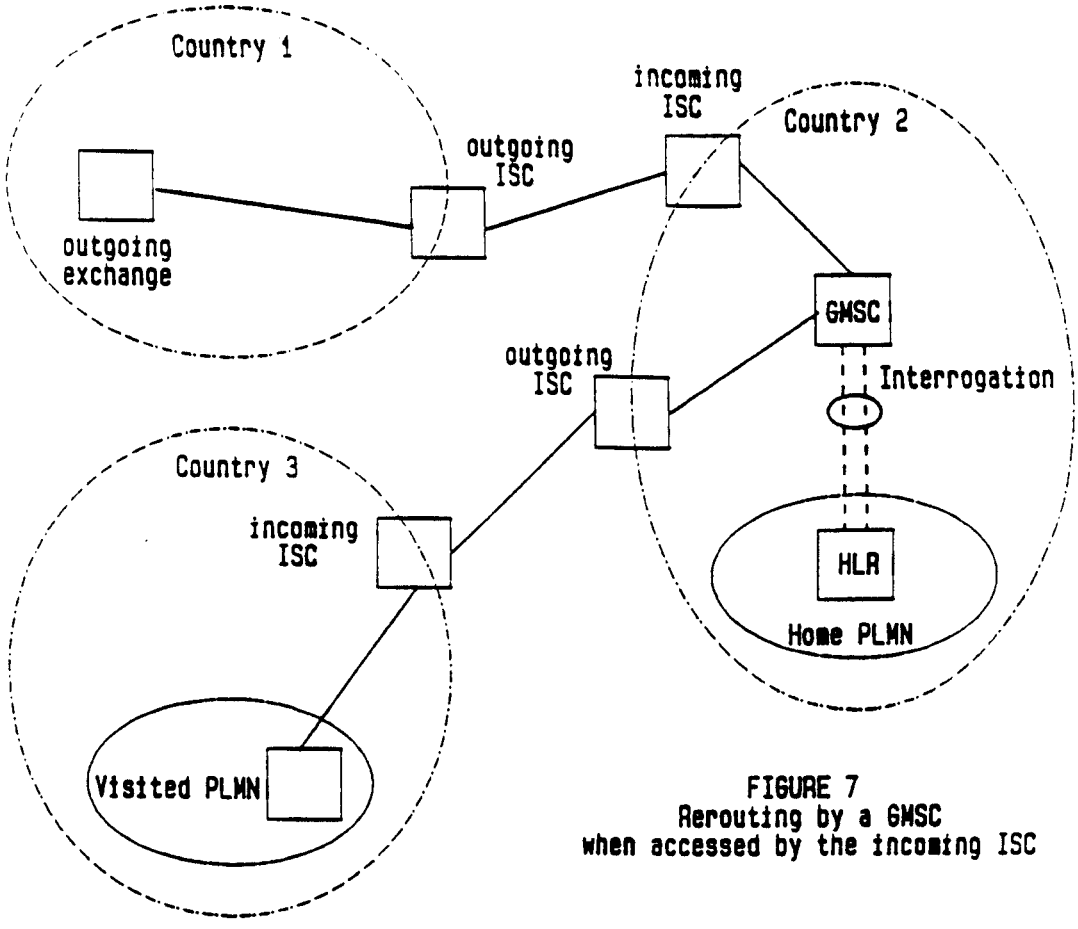

FIGURE 7
Rerouting by a GMSC
when accessed by the incoming ISC

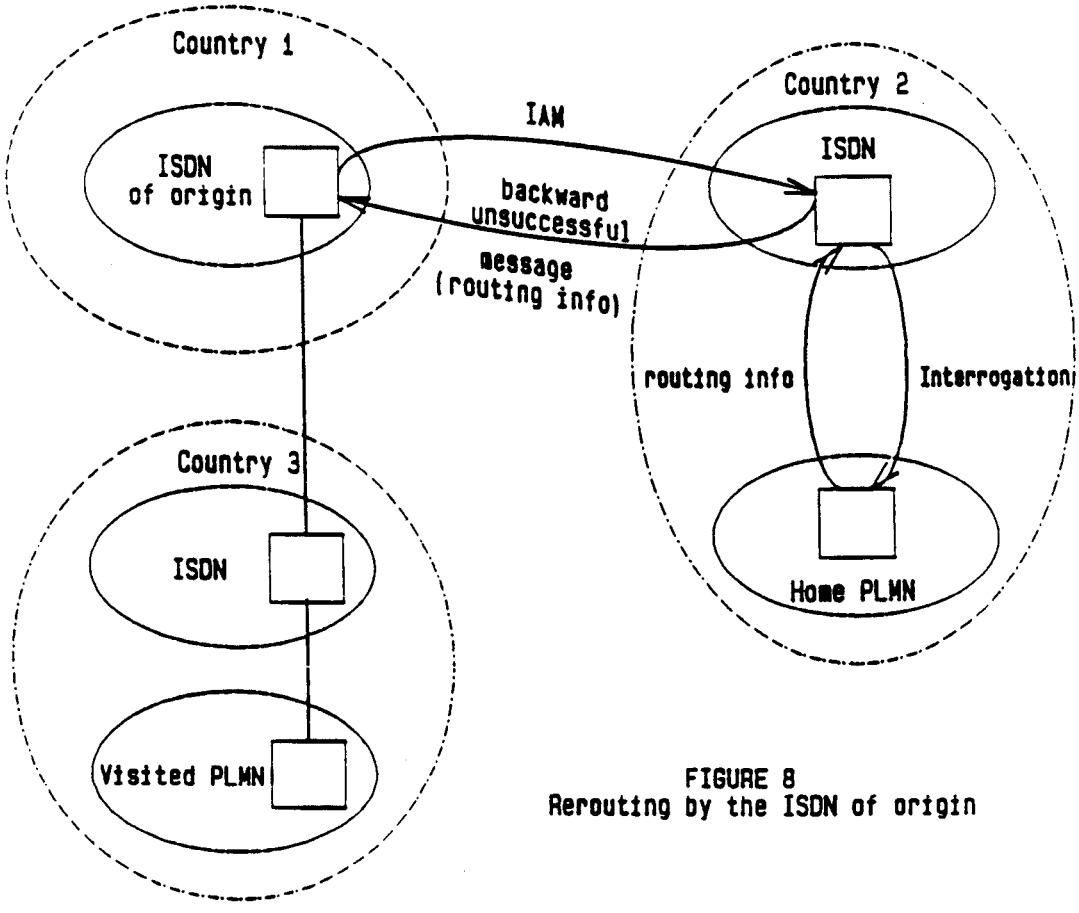

FIGURE 8
Rerouting by the ISDN of origin