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

- if the GMSC is accessed by the outgoing ISC, see Figure 6/Q.1032.

- if the GMSC is accessed by the Incoming ISC, see Figure 7/Q.1032.

6. Alternative solution: re-routing of the call after clearing the previous connection (Figure 8/Q.1032)

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. Unsuccessful call set-up

7.1 Roaming not allowed

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

7.2 Restart of the HLR

After a restart, the HLR considers that the information coming from the back up is still valid. If an interrogation is related to a subscriber whose information is 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 Q.1004 will re-establish the correct information.

7.3 Mobile station roaming number unallocated

If the incoming MSC receives a call which roaming number is declaredunallocated 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 Q.1004).

routes the call directly 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/Q.1032)

When the outgoing International Switching Centre receives the call, for routing purposes it analyzes the digits of 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 destined to a mobile subscriber and needs a preliminary interrogation transaction prior to setting up the connection.

With the roaming number, the ISC then routes the call to the MSC where the mobile 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 International Switching Centre is unable to perform the interrogation of the HLR (Figure 5/Q.1032)

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 ISC receiving the call notices that it is destined 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 mobile is roaming in the country of the calling subscriber: the complete connection comprises 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

As it is described below, in the case where there are no interrogation facilities in the fixed network, on recognition that a call is destined to a mobile subscriber, the routing is first performed to a Gateway MSC. The interrogation of the HLR is then performed by the 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. Signalling aspects on routing a call to a mobile managed by a home PLMN situated in the same country

4.1 The originating exchange is adapted to the interrogation procedure (Figure 1/Q.1032)

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 re-routed by a Gateway MSC.

4.2.1 The interrogation is performed by a transit exchange (Figure 2/Q.1032)

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

4.2.2 The call is re-routed by a Gateway MSC (Figure 3/Q.1032)

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 a Gateway MSC.

The Gateway MSC interrogates the HLR of the called MS (using MAP in general cases). It receives back the roaming number of the subscriber. With this address, the GMSC set-up a connection via the telephone (or ISDN) network to the MSC where the mobile 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 join a foreign mobile subscriber, dials the international access prefix first. His local exchange, according to this prefix,

This Recommendation assumes that the routing analysis requirements specified in 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 are for further study.

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 station he dials the ISDN number of that station.

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 destined 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 the call directly to the outgoing International Switching Centre (ISC) without any further analysis. This ISC can then recognize the mobile national destination code.

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 station 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 to 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 Signalling System No. 7.

4) 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 Signalling System No. 7. The preferred solution is that the local exchanges be adapted to TC, and able to perform this interrogation: then they can route the call directly to the called mobile 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.

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Recommendation Q.1032

SIGNALLING REQUIREMENTS RELATING TO ROUTING OF CALLS
TO MOBILE SUBSCRIBERS

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 Q.1003 on location registration). This contribution tries to present the signalling 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 signalling procedures prior to call set-up.