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Contents

Foreword		5
1	Scope	7
2	Normative references	7
3	Definitions and abbreviations	7
4	General routing rules.....	7
5	Routing of a call from a subscriber served by the HPLMN	8
6	Routing of a call from a subscriber in the same country as the HPLMN but not served by the HPLMN.....	9
	6.1 Interrogation by a Gateway MSC	9
	6.2 Interrogation by the Originating LE	11
7	Routing of a call from a subscriber in a different country from the HPLMN	13
	7.1 Interrogation by a Gateway MSC	13
	7.2 Interrogation by the Incoming ISC in the Destination Country	16
	7.3 Interrogation by the Outgoing ISC in the Originating Country	18
8	Impact of supplementary services.....	19
	8.1 Call Forwarding.....	19
	8.2 Closed User Group	20
	8.3 Barring of Incoming Calls.....	20
	8.4 Supplementary Service Incompatibility	20
9	Unsuccessful call setup.....	20
	9.1 Roaming Not Allowed	20
	9.2 VPLMN Cannot Support The Required Service.....	20
	9.3 HLR Restart	20
	History.....	21

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Foreword

This Global System for Mobile communications Technical Specification (GTS) has been produced by the Special Mobile Group (SMG) Technical Committee (TC) of the European Telecommunications Standards Institute (ETSI).

This GTS defines the Signalling requirements relating to routing of calls to mobile subscribers within the digital cellular telecommunications system.

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

Version 5.x.y

where:

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

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1 Scope

When a subscriber wants to call a mobile station (MS), the network needs to know the location of the called MS in order to route the call to the appropriate Mobile services Switching Centre (MSC) (see GSM 03.12 on location registration). This Global System for Mobile communications Technical Specification (GTS) describes how the routing process can be performed, and considers the effect on the routing process of the capabilities of the exchanges involved.

This GTS assumes that the Mobile Station ISDN Number includes a specific National Destination Code which identifies the Home PLMN (HPLMN) of the called MS (referred to below as "the HPLMN"). If the numbering plan for MSs is fully integrated into the fixed network numbering plan, the method of routing may be different.

In the diagrams in clause 6, the originating local exchange is shown as being part of an ISDN. The same routing principles apply if the originating local exchange is part of a PSTN.

Short Messages are routed in the same way as circuit-switched calls; the SMS Gateway MSC must be able to interrogate the HLR of the MS for which the short message is intended, in order to route the short message to the visited MSC.

2 Normative references

This GTS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this GTS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

- [1] GSM 01.04 (ETR 350): "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".
- [2] GSM 03.07: "Digital cellular telecommunications system (Phase 2+); Restoration procedures".
- [3] GSM 03.12: "Digital cellular telecommunications system; Location registration procedures".
- [4] GSM 09.02 (ETS 300 974): "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification".

3 Definitions and abbreviations

Abbreviations used in this specification are listed in GSM 01.04.

4 General routing rules

The number dialled by the calling subscriber contains no indication of the location of the called MS. In order to route the call to the MS the network must be aware of the location of the MS and the routing address to be used. The routing address is the Mobile Station Roaming Number (MSRN); the only network entity which can provide the MSRN is the Home Location Register (HLR) of the HPLMN, hence in order to route the call to the visited MSC (VMSC) where the called MS is located it is necessary to interrogate the HLR.

The preferred arrangement for interrogation of the HLR is to direct the call to a Gateway MSC (GMSC) which is part of the HPLMN. This simplifies the process of charging the called subscriber correctly if the call has to be re-routed because the called MS has roamed to a different PLMN or if the call has to be forwarded.

The consequence of this is that the preferred signalling procedure is as follows:

- i) When a subscriber wants to call an MS he dials the MSISDN of the called MS.
- ii) The originating local exchange (LE), or a transit exchange, analyses the dialled number and recognizes the NDC which identifies the HPLMN. If the calling subscriber is in a different country from the called MS, this analysis will in general not be performed by the originating LE; when the international prefix is recognized, the call is routed to an outgoing International Switching Centre (ISC) without any further analysis, and the incoming ISC in the destination country recognizes the NDC of the HPLMN.
- iii) The call is directed to a GMSC in the HPLMN. The GMSC interrogates the HLR, which returns the MSRN for the called MS. The HLR obtains the MSRN by interrogating the VLR where the called MS is currently registered. This procedure uses the Mobile Application Part of Signalling System CCITT No 7 (see Technical Specification GSM 09.02).
- iv) The GMSC uses the MSRN to route the call to the VMSC.

Clause 5 describes the routing of a call from a subscriber served by the HPLMN.

Clause 6 describes the routing of a call from a subscriber in the same country as the HPLMN, but not served by the HPLMN.

Clause 7 describes the routing of a call from a subscriber in a different country from the HPLMN.

5 Routing of a call from a subscriber served by the HPLMN

If the calling subscriber is served by an exchange which is part of the HPLMN, the configuration is as shown in figure 1. The originating MSC is able to interrogate the HLR for an MSRN, and the call is routed within the PLMN. If the called MS has roamed to another PLMN the originating MSC routes the call to the visited PLMN (VPLMN) as shown in figure 2.

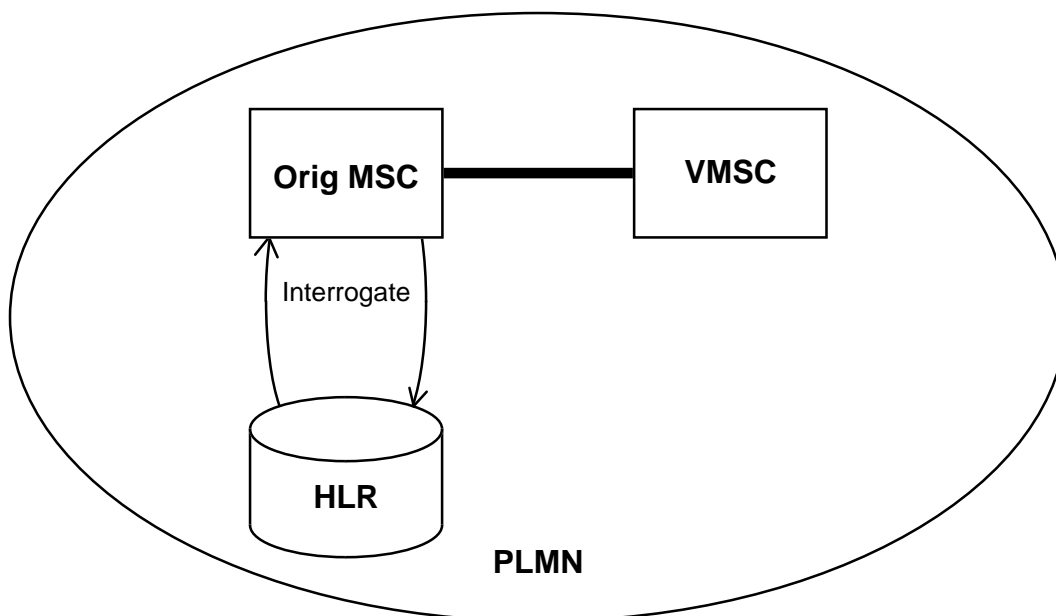


Figure 1: Call from a subscriber in the HPLMN of the called MS

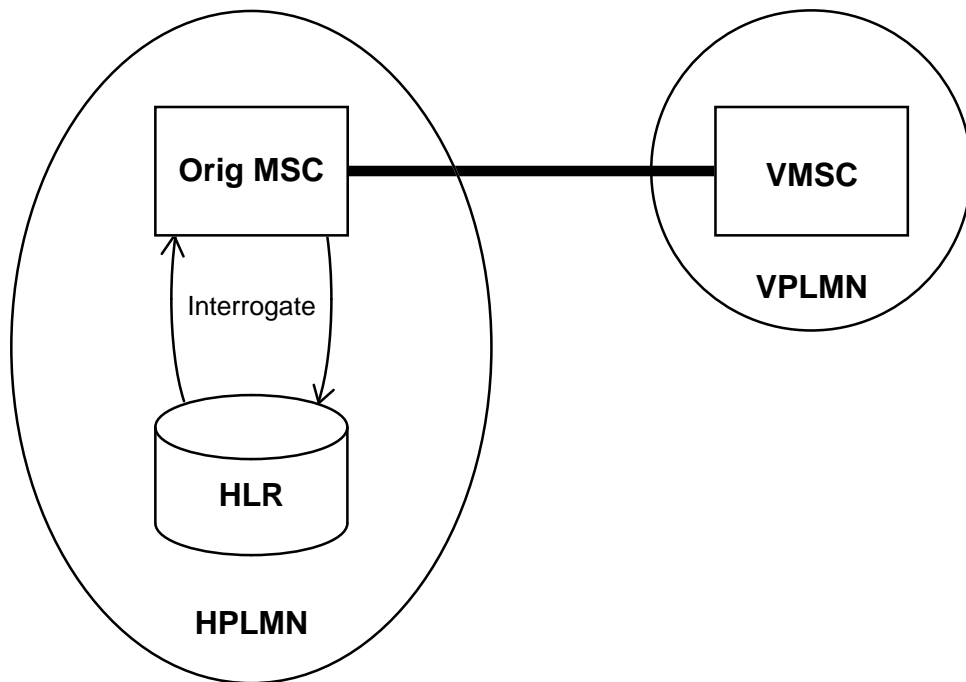


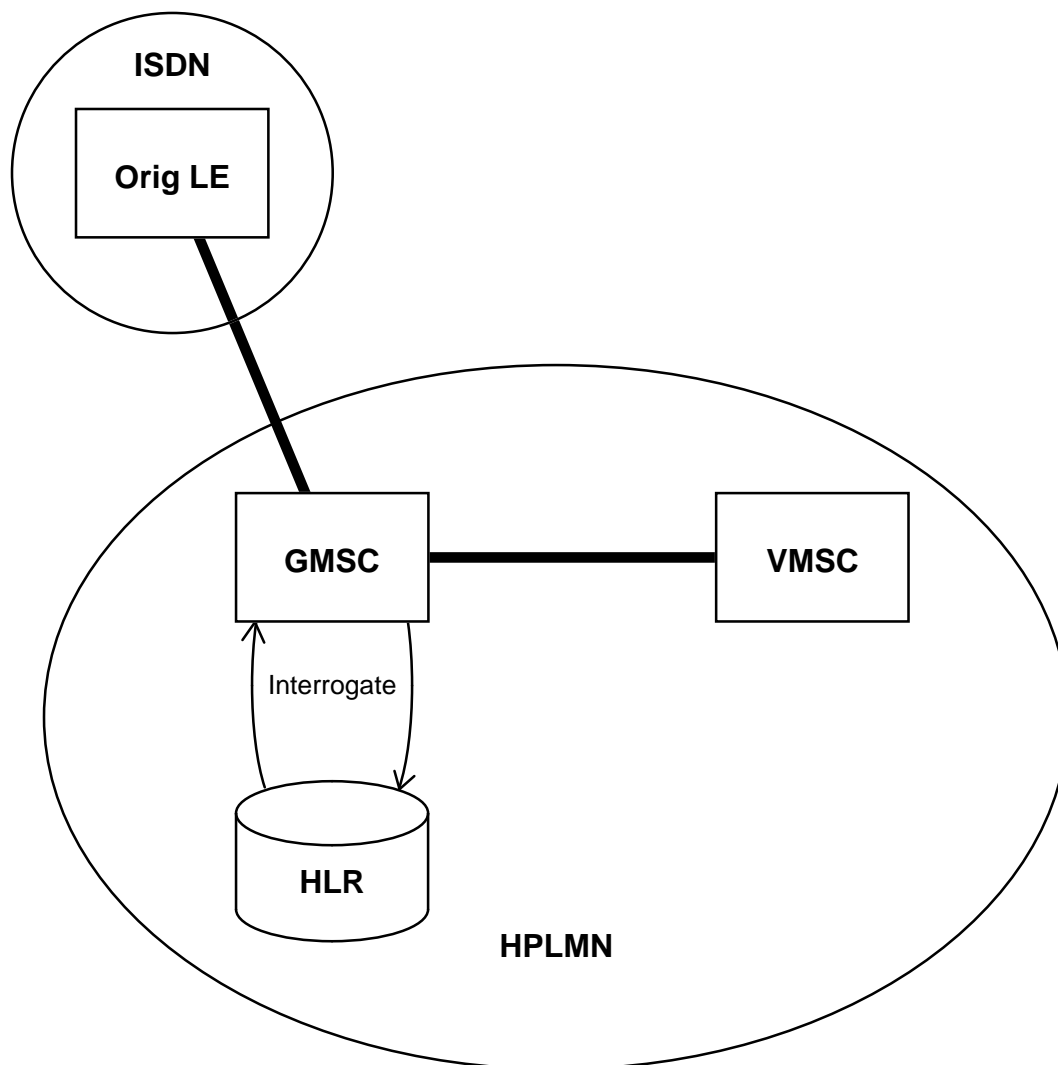
Figure 2: Call from a subscriber in the HPLMN of the called MS;
called MS roamed to another PLMN

6 Routing of a call from a subscriber in the same country as the HPLMN but not served by the HPLMN

This clause considers two configurations: where the HLR is interrogated by a gateway exchange which is part of the HPLMN (the preferred configuration), and where the HLR is interrogated by the originating LE.

6.1 Interrogation by a Gateway MSC

If the HLR is interrogated by a gateway exchange which is part of the HPLMN, the configuration is as shown in figure 3. The call is handled as described in clause 4. If the called MS has roamed outside its HPLMN the GMSC routes the call to the visited PLMN (VPLMN) as shown in figure 4.



**Figure 3: Call from a subscriber in the HPLMN country of the called MS;
interrogation by GMSC in the HPLMN**

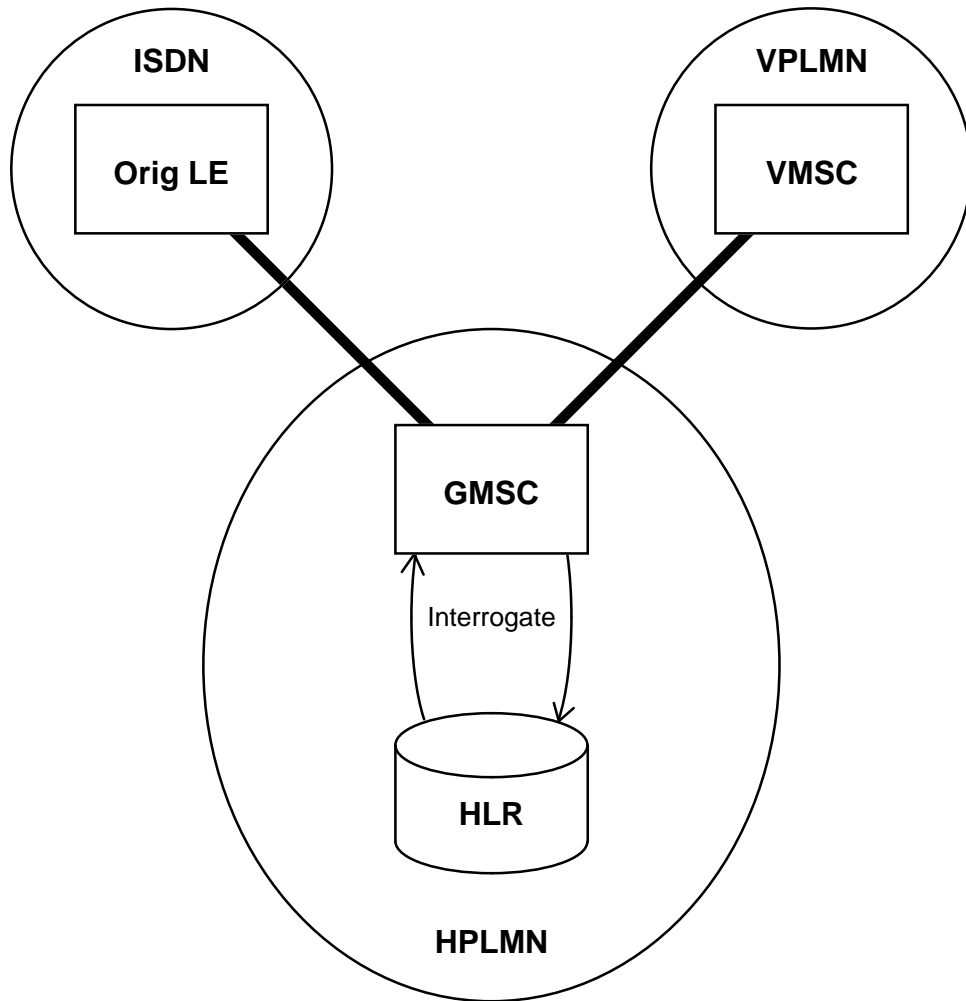


Figure 4: Call from a subscriber in the HPLMN country of the called MS; interrogation by GMSC in the HPLMN; called MS roamed to another PLMN

6.2 Interrogation by the Originating LE

If the HLR is interrogated by the originating LE, the configuration is as shown in figure 5. After the HLR has returned the MSRN to the originating LE, the LE routes the call to the VMSC. If the called MS has roamed outside its HPLMN the originating LE routes the call to the visited PLMN (VPLMN) as shown in figure 6. In this case, the routing for the call does not pass through the HPLMN.

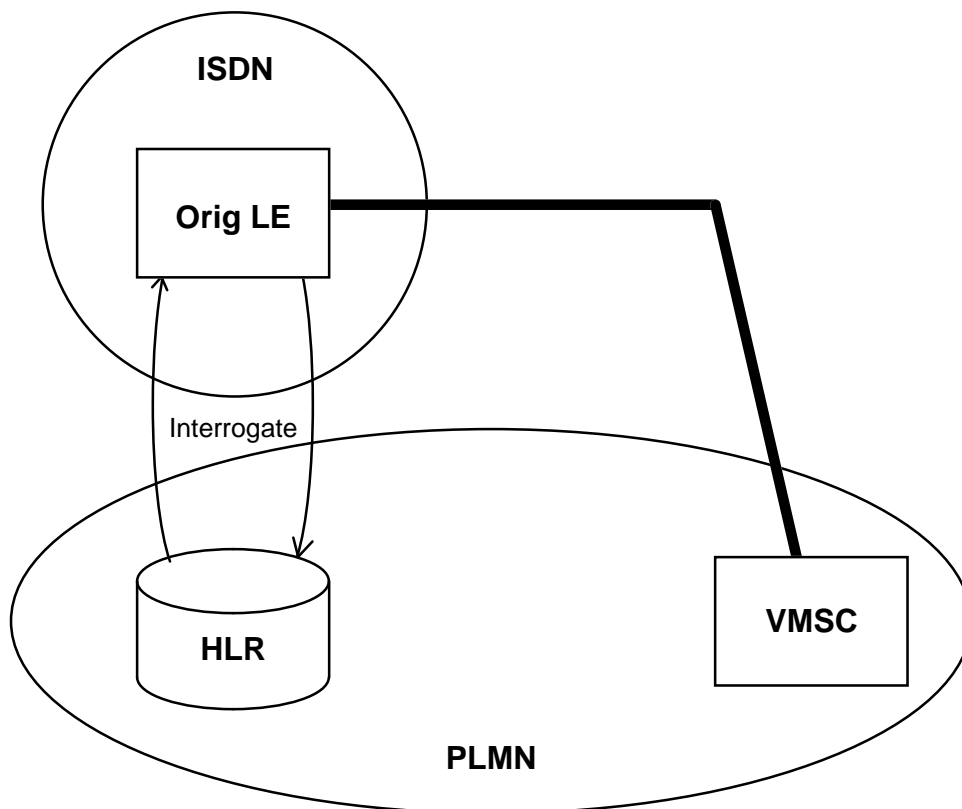


Figure 5: Call from a subscriber in the HPLMN country of the called MS; interrogation by originating LE

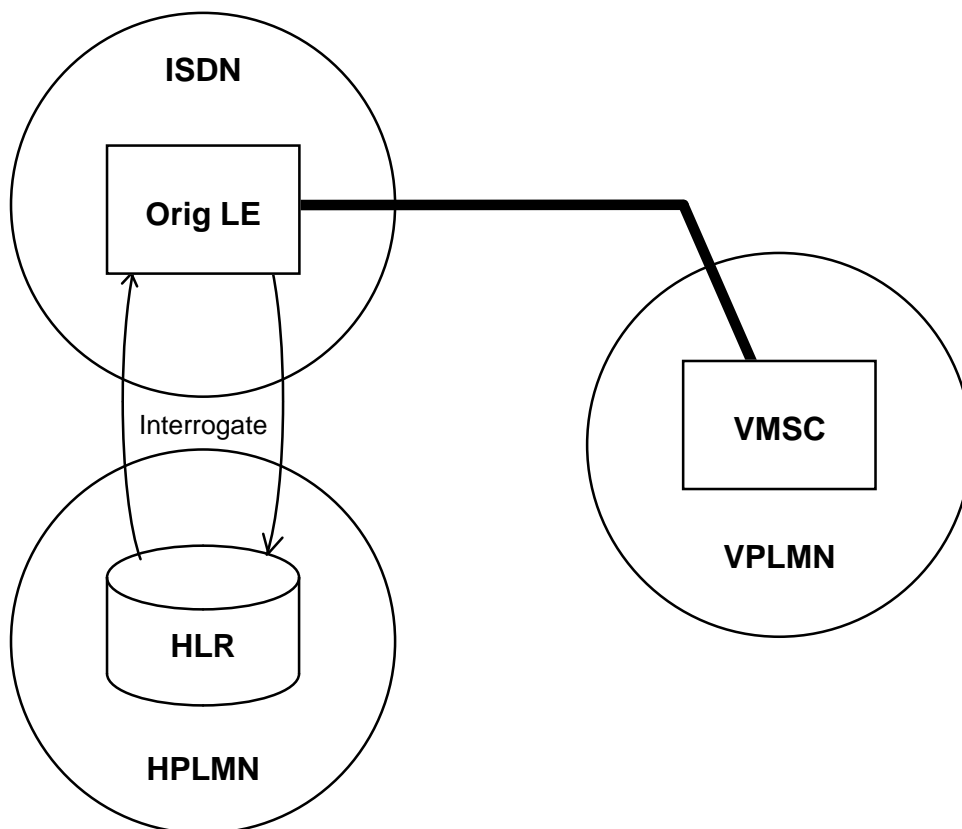


Figure 6: Call from a subscriber in the HPLMN country of the called MS; interrogation by originating LE; called MS roamed to another PLMN

7 Routing of a call from a subscriber in a different country from the HPLMN

This clause considers three configurations: where the HLR is interrogated by a gateway exchange which is part of the HPLMN (the preferred configuration), where the HLR is interrogated by the incoming ISC in the country of the HPLMN, and where the HLR is interrogated by the outgoing ISC in the country of the calling subscriber.

7.1 Interrogation by a Gateway MSC

If the HLR is interrogated by a gateway exchange which is part of the HPLMN, the configuration is as shown in figure 7. The call is handled as described in clause 4. If the called MS has roamed outside its HPLMN country the GMSC routes the call to the visited PLMN (VPLMN) via a second international route, as shown in figure 8.

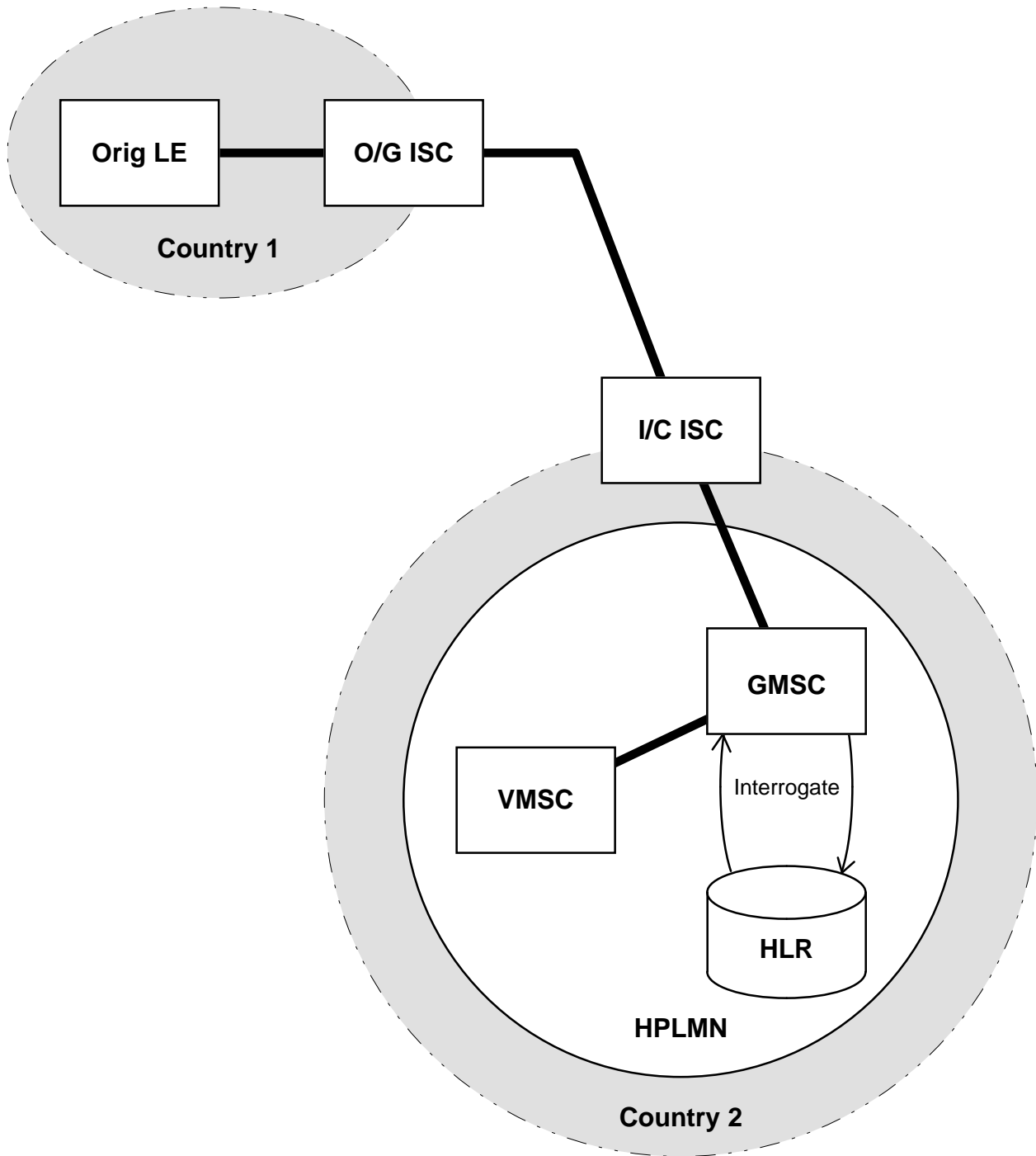


Figure 7: Call from a subscriber in a different country from the called MS; interrogation by GMSC in the HPLMN

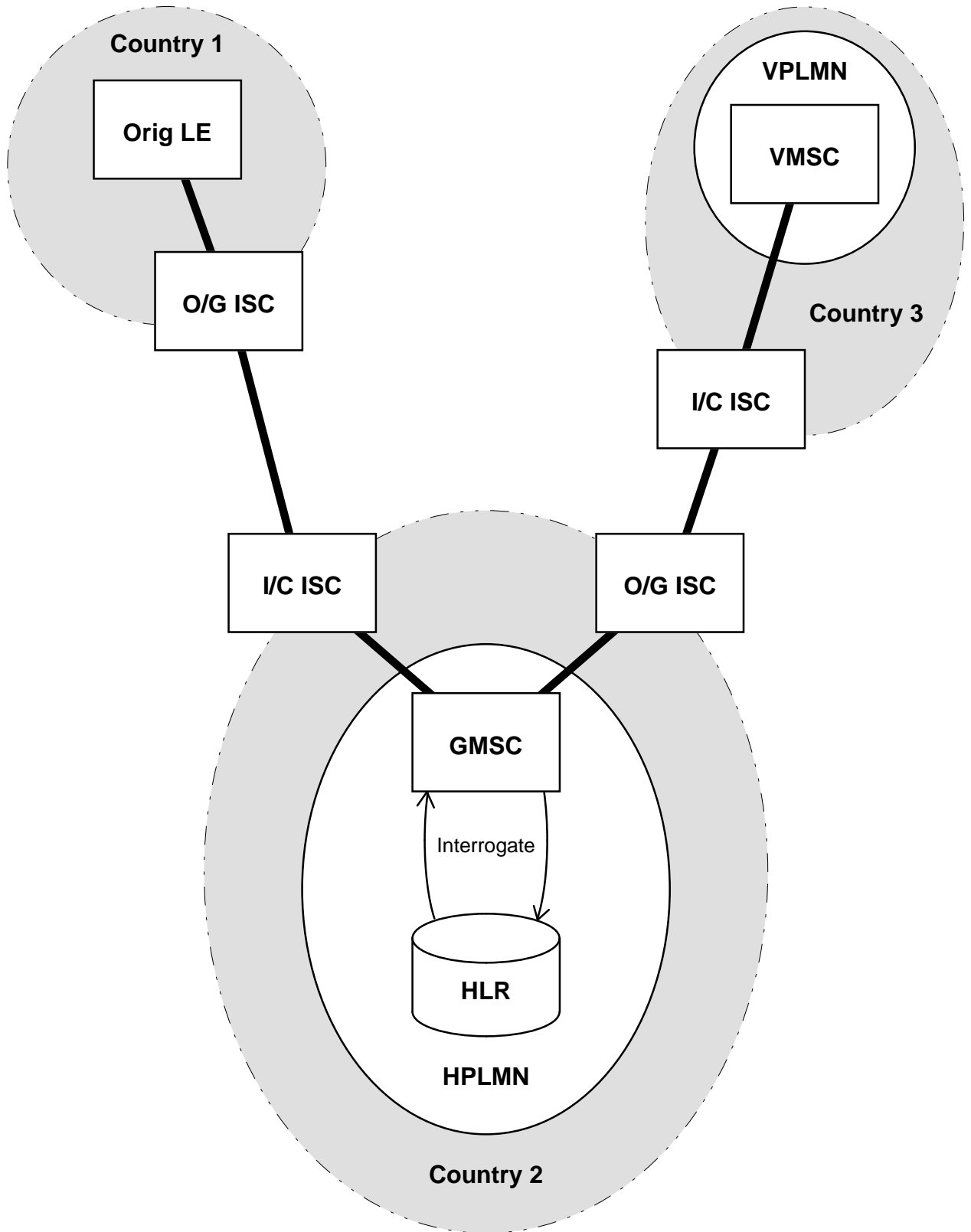


Figure 8: Call from a subscriber in a different country from the called MS; interrogation by GMSC in the HPLMN; called MS roamed to another PLMN

7.2 Interrogation by the Incoming ISC in the Destination Country

If the HLR is interrogated by the incoming ISC in the HPLMN country, the configuration is as shown in figure 9. After the HLR has returned the MSRN to the incoming ISC, the incoming ISC routes the call to the VMSC. If the called MS has roamed to another country the incoming ISC routes the call to the visited PLMN (VPLMN) as shown in figure 10. In this case, the routing for the call does not pass through the HPLMN.

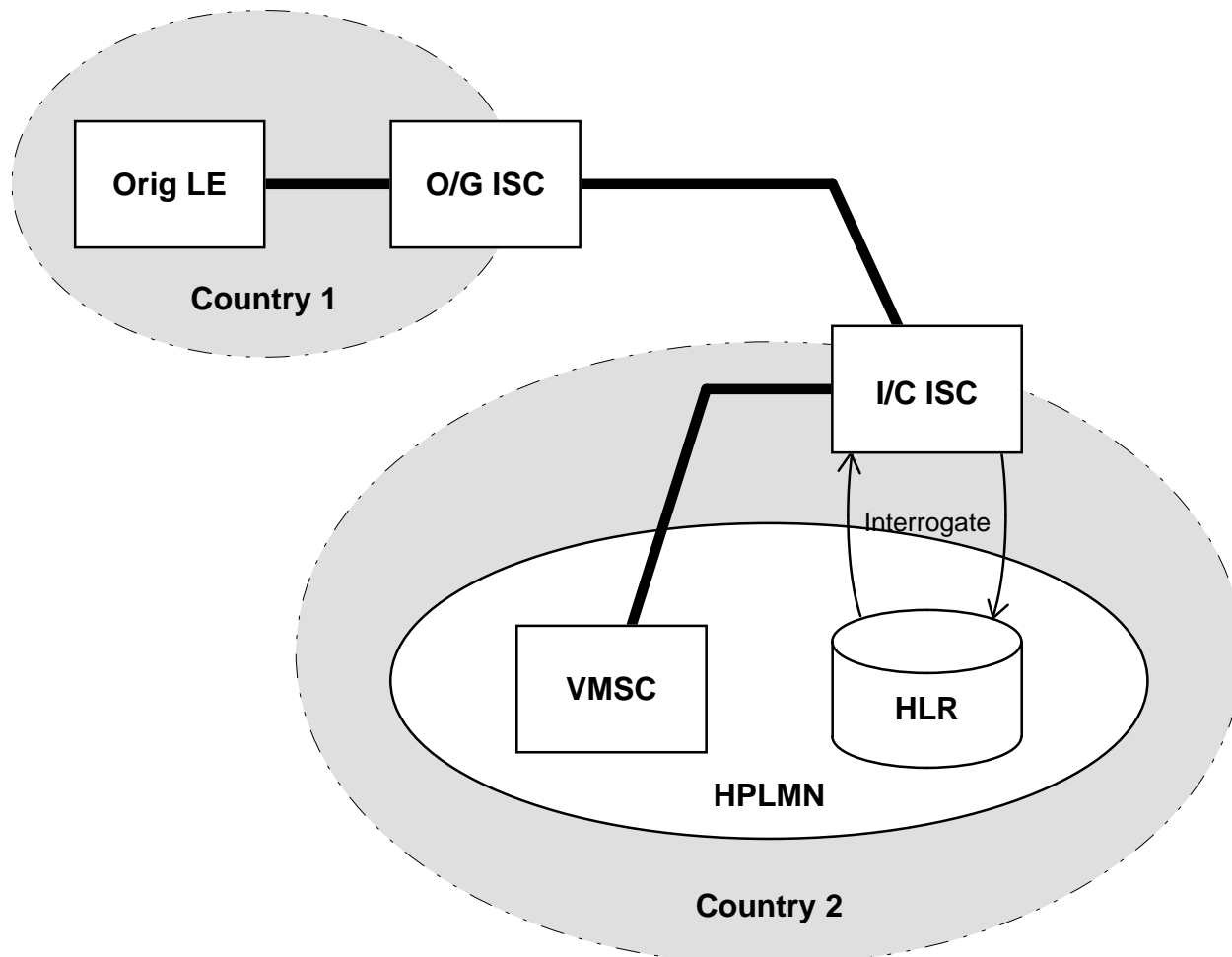


Figure 9: Call from a subscriber in a different country from the called MS; interrogation by incoming ISC

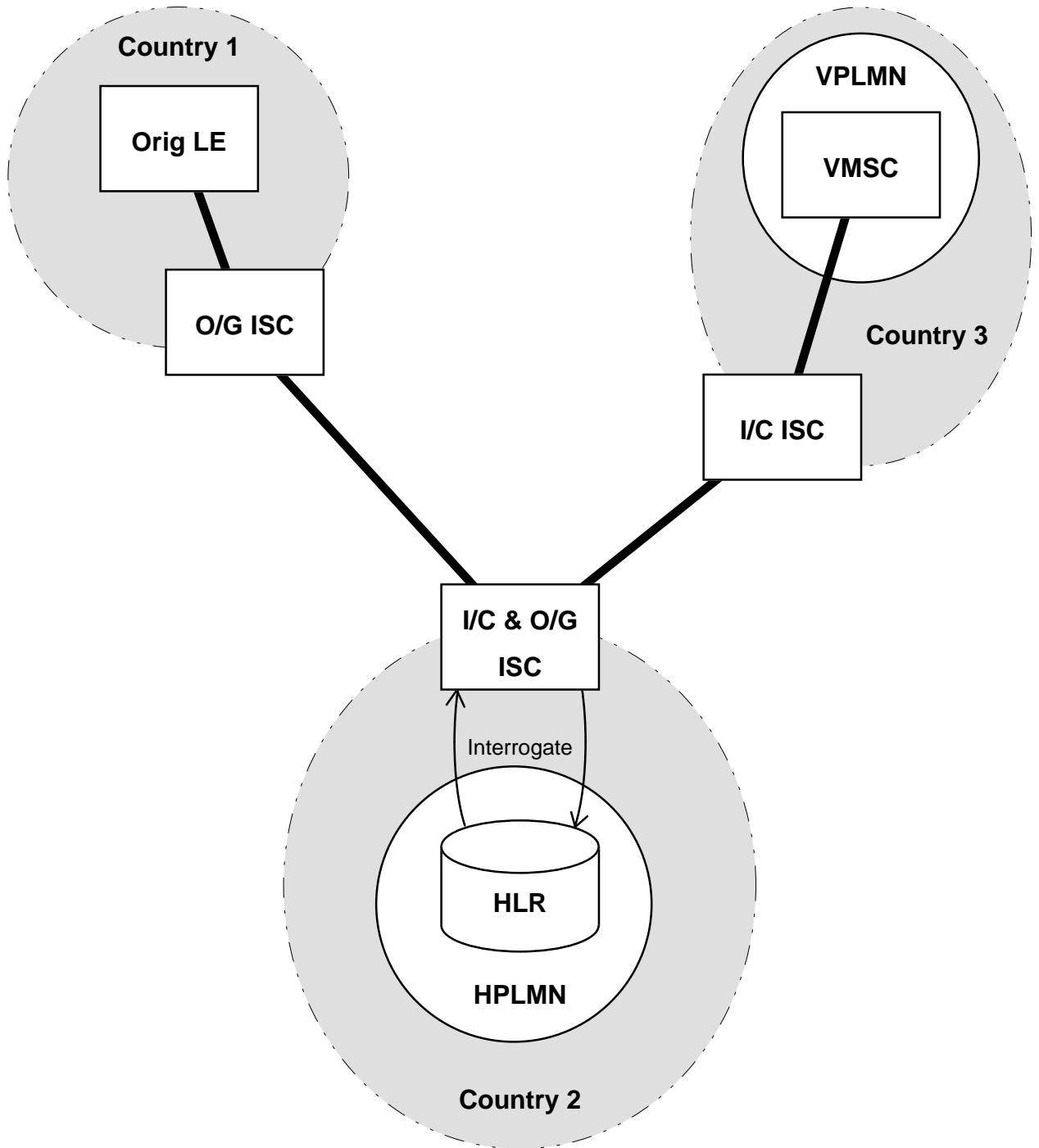


Figure 10: Call from a subscriber in a different country from the called MS; interrogation by incoming ISC; called MS roamed to another PLMN

7.3 Interrogation by the Outgoing ISC in the Originating Country

If the HLR is interrogated by the outgoing ISC in the originating subscriber's country, the configuration is as shown in figure 11. After the HLR has returned the MSRN to the outgoing ISC, the outgoing ISC routes the call to the VMSC via an incoming ISC in the HPLMN country. If the called MS has roamed to another country the outgoing ISC routes the call to the visited PLMN (VPLMN) as shown in figure 12. In this case, the routing for the call does not pass through the HPLMN country.

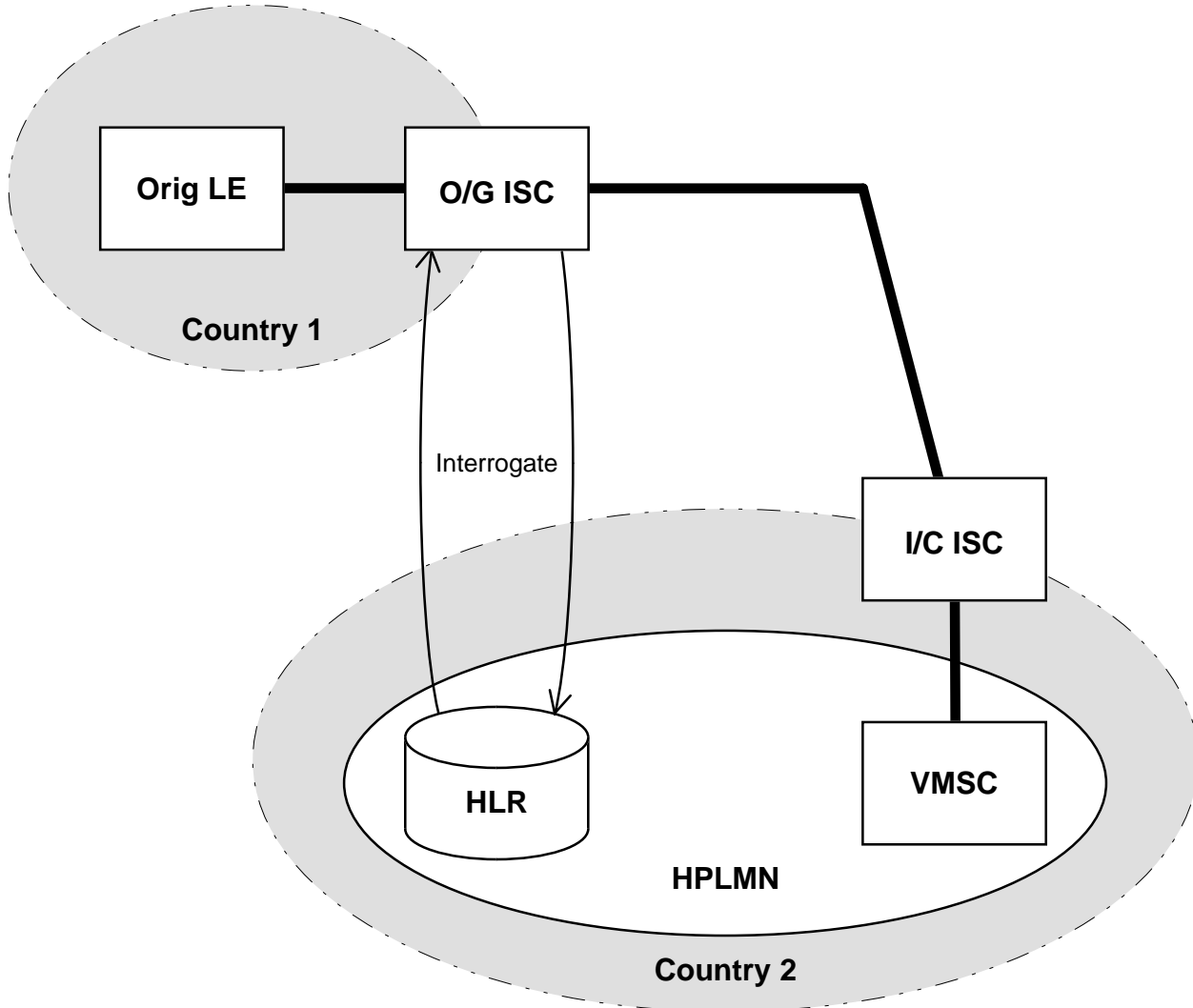


Figure 11: Call from a subscriber in a different country from the called MS; interrogation by outgoing ISC

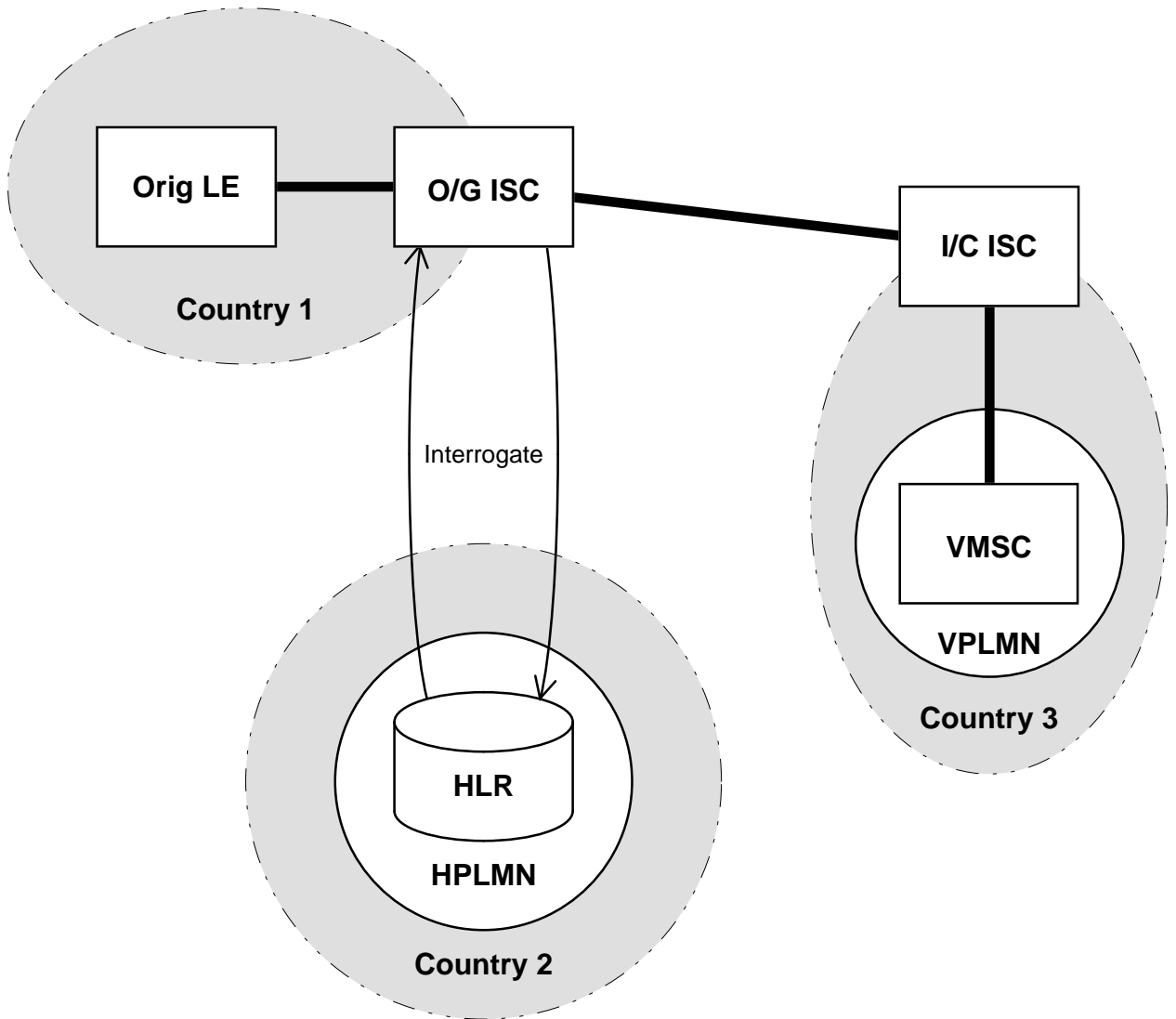


Figure 12: Call from a subscriber in a different country from the called MS; interrogation by outgoing ISC; called MS roamed to another PLMN

8 Impact of supplementary services

8.1 Call Forwarding

If Call Forwarding Unconditional is active, the HLR returns the forwarded-to number in response to the interrogation. The exchange which interrogated the HLR routes the call to the forwarded-to number; if the forwarded-to number identifies a mobile subscriber then the call will be routed from the interrogating exchange as described above.

If the called MS is marked as detached, the VLR returns an "absent subscriber" error in response to the request for an MSRN. If Call Forwarding on Mobile Subscriber Not Reachable is active, the HLR returns the forwarded-to number in response to the interrogation. The exchange which interrogated the HLR routes the call to the forwarded-to number; if the forwarded-to number identifies a mobile subscriber then the call will be routed from the interrogating exchange as described above.

In other cases where a conditional Call Forwarding service (on MS busy, on no reply or on MS not reachable) is active, the call forwarding is invoked at the VMSC as a result of the call setup attempt there after the call has been routed to the VMSC as described above.

8.2 Closed User Group

If the called MS is a member of a Closed User Group (CUG) the CUG parameters are stored in the HLR. When the HLR receives an interrogation to route a call to the MS, it checks the CUG parameters. If the call is authorized, the HLR returns an MSRN in the response to the interrogation; if the call is not authorized the HLR returns an appropriate error.

8.3 Barring of Incoming Calls

If Barring of Incoming Calls is active, the HLR returns an error response to the interrogation; this causes the interrogating exchange to return an appropriate indication to the calling subscriber to discourage repeated attempts to call the barred MS.

8.4 Supplementary Service Incompatibility

If the interrogation message to the HLR contains information which shows that the call would be incompatible with one of the supplementary services active for the called MS, the HLR returns an error response to the interrogation; this causes the interrogating exchange to return an appropriate indication to the calling subscriber to discourage repeated attempts to call the MS under the same conditions.

9 Unsuccessful call setup

This clause deals with those cases which are specific to calls to a mobile subscriber. The case where the called subscriber does not subscribe to the service required by the call is the same as for a call to a subscriber on the fixed network.

9.1 Roaming Not Allowed

If the called MS has roamed to a PLMN where it is not allowed service, the HLR has no location information for the called MS. If Call Forwarding on MS Not Reachable is active, the HLR returns the forwarded-to number in response to the interrogation as described in subclause 8.1. If Call Forwarding on MS Not Reachable is not active, the HLR returns an error response to the interrogation.

If the called MS has roamed to a location area where it is not allowed service, the HLR contains the identity of the VLR to which the MS has roamed, but the MS is marked as detached in the VLR. The VLR therefore returns an "absent subscriber" error in response to the request for an MSRN. If Call Forwarding on MS Not Reachable is active, the HLR returns the forwarded-to number in response to the interrogation as described in subclause 8.1. If Call Forwarding on MS Not Reachable is not active, the HLR returns an error response to the interrogation.

9.2 VPLMN Cannot Support The Required Service

If the called MS has roamed to a PLMN which does not support the service required by the call (as indicated in the information sent in the request for the MSRN), the VLR returns an appropriate error indication to the HLR, which relays the error indication to the interrogating exchange.

9.3 HLR Restart

If the HLR has restarted, the location information for the called MS which has been reloaded from the backup may be incorrect. In this case, the request for an MSRN is directed to the wrong VLR, but the VLR returns an MSRN and requests subscriber data from the HLR as described in Technical Specification GSM 03.07. The HLR returns the MSRN in response to the request for routing information and the call is routed to the VMSC as described above, but the MS will not respond to paging, so the call will fail with a cause of absent subscriber, or be forwarded if Call Forwarding on MS Not Reachable is active.

History

Document history	
November 1996	Publication of version 5.0.0 (based on version 4.0.4)