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INTERNATIONAL TELECOMMUNICATION UNION

# CCITT

THE INTERNATIONAL  
TELEGRAPH AND TELEPHONE  
CONSULTATIVE COMMITTEE

**BLUE BOOK**

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**VOLUME VI – FASCICLE VI.13**

## **PUBLIC LAND MOBILE NETWORK MOBILE APPLICATION PART AND INTERFACES**

**RECOMMENDATIONS Q.1051-Q.1063**

---



**IXTH PLENARY ASSEMBLY**  
MELBOURNE, 14-25 NOVEMBER 1988

Geneva 1989



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## PRELIMINARY NOTES

1 The Questions entrusted to each Study Group for the Study Period 1988-1992 can be found in Contribution No. 1 to that Study Group.

2 In this Volume, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.

3 The strict observance of the specifications for standardized international signalling and switching equipment is of the utmost importance in the manufacture and operation of the equipment. Hence these specifications are obligatory except where it is explicitly stipulated to the contrary.

The values given in Fascicles VI.1 to VI.14 are imperative and must be met under normal service conditions.

**FASCICLE VI.13**

**Recommendations Q.1051 to Q.1063**

**PUBLIC LAND MOBILE NETWORK  
MOBILE APPLICATION PART AND INTERFACES**

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## SECTION 1

### MOBILE APPLICATION PART

#### Recommendation Q.1051

### MOBILE APPLICATION PART

#### 1 Introduction

##### 1.1 General

The purpose of this Recommendation is to specify procedures by which PLMNs can be interconnected internationally. It does not constrain national implementations of interconnection between functional entities of PLMNs.

The Mobile Application Part specified here gives the necessary signalling functions required in using Signalling System No. 7 to provide necessary services such as mobile facilities for voice and non-voice applications in a mobile network. The Mobile Application Part functions are the information exchange mostly related to the possibility for a mobile station (MS) to roam.

The Mobile Application Part meets all requirements for service features, user facilities and mobile network capabilities for national and international roaming and service provisions.

The Mobile Application Part makes use of services provided for transfer of information between functional units in a PLMN equipped with the MAP-function.

##### 1.2 Mobile Application Part procedures

Most of the following procedures are necessary to allow a mobile subscriber to roam within and between PLMNs:

- location registration gives the subscriber facilities for receiving and making calls in the whole network;
- location cancellation of an earlier location registration, e.g., when a new location registration occurs or the subscriber ceases the subscription;
- mobile station detach/attach procedures and de-registration of mobile station by administrative means;
- handling of supplementary services allowed for the subscriber. Information about relevant parameters may also be given as part of locating updating procedure;
- management of subscriber parameters to update home and visited location registers with regard to changes in subscriber parameters;
- retrieval of subscriber parameters during a call set up;

- handover which means that a call can be switched over to a better radio channel if the transmission quality drops below a specified level. This radio channel can be controlled by either the same or another MSC;
- subscriber management gives the possibility for a location information request in order to update a location registration in a visited location register or give the home location register information, e.g., about the roaming number used in a visited register for the subscribers. This type of management can be used after a restart followed by automatic reload of a location register;
- management of registration/erasure, activation/deactivation, invocation or interrogation for supplementary services;
- transfer of charging information between an MSC and the home location register;
- fault recovery in the network in case of restart with automatic reload in any node involved in the network;
- management of IMEI (International Mobile Equipment Identities);
- management of authentication;
- management of security related functions;
- fault recovery is also inherent in each procedure mentioned above;
- the Mobile Application Part will support various O & M procedures.

## 2 Requirements concerning the use of SCCP and TCAP

### 2.1 Use of SCCP

#### 2.1.1 SCCP class

The Mobile Application Part requires only class 0 operation of the SCCP.

#### 2.1.2 Sub-system number

The Mobile Application Part has been allocated the following SSN:

0000 0101.

#### 2.1.3 SCCP addressing

##### 2.1.3.1 Introduction

Various SCCP addresses are needed in order to access the entities of the mobile system and to route MAP messages or to support transactions with exchanges of the fixed network. Two cases are considered:

- both ends of the transaction are located in the same country;
- an international connection has to be set up.

The following entities are considered as end points:

- the Mobile-Services Switching Centre (MSC);
- the Home Location Register;
- the Visitor Location Register;
- the Gateway MSC.

##### 2.1.3.2 The Mobile-Services Switching Centre

Addressing of the MSC is required in the following cases:

- i) by the VLR when the location of a mobile has to be determined;
- ii) by the VLR when responding to a transaction initiated by the MSC;

- iii) by the HLR to acknowledge a request or information coming from the MSC;
- iv) by another MSC in case of handover.

#### 2.1.3.2.1 *Configuration i)*

In case i), the VLR knows the Signalling Point Code (SPC) of the MSC and can use it as an address for the message.

#### 2.1.3.2.2 *Configurations ii) & iii)*

In cases ii) and iii) the transaction is initiated by the MSC itself. Therefore the message received by the remote end contains, in the calling party address field, the necessary information. If both entities are in the same country, i.e. connected to the same signalling network (this is always the case with the VLR), the address given could be the SPC of the MSC. If the remote entity is not in the same signalling network a global title must be given; this information could be either the roaming number of the relevant mobile station or a number taken in the series allocated to that MSC and used as a service address to identify the exchange.

#### 2.1.3.2.3 *Configuration iv)*

In case iv), the MSC called is obviously a neighbour exchange. The outgoing MSC therefore knows the identity and the address of the destination MSC.

### 2.1.3.3 *The Home Location Register*

The HLR is called in the following cases:

- i) by a fixed exchange or the Gateway MSC when a call to a mobile subscriber has to be set-up. This interrogation is used to obtain the roaming number of the mobile.  
*Particular case:* if it is a mobile-to-mobile call, the interrogation is performed by the MSC of the calling party;
- ii) by a VLR when the latter has to perform a location updating procedure;
- iii) by a VLR when it has to request or send some data related to a subscriber located in its area;
- iv) by a Visited MSC when the latter has to send information directly to the HLR (e.g. charging information).

#### 2.1.3.3.1 *Configuration i)*

In configuration i), the address information possessed is the ISDN number of the called mobile subscriber. If both ends involved in the transaction are in the same country, the SCCP can translate this address into the SPC of the HLR. If they are situated in foreign countries, the ISDN number can be used as a global title to access to the HLR.

#### 2.1.3.3.2 *Configuration ii)*

In configuration ii), two cases can be considered:

- the VLR and the HLR are in the same country or in the same PLMN. Then, the VLR may have a translation table in which the SPC of the HLR can be obtained from the first digits of the IMSI;
- the VLR and the HLR are not in the same country. Then to route the location updating message, the only data known by the VLR is the IMSI of the mobile. The IMSI does not comply with ISDN numbering plan rules (see CCITT Recommendation E.164).

One solution is to use directly the IMSI as the global title to address the HLR. According to the SCCP specification, this method can be used, since a Numbering Plan Indicator E.212 exists in the Recommendation. But this solution implies the introduction of specific routing tables for the E.212 identification plan in the SCCP nodes of the fixed network.

In order to avoid the implementation of these specific tables, at least in the international network, another alternative is that the Mobile Country Code and the Mobile Network Code (E.212) are translated in the VLR into the E.164 Country Code and the E.164 Access Code corresponding to the Home PLMN of the mobile station as specified in Recommendation E.214. The global title is then composed of the following elements:

- E.164 Country Code: derived from the Mobile Country Code (E.212);



- E.164 National Destination Code: derived from the Mobile Network Code (E.212);
- first N digits of National part of the IMSI (E.212) in order to comply with the maximum number length of the ISDN numbering plan (see Recommendations E.164 and E.165).

The translation is done in the application specific entity of the VLR.

The Country Code is used to route the message in the country of the VLR and in the international network. Therefore no specific routing tables have to be implemented in the outgoing and in the international networks. In the incoming network, two alternatives can be imagined.

- 1) The National Destination Code is used to route the message to the Home PLMN of the mobile. For that purpose a SCCP gateway is implemented in the PLMN to complete the routing of the message up to the HLR. The SPC of the HLR is deduced from the first digits of the NMSI. With this solution, no specific routing tables have to be implemented in the fixed SCCP nodes of the incoming country.
- 2) A specific routing table is implemented in the incoming international SCCP gateway of the home country. From the National Destination Code and the first digits of the NMSI, the SCCP node determines the SPC of the HLR and routes the message to the actual destination point. In this solution, the specific routing tables have to be implemented only in the incoming international SCCP gateway of the home country. No specific mobile SCCP gateway has to be implemented in the PLMN and therefore the routing is direct in the incoming signalling network.

Both solutions can coexist in the service, depending on the choice made in each country.

With the above arrangement, the global title is not a pure E.164 ISDN number: it is then necessary to highlight this difference by using a specific Numbering Plan Indicator. In the visited country and in the international network this indicator is treated in the same way as the normal E.164 Numbering Plan Indicator, so that no specific action has to be taken there when this kind of address is received. The only difference is in the incoming country where the digits of the NMSI may require analysis in order to determine the SPC of the HLR.

#### 2.1.3.3.3 *Configuration iii)*

In case iii), it is not the first transaction that the VLR has with the HLR: the location updating procedure has already been performed. Therefore, the VLR has stored the SCCP address of the HLR:

- a) if both entities are in the same country, the address stored is the SPC of the HLR;
- b) if the entities are not in the same country, the stored address is a global title for the SCCP. This address may be either the International ISDN number of the mobile subscriber or a number allocated to designate the HLR.

In this case there is no difficulty to route the message.

#### 2.1.3.3.4 *Configuration iv)*

In case iv), the mobile station is already registered in the VLR in charge of that area. When the VMSC wants to initiate a transaction with the HLR, it requests from its VLR the called SCCP address. The configuration is then the same as the one in § 2.1.3.3.3.

#### 2.1.3.4 *The Visitor Location Register*

The transactions with the VLR appear in the following cases:

- i) when one of the MSCs attached to that VLR has to start a dialogue with it;
- ii) when an HLR wants to send a request or some information to the VLR;
- iii) another VLR has to request an IMSI from the VLR.

##### 2.1.3.4.1 *Configuration i)*

In case i), due to the particular relationship between the VLR and its MSC, the MSC knows the SPC needed to address the messages.

#### 2.1.3.4.2 Configuration ii)

At the location updating, the VLR gives to the HLR the address which can be used in transactions. The HLR stores it and then it has no problem to start a transaction later on: therefore the case ii) is solved. This address is:

- if both entities are in the same country (i.e. on the same signalling network), the address stored can be the SPC of the VLR;
- if the HLR is situated in a foreign country, the address given is then an ISDN number allocated to designate that VLR which can be used as a global title for SCCP routing.

#### 2.1.3.4.3 Configuration iii)

In this case the two VLRs will most likely be in the same PLMN so that the SPC of the destination will be known.

#### 2.1.3.5 The Gateway MSC

The GMSC is always the starting point of the interrogation transaction with the HLR. The interrogation message contains the calling party address: therefore, the HLR has no difficulty to address back the answer message containing the roaming number.

The GMSC address given there could be:

- the SPC of this exchange if both entities are on the same signalling network;
- an ISDN number allocated to designate that exchange if the transaction is set internationally or via different signalling networks.

TABLE 1/Q.1051

SCCP Addressing for MAP: Summary of § 2.1.3 of Recommendation Q.1051

TO FROM	FIXED NETWORK	HLR	VLR	MSC
FIXED NETWORK	-	MS ISDN (Note 1)	-	-
HOME LOCATION REGISTER	Address given in interrogation message (Note 1)	-	- N: SPC/GT - INT: GT given in location updating	- N: SPC/GT - INT: GT given in the invoke
VISITOR LOCATION REGISTER	-	1) SPC or E.214 2) SPC MSISDN (Note 2)	SPC/GT (National only)	SPC/GT (National only)
MOBILE SWITCHING CENTRE	-	N: SPC/MSISDN INT: MSISDN	SPC/GT (National only)	SPC/GT (National only)

INT International; GT Global Title; N National

Note 1 - MAP is not used for this exchange.

Note 2

1) First transaction: corresponds to location updating procedure. The VLR has to derive the address of the HLR from the IMSI of the mobile. The result can be an SPC if both entities are in the same signalling network. If it is not the case, the result will be a global title as specified in E.214 (see § 2.1.3.3.2).

2) For the subsequent transactions, the HLR gives the MSISDN of the subscriber in the return result of the location updating. In the same country, i.e. the same signalling network, the HLR can give its SPC.

## 2.2 Use of TCAP

The Mobile Application part makes use of the services offered by the Transaction Capabilities (TC) of Signalling System No. 7. Recommendations Q.771 through Q.775 should be consulted for the full specification of TC.

The OSI Layered reference model (Recommendation X.200) is recognized as a useful tool in defining services and protocol specifications; in this way, the Mobile Application Part can be regarded as including the application process and a part of the layer-7 (i.e. the communication functions) interfacing the Transaction Capabilities Application Part (TCAP).

Transaction Capabilities refers to the protocol structure above the network layer interface (i.e. the SCCP service interface) up to the application layer including common application service elements but not the application specific elements using them. TCAP refers to the part of TC included in the OSI layer-7.

TCAP is structured as a Component sub-layer above a transaction sub-layer. Since only a connectionless service is required, TCAP interfaces directly with the SCCP. The general model is as shown in Figure 1/Q.1051.

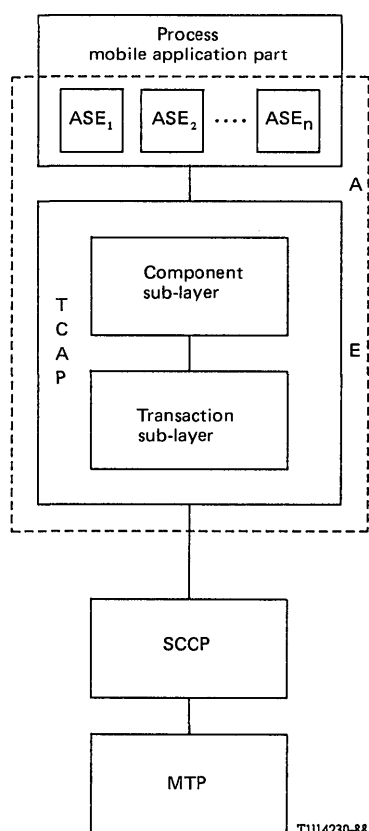


FIGURE 1/Q.1051

**Facilities for supporting the Mobile Application Part  
in Signalling System No. 7**

The Component sub-layer provides application services for the exchange of protocol data units invoking tasks (operations), and reporting their outcomes (results of errors) plus any non-application specific protocol errors detected by the component sub-layer. The reporting of application specific protocol errors by the user, as distinct from application process errors, is also provided. These services are accessed using the TC-Component handling primitives.

The Transaction sub-layer provides a simple association service over which several related protocol data units can be exchanged. A Transaction termination can be prearranged (no indication provided to the user) or basic (indication provided). These services are accessed through the Component sub-layer using the TC-Dialogue handling primitives.

As a TCAP user, the communication part of the MAP can be modelled by a set of Application Service Elements consisting of operation, errors and parameters invoked by the processes and sent to the peer entity, using the component sub-layer facilities.

In each network entity TCAP and the required ASEs form the Mobile Application Entity.

### **3 Procedures**

#### **3.1 General**

##### **3.1.1 Overview of procedures and interfaces**

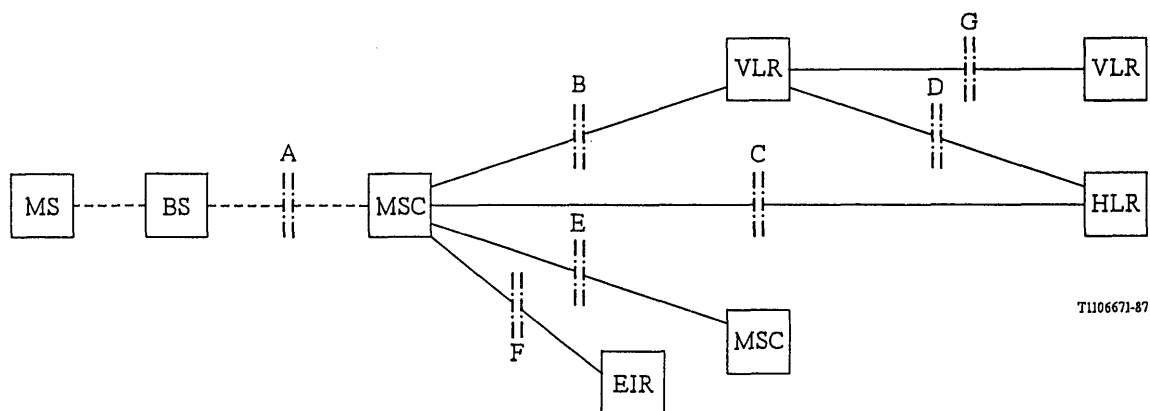
The following procedures are defined below:

- location registration/cancellation (§ 3.2);
- handling of supplementary services (§ 3.3);
- retrieval of subscriber parameters during call set-up (§ 3.4);
- handover (§ 3.5);
- subscriber management (§ 3.6);
- operation and maintenance (§ 3.7);
- fault recovery of location registers (§ 3.8);
- management of international mobile equipment identities (§ 3.9);
- authentication (§ 3.10);
- management of security related functions (§ 3.11).

The procedures are defined for exchange of information between the following system components with interfaces as shown in Figure 2/Q.1051:

- i) between an MSC and its associated visited location register (interface B);
- ii) between an MSC and a home location register (HLR) (interface C);
- iii) between a visited location register (VLR) and a home location register (HLR) (interface D);
- iv) between two MSCs for handover (interface E);
- v) between MSCs and EIR (equipment identity register) for management of IMEIs (interface F);
- vi) between two VLRs (interface G).

*Note* - Authentication and security related functions may require the definition of other interfaces.



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FIGURE 2/Q.1051

**Interfaces in and between PLMNs for definition of  
Mobile Application Part procedures**

The Mobile Application Part may also include procedures for information transfer between MSCs/LRs and operation and maintenance centres. This is regarded as being a national option which is not included in this Recommendation.

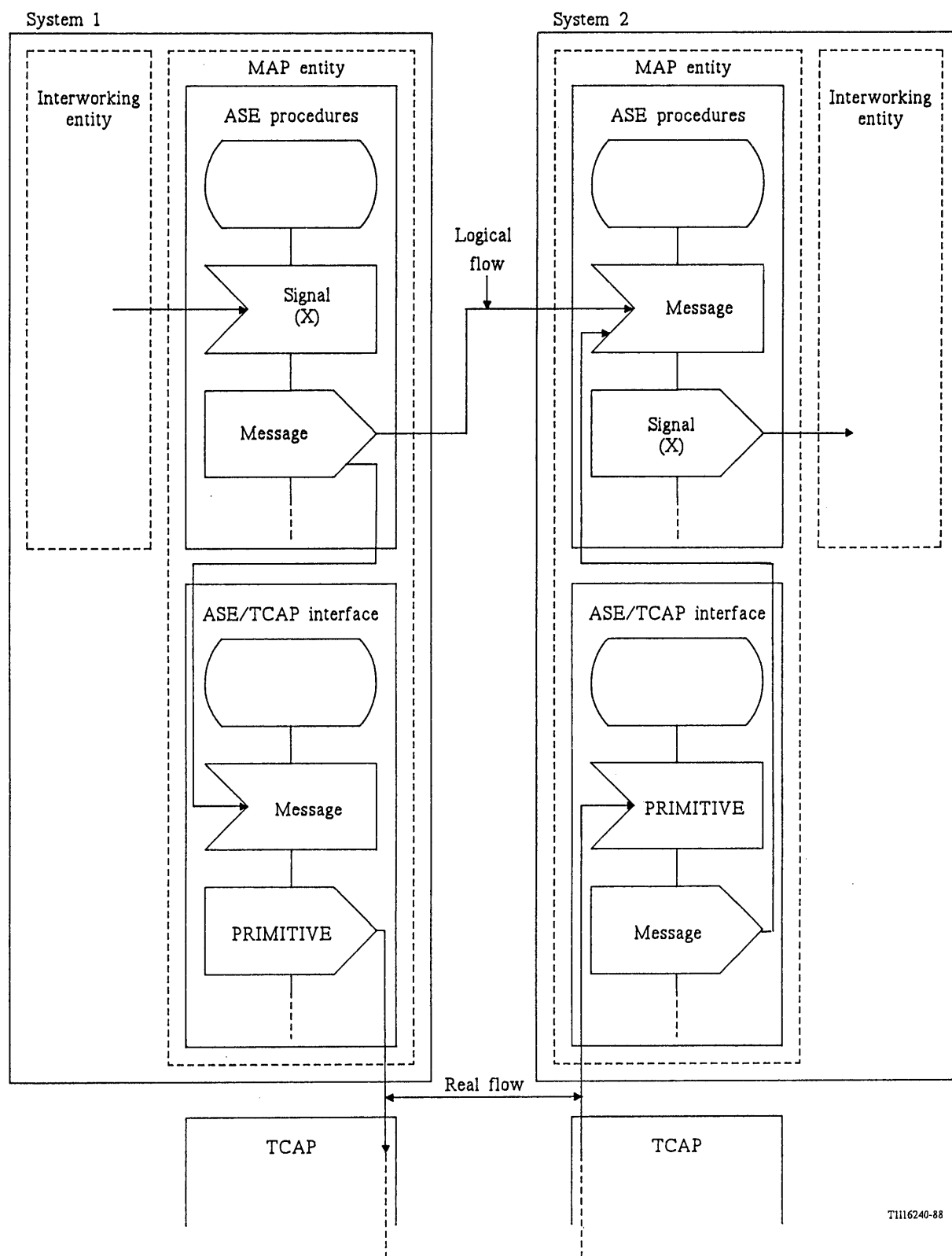
In Figure 2/Q.1051 also the interface between the MS and the MSC is shown (interface A). The procedures on interface A are not considered in this Recommendation. However, in order to define the procedures in an MSC, information flows across interface A are shown in terms of abstract interworking messages. These messages are related to the messages sent on the radio path.

### 3.1.2 Specification principles

The procedures are defined using narrative description. In addition, for each procedure two sets of SDL diagrams are included for clarification:

- a) one set describing the application specific protocols between Application Entities (AE), i.e. the description of the Application Service Elements (ASE) invoked by the mobile application process;
- b) one set describing the generation and interpretation of TC primitives, i.e. the functional procedure across the ASE/TCAP interface. This information is formally defined in § 4 of this Recommendation.

Figure 3/Q.1051 shows an example of a simple MAP procedure where only two systems are involved.



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FIGURE 3/Q.1051

Logical and real information flows between MAP application specific entities in two systems

*Note* - The description of the interworking entity for interworking between MAP and other entities in a functional unit is not included in this Recommendation and is not a part of the MAP application entity.

The following naming conventions are used in the SDL diagrams in order to make them easily readable:

- signals received from or sent to the interworking entity are marked with (X);
- messages belonging to the peer-to-peer protocol between ASE peers are written in small letters;
- TC primitives are written in capitals.

For the ASE/TCAP interface procedures the dialogue handling primitives TC-BEGIN, TC-CONTINUE and TC-END are not shown in the SDL diagrams.

In most cases a mobile application process only involves ASEs in two systems.

Figure 4/Q.1051 gives an example of a more complex case (e.g. handover) where an application process (system 0) involves several ASEs in order to communicate with application processes in other systems (systems 1, 2 and 3) at the same time. For system 0 the entire application process is described including each ASE and the sequencing between them.

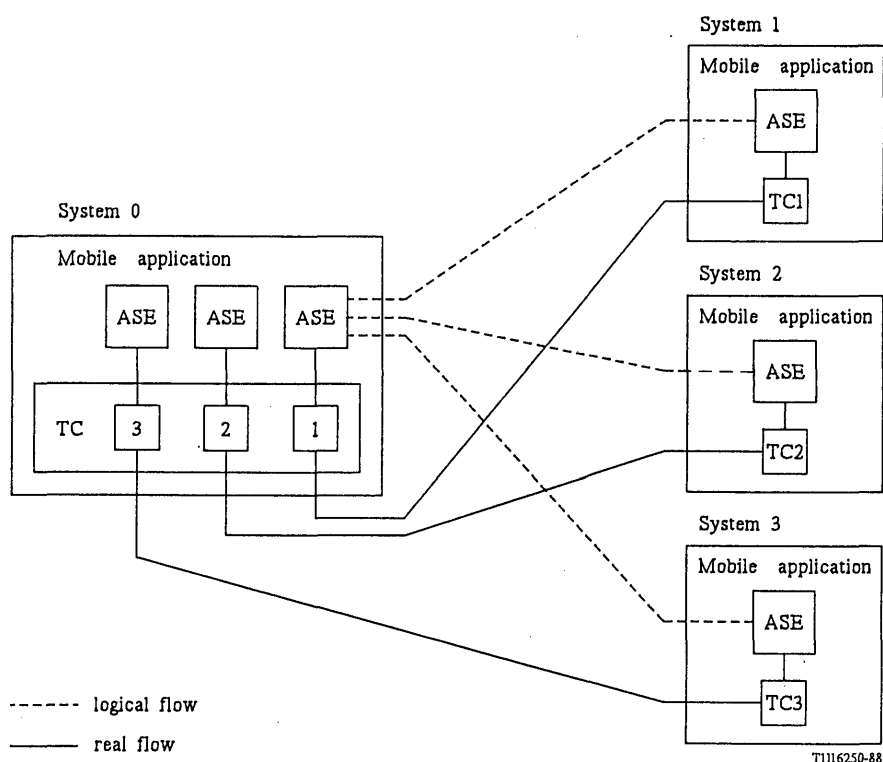


FIGURE 4/Q.1051

**Logical and real information flows when one ASE procedure  
interacts with several ASEs at the same time**

The principles described above will be apparent from the text and the SDL diagrams associated with each of the procedures.

The description of each procedure is structured in the following way:

- i) first, all functional units and interfaces involved are identified;

- ii) second, a general overview of the mobile application procedure is given where the main information flows between functional units are described;
- iii) third, a detailed description of the procedures in each functional unit is given using SDL diagrams for clarification.

### 3.1.3 Mapping between MAP messages and TC primitives

The mapping between MAP messages and TC primitives is given in § 4.4. In each ASE/TCAP interface procedure the operation name is also given against the TC-INVOKE primitives.

## 3.2 Location registration/cancellation

### 3.2.1 Location registration

#### 3.2.1.1 Definition of interfaces

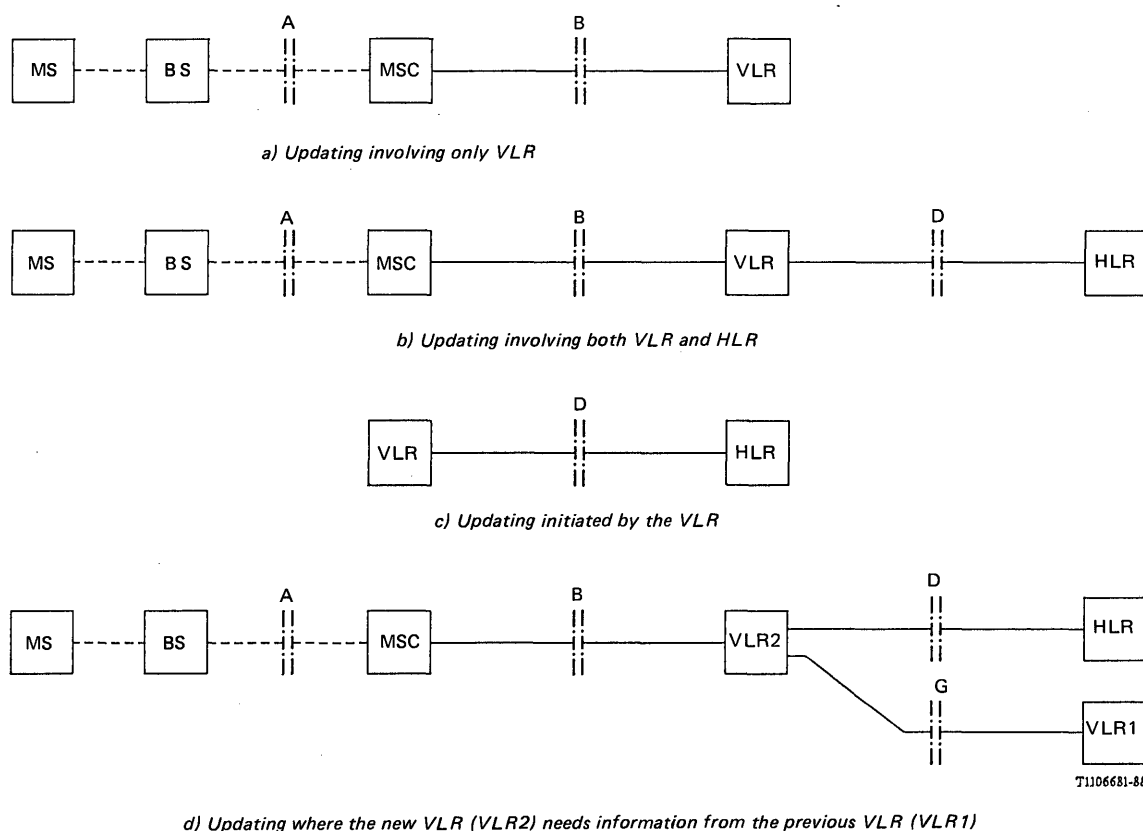


FIGURE 5/Q.1051

### Interfaces related to location registration

Figure 5/Q.1051 shows the system components and interfaces involved in the procedure. Four cases are identified:

- i) the location registration involves only a location register associated with the MSC (Figure 5/Q.1051 a)).

This case applies when the MS initiates a location updating within the area covered by the MSC and new routing information need not be provided to the home location register;

- ii) the MS registers in a new visitor location register or between areas of a visitor location register where new routing information has to be provided to the home location register (Figure 5/Q.1051 b));

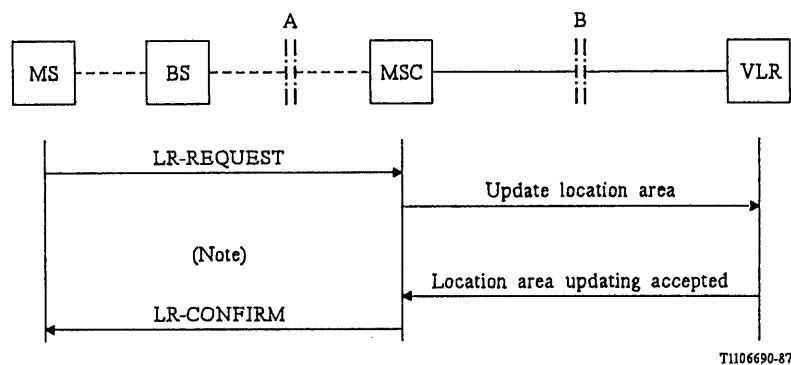


- iii) the visitor location register may initiate location registration (Figure 5/Q.1051 c)) in the following cases:
  - the MSC associated with the visitor location register requests subscriber parameters for call set-up or for operation of a supplementary service for an MS which is not registered in the visitor location register;
  - the visitor location register has to re-allocate mobile station roaming numbers;
- iv) the MS registers in a new visitor location register VLR2 and identifies itself by the temporary mobile station identity (TMSI) allocated to it in the previous VLR (VLR1). VLR2 must then obtain the IMSI from VLR1 before the HLR can be updated (Figure 5/Q.1051 d)).

### 3.2.1.2 General description of location registration

#### 3.2.1.2.1 Updating involving only the visitor location register

The procedure when initiated by the MS is shown in Figure 6/Q.1051.



*Note* - The signals on the radio path shown here are those generated by the interworking procedure between the Mobile Application Part and the signalling on the radio path.

FIGURE 6/Q.1051

#### Updating involving only the visitor location register

Receiving a request for location register updating (LR-REQUEST) the MSC sends the *update location area* message to its associated location register. This message will contain location information as required.

The location register will analyze the IMSI or TMSI (Temporary Mobile Station Identity) contained in the message, as well as other parameters (see § 4). If the updating is within the area controlled by the location register and no information needs to be provided to the home location register, the visitor location register will return the *location area updating accepted* message when roaming is allowed. If roaming is not allowed or updating is otherwise unsuccessful, the VLR will return the *roaming not allowed* message or an indication giving the cause for unsuccessful operation.

The MSC will then terminate the procedure by signalling on the radio path (indicated by the signal LR-CONFIRM in Figure 6/Q.1051).

*Note* - In some networks the LR-CONFIRM message may be sent before the *location area updating accepted* message is received from the VLR.

#### 3.2.1.2.2 Updating involving both a VLR and an HLR

The procedure for location registration is shown in Figures 7/Q.1051 and 8/Q.1051.

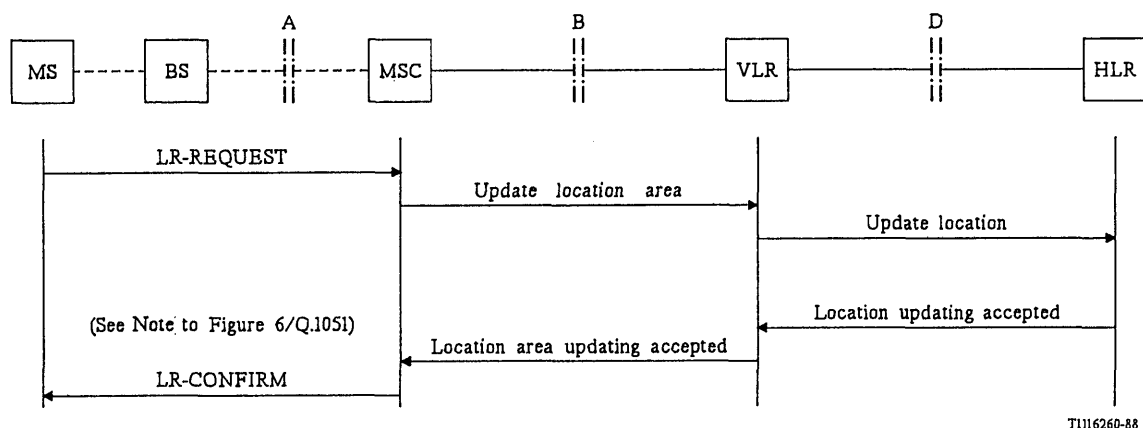


FIGURE 7/Q.1051

Updating involving both a VLR and an HLR

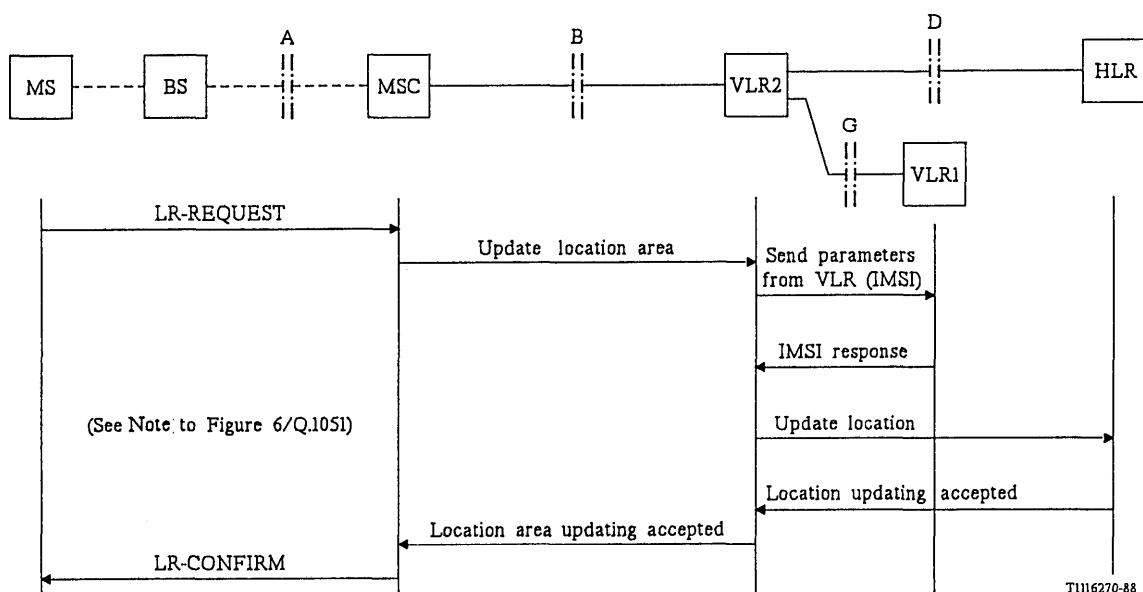


FIGURE 8/Q.1051

Updating where the MS identifies itself by using the TMSI allocated to it by the previous VLR (VLR1)

The procedure on the radio path and the procedure between the MSC and the visitor location register (VLR) are as described in § 3.2.1.2.1.

In Figure 7/Q.1051 the MS identifies itself using the IMSI. Then the new VLR can identify the HLR of the MS directly. In Figure 8/Q.1051 the MS identifies itself using the TMSI allocated to it in the previous VLR. The LR-REQUEST will also contain the identity of the previous VLR (VLR1). The new VLR (VLR2) must then obtain the IMSI by interrogating the previous VLR by sending the MAP message *send parameters from VLR (IMSI)*. The previous VLR responds by the message *IMSI response*. If the IMSI response is not received, the updating is unsuccessful and an indication is provided to the MS.

When the new VLR has received the IMSI either from the MS or the previous VLR, the visitor location register will send the *update location* message to the home location register of the MS. This message will contain the mobile station roaming number allocated to the MS. This number will be used for two purposes:

- ISDN/PSTN routing of calls to the MS;
- routing of Mobile Application Part messages associated with that MS (see § 4).

If the MS is allowed to roam, the home location register will return the *location updating accepted* message. This message will contain the information elements "mobile station category" and "supplementary services", as well as other information elements as defined in § 4.

The visited location register will also send the *location area updating accepted* message to the MSC.

If the MS is not allowed to roam, the home location register will mark the MS with a roaming not allowed indicator and return the *roaming not allowed* message in response to the *update location* message. The visitor location register will then send the *roaming not allowed* message to the MSC. The reason for refusing the location updating is also sent to the MS in the LR-CONFIRM message.

When the roaming not allowed indicator is set, the HLR will bar incoming calls to the MS. If the MS is making a call, the procedure of § 3.4 is to be followed. The HLR will then indicate to the VLR that roaming is not allowed for the particular MS.

### 3.2.1.2.3 Location register updating initiated by VLR

The visitor location register may initiate location register updating in the following cases:

- the VLR receives a request for call set-up parameters for an MS originating call where the MS is not registered in the VLR (Note);
- the VLR receives a request concerning a supplementary service for an MS which is not registered in the VLR (Note);
- the VLR has to re-allocate mobile station roaming numbers.

Other cases where the VLR initiates location register updating may be identified in the future.

*Note* - In these cases the call set-up or operation of the supplementary service is suspended until the updating has been completed.

The procedures for updating the home location register are shown in Figure 9/Q.1051 and are similar to those described in § 3.2.1.2.2 for information exchange between the visitor location register and the home location register.

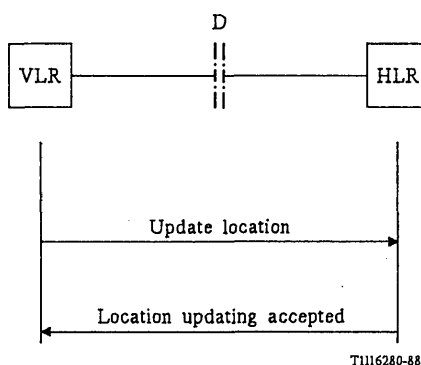


FIGURE 9/Q.1051

Updating initiated by VLR

### 3.2.1.3 *Detailed procedures for location registration*

#### 3.2.1.3.1 *Procedures in the MSC*

Figure 10/Q.1051 shows the application specific procedures and Figure 11/Q.1051 shows the ASE/TCAP interface procedures.

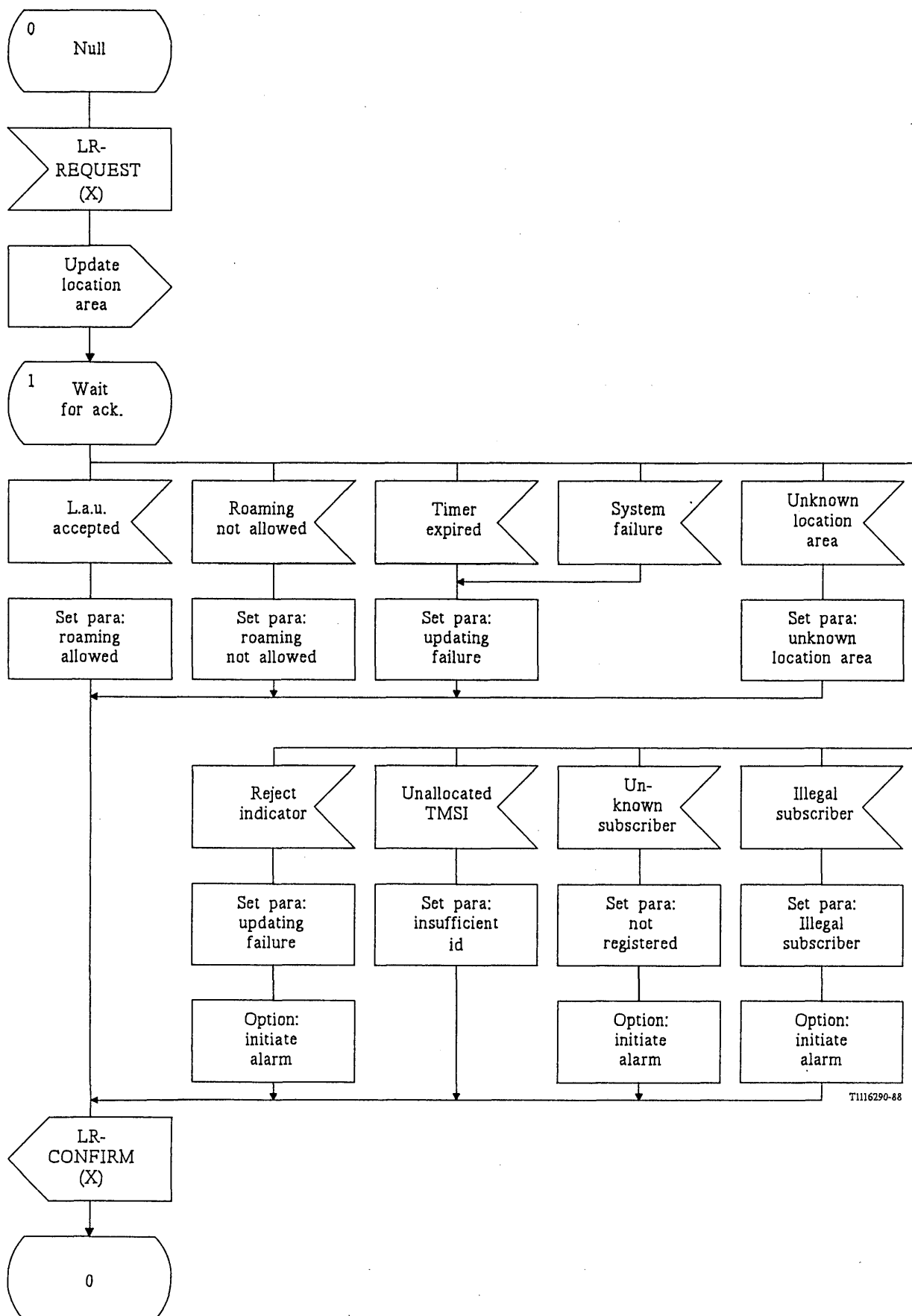


FIGURE 10/Q.1051

Application specific procedure in MSC for location registration

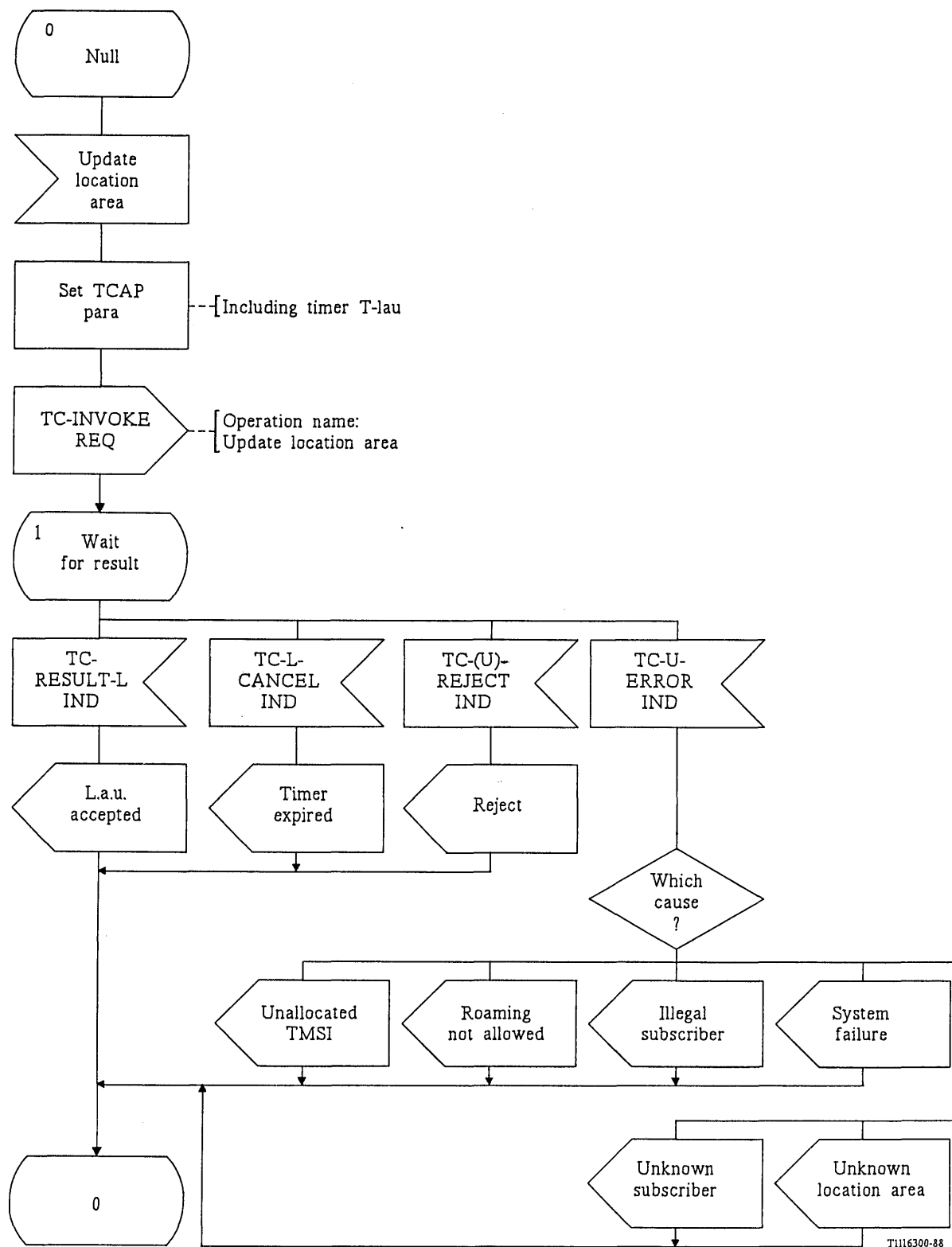


FIGURE 11/Q.1051

ASE/TCAP interface procedure in the MSC for location registration

The *update location area* message is sent in a TC-INVOKE REQUEST primitive. Time-out supervision is requested from TCAP (timer T-lau). Timer T-lau must be large enough to allow the VLR to perform all functions as defined in § 3.2.1.3.2. The following responses may be received from TCAP:

- TC-RESULT-L INDICATION primitive containing the *location area updating (l.a.u.) accepted* message. This message indicates a successful outcome of the procedure and the roaming allowed indication is returned to the MS (in the LR-CONFIRM (X) message);
- TC-L-CANCEL INDICATION primitive which is seen by the ASE as a *timer expired* message. The indication provided to the MS is updating failure;
- TC-(U)-REJECT INDICATION primitive which is seen by the ASE as a *reject indication* message containing the cause for rejection as inserted by the VLR or TCAP. The indication updating failure is sent to the MS. As an option the MSC may initiate an alarm condition since the TC-(U)-REJECT INDICATION normally will indicate a protocol error. The MSC should not restart the operation;
- TC-U-ERROR INDICATION is received if the VLR has to return a negative result as follows:
  - i) unallocated TMSI, indicating that the TMSI is not allocated and that the received information is insufficient for identifying the MS. This information is passed to the MS;
  - ii) roaming not allowed in the new area. This indication is provided to the MS;
  - iii) illegal subscriber is received when authentication was performed in conjunction with the location registration and the MS did not pass the authentication check (see § 3.10 for procedures). The condition is shown to ASE as an *illegal subscriber* message and the corresponding information is provided to the MS. Since this case may correspond to fraudulent access from an MS, an alarm condition may be set in the MSC;
  - iv) system failure, i.e. the procedure between the VLR and the HLR failed. This indication is also provided to the MS;
  - v) unknown subscriber, i.e. the IMSI is unknown in the HLR. This indication is provided to the MS and, as an option, an alarm condition may be set in the MSC;
  - vi) unknown location area is received when the updating message from the MS was indicating a non-existing location area. The indication is provided to the MS.

### 3.2.1.3.2 Procedures in the VLR

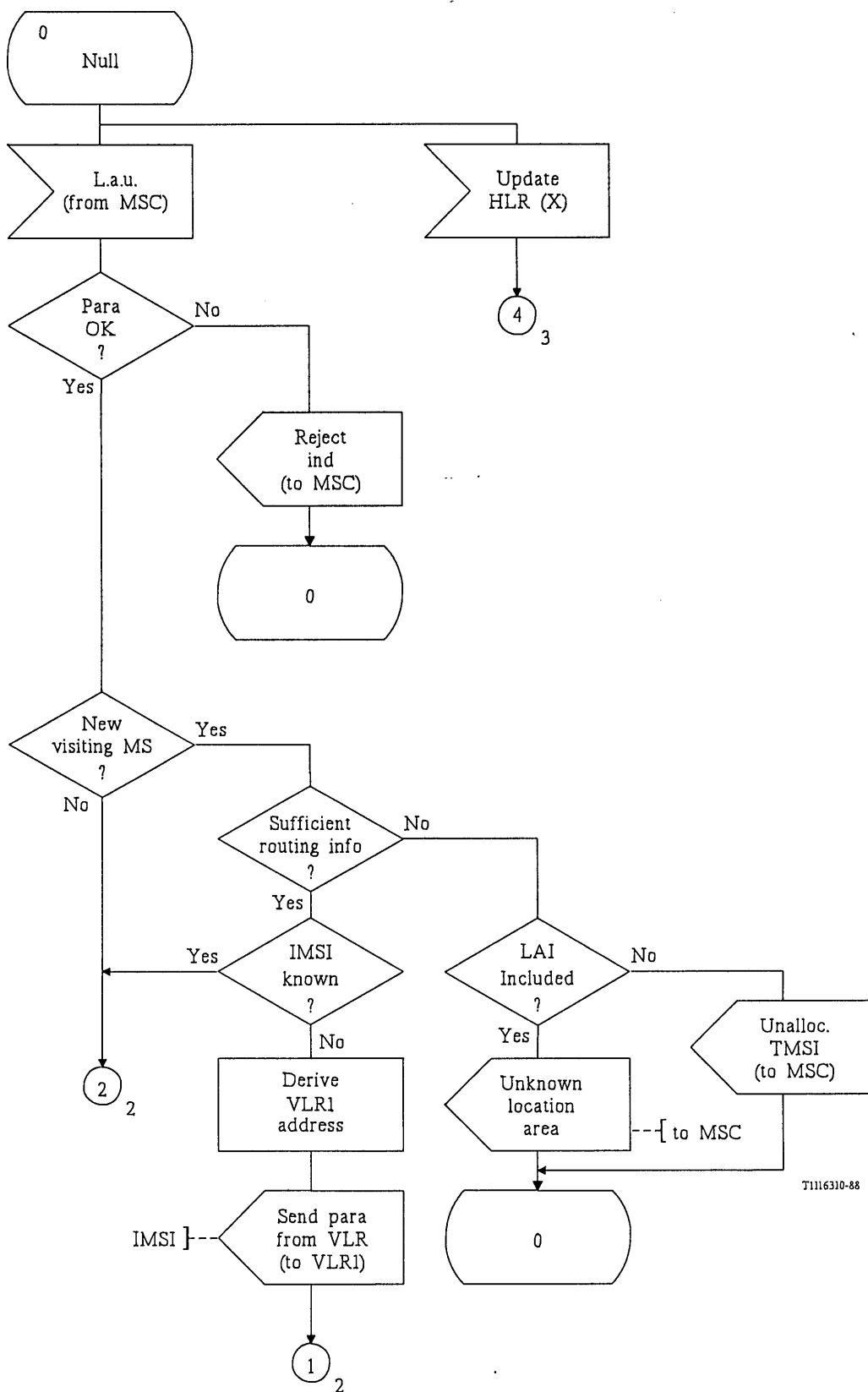
The detailed procedures in the VLR associated with the MSC are given in Figures 12/Q.1051, 13/Q.1051, 14/Q.1051 and 15/Q.1051.

The application specific procedure in the VLR associated with the MSC is shown in Figure 12/Q.1051. When an *update location area (u.l.a.)* message is received from the MSC, various decision processes take place:

- if the MS is already registered in the VLR (decision: new visiting MS), updating of the HLR needs only take place if a new mobile station roaming number (MSRN) has to be allocated. Otherwise the *update location area (u.l.a.) accepted* message is returned to the MSC;
- if the MS is not registered in the VLR, the VLR can only update the HLR if the *update location area (u.l.a.)* message contains enough routing information, i.e. either the IMSI or a TMSI plus the location area identity (LAI) of the previous location area. In the first case the VLR will derive the required routing information for accessing the HLR of the MS. In the latter case the LAI will enable the VLR to derive the address of the previous VLR (VLR1) and to initiate the *send parameters from VLR* operation. The previous VLR will in response provide the IMSI and the authentication parameters of the MS;

- authentication may be required during location register updating. If the authentication parameters are not already stored in the VLR, they may be obtained either from the previous VLR or from the HLR depending on whether the MS identified itself by the TMSI or IMSI. The authentication procedure towards the MSC/MS will take place (state 2). This procedure is defined in § 3.10 and is only included here to identify which action needs to take place depending on the outcome of the procedure: the *illegal subscriber* message is generated if the authentication response from the MS does not pass the authentication check and the *unknown subscriber* message is generated if the VLR (or HLR) is not able to identify the MS. The *system failure* message is generated if the authentication procedure fails for other reasons (e.g., authentication parameters are not obtained).

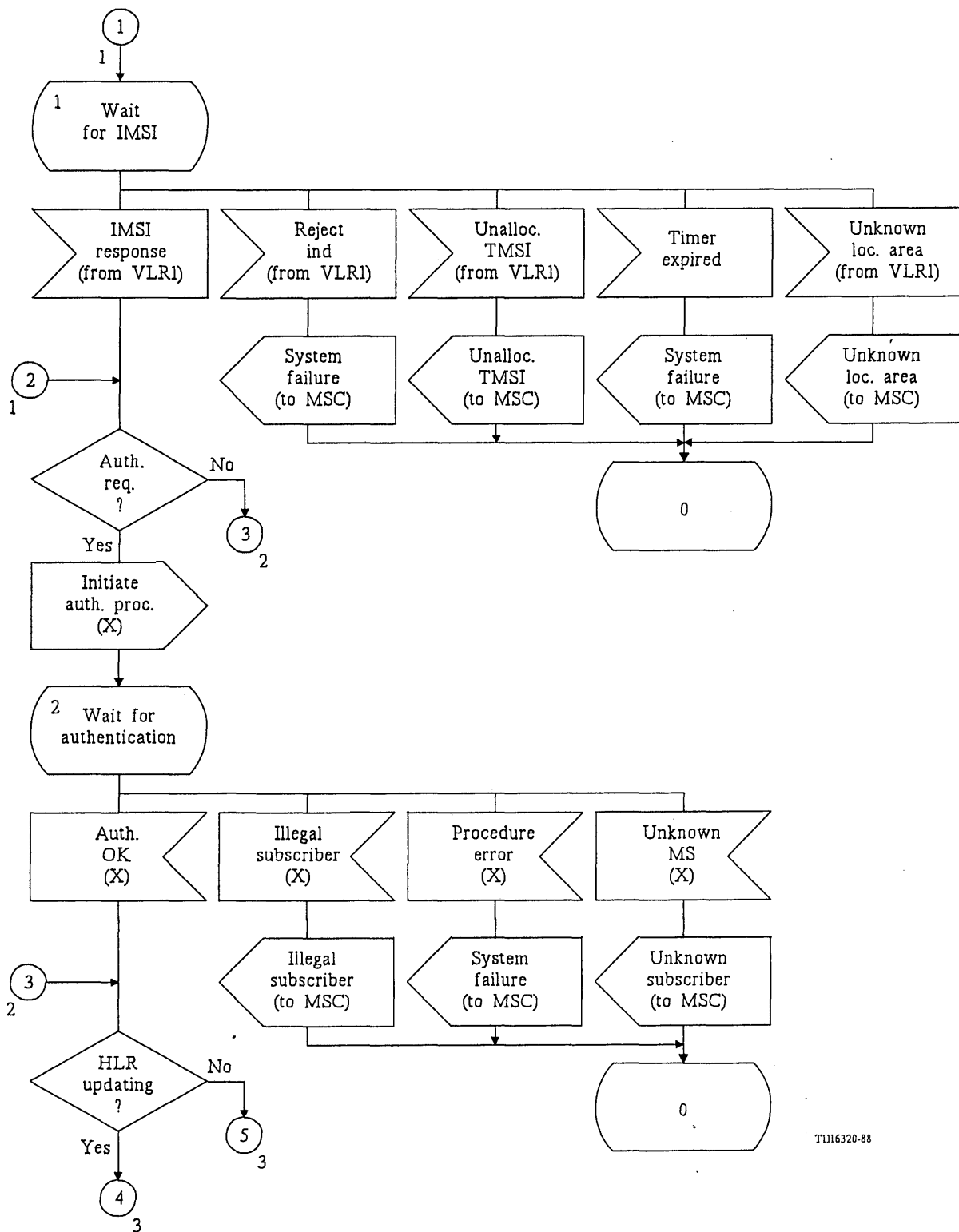




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FIGURE 12/Q.1051 (Sheet 1 of 4)

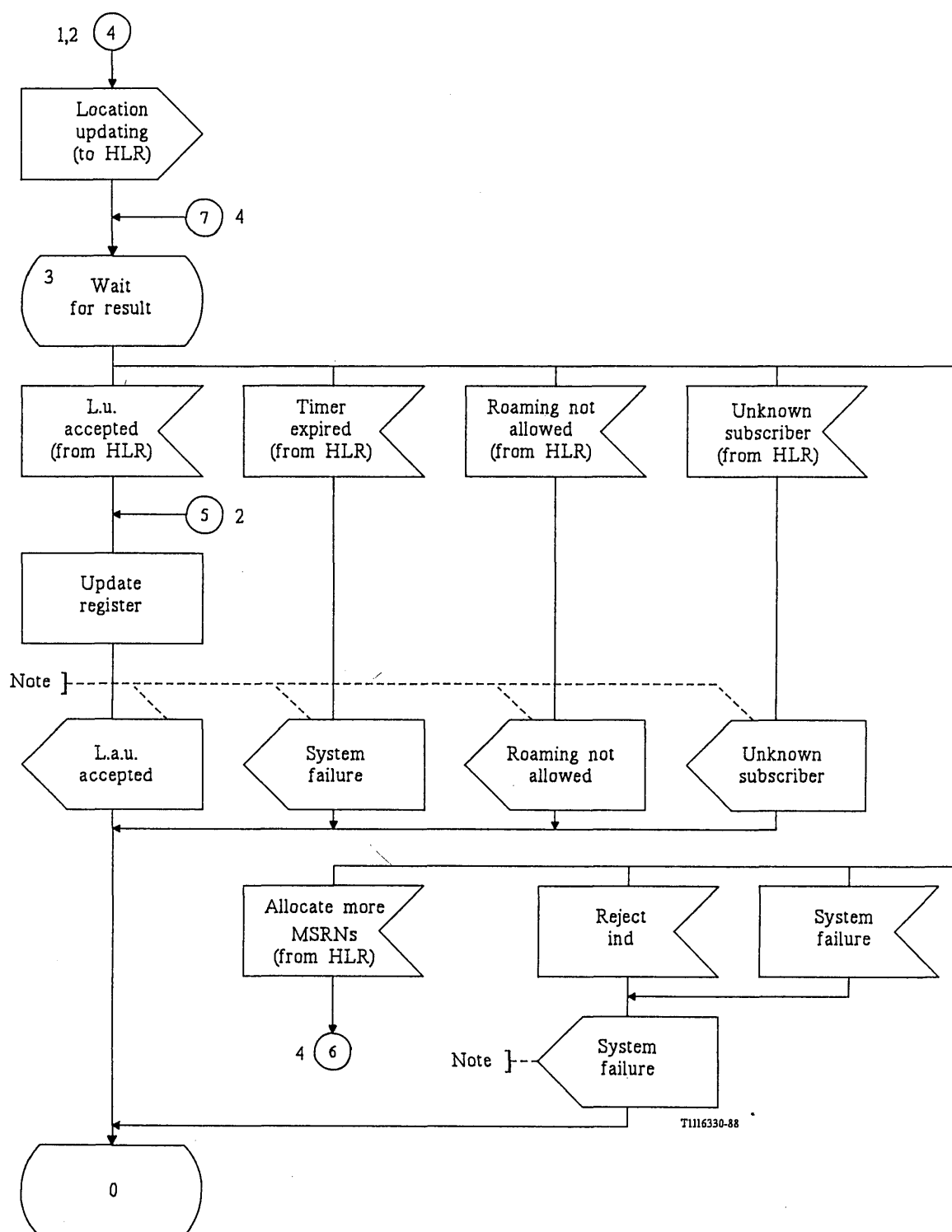
**Application specific procedure in  
VLR for location registration**



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FIGURE 12/Q.1051 (Sheet 2 of 4)

Application specific procedure in  
VLR for location registration



Note - These messages are sent only when the procedure was initiated by the MSC.

FIGURE 12/Q.1051 (Sheet 3 of 4)

Application specific procedure in  
VLR for location registration

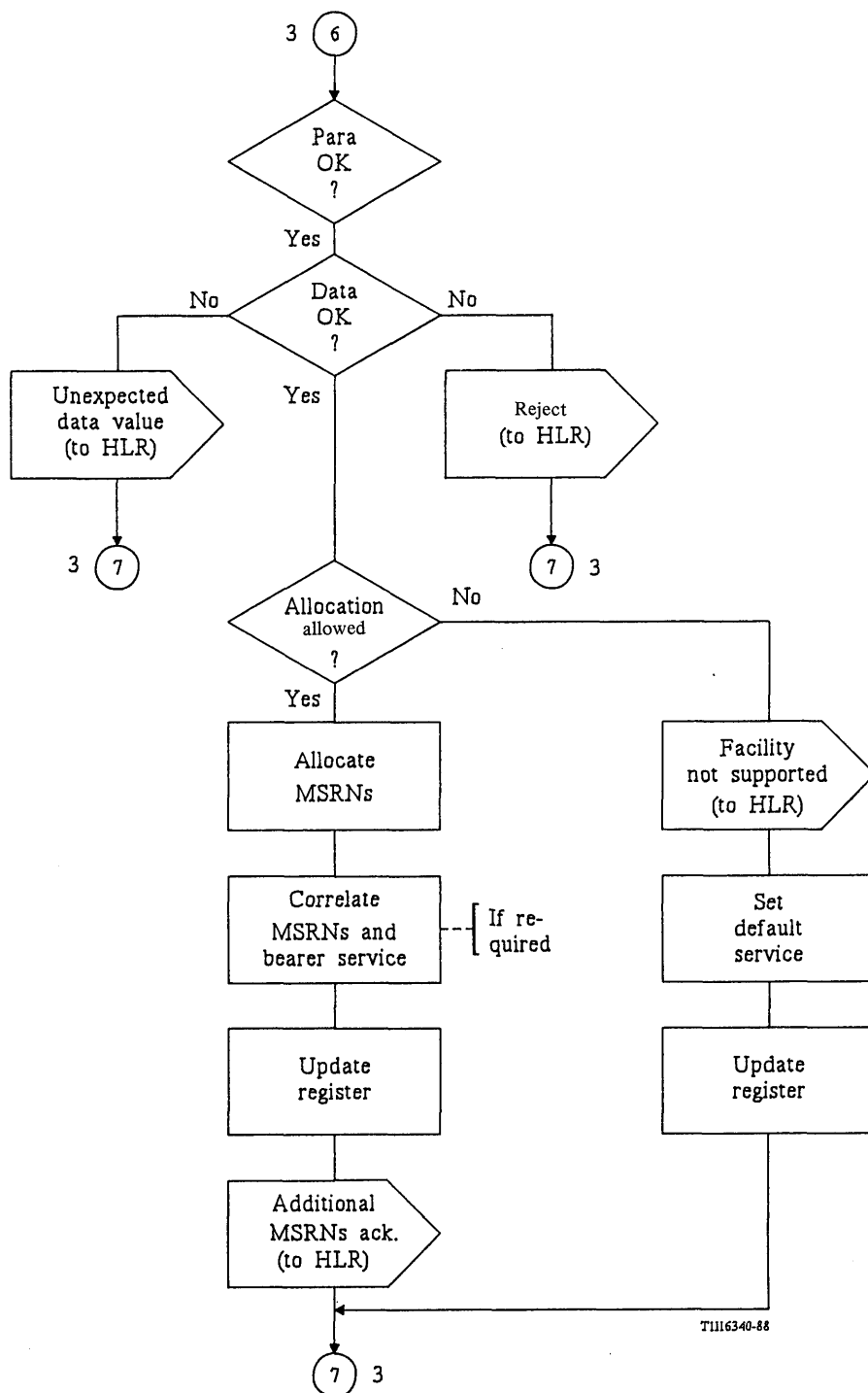


FIGURE 12/Q.1051 (Sheet 4 of 4)

**Application specific procedure in  
VLR for location registration**

The procedure for updating of the HLR is shown in state 3. The VLR first sends the *update location* message to the HLR. A successful outcome is indicated in the *location updating (l.u.) accepted* message. The information content of this message is stored in the VLR. Unsuccessful outcome is indicated in the messages:

- *roaming not allowed* if the MS is not allowed to roam into the area controlled by the VLR. The VLR will not store any information on the MS;
- *unknown subscriber* if no subscription information on the MS is contained in the HLR.

The corresponding messages are sent to the MSC if the MSC initiated the updating.

The VLR may also receive an *allocate additional roaming numbers* message from the HLR before the *location updating accepted* message is received. The VLR will then return:

- the *additional roaming numbers acknowledge* message both when additional roaming numbers are and are not allocated. If one or more roaming numbers are not allocated, this is indicated by a NULL parameter, see § 6.

*Note* - It would be a need to transfer these numbers to the MS. These procedures require further study.

- the *facility not available* message if the VLR cannot comply with the request;
- the *unexpected data value* message if one or more parameters are out of range.

The VLR may also return a reject indication if there are parameter errors in the message.

Updating of the HLR may be initiated by other processes in the VLR, e.g. if the mobile station roaming numbers have to be re-allocated.

For location updating purposes the VLR must support three MAP interfaces:

- to the MSC (Figure 13/Q.1051);
- to the HLR (Figure 14/Q.1051);
- to the previous VLR (Figure 15/Q.1051).

The interface procedure is as follows: At the VLR/MSC interface (Figure 13/Q.1051) the VLR will receive a TC-INVOKE INDICATION primitive containing the *update location area (u.l.a.)* message. Either of the following responses may be received from the application specific procedure of Figure 12/Q.1051.

- reject indicator if procedure errors are discovered in the *update location area* message. This indication is sent in a TC-U-REJECT REQUEST primitive;
- *location area updating (l.a.u.) accepted* message if the updating was successful and the MS is allowed to roam into the area. The message is sent in the TC-RESULT-L-REQUEST primitive;
- other unsuccessful events are returned in TC-U-ERROR REQUEST primitives:
  - i) unallocated TMSI, i.e. the VLR received either an unallocated TMSI without a LAI or the VLR received an indication from the previous VLR that the TMSI used is unallocated;
  - ii) roaming not allowed;
  - iii) illegal subscriber if the authenticity of the MS was not established;
  - iv) system failure if updating failed for a variety of reasons (see Figure 12/Q.1051 for details): the send parameters (IMSI) operation failed, the authentication procedure failed or the updating of the HLR failed;
  - v) unknown subscriber if the MS is unknown in the HLR;
  - vi) unknown location area if the MS identified itself by use of a TMSI plus LAI and LAI is unknown in the VLR.

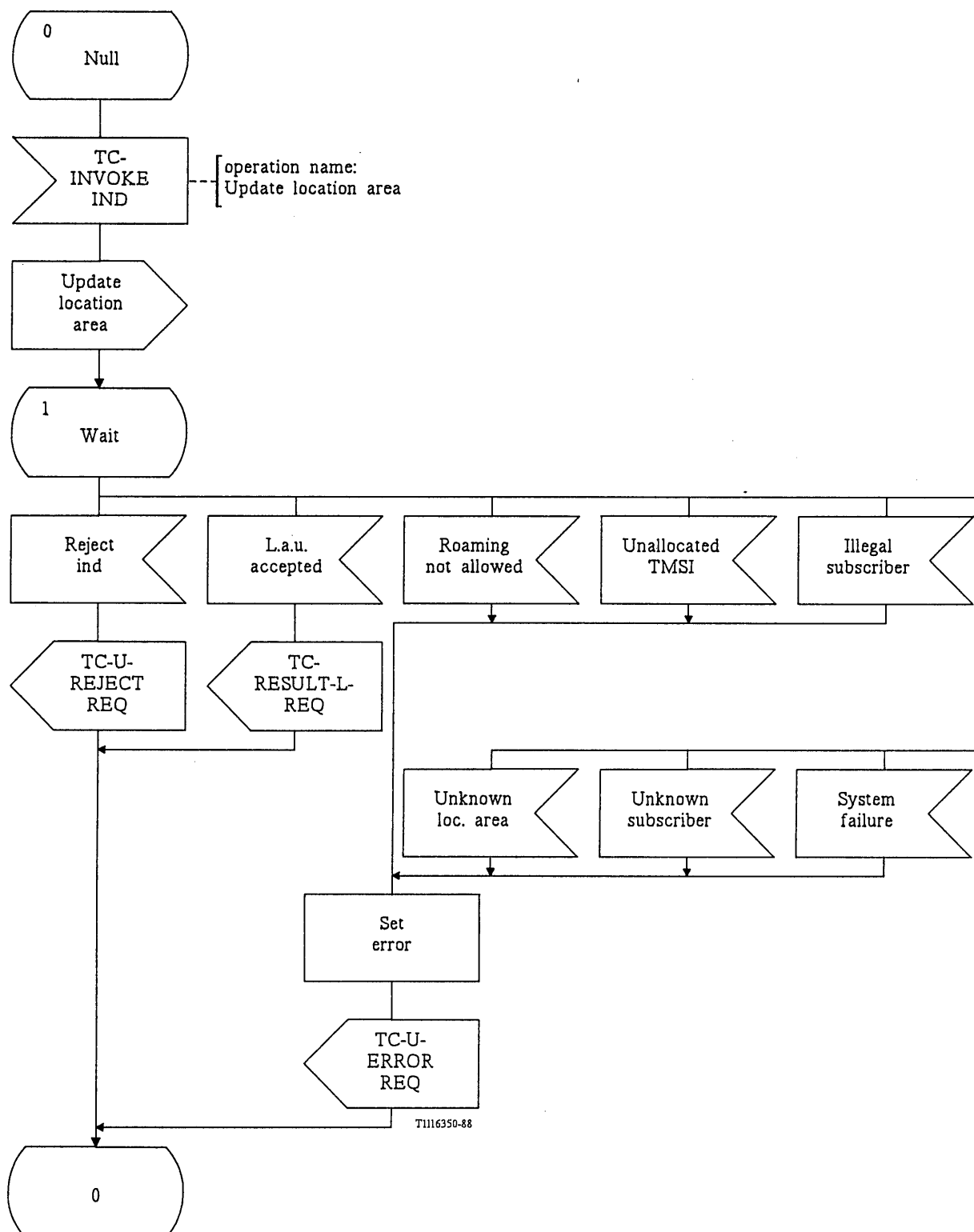


FIGURE 13/Q.1051

ASE/TCAP VLR/MS interface procedure in the VLR for location registration

At the VLR/HLR interface (Figure 14/Q.1051) the VLR initiates the operation update register. TCAP is requested to supervise the procedure by timer T-lu. The results of the procedure are as follows:

- the *location updating (l.u.) accepted* message is contained in the TC-RESULT-L INDICATION primitive. The parameters comprise all information to be stored in the VLR;
- if timer T-lu expires, this is indicated in a TC-L-CANCEL INDICATION primitive;
- if the HLR or TCAP rejects the operation because of procedure errors, the cause and diagnostics are received in a TC-(U)-REJECT INDICATION;
- if the updating is unsuccessful, the cause is received in a TC-U-ERROR INDICATION primitive:
  - i) unknown subscriber, the MS is not known in the HLR;
  - ii) roaming not allowed into the area.

The ASE/TCAP interface procedure for allocation of additional roaming numbers in the VLR is given in § 3.6.2.

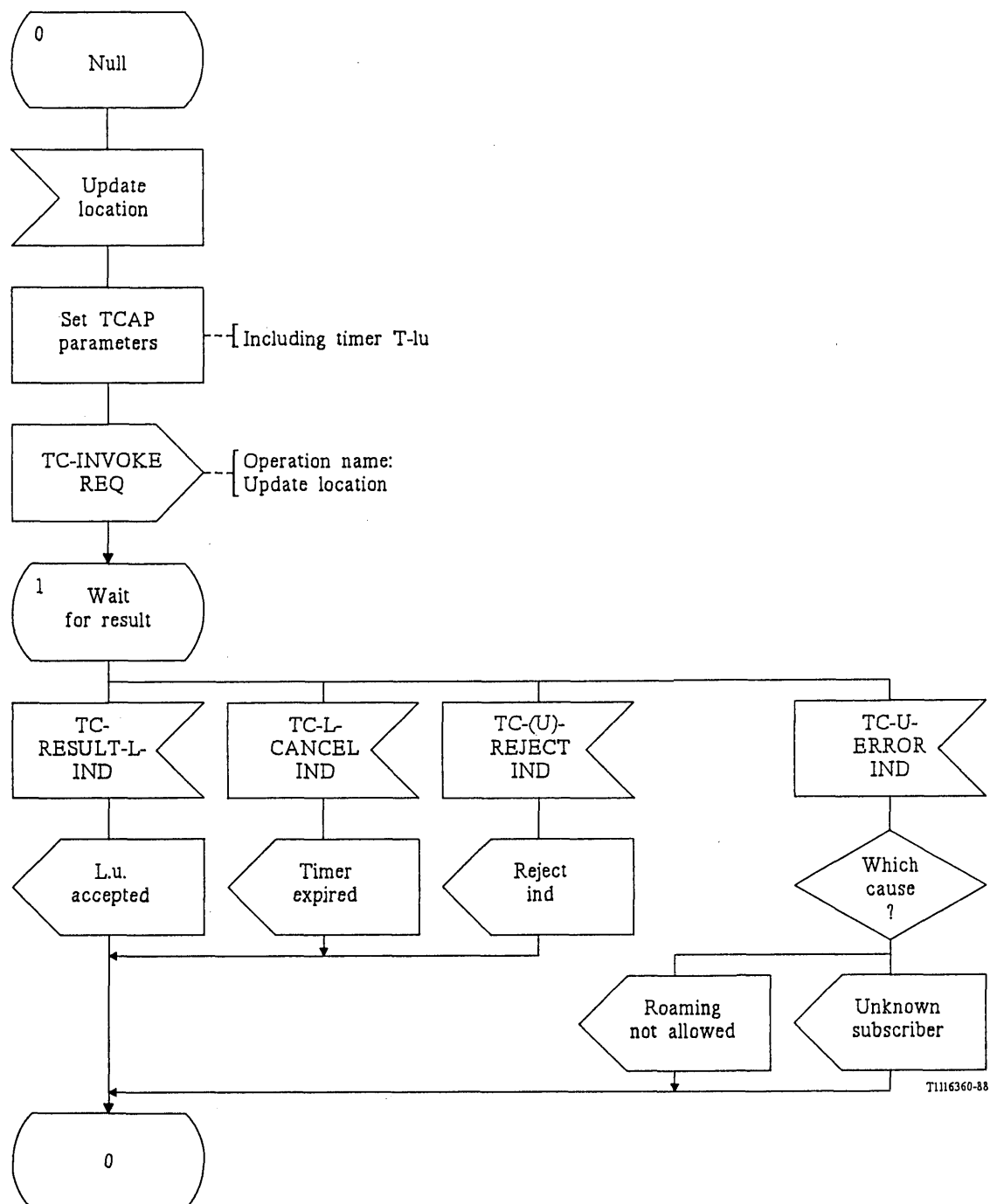


FIGURE 14/Q.1051

ASE/TCAP VLR/HLR interface procedure in the  
VLR for location registration



At the VLR/previous VLR (VLR1) interface (Figure 15/Q.1051) the VLR initiates the operation *send parameters from VLR* (IMSI). VLR1 is requested to provide the IMSI corresponding to the indicated TMSI, and also authentication parameters for that MS. TCAP is requested to supervise the procedure by the timer T-pv. The results of the procedure are as follows:

- the *IMSI response* message is contained in a TC-RESULT-L INDICATION primitive;
- the TC-L-CANCEL INDICATION primitive is used to indicate expiry of timer T-ie;
- the TC-(U)-REJECT INDICATION primitive is used to indicate procedure errors discovered by the previous VLR or TCAP;
- the TC-U-ERROR INDICATION is used to indicate an unsuccessful outcome as follows:
  - i) unallocated TMSI, i.e. the TMSI contained in the TC-INVOKE primitive is not allocated to any MS;
  - ii) unknown location area, i.e. the request contained a non-existent location area.

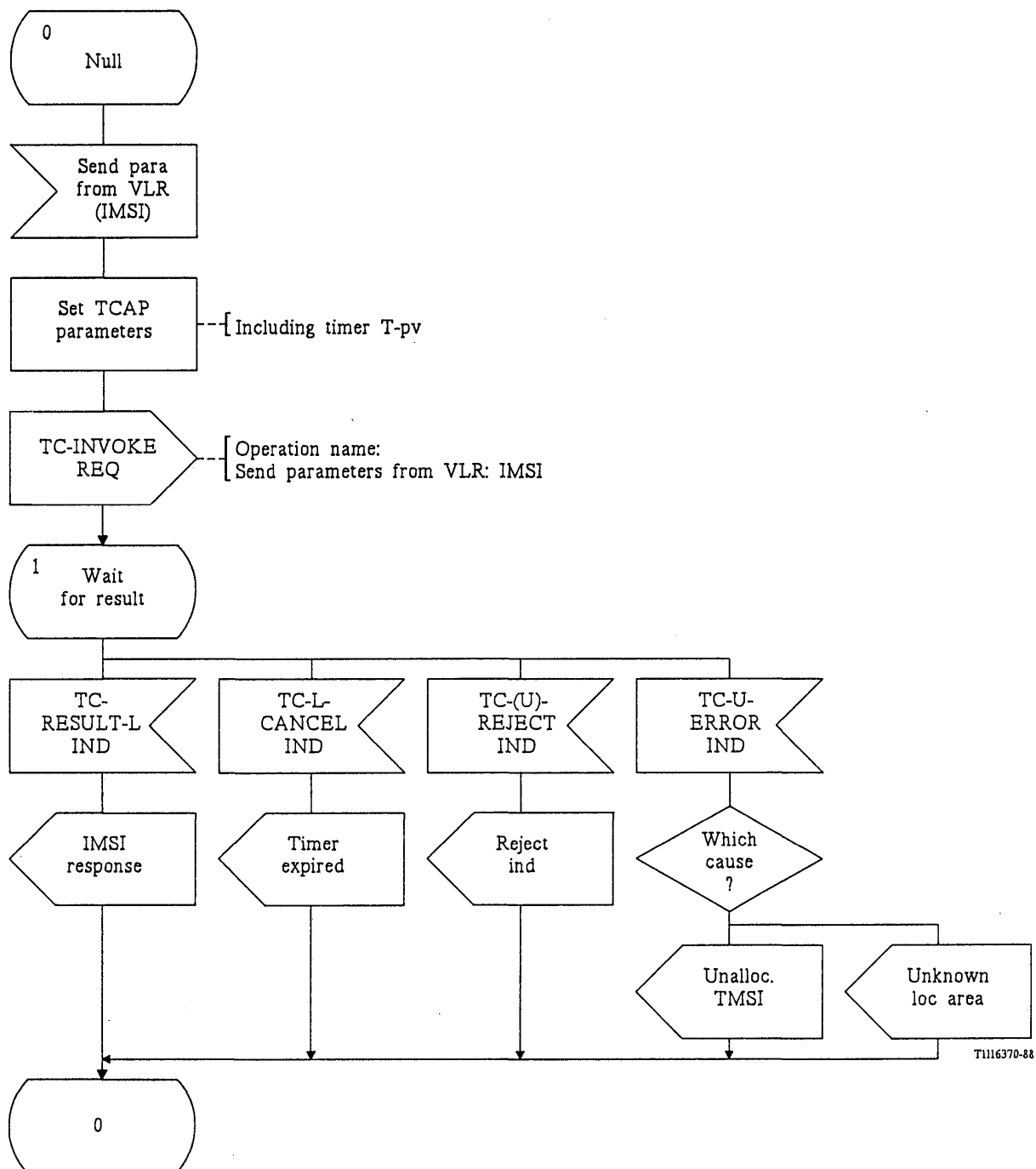


FIGURE 15/Q.1051

ASE/TCAP VLR/previous VLR interface procedure in the VLR for location registration

#### 3.2.1.3.3 Procedures in the HLR

The procedures are shown in Figures 16/Q.1051 and 17/Q.1051.

The application specific procedure for location registration in the HLR is shown in Figure 16/Q.1051 and is as follows:

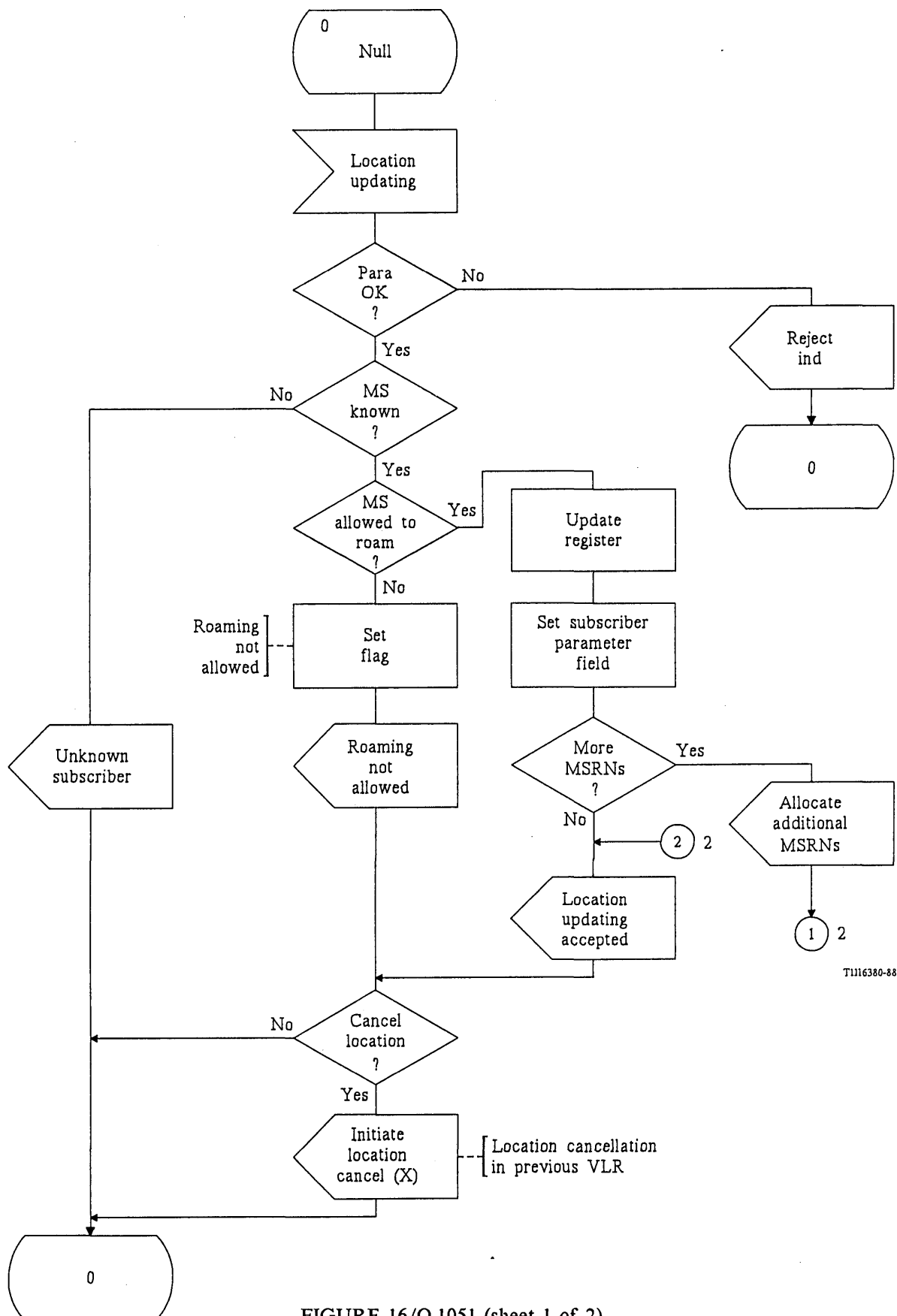
- if the MS is unknown in the HLR, the *unknown subscriber* message is returned;
- if the MS is not allowed to roam into the area controlled by the VLR, the *roaming not allowed* message is returned. The HLR will set a roaming not allowed indicator which will be used for barring MS terminating calls;
- if the MS is allowed to roam into the area and no more mobile station roaming numbers are required, all subscriber parameters required by the VLR for call handling are transferred in the *location updating accepted* message;
- if the HLR requires more than one MSRN, e.g. for provision of analogue data services to the MS, then the HLR will send the *allocate additional roaming numbers* message. The *location updating accepted* message will then be sent when a reply has been received from the VLR.

Depending on the response to the *allocate additional roaming numbers* message, the HLR will act as follows:

- if the *additional roaming numbers acknowledge* message is received, the HLR correlates MSRNs and bearer services, as required, and updates the register;
- if the *facility not available* message is received, the HLR sets barring indications against services other than the default service;
- if a reject indicator, a timer expired indication or the *unexpected data value* message is received, the HLR sets a barring indicator against all bearer services other than the default service and, possibly, a flag indicating that the procedure failed. The HLR may also set a schedule for reinitiating the procedure.

In all cases the HLR will return the *location updating acknowledge* message.

If the location updating message is received from a new VLR, the HLR will initiate the location cancellation procedure of § 5.2.2 towards the previous VLR.



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FIGURE 16/Q.1051 (sheet 1 of 2)

**Application specific procedure for location registration in home location register**

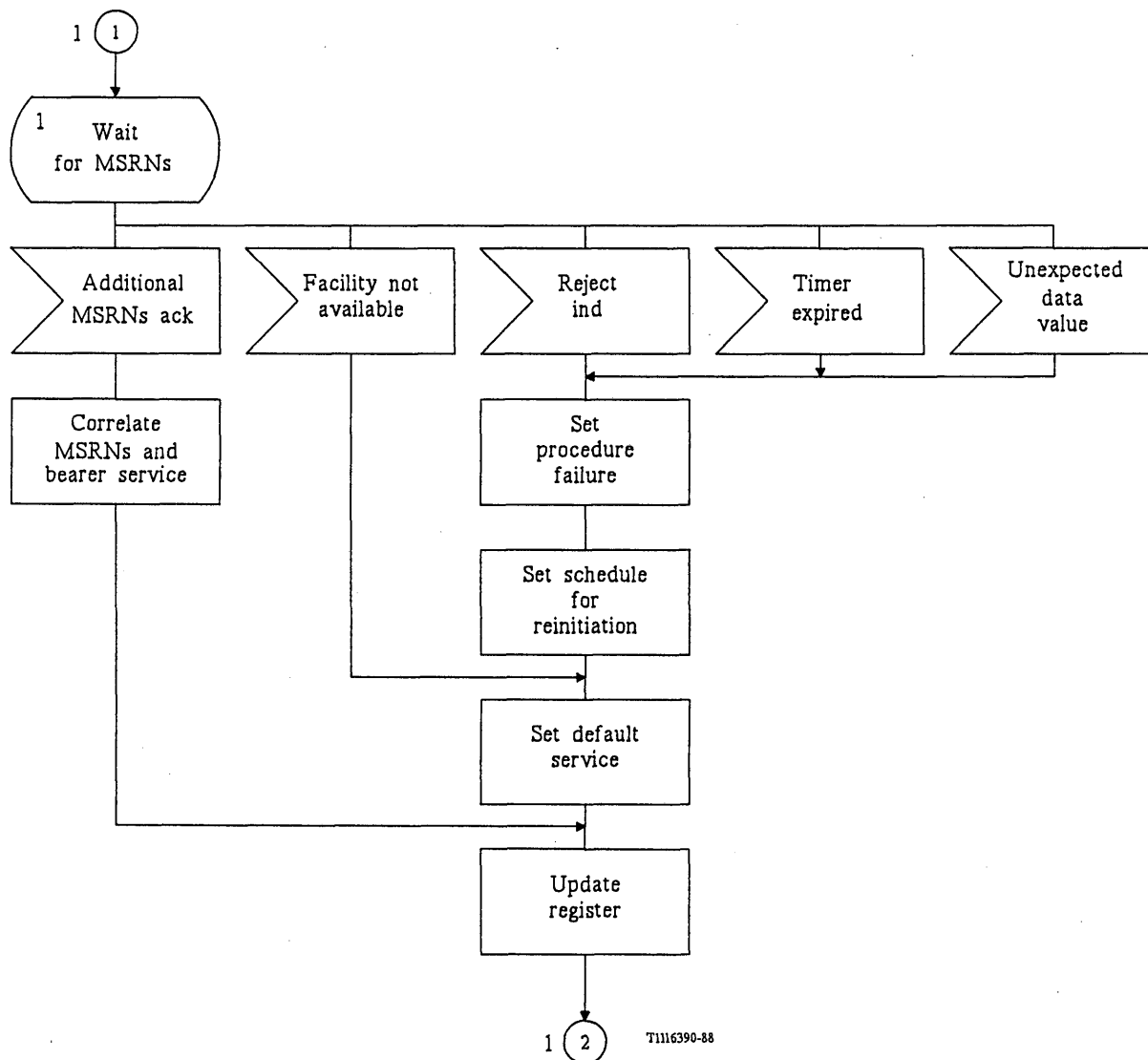


FIGURE 16/Q.1051 (sheet 2 of 2)

**Application specific procedure for location registration in home location register**

The ASE/TCAP procedure is contained in Figure 17/Q.1051. The TC-INVOKE INDICATION primitive will contain the *update location* message. The results are returned as follows:

- a TC-U-REJECT REQUEST primitive is used to provide cause and diagnostics if procedure errors are discovered;
- the *location updating (l.u.) accepted* message is returned in the TC-RESULT-L REQUEST primitive;

- unsuccessful outcomes are contained in a TC-U-ERROR REQUEST primitive as follows:
  - i) unknown subscriber, i.e. the HLR does not have any MS with the indicated IMSI;
  - ii) roaming not allowed, i.e. the MS is not allowed to roam into the area controlled by the VLR.

The ASE/TCAP interface procedure for the allocation of additional MSRN is given in § 3.6.2.

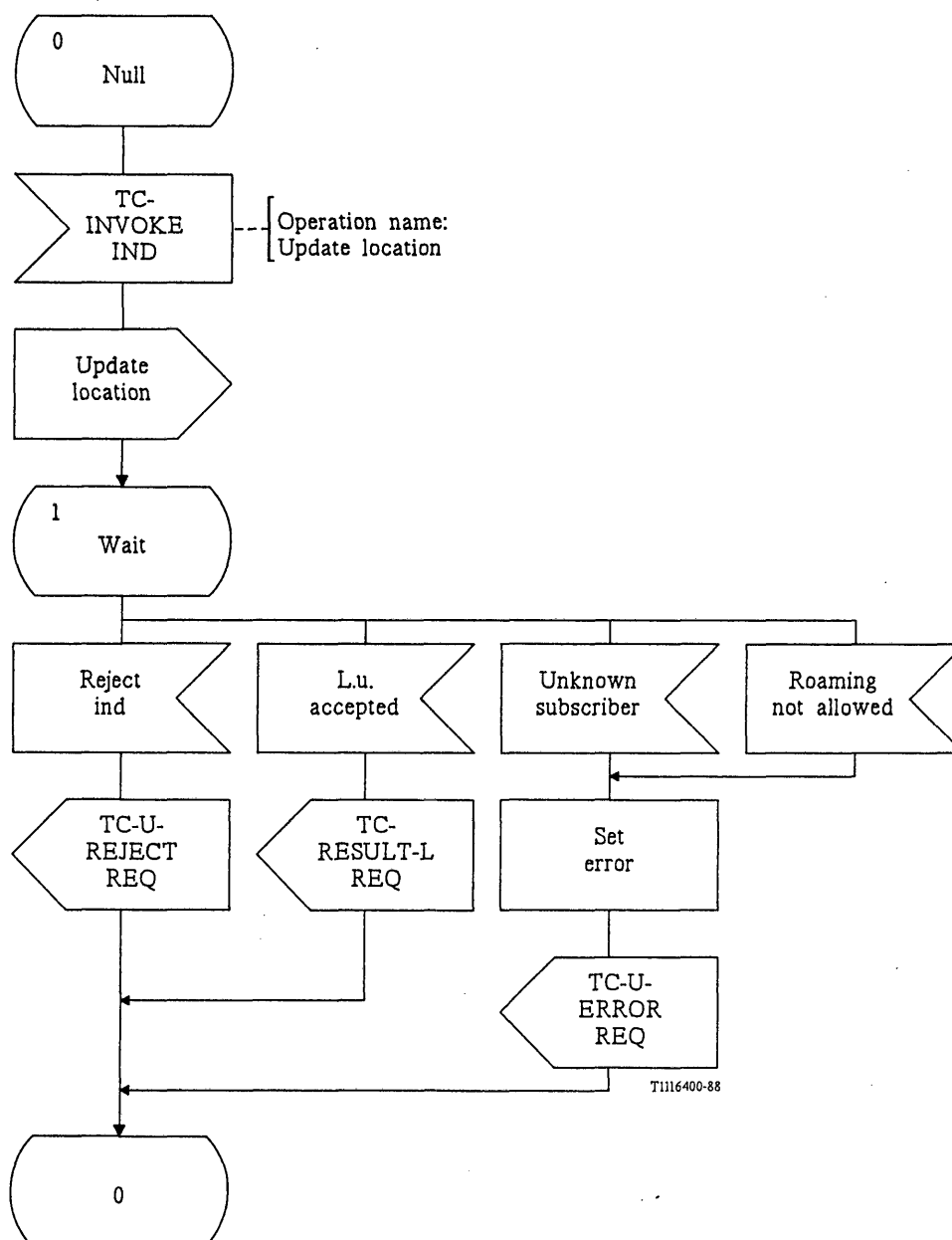


FIGURE 17/Q.1051

ASE/TCAP interface procedure in the HLR for  
location registration

#### 3.2.1.3.4 Procedures in the previous VLR (VLR1)

The application specific procedure is shown in Figure 18/Q.1051. On receiving the *send parameters from VLR (IMSI)* message the previous VLR will return:

- the *IMSI response* message if the TMSI is valid. This message will also contain authentication parameters if requested by the new VLR;
- the *unallocated TMSI* message if the TMSI is not allocated in the VLR;
- the *unknown location area* message if the location area code is unknown in the VLR.

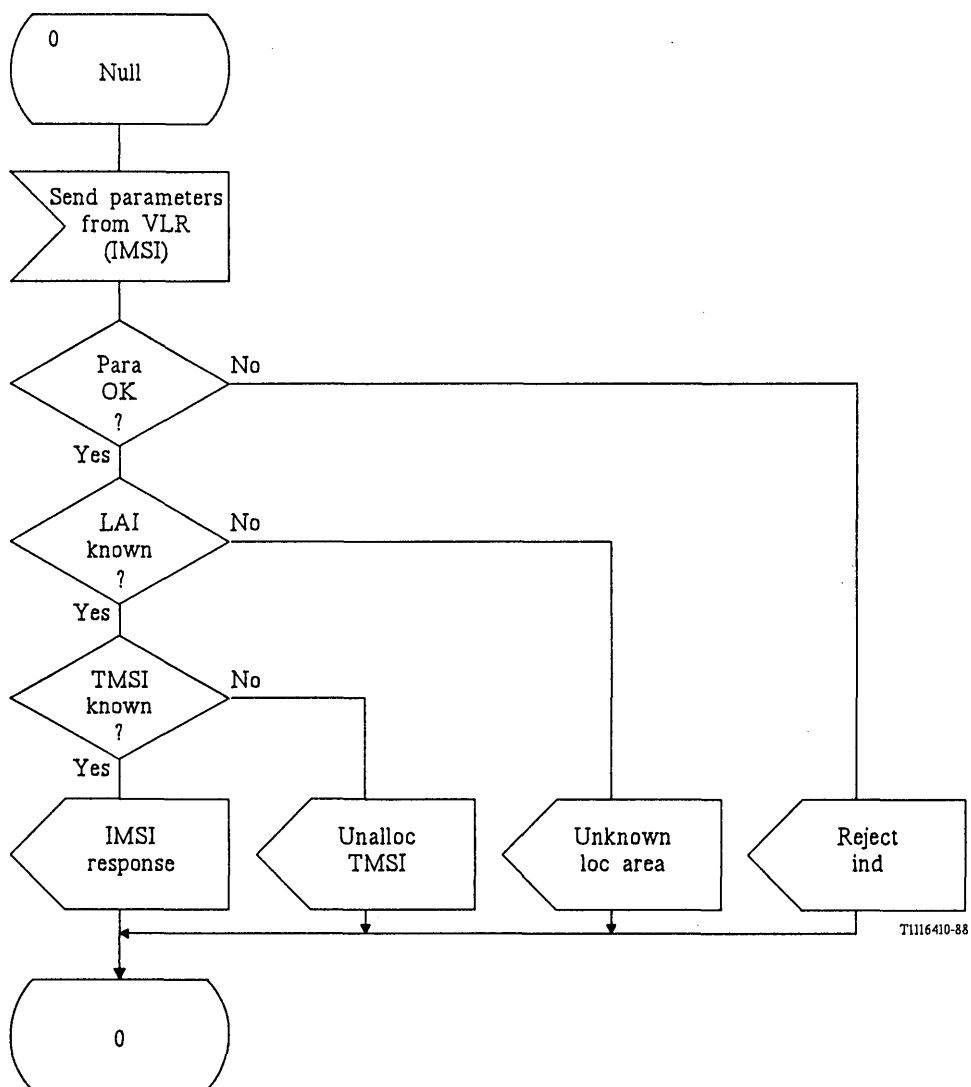


FIGURE 18/Q.1051

**Application specific procedure in previous VLR (VLR1) for location registration**

The interface procedure is contained in Figure 19/Q.1051. The previous VLR will receive the *send parameters from VLR (IMSI)* message in the TC-INVOKE INDICATION primitive. The results are returned as follows:

- a TC-U-REJECT REQUEST primitive is used to provide cause and diagnostics if procedure errors are detected;
- the *IMSI response* message is returned in the TC-RESULT-L REQUEST primitive;
- unsuccessful outcomes are reported in a TC-U-ERROR REQUEST primitive as follows:
  - i) TMSI is not allocated;
  - ii) unknown location area.

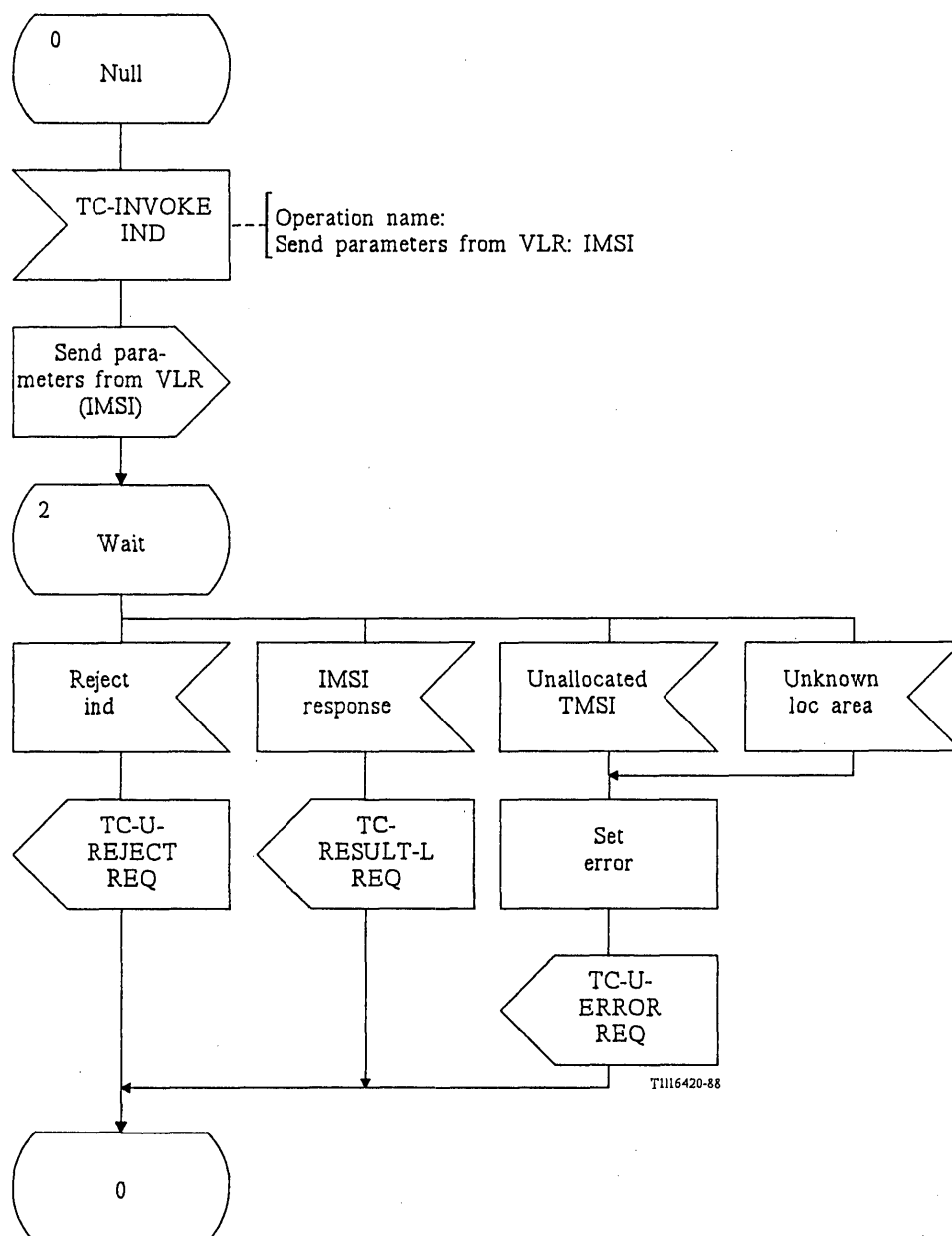


FIGURE 19/Q.1051

ASE/TCAP interface procedure in the previous VLR (VLR1)



### 3.2.2 Location cancellation

#### 3.2.2.1 Definition of interfaces

Figure 20/Q.1051 shows the functional units and interfaces involved in location cancellation, i.e., home location register (HLR), previous visitor location register (VLR) and interface D. A new visitor location register may be involved indirectly as shown in the figure.

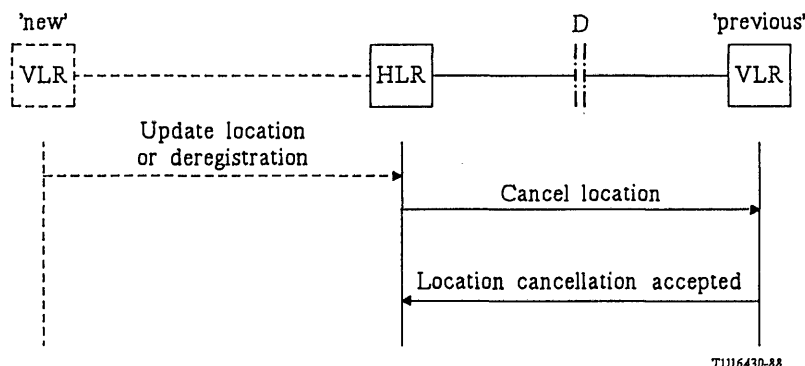


FIGURE 20/Q.1051

#### Interface and procedures for location cancellation

#### 3.2.2.2 General description of location cancellation

The purpose of this procedure is to delete a visiting MS from a visitor location register when the MS registers with a new visitor location register. The procedure may also be used if an MS ceases to be a subscriber.

The procedure is initiated by the home location register when receiving (see Figure 20/Q.1051) an *update location* message from a location register other than that in which the MS was currently located, or when the MS is deregistered by some means (e.g. ceases to be a subscriber).

The home location register will then send the *cancel location* message to the previous visitor location register. The visitor location register receiving this message will return the *location cancellation accepted* message and delete the MS from the list of visiting MSs.

#### 3.2.2.3 Detailed procedures for location cancellation

##### 3.2.2.3.1 Procedures in the HLR

The application specific procedure of Figure 21/Q.1051 is initiated by some other event in the HLR represented by the signal *initiate location cancellation (l.c.) (X)*. The initiation conditions are given in § 3.2.2.2. The HLR then sends the *cancel location* message to the previous VLR. Any of the following events may then occur:

- the HLR receives a *location cancellation (l.c.) accepted* message from the VLR. This terminates the procedure;
- the HLR receives an *unknown subscriber* message. In this case the procedure is also terminated;
- the HLR receives an indication that the timer has expired or the operation has been rejected. In this case a message not delivered indication is set in the HLR. The operation may then be repeated at a later time.

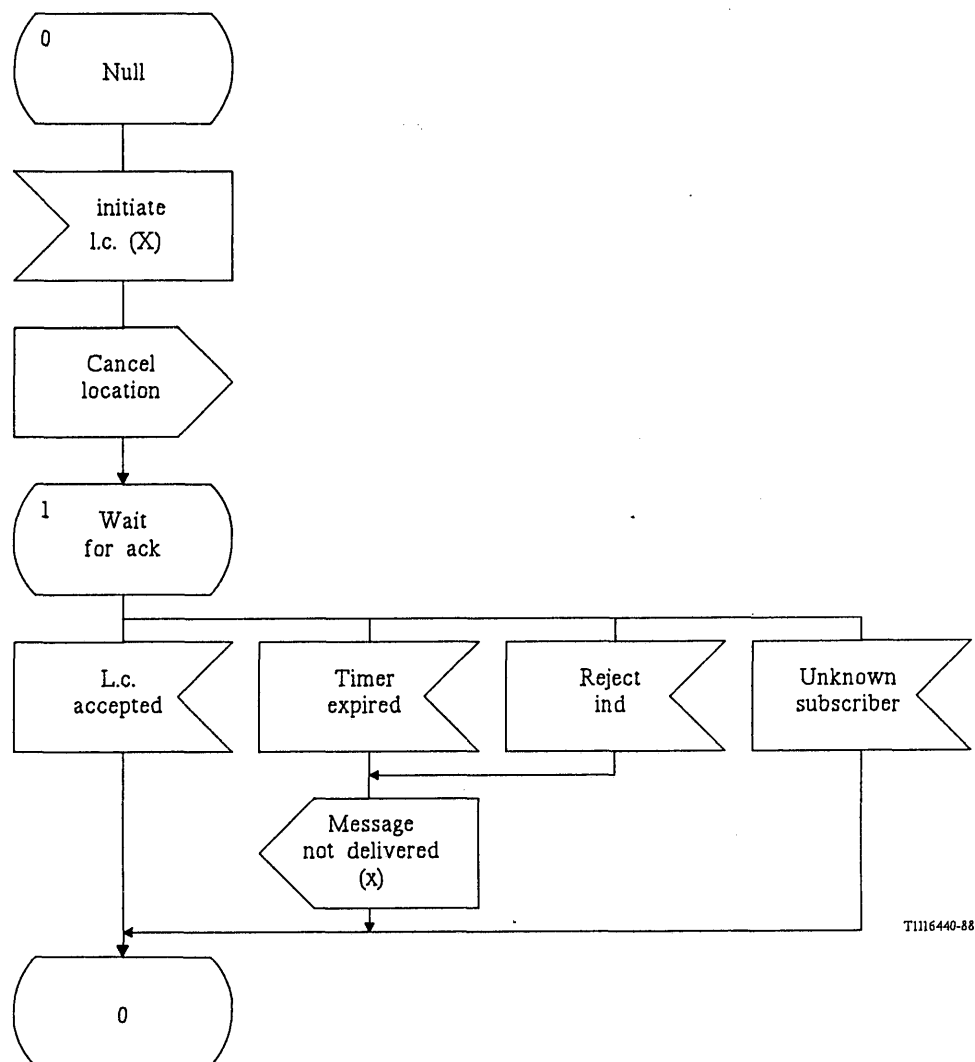


FIGURE 21/Q.1051

**Application specific procedure in HLR for location cancellation**

The ASE/TCAP interface procedure is shown in Figure 22/Q.1051. The *cancel location* message is sent in the TC-INVOKE REQUEST primitive. TCAP is also requested to initiate timer T-lc. The results received from TCAP can be:

- a TC-RESULT-L INDICATION primitive containing the *location cancellation (l.c.) accepted* message;
- a TC-(U)-REJECT INDICATION primitive if the VLR or TCAP rejects the operation because of procedure errors;
- TC-L-CANCEL INDICATION primitive if timer T-lc expires;
- a TC-U-ERROR INDICATION primitive indicating an unsuccessful outcome as follows:
  - i) unknown subscriber indicates that the MS was not registered in the VLR.

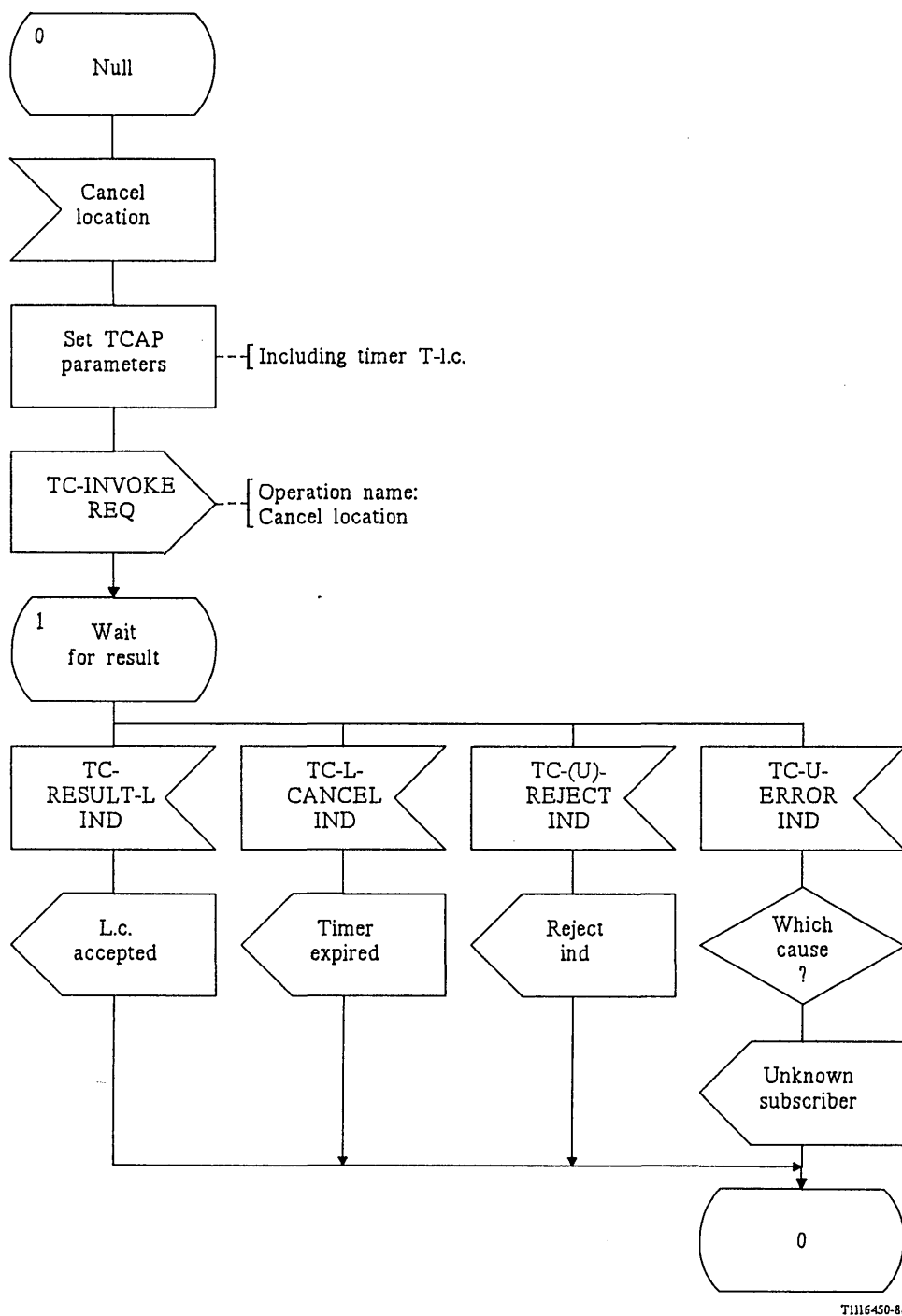


FIGURE 22/Q.1051

ASE/TCAP interface procedure in the HLR for location cancellation

### 3.2.2.3.2 Procedures in the VLR

The application specific procedure is contained in Figure 23/Q.1051 and is as follows.

When receiving a *cancel location* message the VLR will:

- if the MS is registered in the VLR, the VLR will delete the MS from the register and return the *location cancellation (l.c.) accepted* message;
- if the MS is not registered in the VLR, the VLR will return the *unknown subscriber* message.

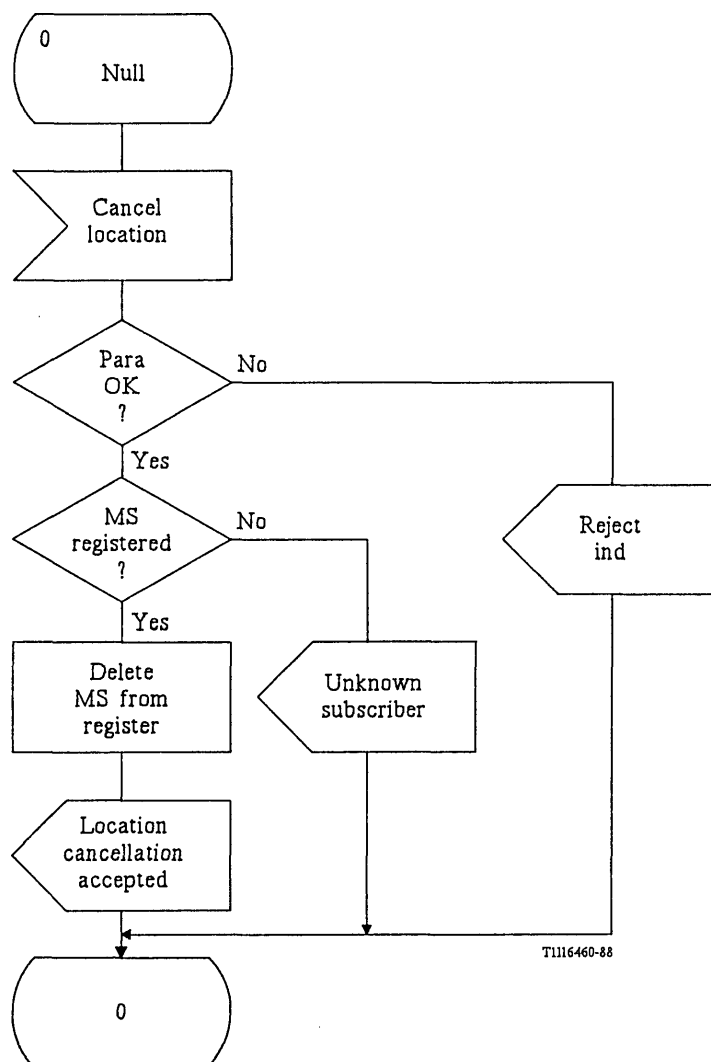


FIGURE 23/Q.1051

**Application specific procedure for location cancellation in visitor location register**

The interface procedure is shown in Figure 24/Q.1051. The *cancel location* message is received in a TC-INVOKE INDICATION primitive. The results are returned as follows:

- the *location cancellation (l.c.) accepted* message is returned in a TC-RESULTS-L REQUEST primitive;

- the TC-U-REJECT REQUEST primitive is used to send cause and diagnostics if procedure errors are discovered by the VLR;
- unsuccessful events are returned in the TC-U-ERROR REQUEST primitive as follows:
  - i) unknown subscriber, the MS is not registered in the VLR.

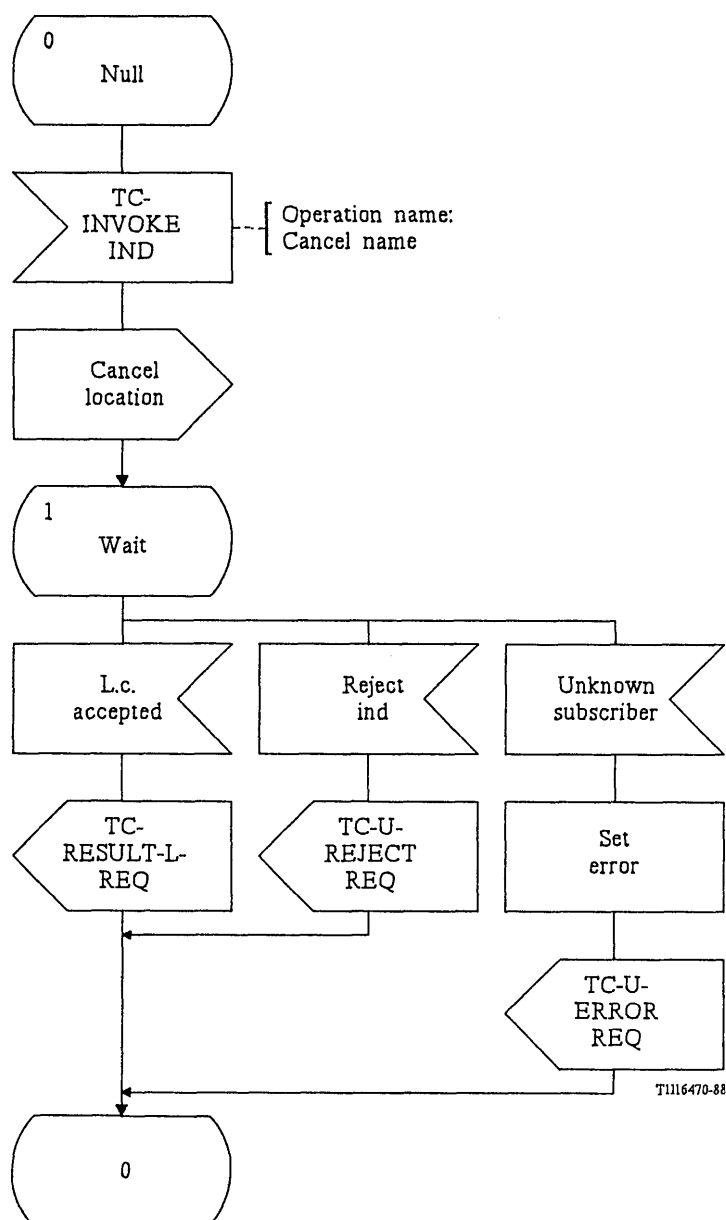


FIGURE 24/Q.1051

**ASE/TCAP interface procedure in VLR for location cancellation**

### 3.2.3 IMSI detach/attach procedures

#### 3.2.3.1 Definition of interfaces for IMSI detach/attach

The interfaces and procedures involved are shown in Figure 25/Q.1051.

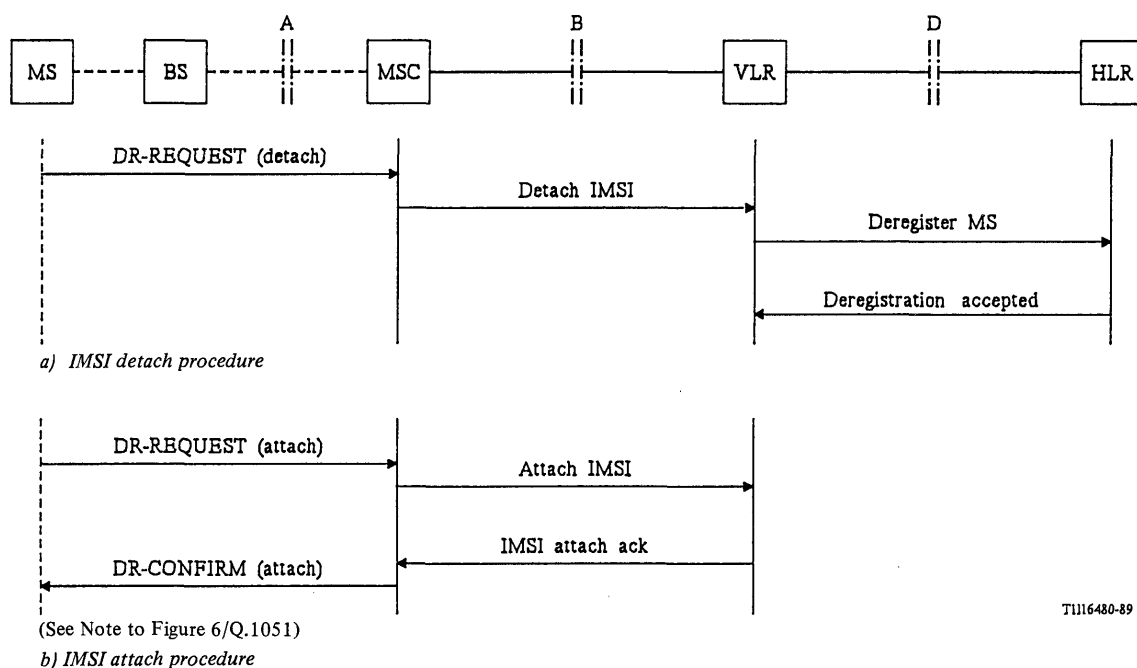


FIGURE 25/Q.1051

### Interfaces and procedures for IMSI detach/attach

The purpose of the IMSI detach procedure is to enable an MS to indicate to the PLMN that it is about to enter an inactive state. The information is used to reject calls to the MS without sending a paging message on the radio path. The IMSI detached information may either be stored in the VLR and no information being passed to the HLR, or optionally, the HLR may be informed and the IMSI detached flag is then set in the HLR.

The IMSI attach procedure is used by the MS to indicate that it has reentered the active state. The procedure is to be used only when the IMSI detach flag is set in the VLR. If the flag is set in the HLR, reentering of the active state requires a normal location updating from the MS.

#### 3.2.3.2 General description of IMSI detach/attach

##### 3.2.3.2.1 IMSI detached flag set in the VLR

When receiving a DR-REQUEST (detach) from the MS, the MSC will send the *detach IMSI* message to the VLR. This message is not acknowledged since it is likely that an acknowledgement message will not be received by the MS.

The VLR will set an IMSI detached flag and reject incoming calls to the MS so long as the flag is set (or forward the call if the call forwarding on MS not registered service applies).

When receiving a DR-REQUEST (attach) from the MS, the MSC will send the *attach IMSI* message to the VLR. The VLR will then remove the IMSI detached flag and resume normal call handling for the MS. The VLR returns the *IMSI attach acknowledge* message to the MSC and the MS is notified by the DR-CONFIRM (attach) message.

##### 3.2.3.2.2 IMSI detached flag set in the HLR

When receiving an *attach IMSI* message from the MSC, the VLR will send the *deregister MS* message to the HLR and the HLR will return the *deregistration accepted* message to the VLR.

If the MS is known to the VLR, it should be deleted from the register.

If the *deregister MS* message is received from a VLR ("new" VLR) other than that in which the MS was originally registered ("previous" VLR), the HLR will initiate the location cancellation procedure of § 3.2.2 towards the previous VLR.

The HLR should set the IMSI detached flag. If the HLR receives an incoming call to the MS and the MS has not activated the call forwarding on MS not registered service, the call should be cleared by an appropriate cause.

Reregistration of the MS will be done by normal location registration.

### 3.2.3.3 Detailed procedures for IMSI detach/attach

#### 3.2.3.3.1 Procedures in the MSC

The IMSI detach procedure in the MSC is shown in Figures 26/Q.1051 and 27/Q.1051.

The MSC sends the *detach IMSI* message in the TC-INVOKE REQUEST primitive. Since this message is not acknowledged on the component sub-layer, the pre-arranged termination procedure will be used (i.e. by a TC-L-CANCEL INDICATION primitive). If a TC-REJECT INDICATION primitive is received, the procedure is also terminated by reporting the event to the MAP ASE. The procedure is supervised by timer T.id.

The IMSI attach procedure in the MSC is shown in Figures 28/Q.1051 and 29/Q.1051.

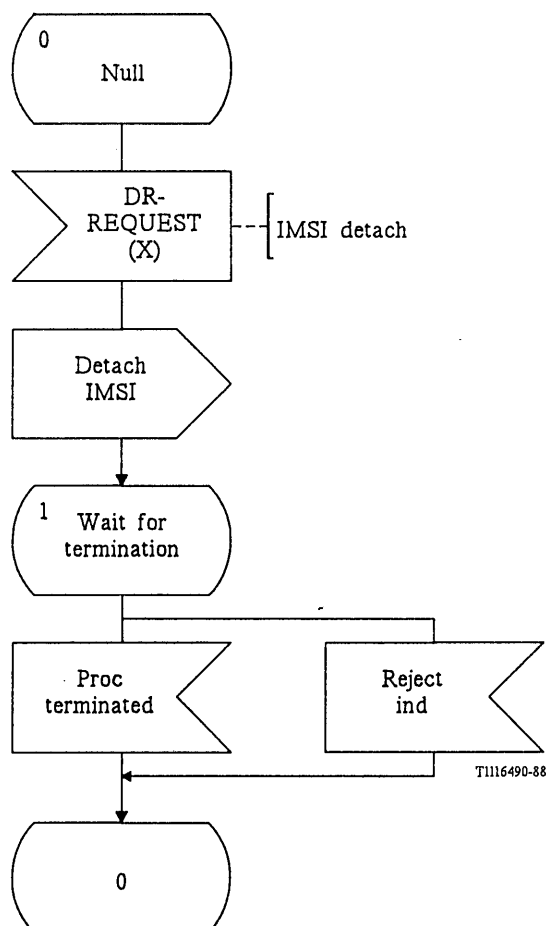


FIGURE 26/Q.1051

**Application specific procedure in the MSC for IMSI detach procedure**

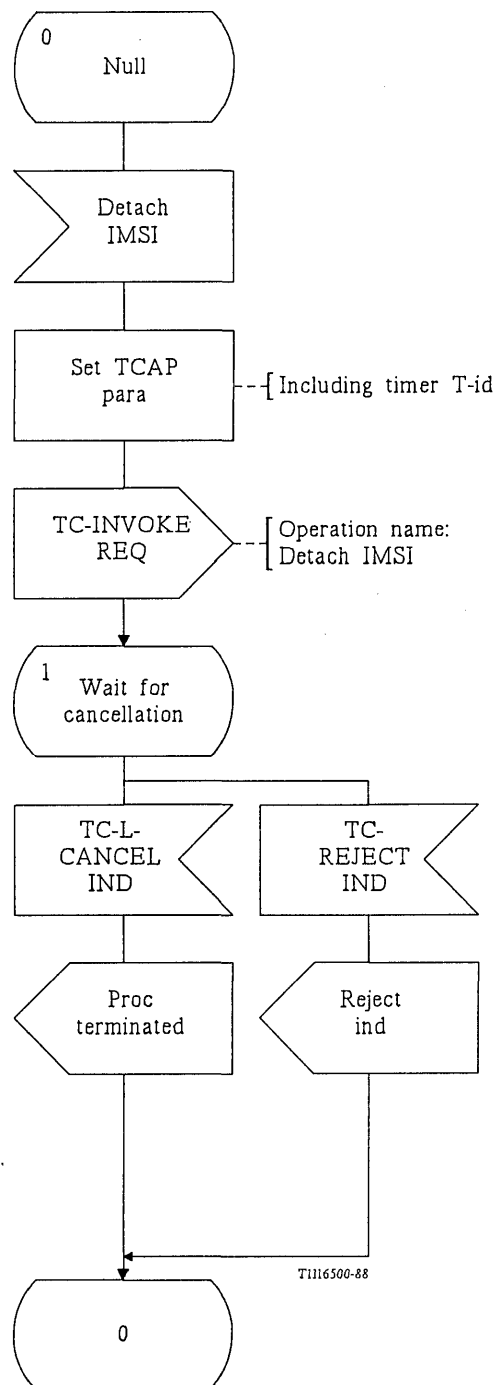


FIGURE 27/Q.1051

**ASE/TCAP interface procedure in the MSC  
for IMSI detach procedure**



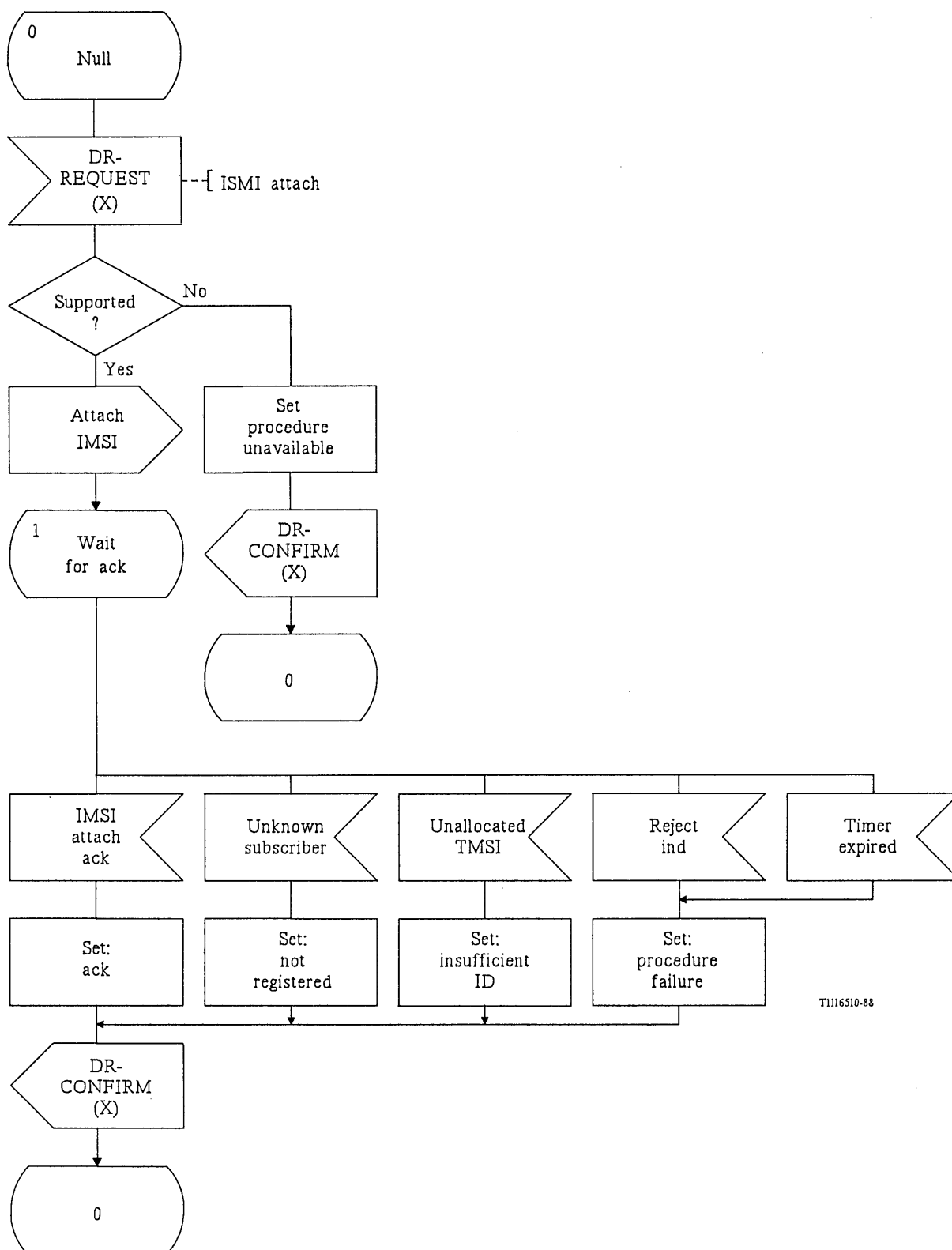


FIGURE 28/Q.1051

Application specific procedure in the MSC for  
IMSI attach procedure

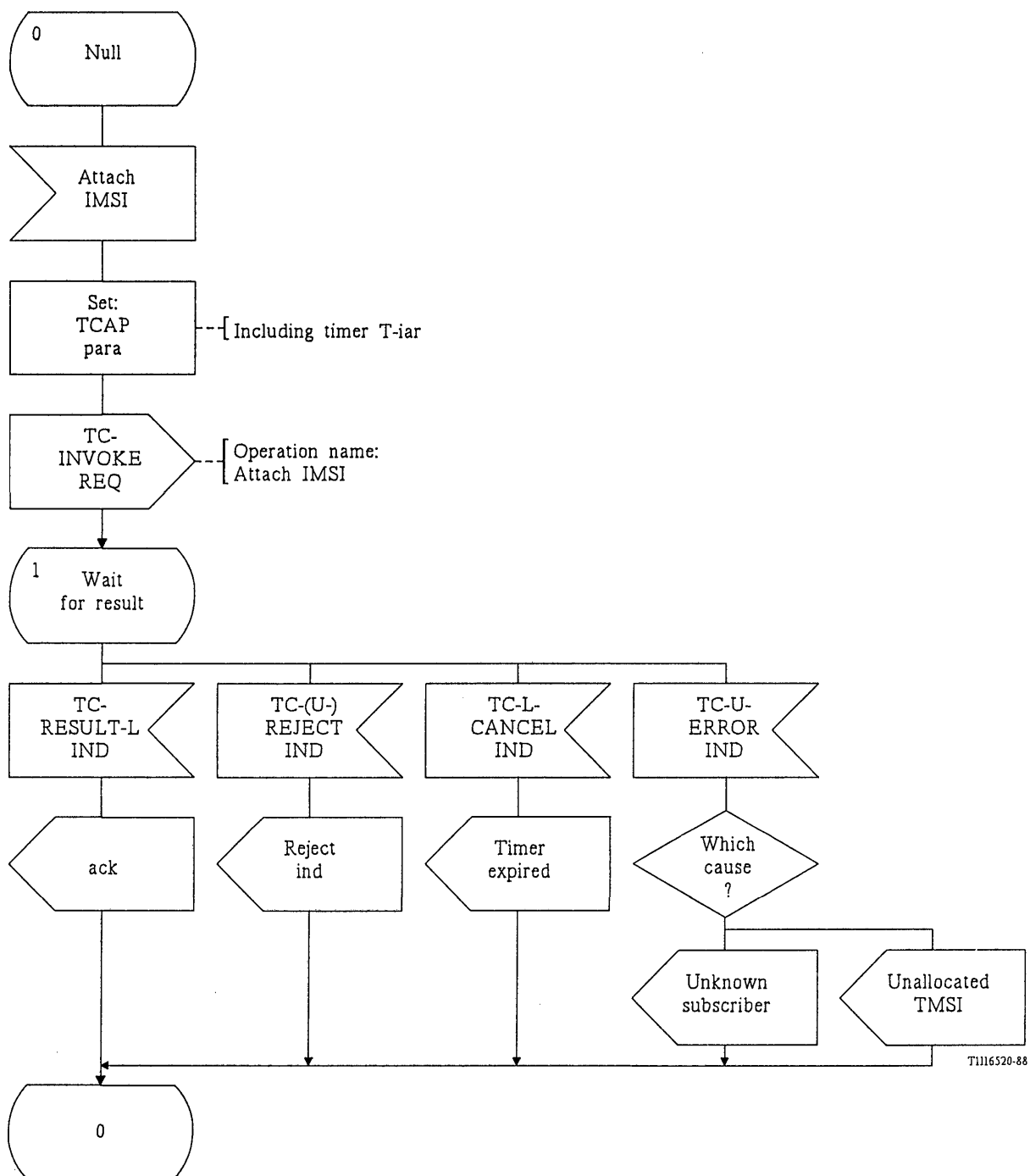


FIGURE 29/Q.1051

ASE/TCAP interface procedure in the MSC for  
IMSI attach procedure

The MSC sends the *attach IMSI* message in the TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-iar. The *IMSI attach acknowledgement* is received in a TC-RESULT-L INDICATION primitive and negative results are reported in a TC-U-ERROR INDICATION primitive as follows:

- i) unknown subscriber if the MS identified itself with an IMSI not known in the VLR;
- ii) unallocated TMSI if the MS identified itself with an unallocated TMSI.

Both positive and negative results are reported to the MS. Expiry of timer T-iar is reported in a TC-L-CANCEL INDICATION primitive. An indication that the procedure failed is sent to the MS.

#### 3.2.3.3.2 Procedures in the VLR

The application specific IMSI detach procedure is given in Figure 30/Q.1051. Figures 31/Q.1051 and 32/Q.1051 contain the ASE/TCAP VLR/MSC interface procedure and the ASE/TCAP VLR/HLR interface procedure, respectively.

The application specific IMSI detach procedure is as follows (Figure 30/Q.1051). When receiving a *detach IMSI* message from the MSC, the VLR may proceed as follows:

- i) if IMSI detach operation is local in the VLR, the VLR sets an IMSI detached flag;
- ii) if the optional facility of deregistration in the HLR is implemented, the VLR sends the *deregister MS* message to the HLR.

*Detach IMSI* messages with parameter errors are ignored.

In case ii) the VLR sends the *deregister MS* message to the HLR. The outcome of this procedure can be as follows:

- if the *facility not supported* message is received, the VLR will keep the MS in the register;
- if either of the messages *deregistration accepted*, *unknown subscriber* or *deregistered subscriber* is received from the HLR the VLR will delete the MS and the roaming number (if allocated);
- if failure condition is reported (reject indication or timer expired), the VLR will block the roaming number. Further actions may then be taken at a later time.

The ASE/TCAP MSC/VLR interface procedure (Figure 31/Q.1051) is simple. The *detach IMSI* message is received in a TC-INVOKE INDICATION primitive and the MAP ASE does not return any acknowledgement.

The ASE/TCAP VLR/HLR interface procedure for deregistration in the HLR (Figure 32/Q.1051) is as follows. The *deregister MS* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-dr. The outcome of the procedure is as follows:

- the *deregistration accepted* message is contained in a TC-RESULT-L INDICATION primitive;
- if the operation is rejected by the HLR or TCAP, a TC-(U)-REJECT INDICATION primitive will be received indicating cause and diagnostics;
- if timer T-dr expires, the TC-L-CANCEL INDICATION primitive is received;
- an unsuccessful outcome is reported in a TC-U-ERROR INDICATION primitive as follows:
  - i) the MS is unknown to the HLR;
  - ii) the MS has already been deregistered;
  - iii) the HLR does not support deregistration.

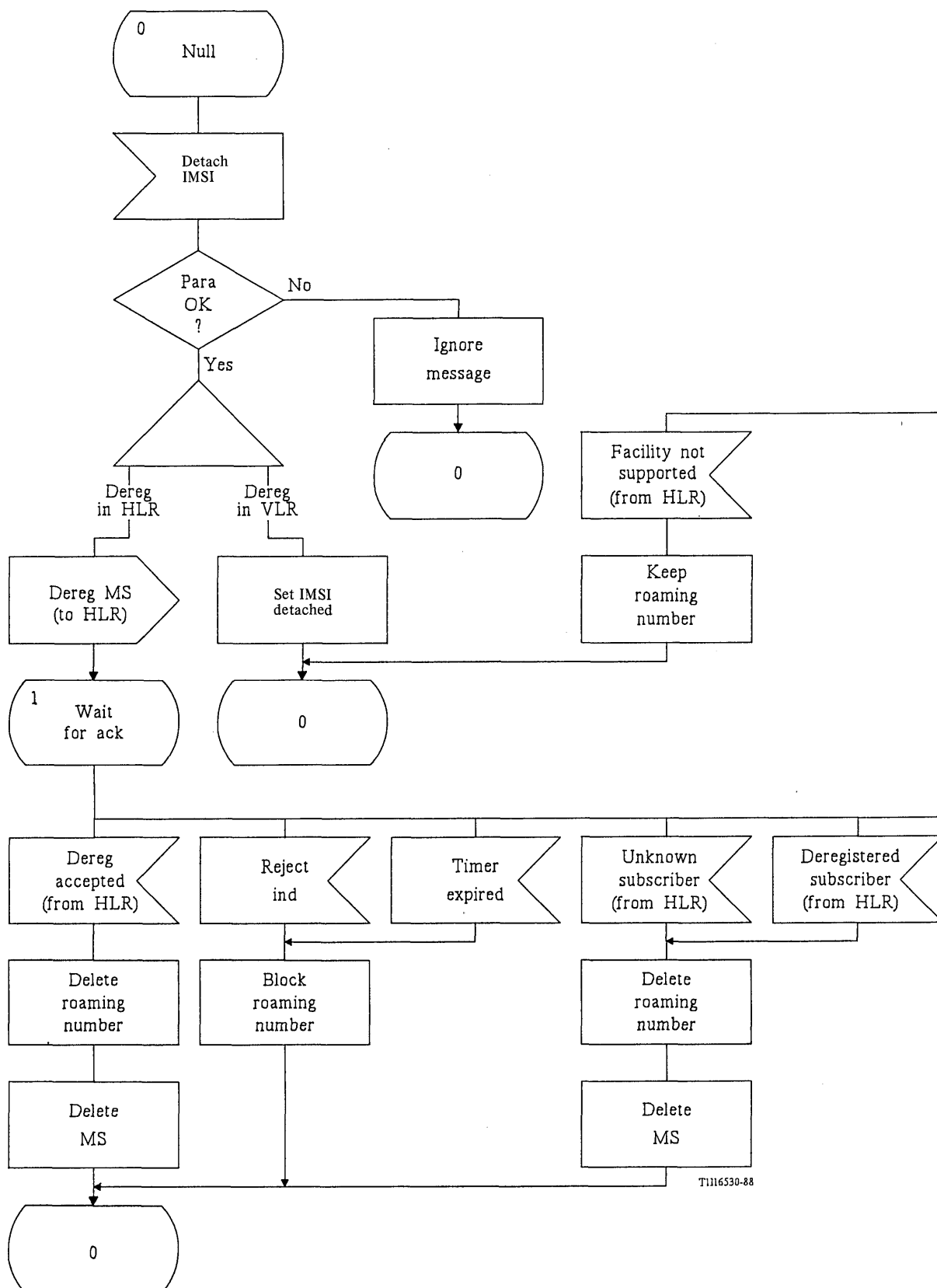


FIGURE 30/Q.1051

Application specific procedure in VLR for  
IMSI detach procedure

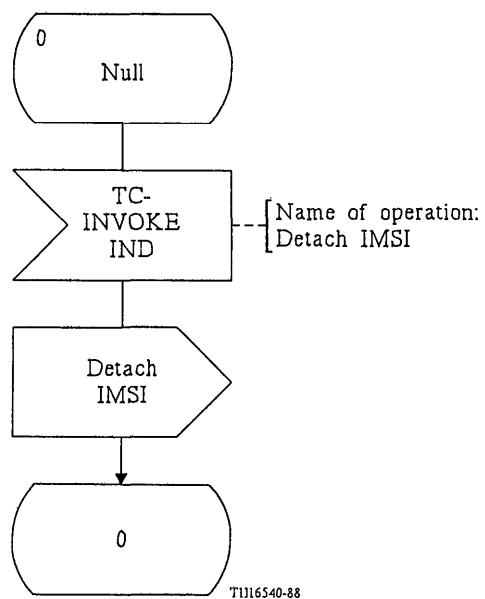


FIGURE 31/Q.1051

**ASE/TCAP MSC/VLR interface procedure in the VLR  
for IMSI detach procedure**

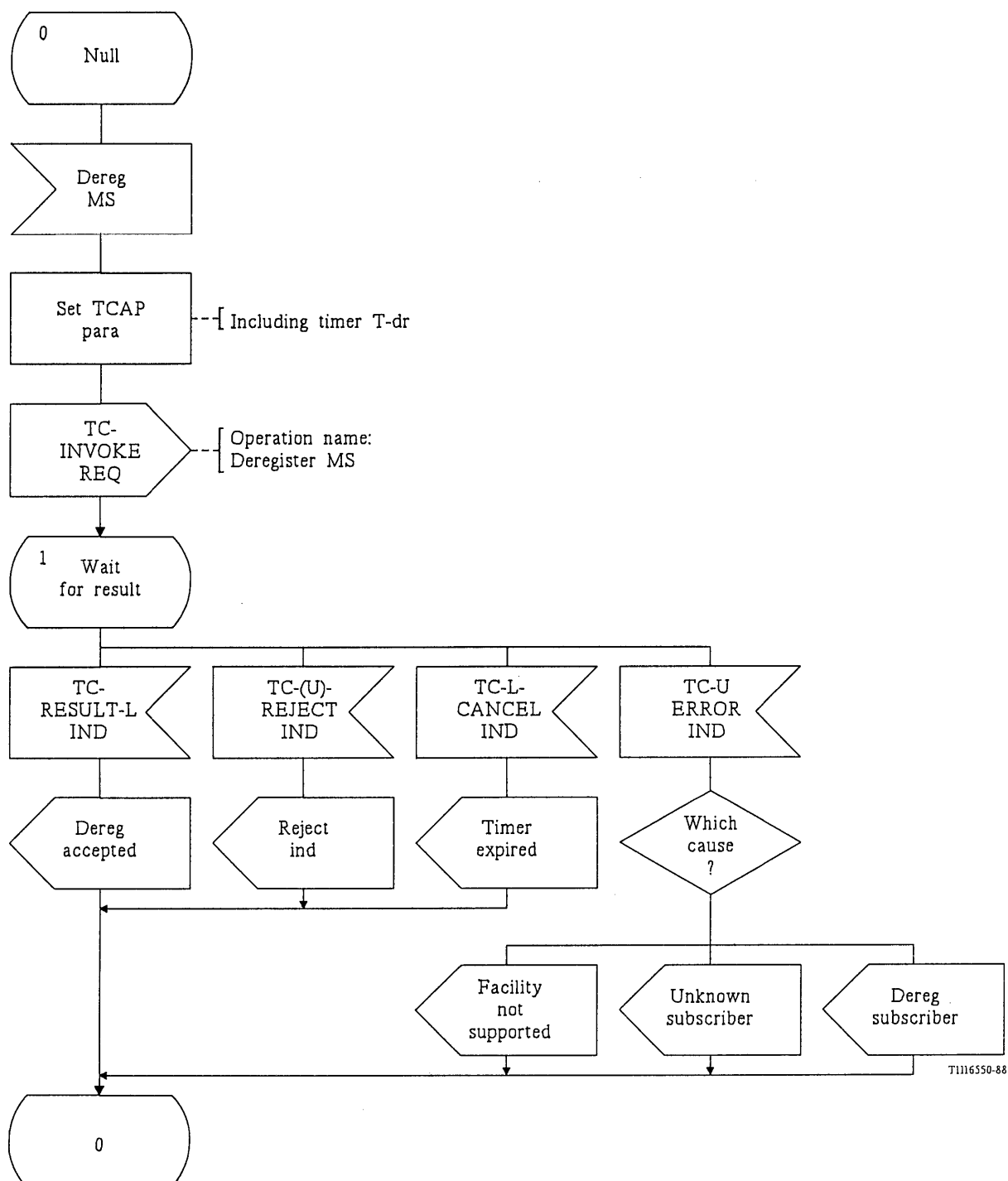


FIGURE 32/Q.1051

**ASE/TCAP VLR/HLR interface procedure in the VLR  
for optional deregistration in the HLR**

The application specific procedure in the VLR for the IMSI attach procedure is shown in Figure 33/Q.1051 and the corresponding ASE/TCAP interface procedure is contained in Figure 34/Q.1051.

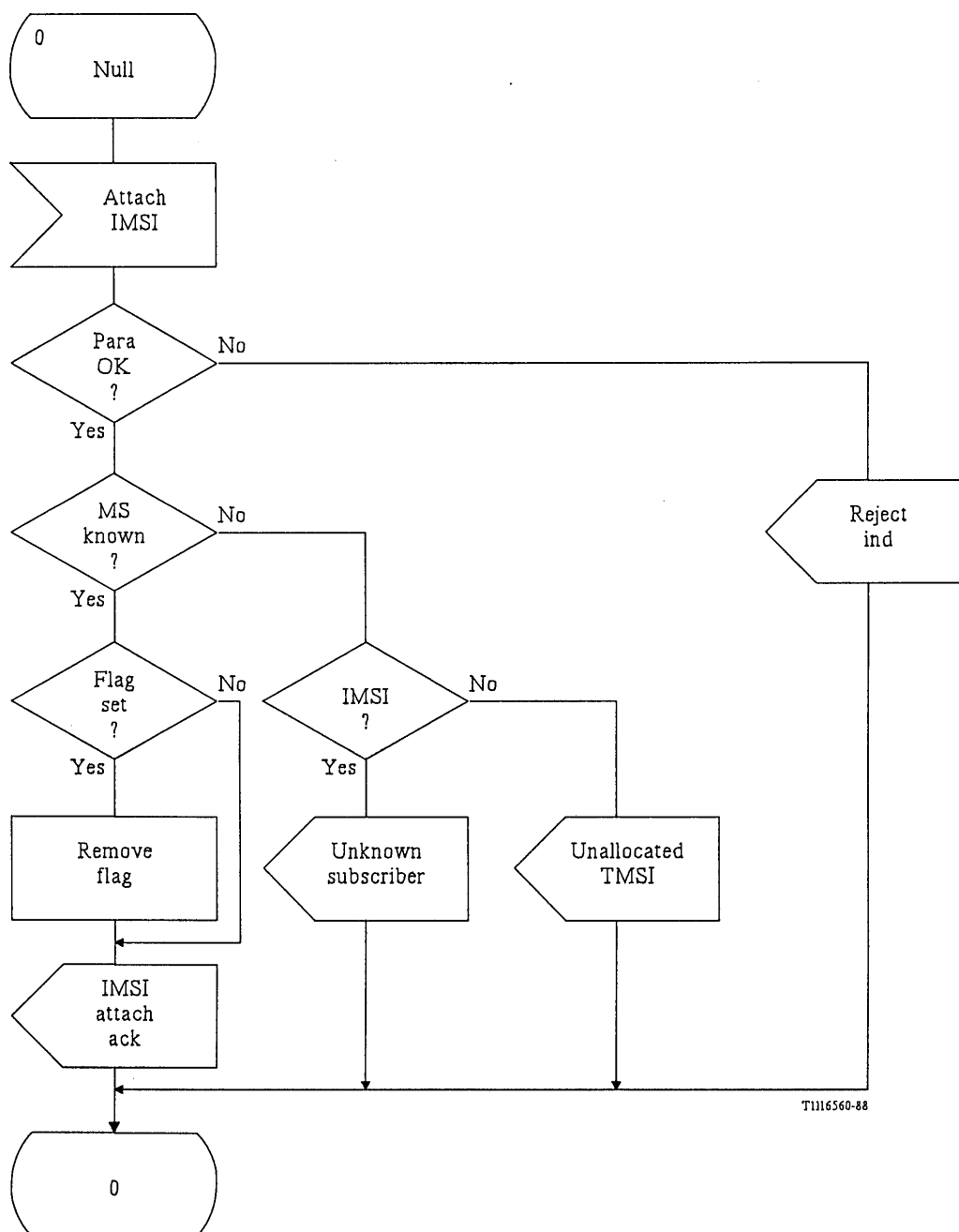


FIGURE 33/Q.1051

Application specific procedure in VLR for IMSI attach

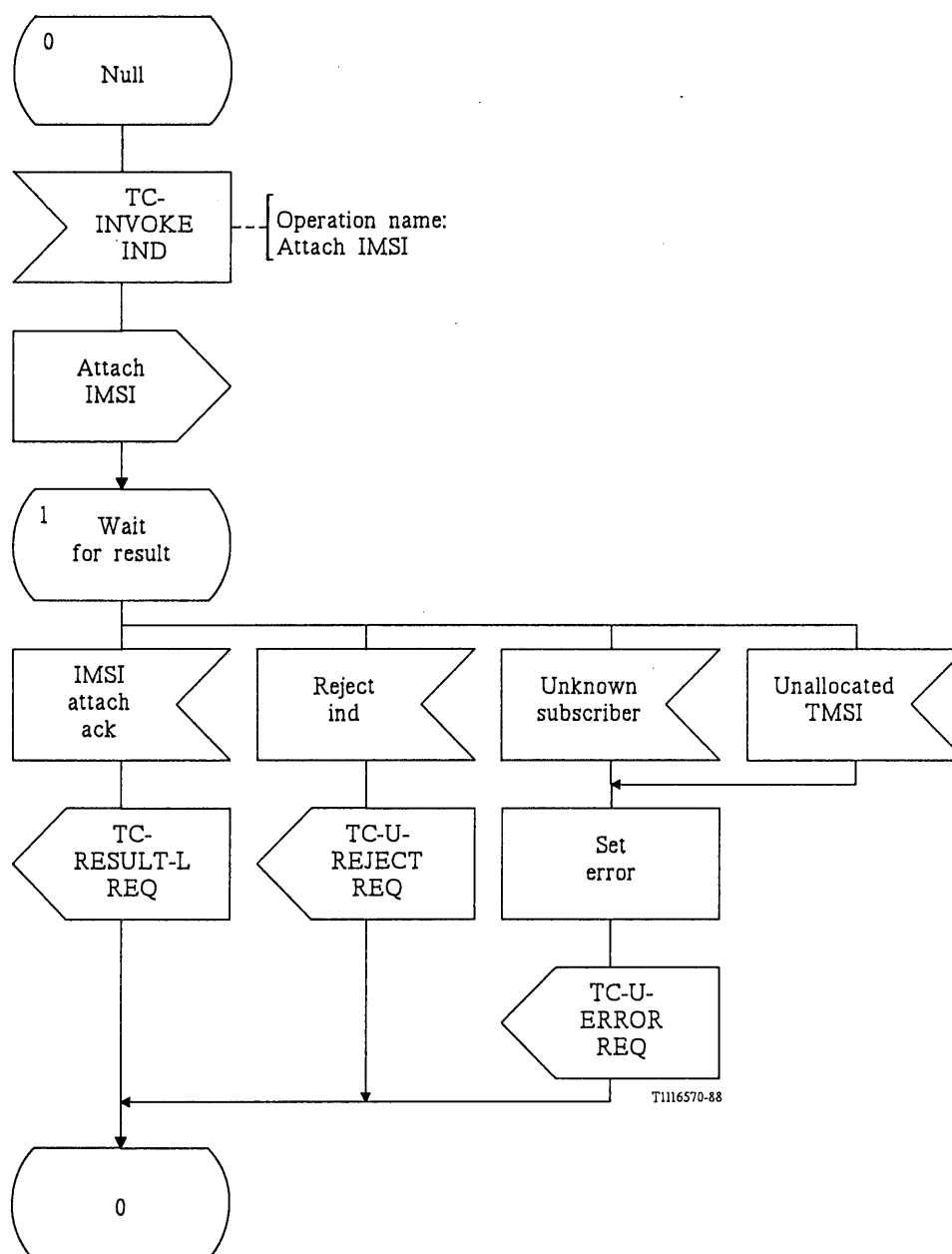


FIGURE 34/Q.1051

**ASE/TCAP interface procedure in VLR for IMSI attach**

The VLR will receive the *attach IMSI* message in a TC-INVOKE INDICATION primitive. If the MS is known in the VLR, the VLR will return the *IMSI attach acknowledge* message in a TC-RESULT-L REQUEST primitive whether the IMSI detached flag is set or not.

Negative results are returned in a TC-U-ERROR REQUEST primitive with the cause set to indicate either of the following events:

- i) unknown subscriber if the MS identified itself with an IMSI not known in the VLR;
- ii) unallocated TMSI if the MS identified itself with an unallocated TMSI.



#### 3.2.3.3.3 Procedures for deregistration in the HLR

The application specific procedure is shown in Figure 35/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 36/Q.1051.

The application specific procedure is as follows.

When receiving a *deregister MS* message from a VLR, the HLR will perform a number of checks:

- if procedure errors are detected, a reject indication is returned;
- if the MS is unknown, the *unknown subscriber* message is returned;
- if the MS is already deregistered, the *deregistered subscriber* message is returned;
- if the HLR does not support deregistration, the *facility not supported* message is returned;
- if none of these conditions apply, the HLR will mark the MS as deregistered and return the *deregistration accepted* message. If the *deregister MS* message indicated another VLR than that contained in the subscriber parameter list, the HLR will initiate location cancellation towards this VLR.

The ASE/TCAP interface procedure is as follows.

The *deregister MS* message is contained in a TC-INVOKE INDICATION primitive. The result is returned as follows:

- the *deregistration accepted* message is returned in a TC-RESULT-L REQUEST primitive;
- a reject indication is returned in a TC-U-REJECT REQUEST primitive containing cause and diagnostics;
- an unsuccessful result is returned in a TC-U-ERROR REQUEST primitive as follows:
  - i) unknown subscriber, i.e. the IMSI is not allocated to any MS;
  - ii) the MS is already deregistered;
  - iii) the HLR does not support deregistration.

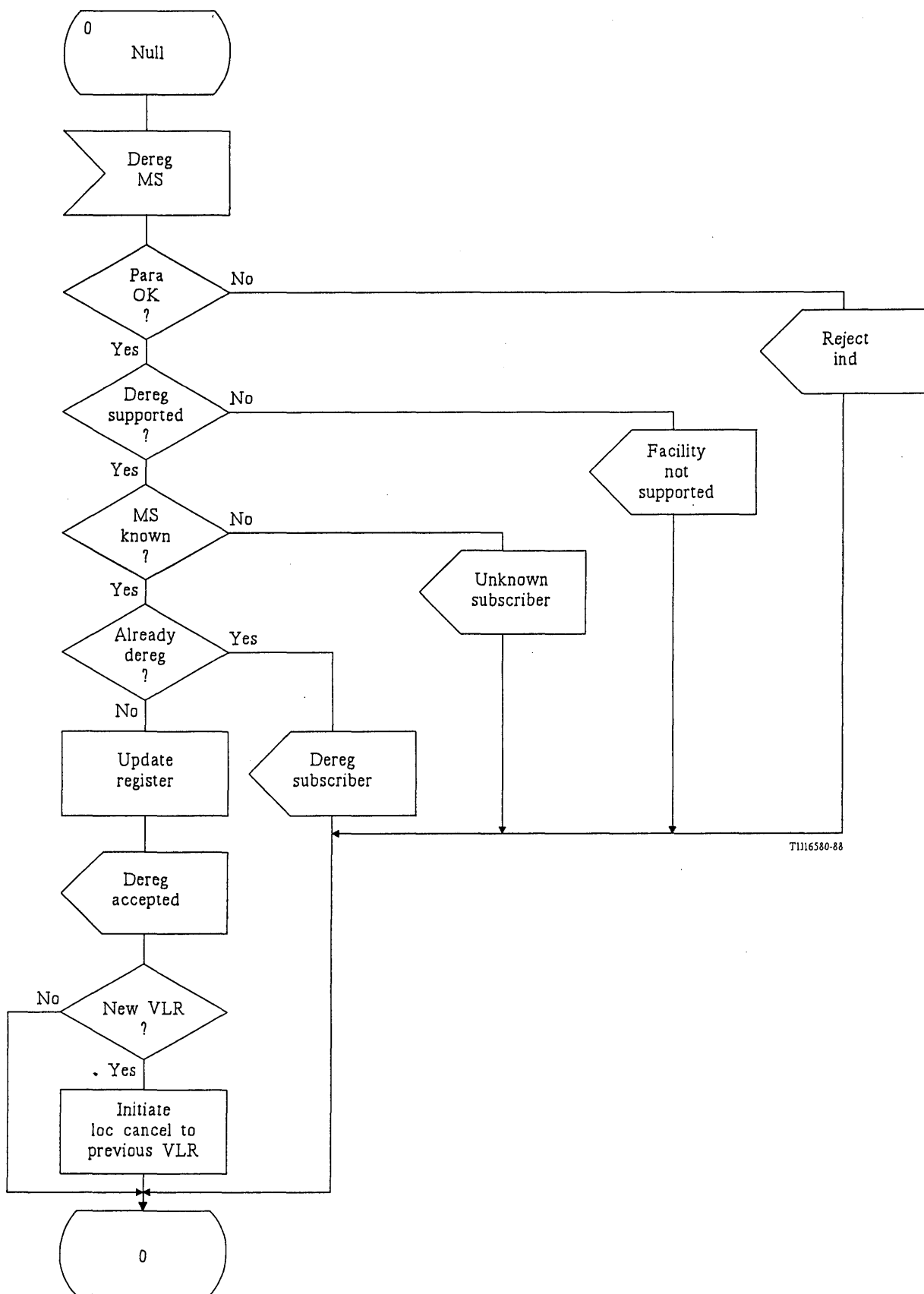


FIGURE 35/Q.1051

Application specific procedure in HLR for deregistration

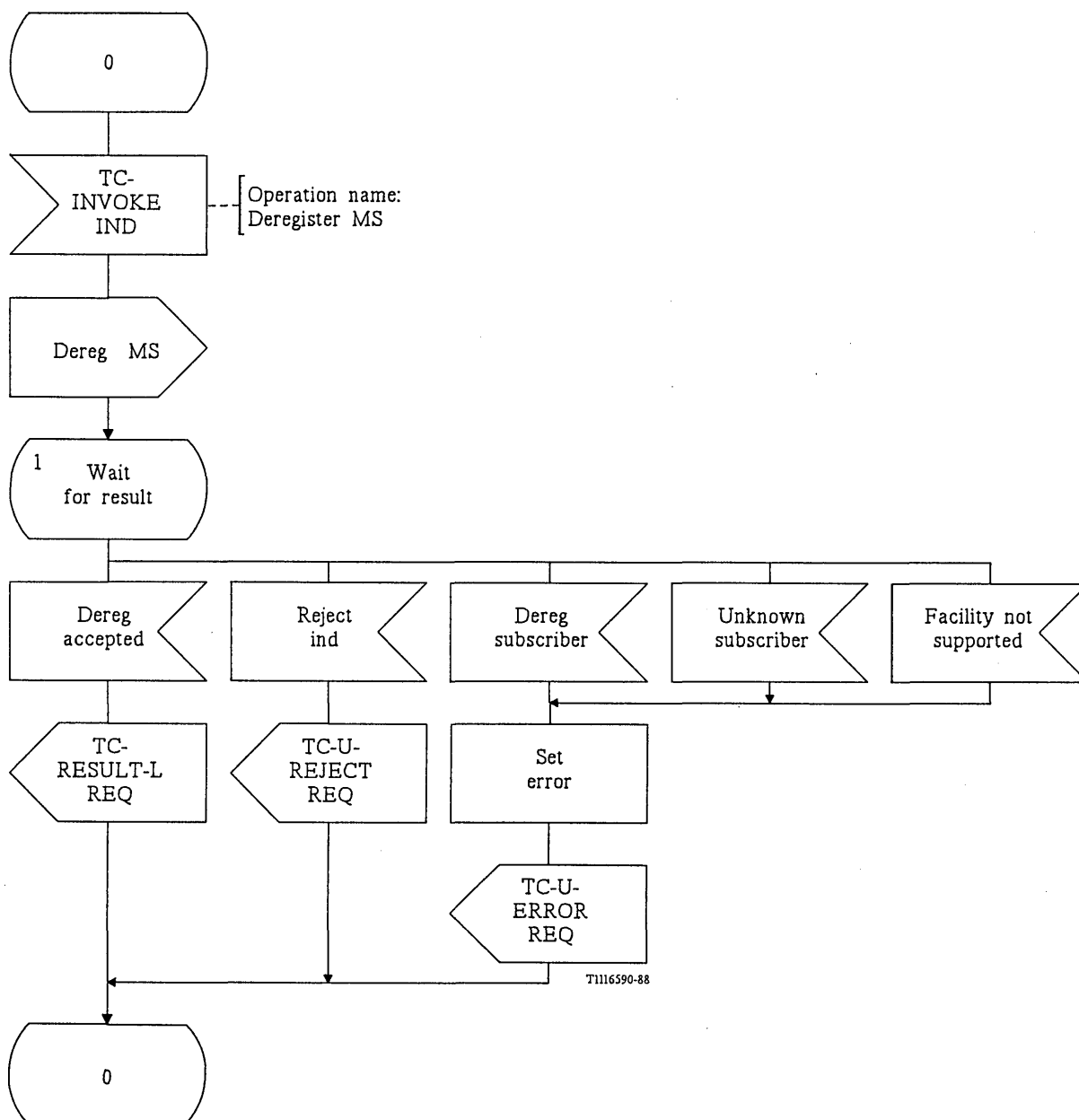
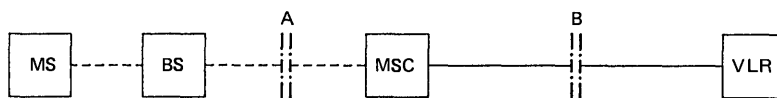
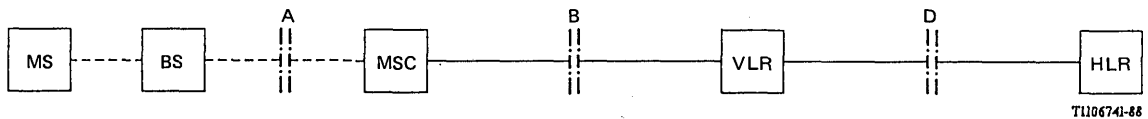


FIGURE 36/Q.1051

ASE/TCAP interface procedure in HLR for deregistration



a) Procedures involving only the visitor location register associated with the MSC.



b) Procedures involving two location registers.

FIGURE 37/Q.1051

### Functional units and interfaces for handling of MS generated supplementary service requests

## 3.3 Handling of supplementary services

### 3.3.1 Registration erasure, activation/deactivation, invocation and interrogation by MS

#### 3.3.1.1 Definition of interfaces

Figure 37/Q.1051 shows the interfaces involved. Several cases are identified as follows:

- i) the visitor location register does not require any information from the home location register in order to comply with the request (Figure 37/Q.1051 a));
- ii) the request is first analyzed by the visitor location register and the home location register is then interrogated and/or updated (Figure 37/Q.1051 b)). This also covers the case where the VLR is transparent to the request from the MS.

Handling of supplementary services as part of the call set-up procedure is defined in § 3.4.

#### 3.3.1.2 General description of procedures for handling of supplementary services

##### 3.3.1.2.1 List of procedures

There will be separate procedures for each of the following cases:

- activation of supplementary service;
- deactivation of supplementary service;
- interrogation of supplementary service;
- registration of supplementary service;
- erasure of supplementary service;
- invocation of supplementary service.

However, for the purpose of simplifying the description, these procedures are treated together under the generic name "handling of supplementary services". The procedures will differ mainly with regard to reporting negative results.

### 3.3.1.2.2 Procedures when the VLR is capable of providing the information

The procedure is initiated by the MS sending a request for supplementary services on the radio path (SS-REQUEST in Figure 38/Q.1051). This message may contain a request for registration/erasure, activation/deactivation, invocation or interrogation. The MSC then sends the *operate supplementary services: VLR* message to its associated location register. For each of the five procedures in § 3.3.1.2.1 this corresponds to a distinct message. The location register returns the *supplementary services acknowledge: VLR* message with the fields appropriately set according to the nature of the request (registration/activation/interrogation, etc.) and the resulting action on the request (provided, not provided, allowed, not allowed, etc.).

The MSC will send an SS-CONFIRM to the MS with fields set in accordance with the content of the *supplementary services acknowledge* message.

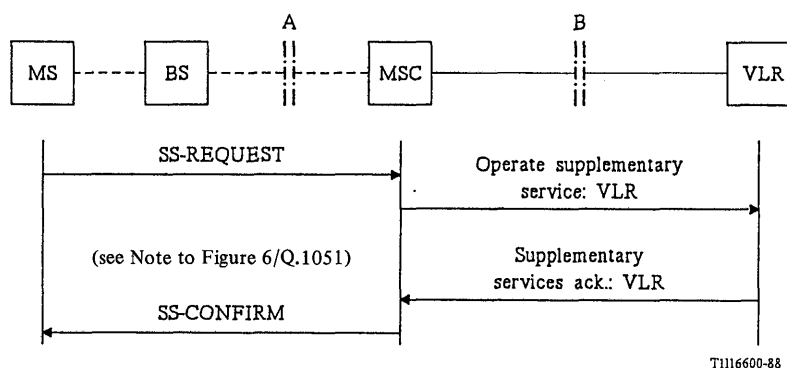


FIGURE 38/Q.1051

### Procedures for handling of supplementary services in a visitor location register associated with an MSC

### 3.3.1.2.3 Procedures for transmitting supplementary services requests via a visited location register

The procedure is shown in Figure 39/Q.1051.

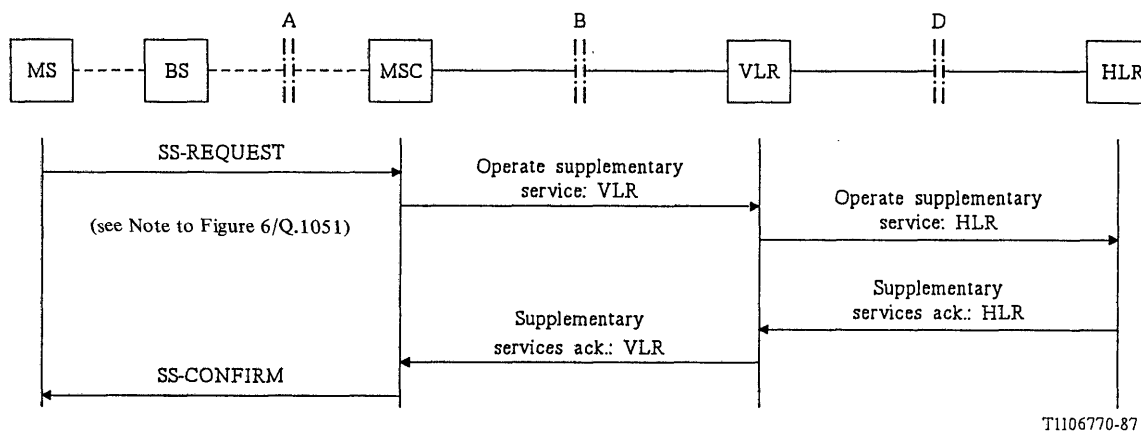


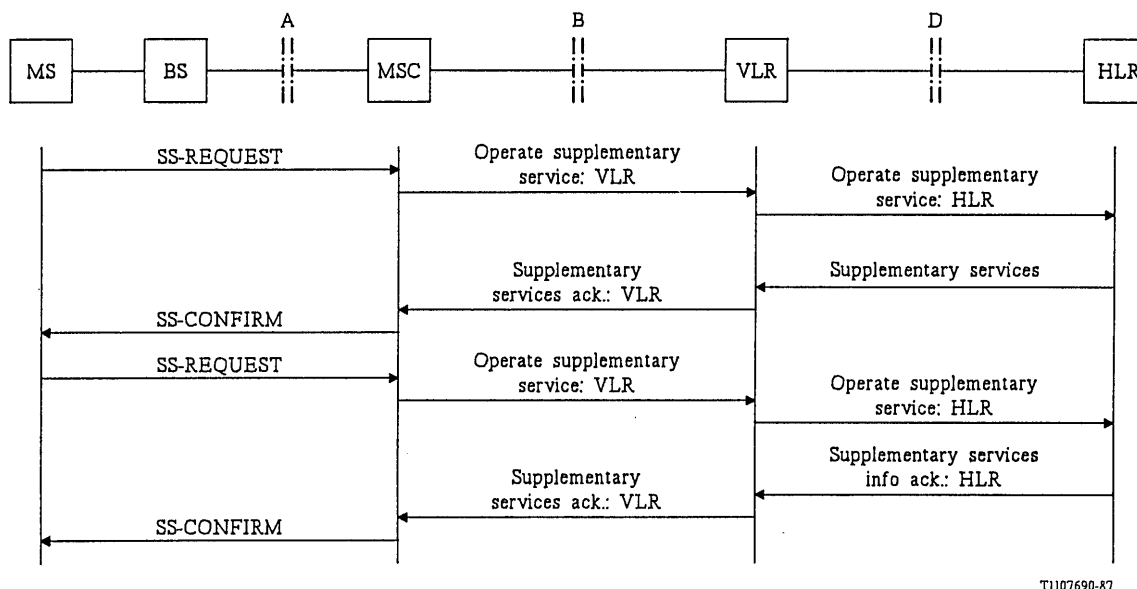
FIGURE 39/Q.1051

### Procedures for handling of supplementary services by both visitor and home location registers

The procedures between the MS and the MSC and between the MSC and the visitor location register are as described in § 3.3.1.2.2.

If the supplementary services need to be known by the home location register or some parameters related to the services are required from the home location register, the visitor location register will send an *operate supplementary services: HLR* message to the home location register of the MS. There will be one distinct message for each of the procedures of § 3.3.1.2.1. The home location register will respond with the *supplementary services acknowledge: HLR* message. This message will contain parameters as requested and also allowed/not allowed information as required.

For some services more than one transaction may be required as illustrated in Figure 40/Q.1051. The two SS-REQUESTs are regarded as independent. However, the application specific procedure in the MSC will correlate the sequences as required.



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FIGURE 40/Q.1051

### Procedures where more than one transaction is required for handling a supplementary service

#### 3.3.1.3 Detailed procedures for handling of supplementary services

##### 3.3.1.3.1 Procedures in the MSC

The application specific procedure is contained in Figure 41/Q.1051 and the ASE/TCAP procedure is contained in Figure 42/Q.1051. The MSC will receive a request from the MS for some operation of supplementary services (SS-REQUEST (X)) in Figure 41/Q.1051. The MSC will then send the *operate supplementary services (SS): VLR* message to its associated VLR. As defined in § 3.3.1.2.1 the *operate supplementary services (SS): VLR* message is a generic name for several messages.

The MSC will receive either of the following responses:

- a *supplementary services (SS) acknowledge: VLR* message if the operation was successful. The result will be provided to the MS in the SS-CONFIRM (X) signal. For some services the procedure may be terminated at this point. For other services further SS-REQUESTs may be required from the MS as indicated;
- a reject indicator if the operation failed because of procedure errors or a timer expired message if the timer in TCAP expired. A failure indication is then inserted in the SS-CONFIRM (X) signal;
- a negative result may be indicated. The appropriate cause is then inserted in the SS-CONFIRM (X) signal. The cause values for each of the operations indicated in § 3.3.1.2.1 are given in Table 2/Q.1051.

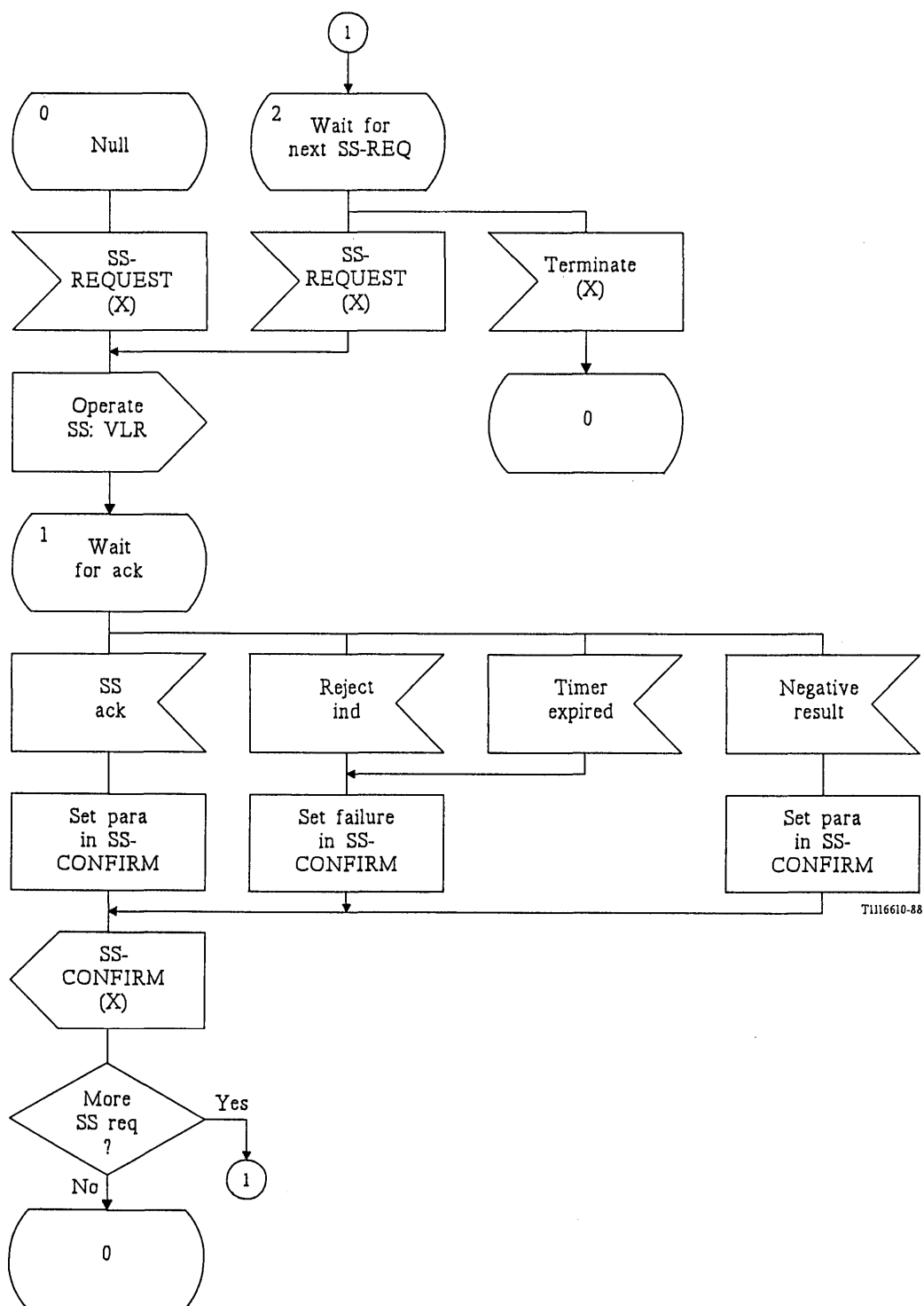


FIGURE 41/Q.1051

Application specific procedure in MSC for handling of supplementary services

TABLE 2/Q.1051

**Negative results for the various supplementary services  
handling operations**

Operation	Cause
Activate SS	Unknown subscriber Illegal subscriber Illegal SS operation System failure SS error status SS not available SS restriction violation Data missing SS incompatibility Unexpected data value
Deactivate SS	Unknown subscriber Illegal subscriber Illegal SS operation System failure SS error status
Interrogate SS	Unknown subscriber Illegal subscriber Unexpected data value System failure Illegal SS operation
Register SS	Unknown subscriber Illegal subscriber SS error status Illegal SS operation System failure SS incompatibility Data missing Unexpected data value
Erase SS	Unknown subscriber Illegal subscriber System failure SS error status Illegal SS operation Unexpected data value
Invoke SS	Unknown subscriber Illegal subscriber System failure SS error status Illegal SS operation Unexpected data value

The ASE/TCAP interface procedure is shown in Figure 42/Q.1051. The *operate supplementary services (SS)*: VLR message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the operation by setting timer T-ss. The result is reported as follows:

- a TC-RESULT-L INDICATION primitive contains the *supplementary services (SS) acknowledge*: VLR message;
- a procedure failure is reported in a TC-(U)-REJECT INDICATION primitive;



- expiry of timer T-ss is reported in a TC-L-CANCEL INDICATION primitive;
- negative results as shown in Table 2/Q.1051 are reported in a TC-U-ERROR INDICATION primitive.

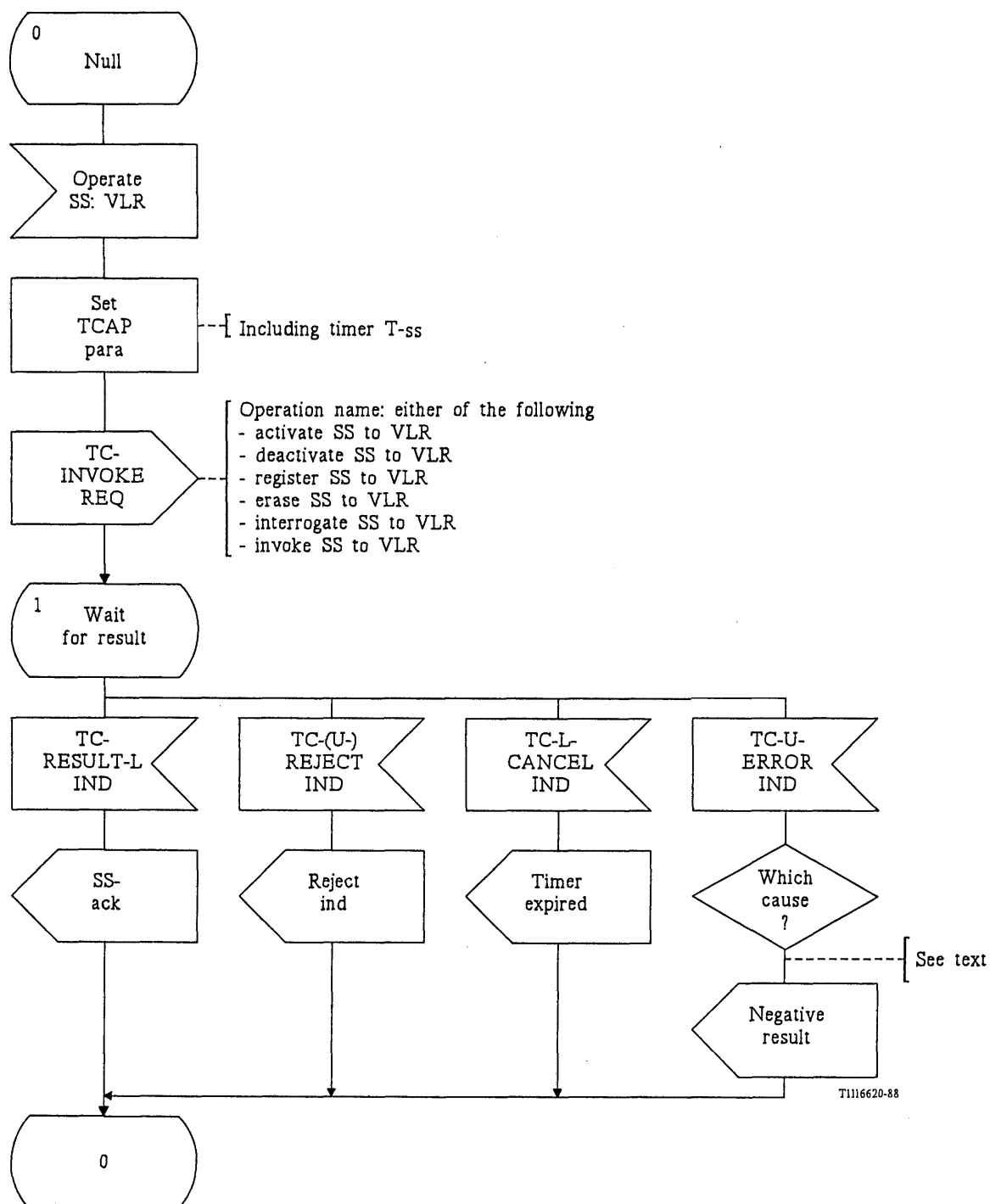


FIGURE 42/Q.1051

ASE/TCAP interface procedure in MSC for handling of supplementary services

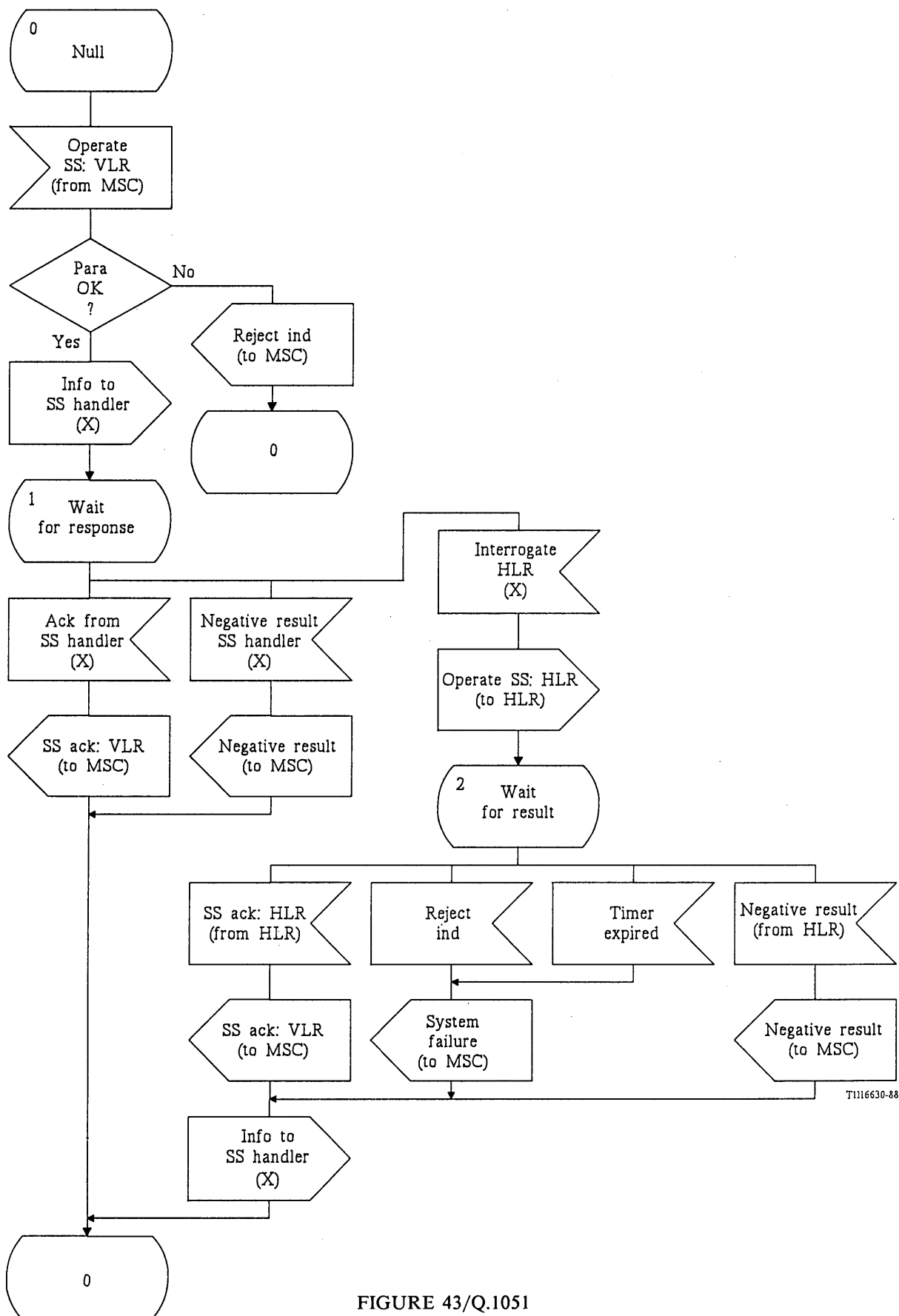


FIGURE 43/Q.1051

Application specific procedures in VLR for handling of supplementary services

### 3.3.1.3.2 Procedures in the VLR

The application specific procedure is contained in Figure 43/Q.1051. Figures 44/Q.1051 and 45/Q.1051 contain the ASE/TCAP interface procedures for the VLR/MSC and VLR/HLR interfaces, respectively.

When receiving an *operate supplementary services (SS): VLR* message, the request will be provided to an entity in the VLR responsible for supplementary services control (indicated as "info to SS handler (X)"). If no operation is required in the HLR, the SS handler may provide either a positive (ack from SS handler (X)) or negative (negative result, SS handler (X)) outcome. These results are provided to the MSC in the corresponding MAP messages.

If actions are to be taken in the HLR, the SS handler will request an operation to be established towards the HLR (interrogate HLR (X)). The VLR then sends the *operate supplementary services (SS): HLR* message to the HLR and will receive either of the results:

- the *supplementary services (SS) acknowledge: HLR* message containing a positive outcome of the operation. This information is forwarded to the MSC in a *supplementary services (SS) acknowledge: VLR* message. The SS handler in the VLR is also informed;
- a reject indicator will indicate procedure errors between the VLR and the HLR and a timer expiry message will indicate time-out in TCAP. Both events are sent to the MSC as a *system failure* message. The SS handler may be informed as shown;
- a negative result as shown in Table 2/Q.1051 may also be received. The result is provided to the MSC and may also be provided to the SS handler.

The ASE/TCAP interface procedure for the VLR/MSC interface is shown in Figure 44/Q.1051. The *operate supplementary services (SS): VLR* message is received in a TC-INVOKE INDICATION primitive. There is one message for each of the operations defined in § 3.3.1.2.1. The results are reported as follows:

- a positive result (*supplementary services acknowledge: VLR* message) is sent in a TC-RESULT-L REQUEST primitive;
- a reject indication (procedure error) is sent in a TC-U-REJECT REQUEST primitive.

The ASE/TCAP interface procedure for the VLR/HLR interface is shown in Figure 45/Q.1051. The *operate supplementary services (SS): HLR* message is sent in a TC-INVOKE REQUEST primitive (one primitive for each of the operations of § 3.3.1.2.1). TCAP is requested to supervise the procedure by timer T-ssi. The outcome of the operation can be as follows:

- a positive result in terms of a *supplementary services (SS) information acknowledge: HLR* message is received in a TC-RESULT-L INDICATION primitive;
- expiry of timer T-ssi is reported in a TC-L-CANCEL INDICATION primitive;
- procedure failure is reported in a TC-(U)-REJECT INDICATION primitive;
- a negative result of Table 2/Q.1051 is reported in a TC-U-ERROR INDICATION primitive.

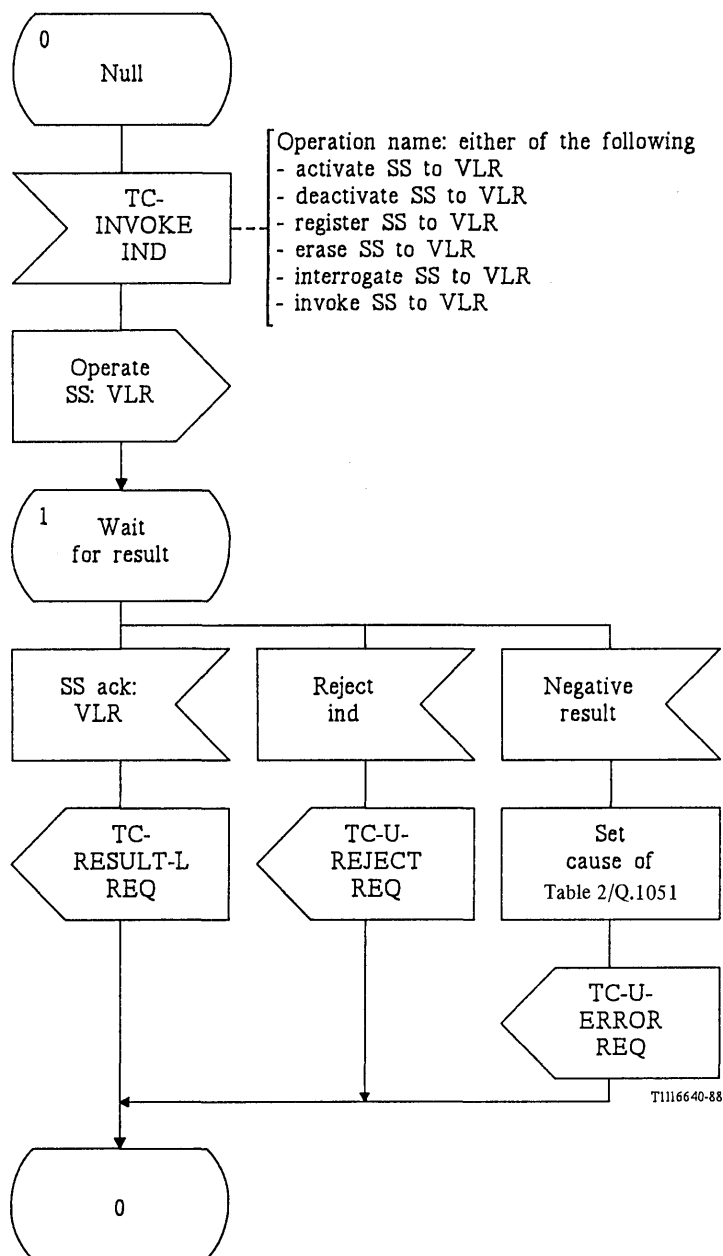


FIGURE 44/Q.1051

ASE/TCAP VLR/MS interface procedure for handling of supplementary services

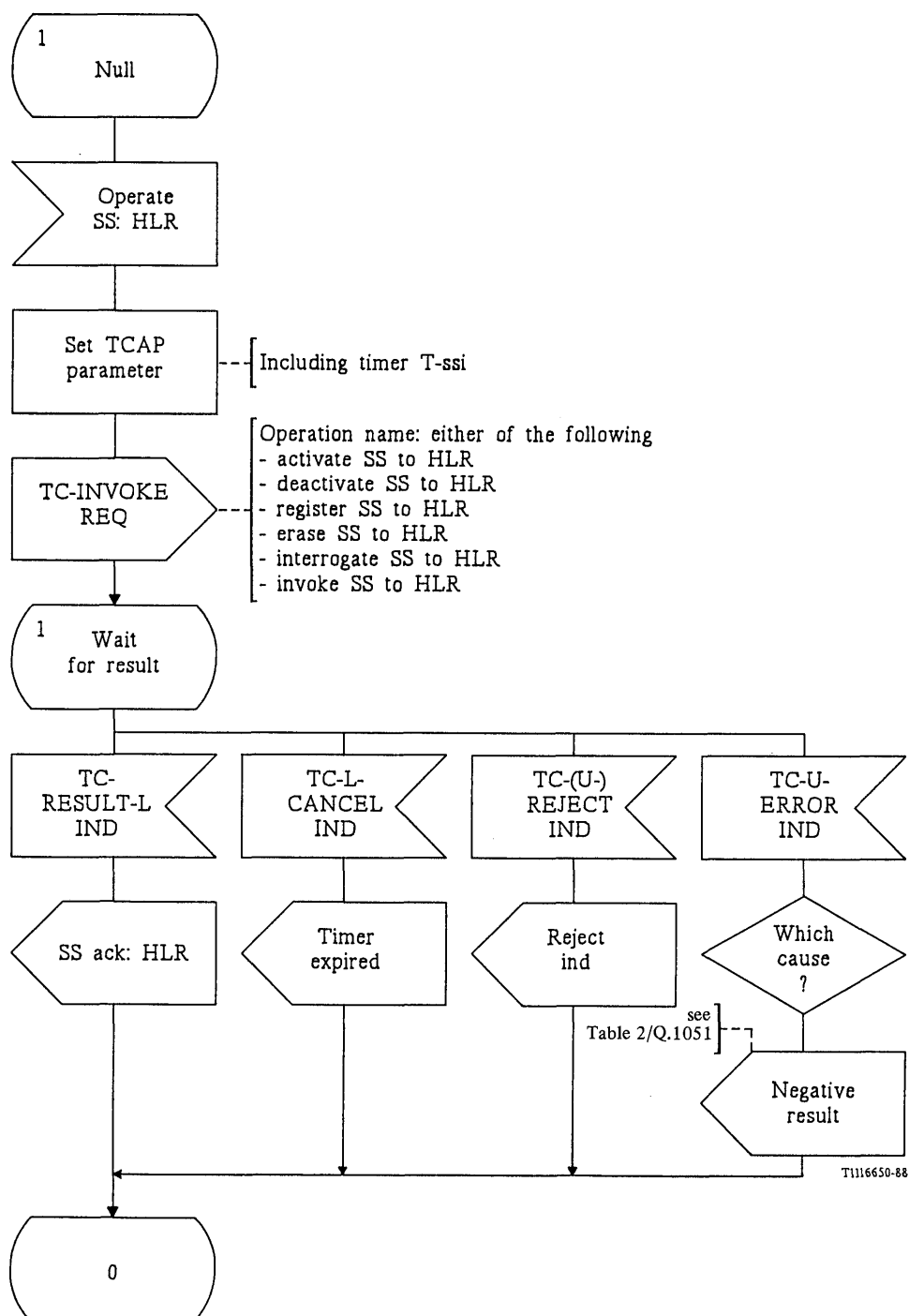


FIGURE 45/Q.1051

**ASE/TCAP VLR/HLR interface procedure for handling of supplementary services**

3.3.1.3.3 *Procedures in the HLR*

The application specific procedure is given in Figure 46/Q.1051 and the ASE/TCAP procedure is given in Figure 47/Q.1051.

The application specific procedure is initiated when the HLR receives an *operate supplementary services (SS): HLR* message from a VLR. The operations on the supplementary services are assumed to be performed by an SS handler function in the HLR not part of the mobile application part. The result (positive: acknowledge from the SS handler, or negative: negative result, SS handler) is returned to the VLR.

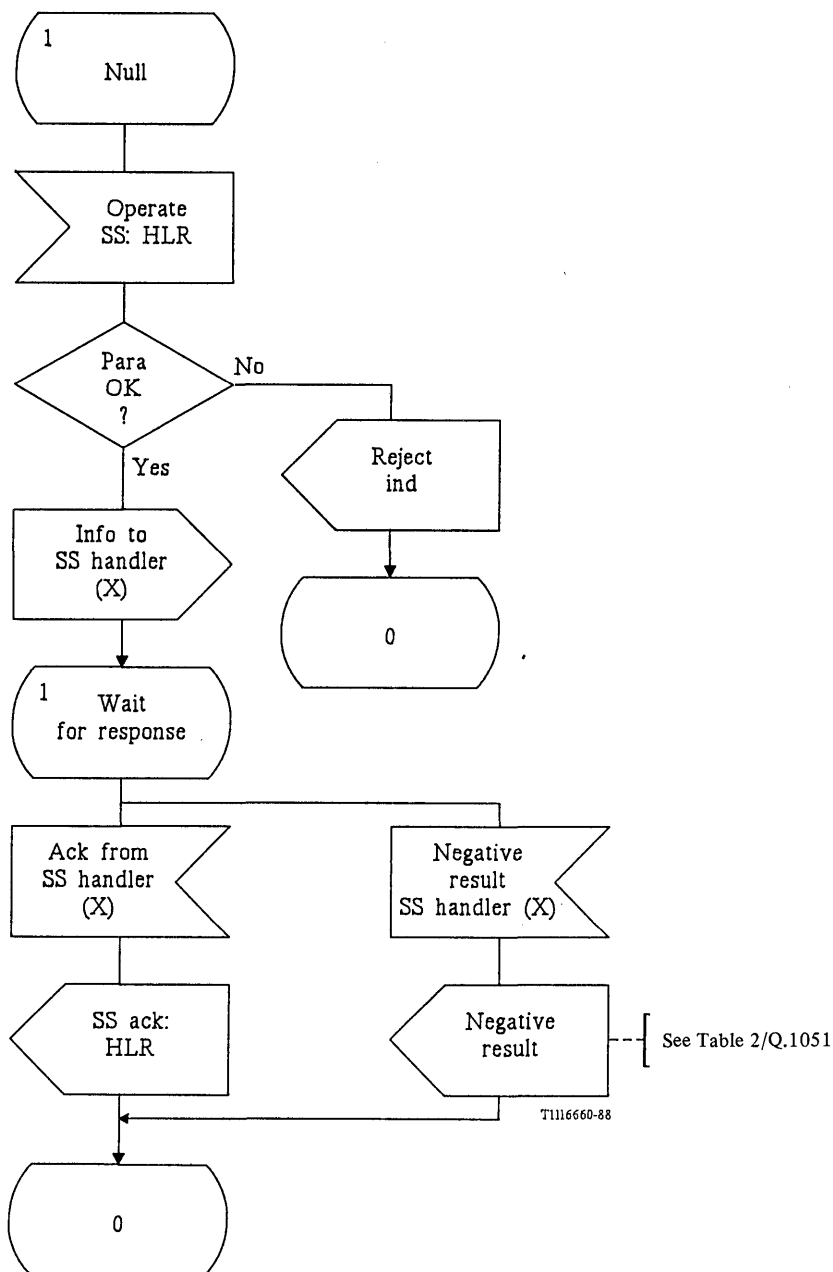


FIGURE 46/Q.1051

**Application specific procedure in HLR for handling of supplementary services**

The ASE/TCAP interface procedure is shown in Figure 47/Q.1051. The *operate supplementary services: HLR* message is received in a TC-INVOKE INDICATION primitive.

The results are returned as follows:

- a positive result (*supplementary services acknowledge: HLR*) is returned in a TC-RESULT-L REQUEST primitive;
- a reject because of procedure failure is returned in a TC-U-REJECT REQUEST primitive;
- a negative result with cause value as given in Table 2/Q.1051 is returned in a TC-U-ERROR REQUEST primitive.

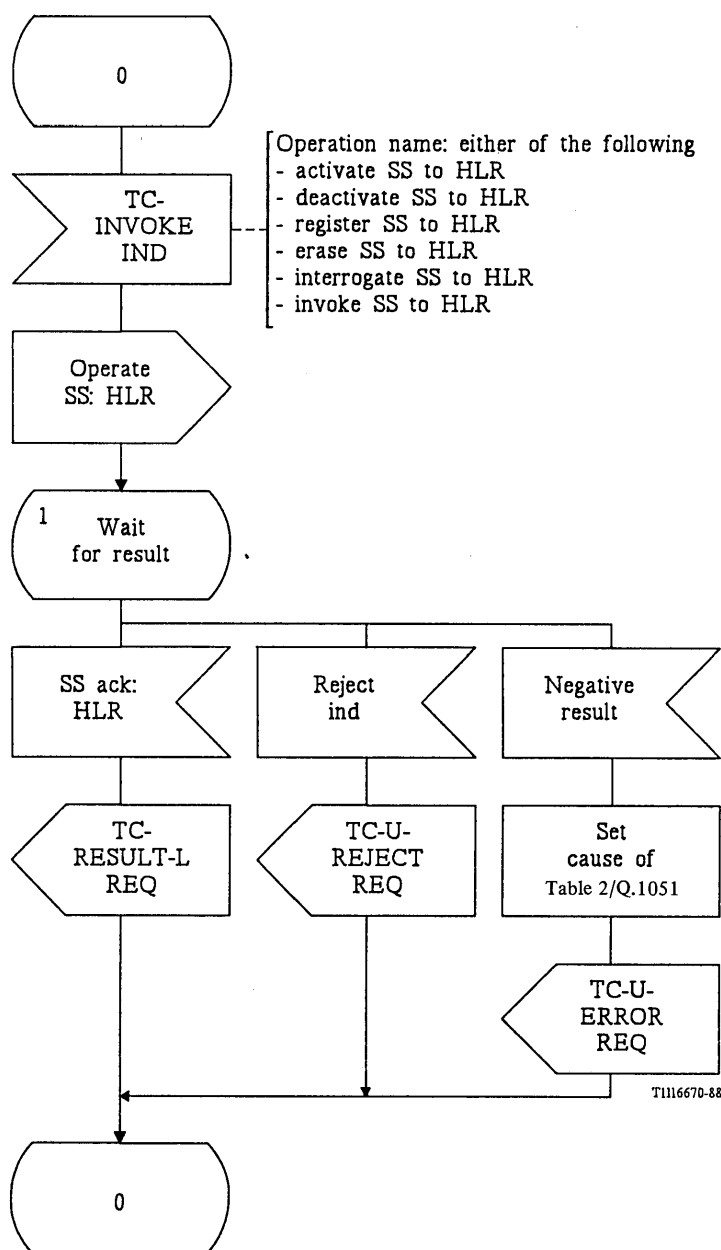


FIGURE 47/Q.1051

ASE/TCAP interface procedure in the HLR for handling of supplementary services

### 3.3.2 Updating of categories and supplementary services in visitor location register

#### 3.3.2.1 Definition of interfaces

The procedure is used in the following cases:

- i) the MS has changed, by administrative means, the subscription of one or more supplementary services or changed its category;
- ii) changes have been made to other subscriber parameters of the MS (e.g. authentication parameters).

#### 3.3.2.2 General description of procedure

The procedure is shown in Figure 48/Q.1051 and consists of the exchange of the following messages:

- *update category/supplementary services* message (from home location register), and
- *category/supplementary services updating acknowledge* message (from visitor location register).

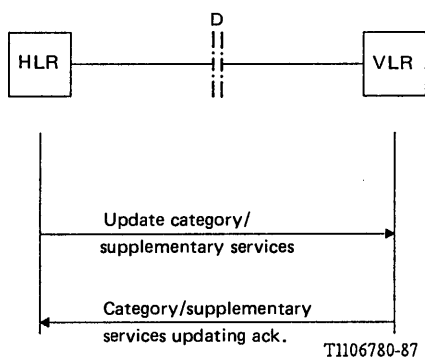


FIGURE 48/Q.1051

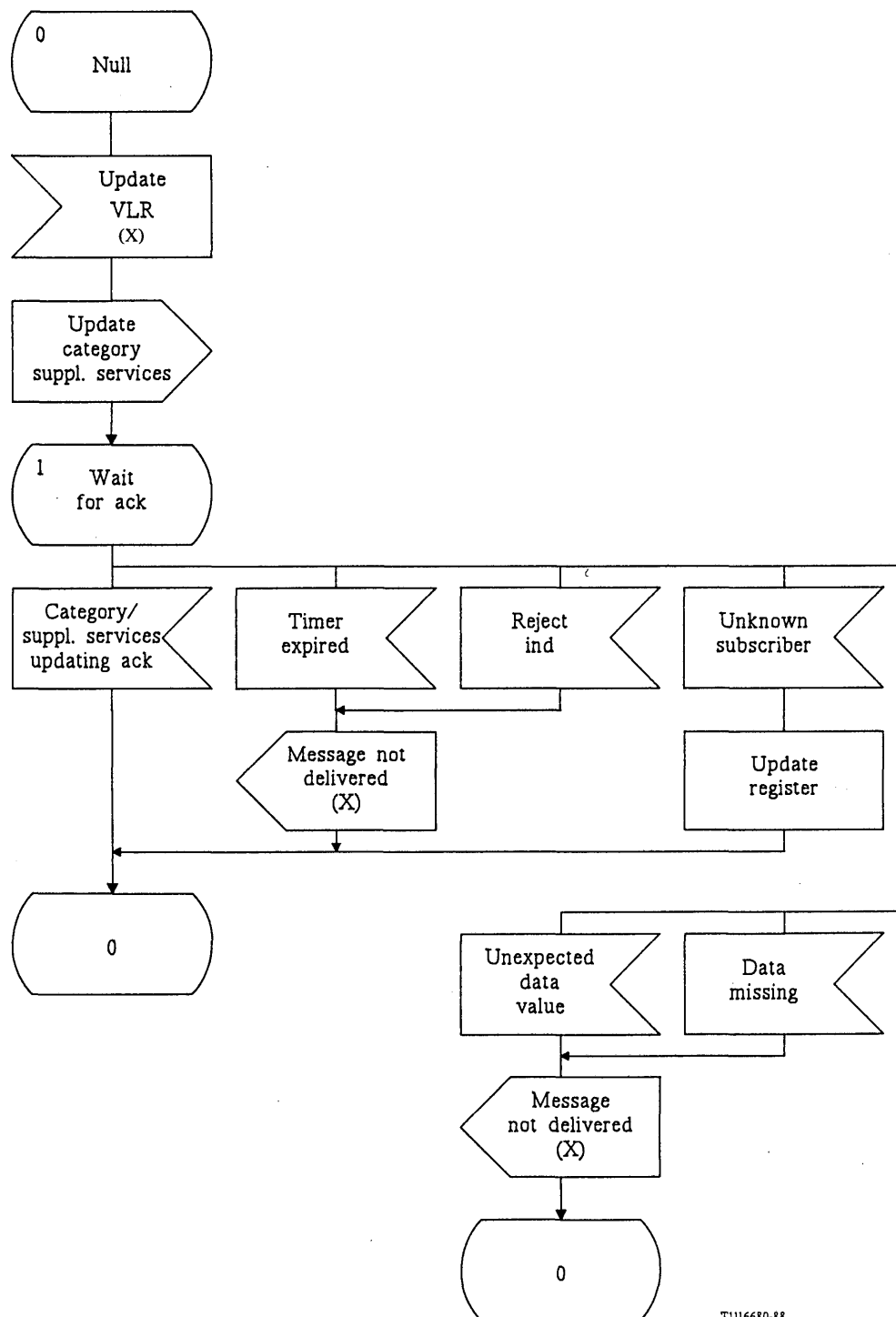
**Interface and procedure for updating of category/supplementary services in visitor location register**

#### 3.3.2.3 Detailed description of procedures

##### 3.3.2.3.1 Procedure in HLR

The application specific procedure is shown in Figure 49/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 50/Q.1051.





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FIGURE 49/Q.1051

Application specific procedure in home location register for updating of category/supplementary services

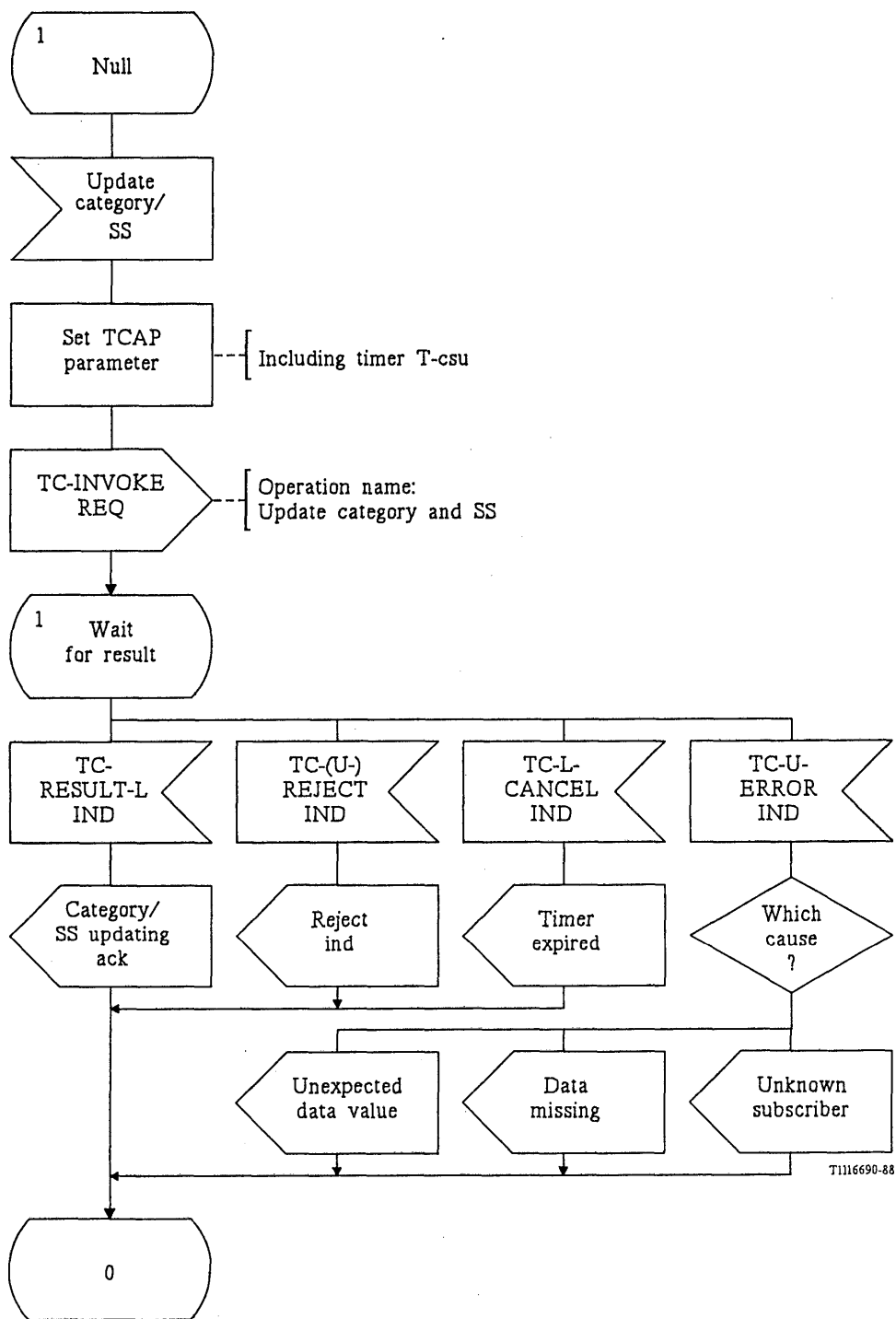


FIGURE 50/Q.1051

ASE/TCAP interface procedure in the HLR for updating of category and supplementary services

When a change is made to some subscriber parameters in the HLR (e.g. supplementary service data, category), the HLR initiates updating of the VLR (*update category/supplementary service* message).

If the MS is in the VLR, the HLR will receive the *category/supplementary services updating acknowledge* message. However, if the procedure fails (timer expiry or rejection), an indication that the message is undelivered should be stored. The message may then be retransmitted later. If an *unknown subscriber* message is received, the HLR should remove the mobile station roaming number and mark the MS as deregistered (indicated by the task: update register).

The *update category/supplementary service* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-csu. The outcome of the procedure is reported as follows:

- the *category/supplementary service updating acknowledge* message is contained in a TC-RESULT-L INDICATION primitive;
- timer expiry (timer T-csu) is reported in a TC-L-CANCEL INDICATION primitive;
- procedure failure is reported in a TC-(U)-REJECT INDICATION primitive;
- the *unknown subscriber* message is contained in a TC-U-ERROR INDICATION primitive. The HLR will also use a TC-U-ERROR INDICATION primitive to report *data missing* and *unexpected data value*.

#### 3.3.2.3.2 Procedures in VLR

The application specific procedure is shown in Figure 51/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 52/Q.1051.

When receiving an *update category/supplementary services* message the VLR will update the register if the MS is registered in the VLR. Otherwise the VLR will return the *unknown subscriber* message.

The *update category/supplementary services* message is received in a TC-INVOKE INDICATION primitive. A TC-RESULT-L REQUEST primitive is used to acknowledge that the VLR has accepted the message and acted upon it. If the message contains parameter errors, the appropriate indication is returned in a TC-U-REJECT REQUEST primitive. The *unknown subscriber*, *data missing* or *unexpected data value* message is returned in a TC-U-ERROR REQUEST primitive.

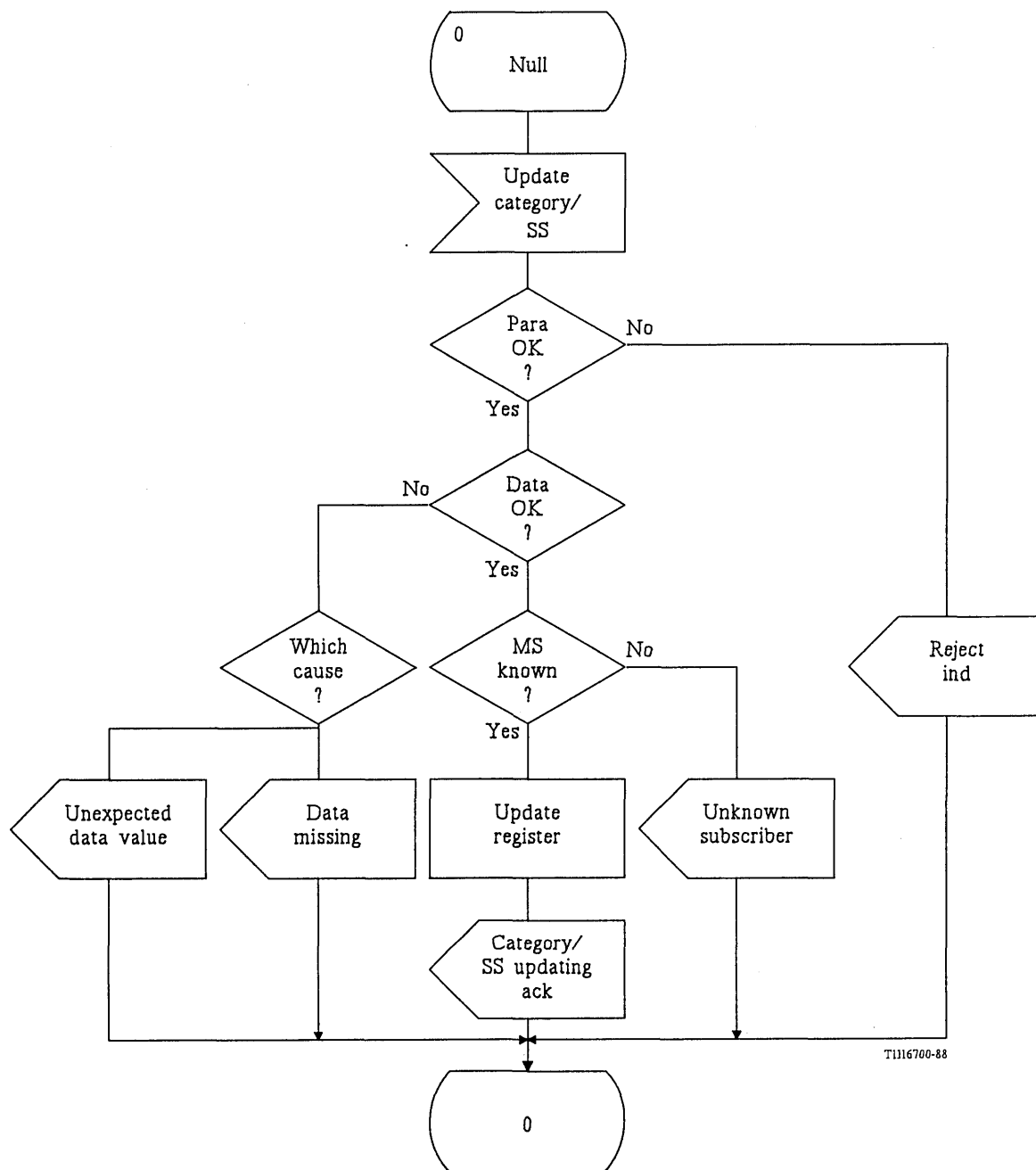


FIGURE 51/Q.1051

**Application specific procedure in visited location register  
for updating of category/supplementary services**

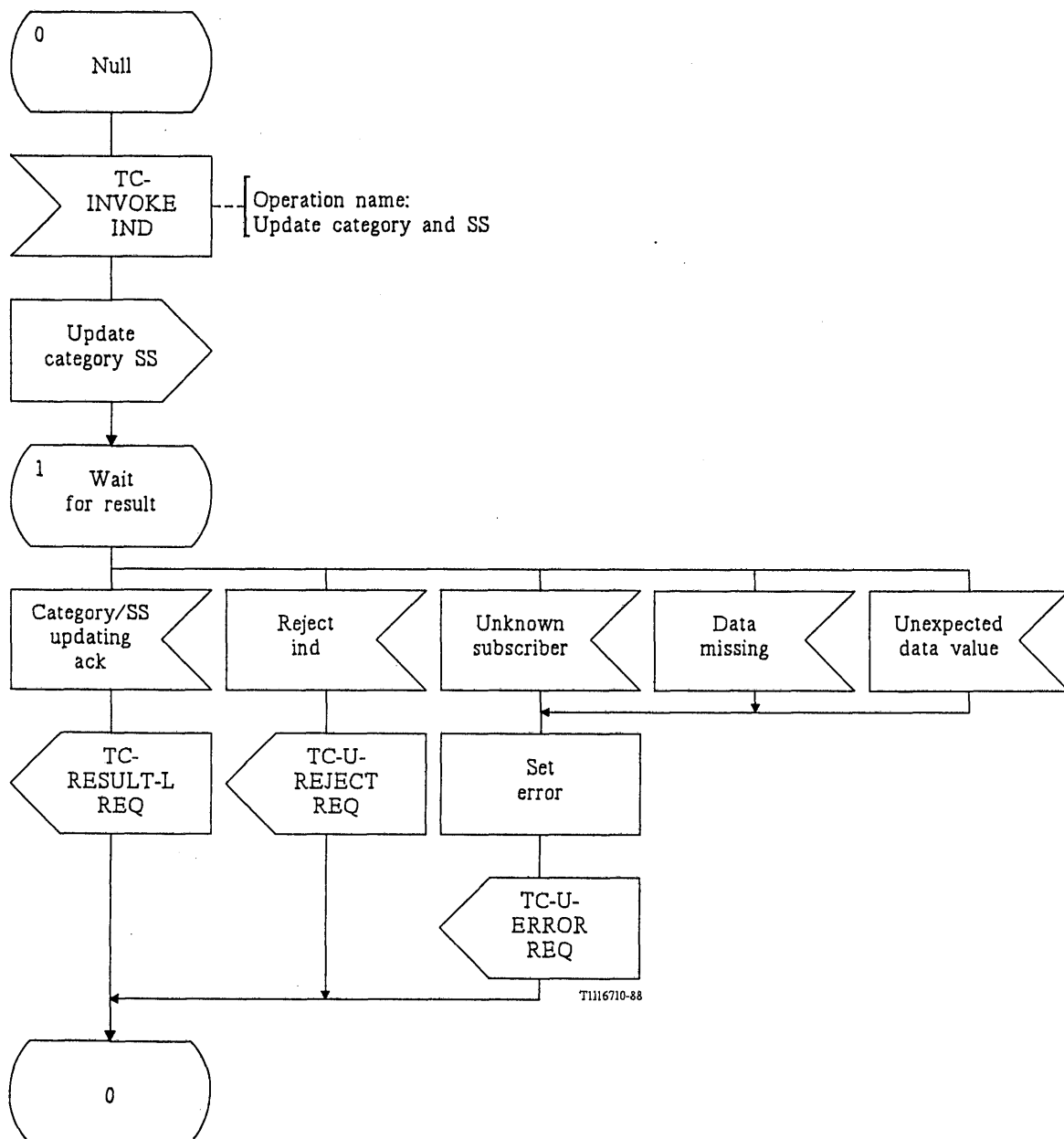


FIGURE 52/Q.1051

ASE/TCAP interface procedures in the VLR for updating of  
category and supplementary services

### 3.4 Retrieval of subscriber parameters during call set-up

#### 3.4.1 Definition of interfaces

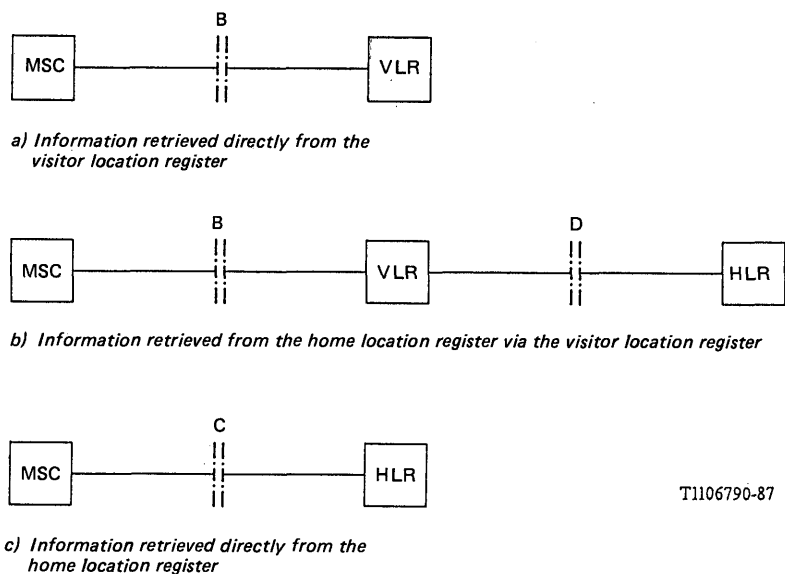


FIGURE 53/Q.1051

#### Functional units and interfaces for retrieval of subscriber parameters during call establishment

As shown in Figure 53/Q.1051 the following cases apply:

- i) for MS terminating or MS originating calls:
  - where the MSC can obtain the required information directly from the visitor location register;
  - where the visitor location register has to obtain the information from the home location register after having been interrogated by the MSC;
- ii) for MS terminating calls where the MSC has to interrogate the home location register in order to obtain routing information. This applies when the MSC is a gateway MSC.

### 3.4.2 General description of procedures

#### 3.4.2.1 Direct information retrieval for MS originating or MS terminating calls

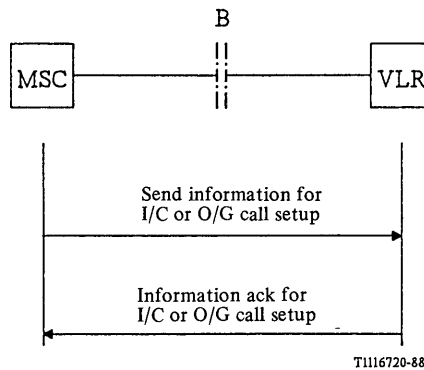


FIGURE 54/Q.1051

#### Procedure for direct information retrieval in the VLR

The procedure shown in Figure 54/Q.1051 relates to the interface shown in Figure 53/Q.1051 a).

For an MS terminating call the procedure consists of the exchange of the following messages:

- *send information for I/C call set-up* message, and
- *information acknowledge for I/C call set-up* message.

The *send information for I/C call set-up* message contains the mobile station roaming number in order to identify the MS. The *information acknowledge for I/C call set-up* message contains all parameters required for call set-up.

For an MS originating call the procedure consists of exchange of the following messages:

- *send information for O/G call set-up* message, and
- *information acknowledge for O/G call set-up* message.

The *send information for O/G call set-up* message contains the identity (IMSI or TMSI) of the MS and the *information acknowledge for O/G call set-up* message contains all parameters required for call set-up.

*Note* - The MSC may also receive a *search for MS* message if the call is an MS terminating call and the visitor location register has had a restart and is in the restoration state (see § 3.8). The MSC initiates a search procedure and returns the *search acknowledge* message with an indication either that the MS is obtainable or unobtainable.

### 3.4.2.2 Indirect information retrieval

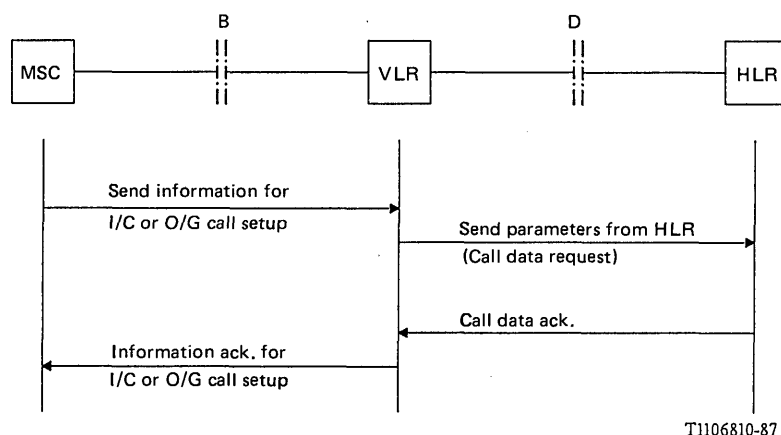


FIGURE 55/Q.1051

#### Procedure for indirect information retrieval

The procedure is shown in Figure 55/Q.1051. The following cases apply:

- i) If the MS is known to the VLR but the VLR cannot provide all requested information, the VLR will send a *send parameters from HLR (call data request)* message to the home location register of the MS. This message will contain a request for those information elements which the home location register must provide to the visitor location register. In some cases this may be all the information elements requested by the MSC; in other cases only some of the information elements need to be returned from the home location register. In any case the acknowledge message sent to the MSC must contain all the information requested by the MSC with the information received from the home location register being passed to the MSC.

If the VLR is in the restoration state, it may initiate a search procedure towards the MSC. See also § 3.8.

If a *call data acknowledge* message is not received from the HLR, the VLR will indicate in the *information acknowledge I/C or O/G call* message sent to the MSC that information is not available.

- ii) If it is an MS originating call and the MS is unknown to the VLR, the VLR will initiate updating of the home location register by using the procedure defined in § 3.2.1.4. When the updating procedure has been completed, the requested information is sent to the MSC in an *information acknowledge I/C or O/G call* message.

If the updating procedure is unsuccessful, the VLR will indicate to the MSC that information is not available.

- iii) If it is an MS terminating call and the MS is unknown to the VLR (i.e., the mobile station roaming number used is not allocated to any MS), the VLR will indicate this to the MSC and block the mobile station roaming number.



### 3.4.2.3 Procedure for obtaining routing data

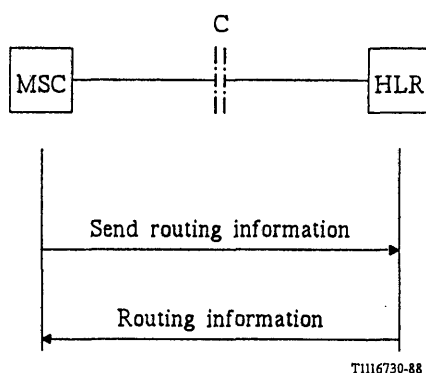


FIGURE 56/Q.1051

#### Procedure for obtaining routing data

Figure 56/Q.1051 shows the procedure used by a gateway MSC for obtaining routing data from the HLR. The procedure consists of the exchange of the messages:

- *send routing information* message, and
- *routing information* message.

*Note* - The same operation may be used by an ISDN exchange for obtaining routing information from the HLR.

### 3.4.3 Detailed description of procedures

#### 3.4.3.1 Procedures in the MSC

##### 3.4.3.1.1 MS terminating calls

The application specific procedure is shown in Figure 57/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 58/Q.1051.

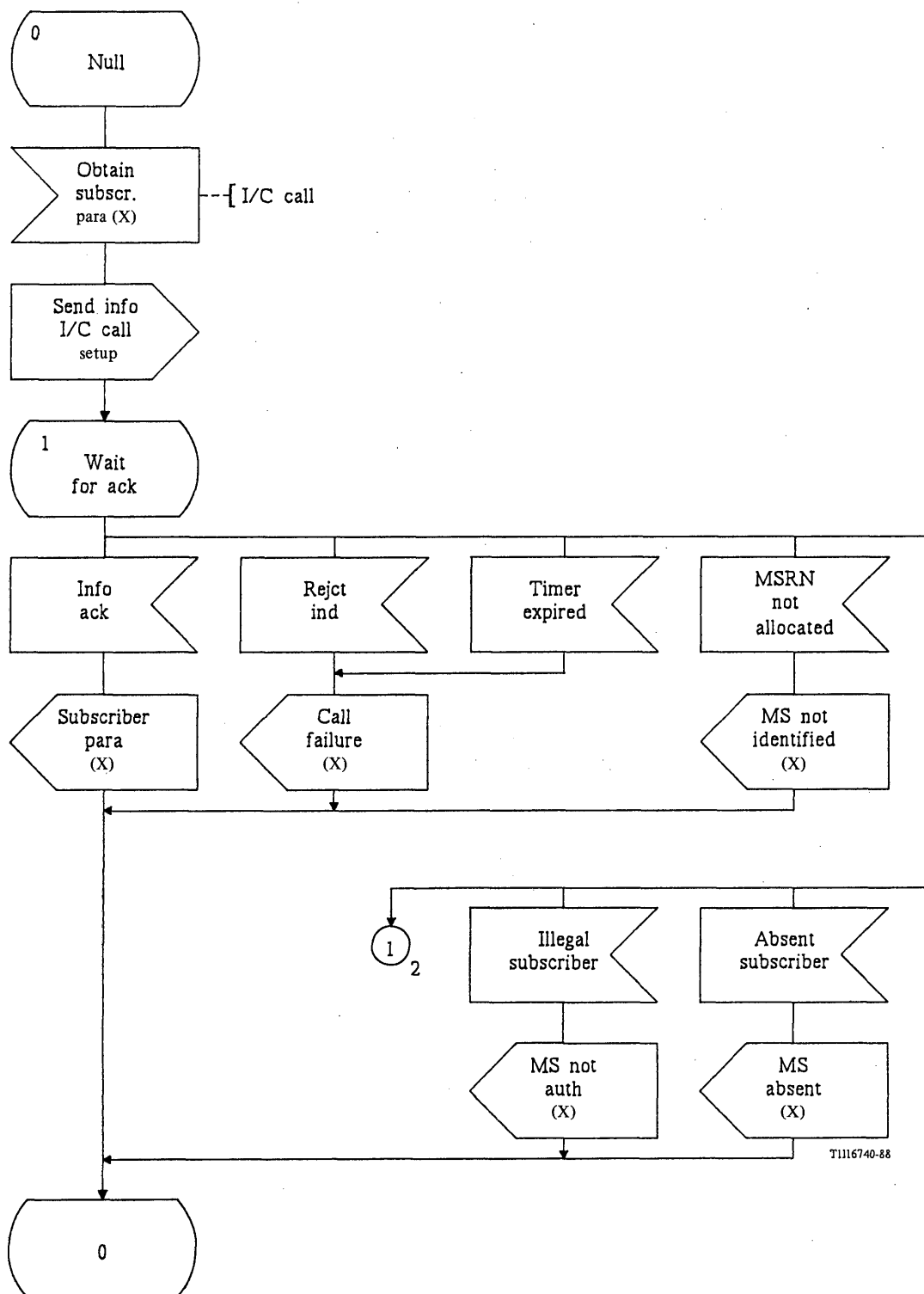


FIGURE 57/Q.1051 (sheet 1 of 2)

Application specific procedure in MSC for retrieval of call data for MS terminating calls

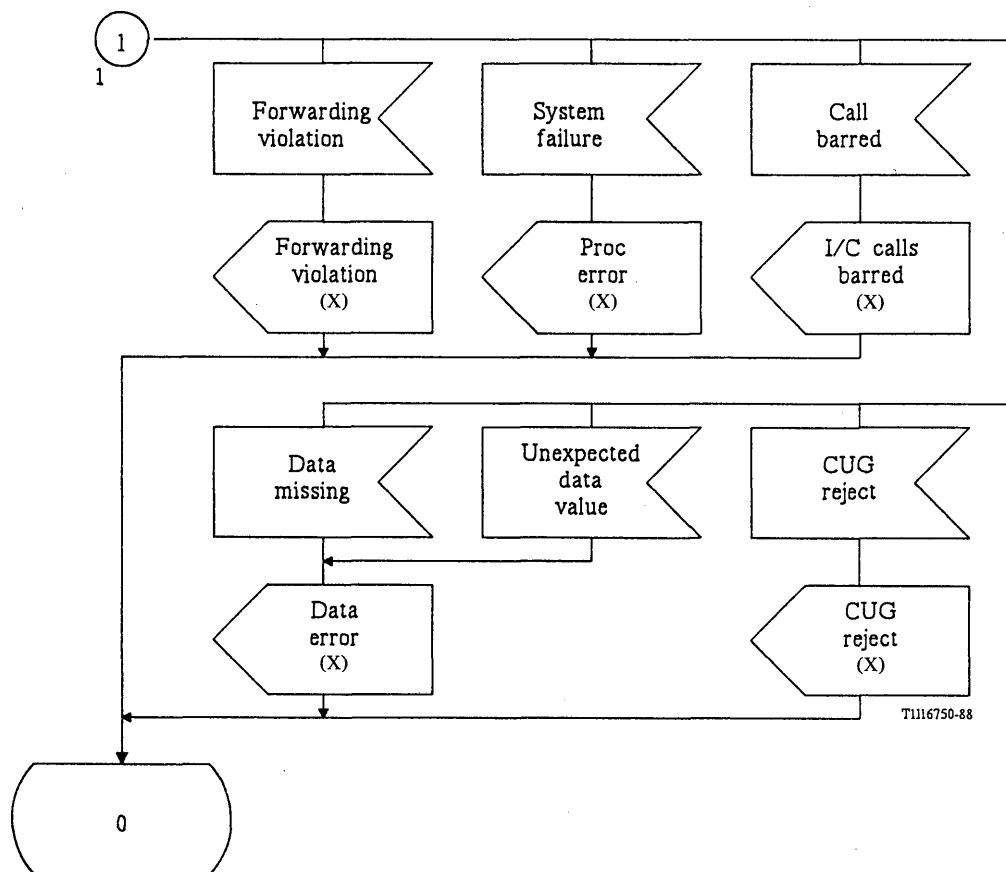


FIGURE 57/Q.1051 (sheet 2 of 2)

**Application specific procedure in MSC for retrieval of call data for MS terminating calls**

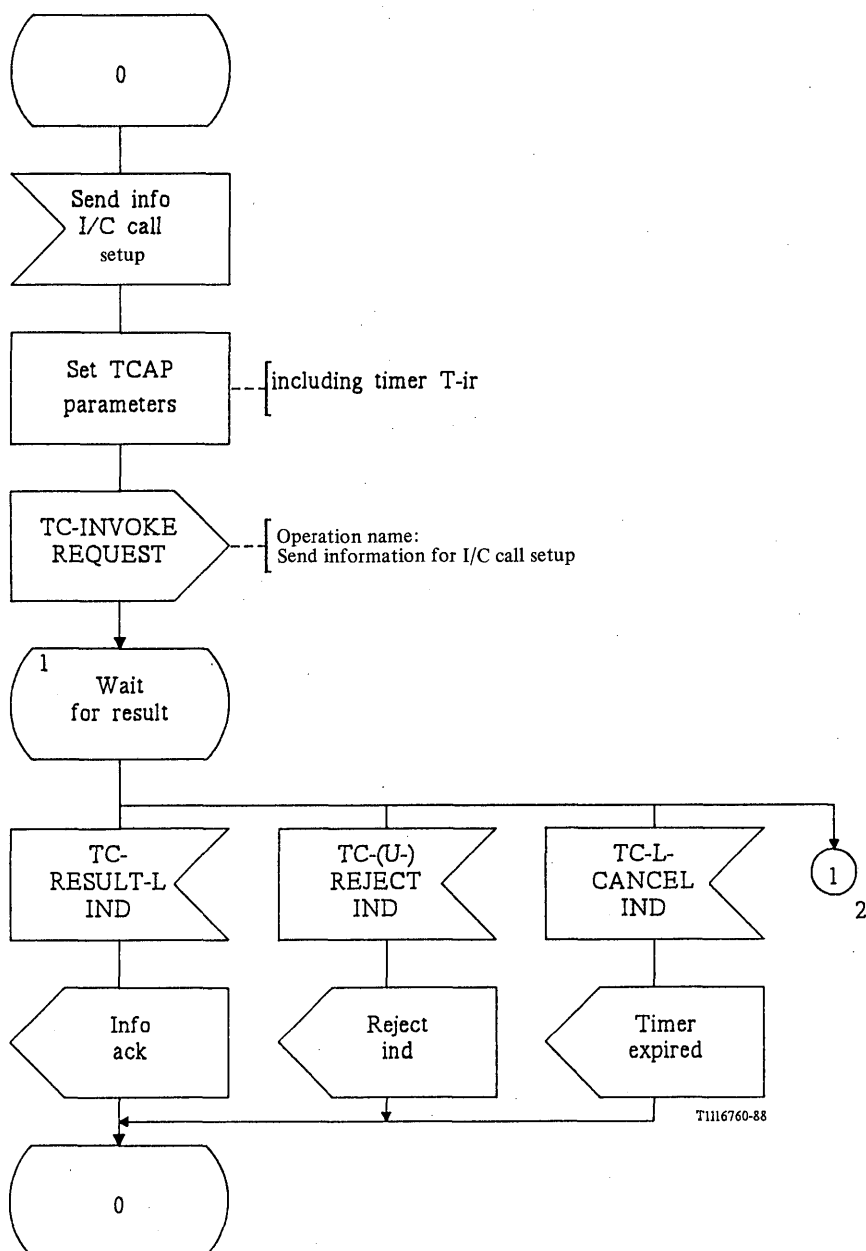


FIGURE 58 (sheet 1 of 2)

**ASE/TCAP interface procedure in the MSC for retrieval of call data for MS terminating calls**

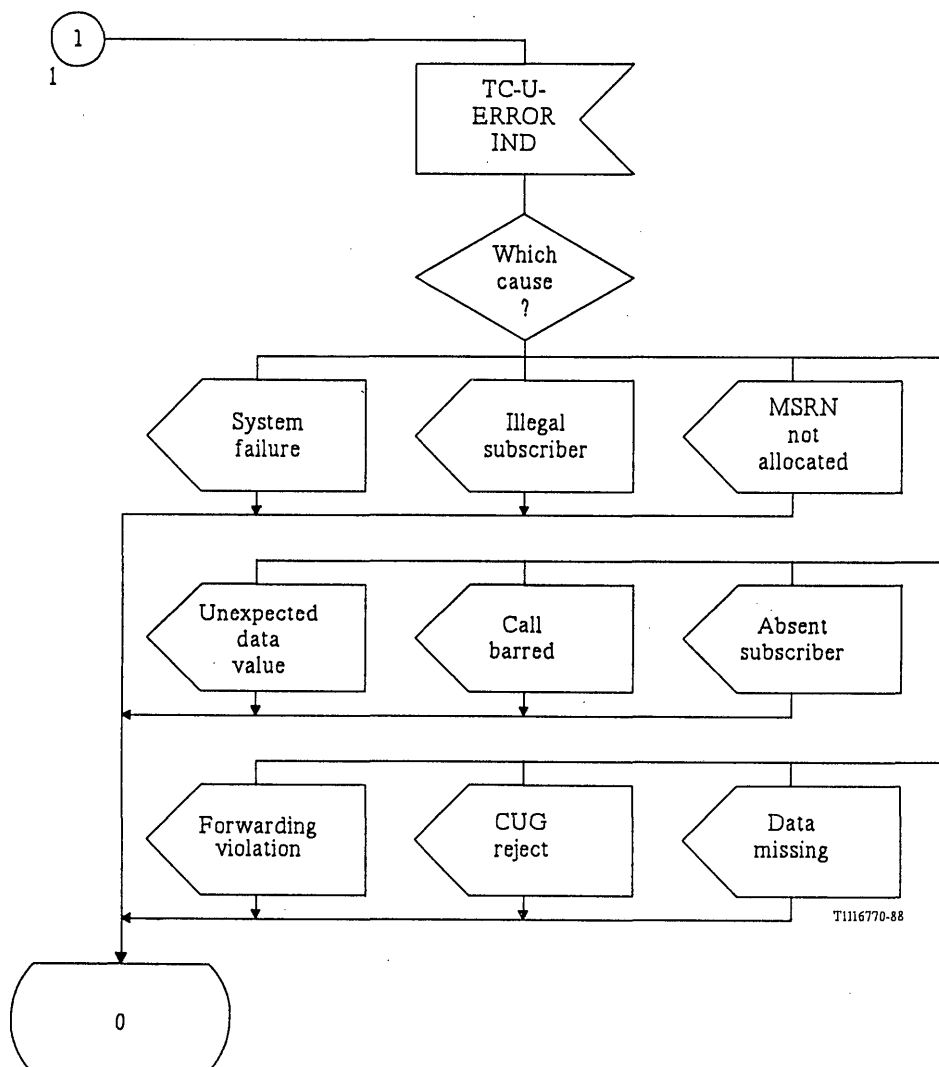


FIGURE 58/Q.1051 (sheet 2 of 2)

**ASE/TCAP interface procedure in the MSC for  
retrieval of call data for MS terminating calls**

For an MS terminating call the call handling function in the MSC will request MAP to obtain subscriber parameters from the VLR. These will include: location area, identity (TMSI or IMSI) and supplementary services information. The event is shown in Figure 57/Q.1051 as the signal obtain subscriber parameters (X) I/C call. The MSC sends the *send information for I/C call set-up* message to the VLR where the mobile station roaming number is used to identify the MS. The message will also contain any supplementary service request requiring control functions in the VLR. As response the MSC will receive either of the following indications:

- the *information acknowledge I/C call set-up* message containing the required parameters for call set-up. The parameters are then provided to the call handling function;
- a reject indication or timer expired indication in case of procedure failure;

- if the MS is not identified, i.e. the mobile station roaming number is not allocated, the indication received is a *roaming number not allocated* message;
- if the mobile station roaming number (MSRN) was dialled by a subscriber and the MS is barred for incoming calls, the *call barred* message is received;
- if authenticity of the MS is not established, the *illegal subscriber* message is received;
- if the authentication procedure (between MSC/VLR or VLR/HLR) was unsuccessful, the *system failure* message is received;
- if the MS cannot be found after a search procedure has been performed, a *subscriber absent* message is received;
- *data missing* or *unexpected data value* may be received if a supplementary service request cannot be operated because of data errors;
- if the call forwarding service is active and the incoming call has been forwarded as many times as are allowed, a *forwarding violation* message is received;
- if an incoming call does not pass the CUG check, the *CUG reject* message is received (*Note* - only to handle the case when the MSRN has been dialled directly);
- other responses, if any, related to supplementary services are for further study.

All of the above unsuccessful events are indicated to the call handling function so that the call can be terminated by an appropriate unsuccessful call indication being provided to the fixed network.

A summary of unsuccessful events is given in Table 3/Q.1051.

TABLE 3/Q.1051

**Unsuccessful call indications for retrieving subscriber parameters at call set-up**

Negative result message	I/C call procedure	O/G call procedure	Routing info procedure
Unknown subscriber	-	x	x
Unallocated TMSI	-	x	-
Absent subscriber	x	-	x
Illegal subscriber	x	x	-
Call barred	x	x	x
CUG reject	x	x	x
Forwarding violation	x	-	x
MSRN not allocated	x	-	-
Data missing	x	x	-
Unexpected data value	x	x	-
System failure	x	x	-

An MS-search procedure may be performed while the subscriber parameters are being retrieved. This is not shown in Figure 57/Q.1051 since it belongs to a separate operation defined in § 3.8.

The *send information for I/C call set-up* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ir. The results are reported as follows:

- a TC-RESULT-L INDICATION primitive contains the *information acknowledge for I/C call set-up* message;
- a TC-(U)-REJECT INDICATION primitive is used to indicate a procedure failure;
- a TC-L-CANCEL INDICATION is used to indicate expiry of timer T-ir;
- a TC-U-ERROR INDICATION primitive contains negative outcome of the procedure:
  - i) the mobile station roaming number is not allocated;
  - ii) the MS is absent (after a search procedure has been completed);
  - iii) data are missing or unexpected data value;
  - iv) the MS is barred for incoming calls;
  - v) illegal subscriber;
  - vi) system failure;
  - vii) forwarding violation;
  - viii) CUG reject.

#### 3.4.3.1.2 MS originating calls

The application specific procedure is contained in Figure 59/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 60/Q.1051.

For an MS originated call the handling function of the MSC will request MAP to obtain the subscriber parameters required for handling the call. These will include category and supplementary services information. The event is illustrated by the signal obtain subscriber parameters O/G call (X). The MSC sends the *send information for O/G call set-up* message to the VLR. The message will contain the IMSI or the TMSI of the MS. Either of the following responses may be received:

- if the procedure is successful, the *information acknowledge for O/G call set-up* message containing the required parameters is received. These parameters are provided to the call handling function;
- a reject indicator or timer expired indication if the procedure fails;
- if the MS is not identified in the VLR, either the *unallocated TMSI* or the *unknown subscriber* message is received;
- if subscriber data was not obtained for the MS (see also the procedure in the VLR), the *system failure* message is received from the VLR;
- if the CUG index provided by the MS does not exist, the *CUG reject* message is received;
- if the authenticity of the MS was not established, the *illegal subscriber* message is received;
- if the authentication procedure was unsuccessful (network failure), the *system failure* message is received;
- if the MS is barred for outgoing calls, the *call barred* message is received;
- if there are errors in the data fields, the *data missing or unexpected data value* message is received.

All of the above unsuccessful events are provided to the call handling function so that the call can be terminated by providing the appropriate unsuccessful call indication to the MS.

A summary of unsuccessful events is given in Table 3/Q.1051.

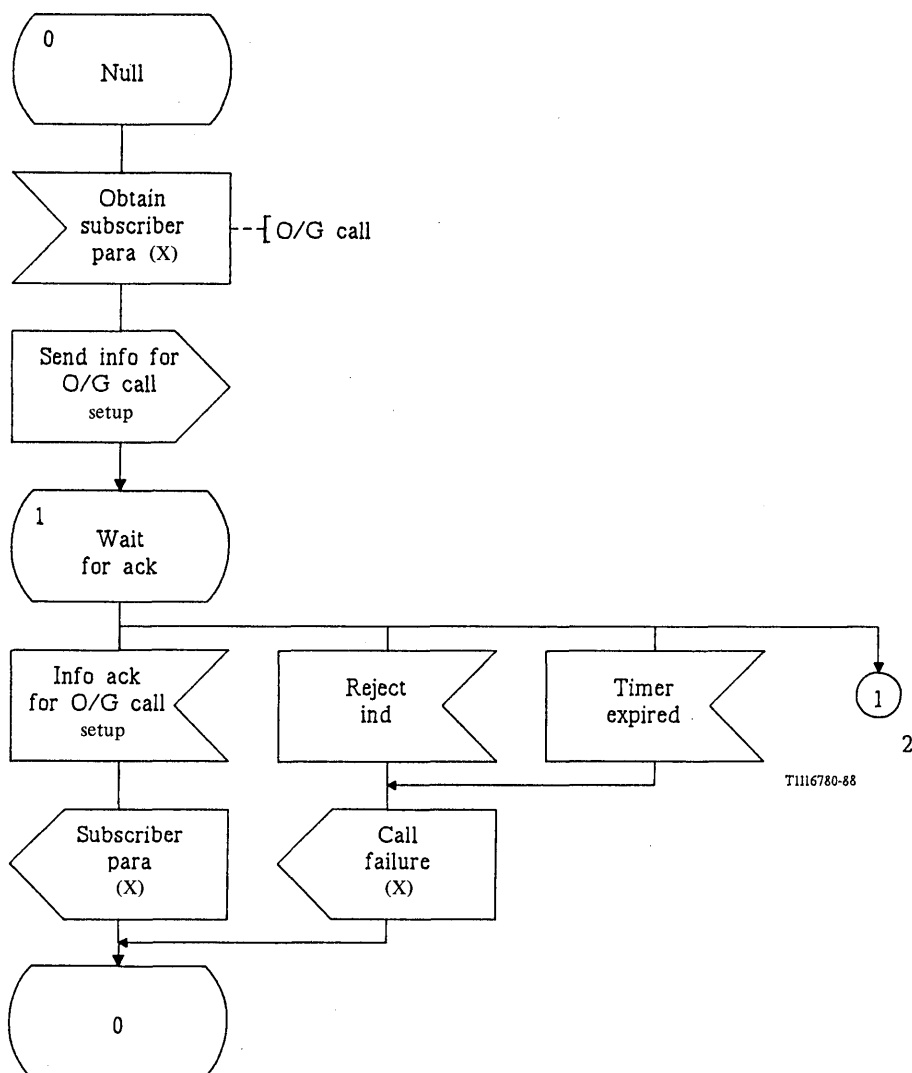


FIGURE 59/Q.1051 (sheet 1 of 2)

**Application specific procedure in MSC for retrieval of call data for MS originated call**



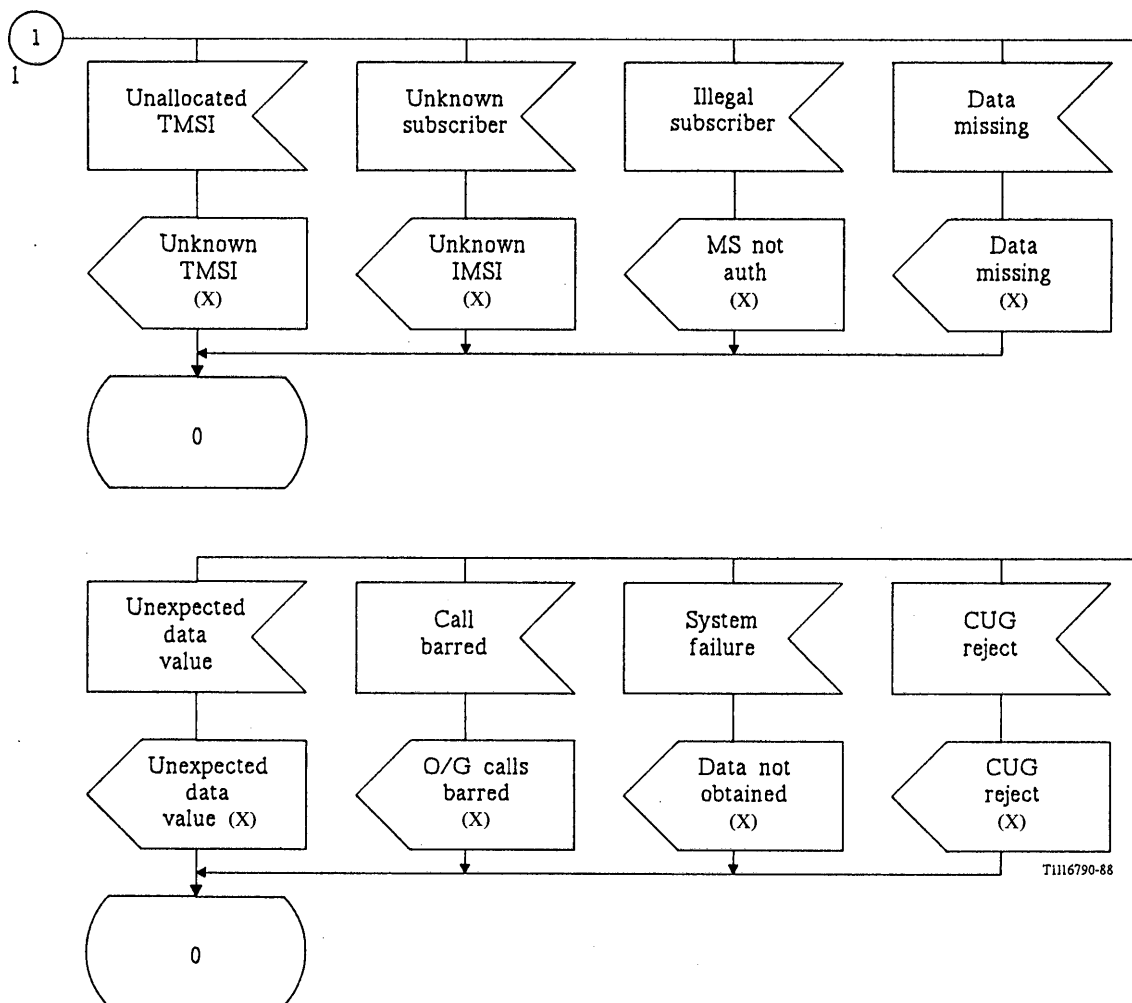


FIGURE 59/Q.1051 (sheet 2 of 2)

Application specific procedure in MSC for  
retrieval of call data for MS originated call

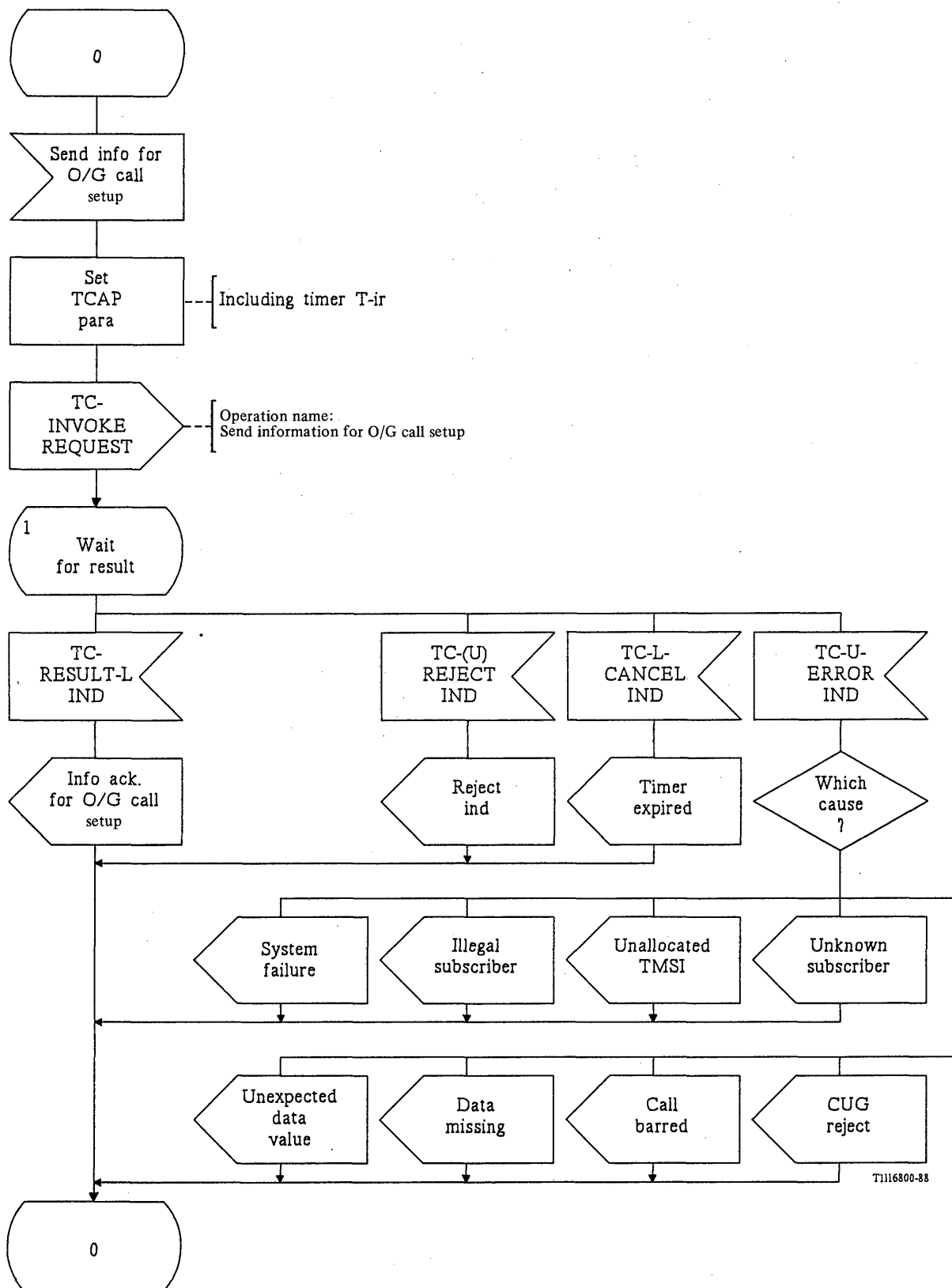


FIGURE 60/Q.1051

ASE/TCAP interface procedure in the MSC for retrieval of call data for MS originated call

The *send information for O/G call set-up* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ir. The results are reported as follows:

- a TC-RESULT-L INDICATION primitive contains the *information acknowledge for O/G call set-up* message;
- a TC-(U)-REJECT INDICATION primitive is used to report procedure failure;
- a TC-L-CANCEL INDICATION primitive is used to report expiry of timer T-ir;
- a TC-U-ERROR INDICATION primitive is used to report a negative result as follows:
  - i) the TMSI is unknown to the VLR (unallocated TMSI) (if TMSI was used to identify the MS);
  - ii) the IMSI is unknown to the VLR (unknown subscriber) (if IMSI was used for identifying the MS);
  - iii) call data cannot be obtained;
  - iv) illegal subscriber;
  - v) the MS is barred for outgoing calls;
  - vi) data are missing or the data are unexpected (in association with supplementary services);
  - vii) the CUG reject, i.e. the CUG index provided by the MS did not exist.

#### 3.4.3.1.3 Retrieval of routing information

The application specific procedure is contained in Figure 61/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 62/Q.1051.

The call handling function in the gateway MSC will request MAP to obtain routing information [the obtain routing information (X) signal]. The MSC then sends the *send routing information* message to the HLR of the MS. The message contains the directory number of the MS and any supplementary services request contained in the request from the call handling function. The outcome of the procedure can be as follows:

- if a routing address (either a mobile station roaming number or a forwarded-to number) can be provided, it is included in the *routing information acknowledge* message. The routing address is provided to the call handling function;
- a procedure failure is reported either as a rejected indication or a timer expiry indication. In both cases a call failure indication is provided to the call handling function;
- unsuccessful events are reported in various messages as shown in Table 3/Q.1051. Corresponding messages are provided to the call handling function.

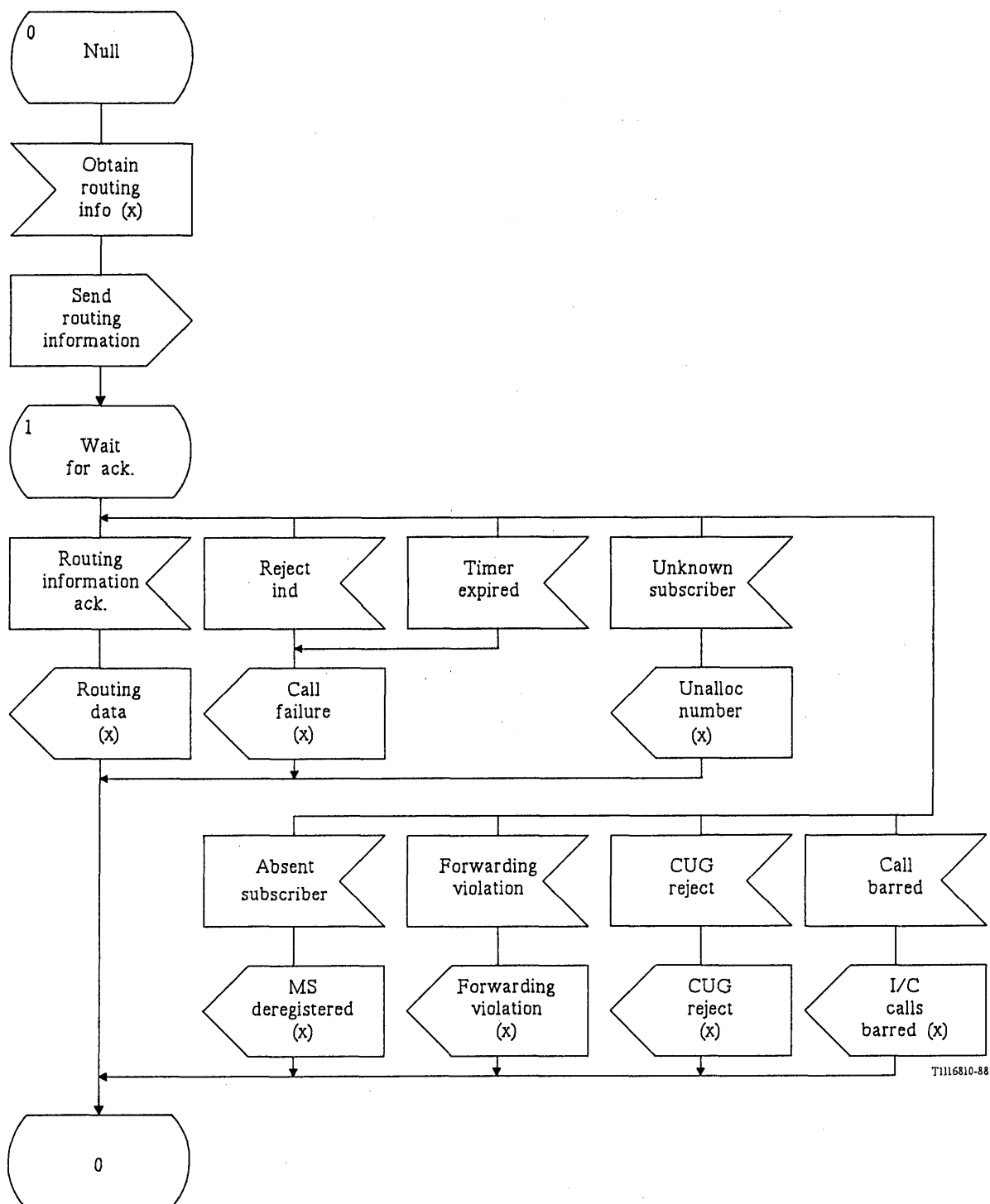


FIGURE 61/Q.1051

Application specific procedure in a gateway MSC  
for obtaining routing information

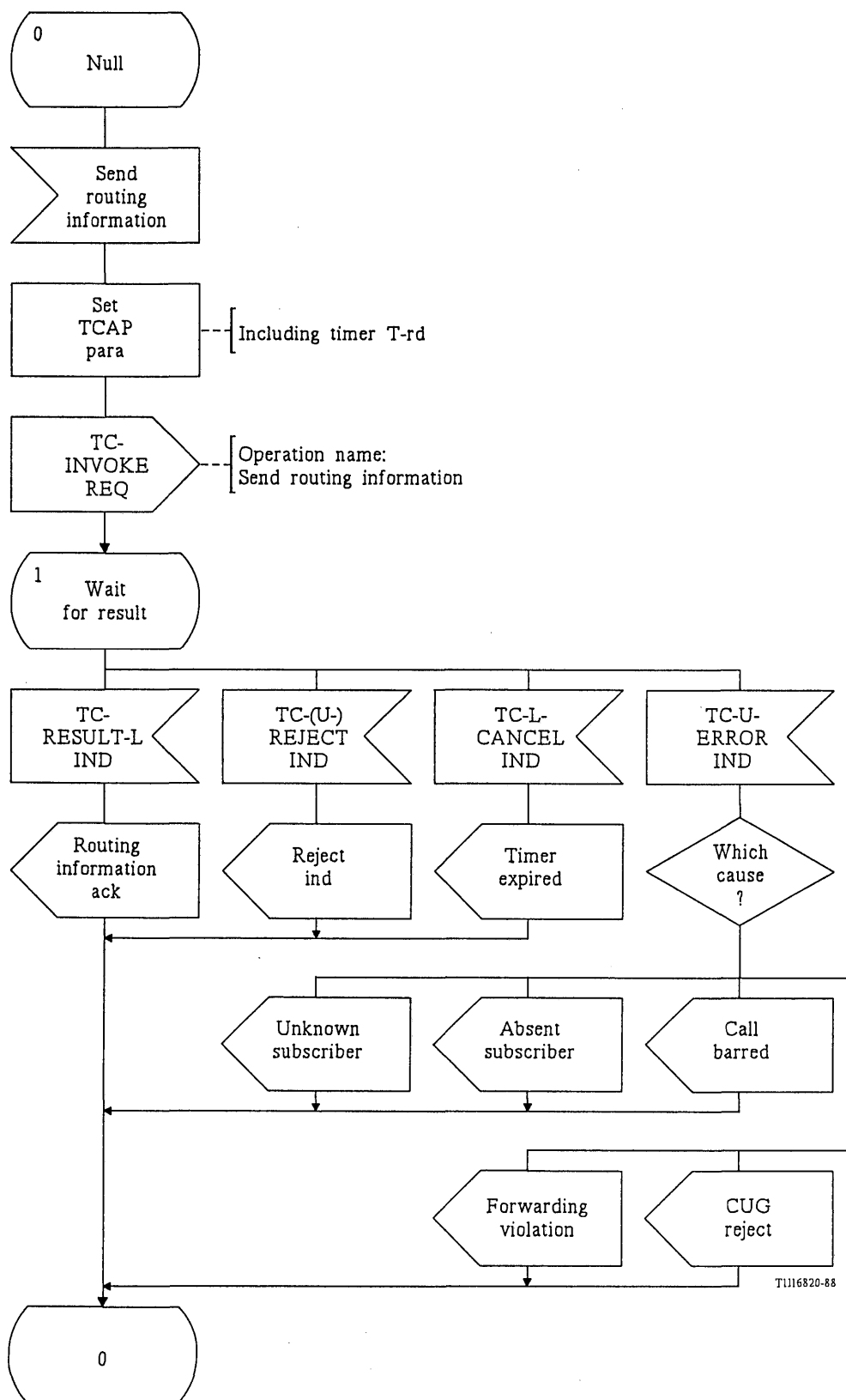


FIGURE 62/Q.1051

ASE/TCAP interface procedure in a gateway MSC for  
obtaining routing information

The *send routing information* message is sent in a TC-INVOKE REQUEST primitive. TCAP is also requested to supervise the procedure by timer T-rd. The results are received as follows:

- the *routing information acknowledge* message is contained in a TC-RESULT-L INDICATION primitive;
- procedure failure is indicated by a TC-(U)-REJECT INDICATION primitive;
- expiry of timer T-rd is reported in a TC-L-CANCEL INDICATION primitive;
- negative results are reported in a TC-U-ERROR INDICATION primitive as follows:
  - i) unknown subscriber (directory number not allocated);
  - ii) absent subscriber (MS deregistered);
  - iii) call barred (incoming calls barred);
  - iv) CUG rejection;
  - v) forwarding violation.

#### 3.4.3.2 Procedures in the VLR

##### 3.4.3.2.1 MS terminating call

The application specific procedure is shown in Figure 63/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 64/Q.1051.

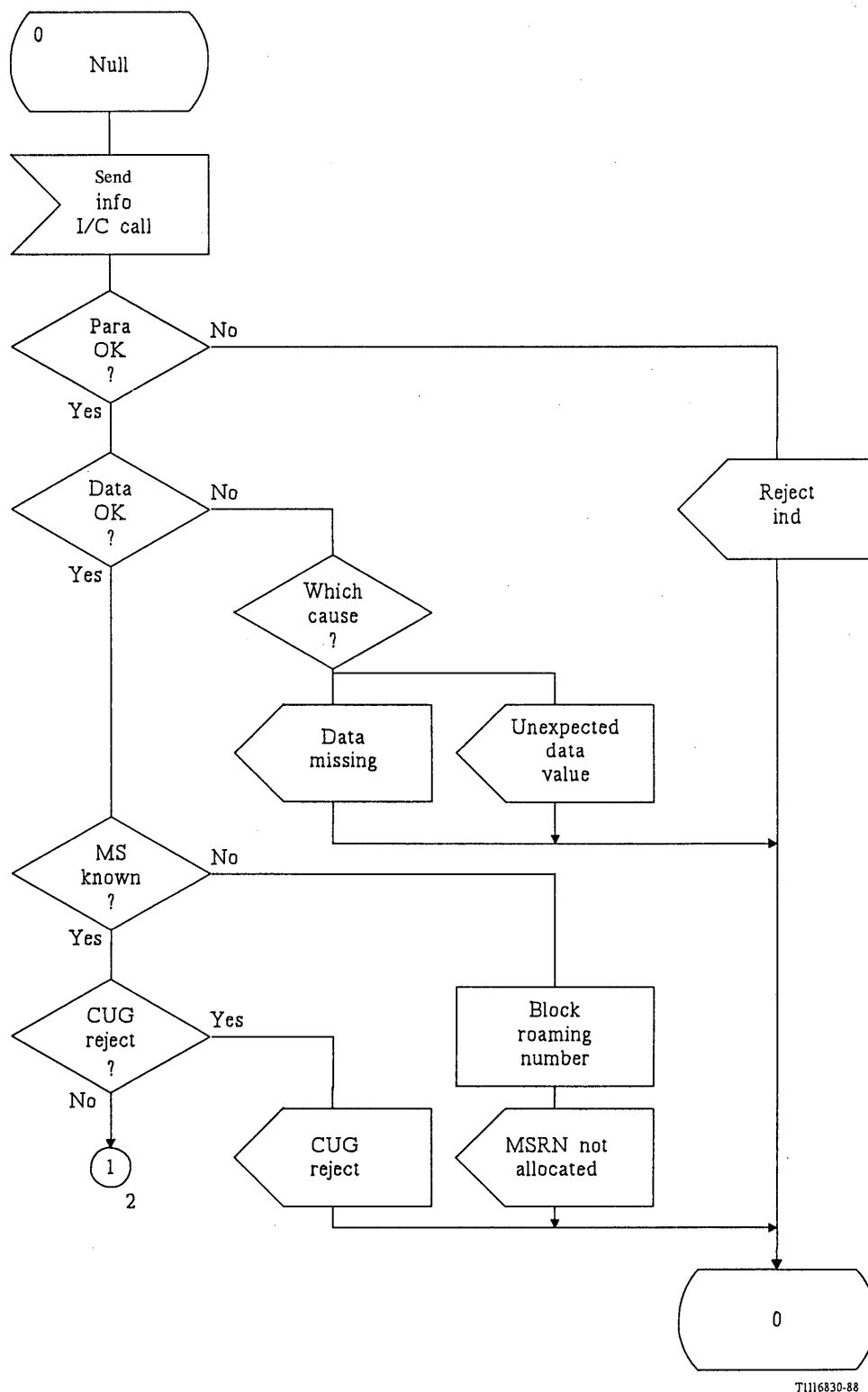
When receiving the *send information for I/C call set-up* message, the VLR will return the *information acknowledge for I/C call set-up* message containing all required subscriber parameters provided that the MS is known to the VLR (i.e. the mobile station roaming number is allocated) and the authenticity of the MS is established. If the mobile station roaming number is not allocated, the VLR will block the roaming number and send an *MSRN not allocated* message to the MSC.

A search procedure may also be required if the VLR has had a restart and the current location area of the MS has to be verified. This procedure is described in § 3.8. The outcome of the procedure is indicated as follows:

- MS obtained (X) if the search is successful. In this case the required information is sent to the MSC;
- MS not obtained (X) if the search is unsuccessful. In this case the *absent subscriber* message is sent to the MSC.

Authentication is also required (§ 3.10). Successful authentication is indicated by the signal authentication OK (X). Unsuccessful outcome is reported as follows:

- illegal subscriber (X) if the authenticity of the MS was not established. In this case the *illegal subscriber* message is sent;
- authentication procedure error (X) if the authentication procedure failed (in the network or on the radio path). In this case the *system failure* message is sent.



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FIGURE 63/Q.1051 (sheet 1 of 3)

**Application specific procedure in VLR for  
retrieval of call data for MS terminating call**

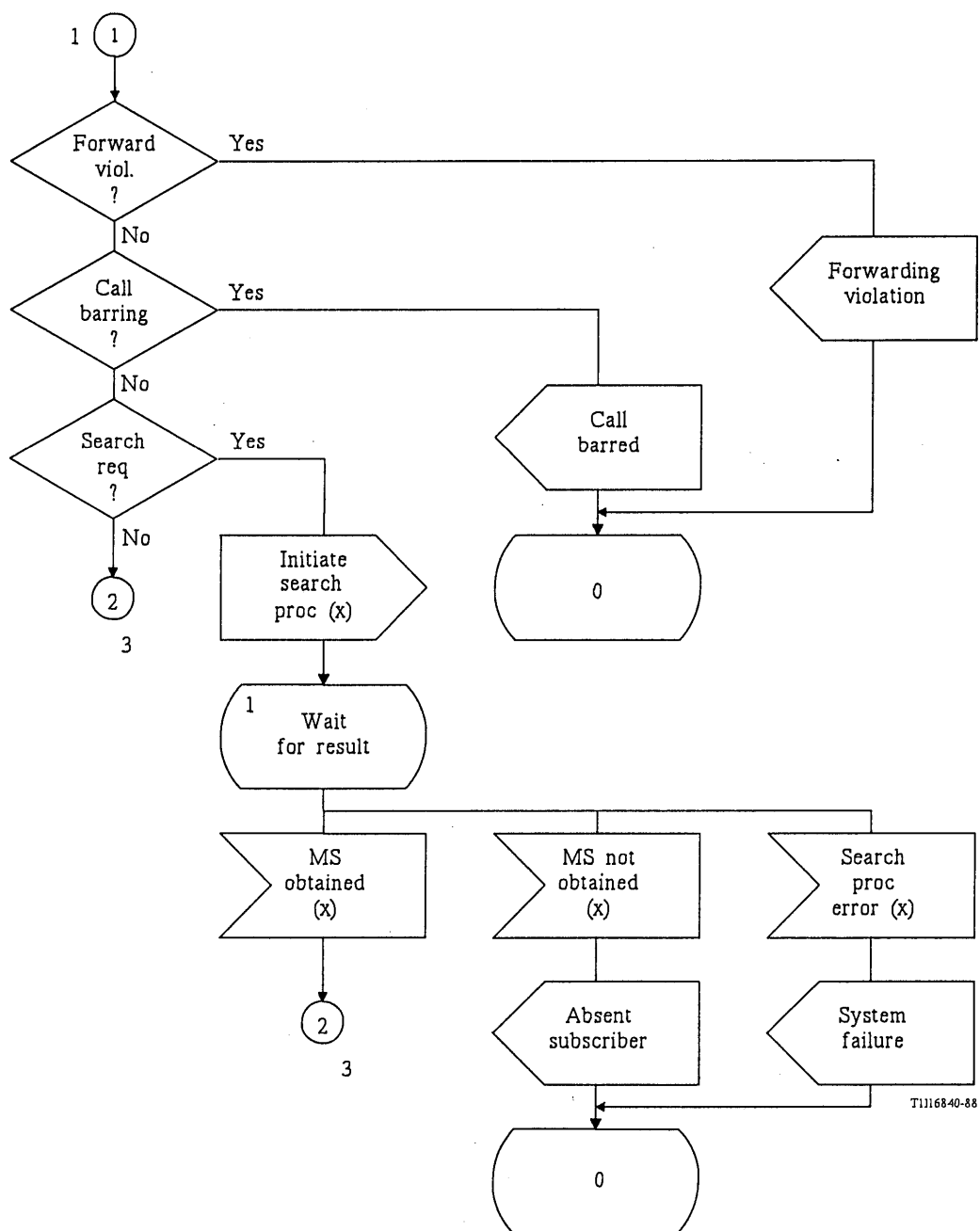


FIGURE 63/Q.1051 (sheet 2 of 3)

**Application specific procedure in VLR for retrieval of call data for MS terminating call**



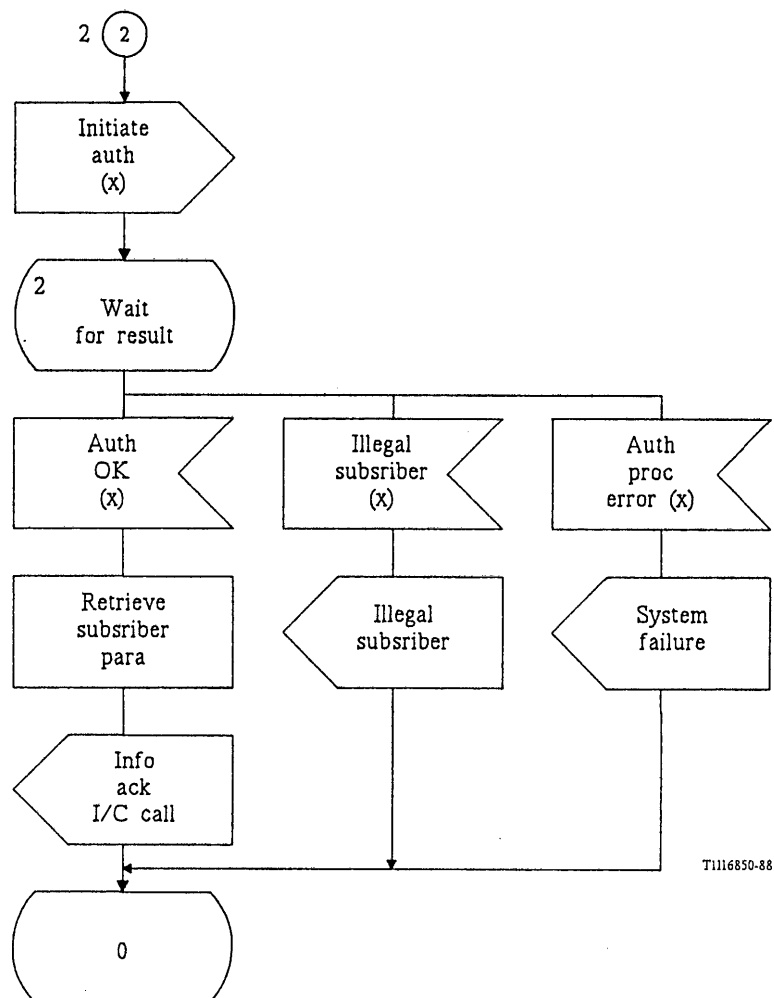


FIGURE 63/Q.1051 (sheet 3 of 3)

**Application specific procedure in VLR for  
retrieval of call data for MS terminating call**

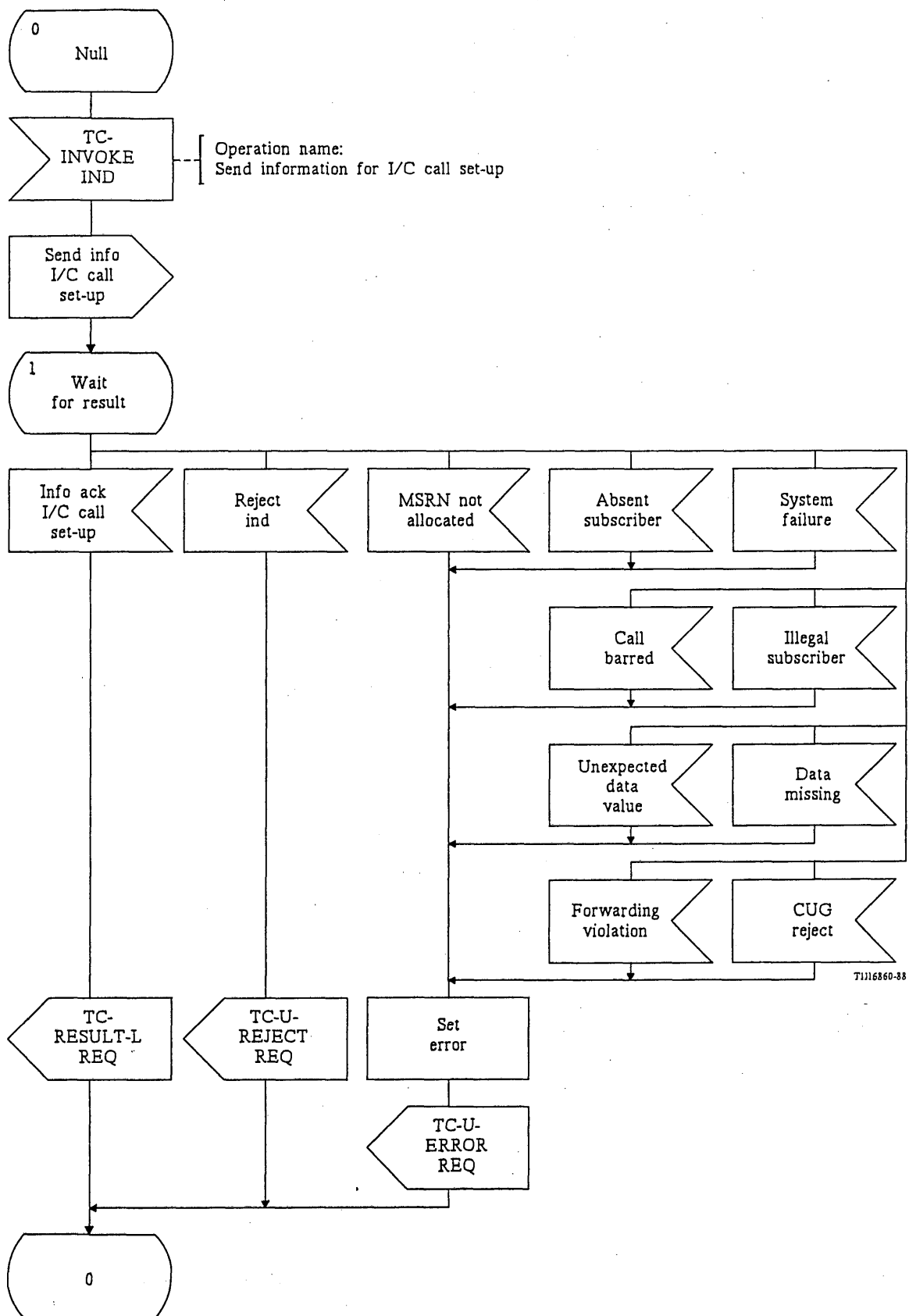


FIGURE 64/Q.1051

ASE/TCAP interface procedure in VLR for retrieval  
of call data for MS terminating call

A TC-INVOKE INDICATION primitive will contain the *send information I/C call set-up* message. The result of the procedure is reported as follows:

- the *information acknowledge for I/C call set-up* message is sent in a TC-RESULT-L REQUEST primitive;
- in case of procedure failure the reject indication is provided in a TC-U-REJECT REQUEST primitive;
- negative results are reported in a TC-U-ERROR REQUEST primitive as follows:
  - i) the MS was not identified (i.e. the mobile station roaming number is not allocated);
  - ii) the MS is absent (i.e. unsuccessful search);
  - iii) data missing or unexpected data values in the request;
  - iv) illegal subscriber;
  - v) failure in subsequent authentication procedure (VLR/HLR);
  - vi) call barred, i.e. the I/C calls barred service has been activated.

#### 3.4.3.2.2 MS originated call

The application specific procedure is contained in Figure 65/Q.1051. The ASE/TCAP VLR/MS interface procedure is contained in Figure 66/Q.1051 and the ASE/TCAP VLR/HLR interface procedure is contained in Figure 67/Q.1051.

If the MS is identified by a TMSI, the VLR will check whether or not the TMSI is allocated. If it is not allocated, the *unallocated TMSI* message is returned to the MSC. If the VLR has all subscriber data required for establishing the call, the *information acknowledge O/G call set-up* message is returned to the MSC.

The VLR will also check the activation status of supplementary services. If the MS is barred for outgoing calls or the call is rejected by a CUG check, the *call barred* or *CUG reject* message is returned to the MSC.

In some cases the VLR needs to obtain data from the HLR, e.g. the call requires supplementary services checking in the HLR. In such cases the VLR will send a *send parameters from HLR (call data request)* message to the HLR. The response to this message can be either of the following:

- a *call data acknowledge* message containing the required information. When receiving this message, the VLR will return the *information acknowledge O/G call set-up* message to the MSC;
- procedure errors are reported as reject indication and timer expired information. In such cases the *system failure* message is returned to the MSC;
- if the MS is not registered in the HLR, the *unknown subscriber* message is received. The *unknown subscriber* message is sent to the MSC;
- if the MS does not pass a CUG check in the HLR, the *CUG reject* message is received. The same message is sent to the MSC;
- if the *unexpected data value* or the *data missing* message is received, the *system failure* message is sent to the MSC.

Authentication is also required (§ 3.10). Successful authentication is indicated by the signal authentication OK (X). Unsuccessful outcome is reported as follows:

- illegal subscriber (X) if the authenticity of the MS is not established. The *illegal subscriber* message is sent to the MSC;
- authentication procedure error (X) if the authentication procedure failed (in the network or on the radio path). The *system failure* message is sent to the MSC.

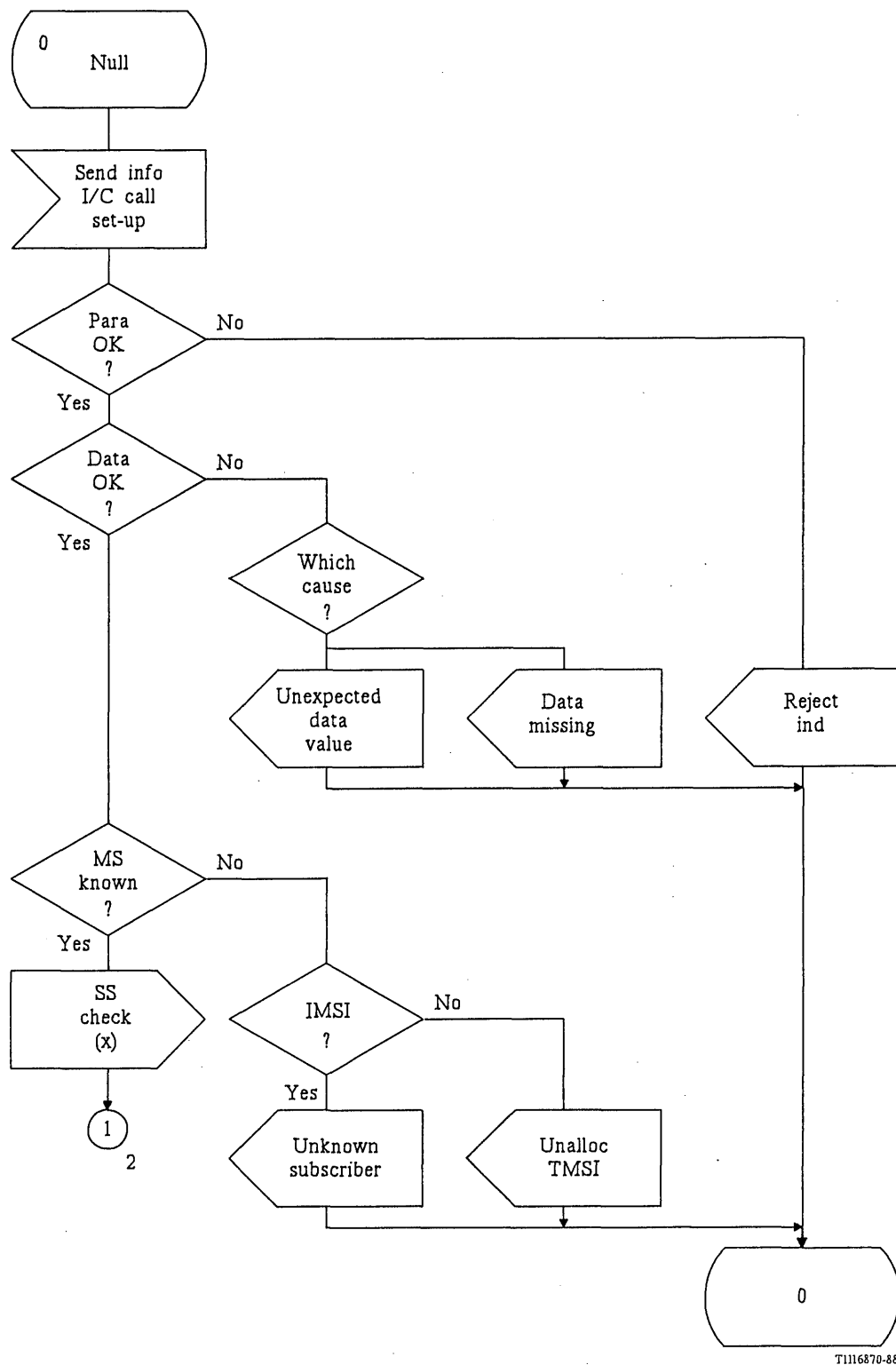
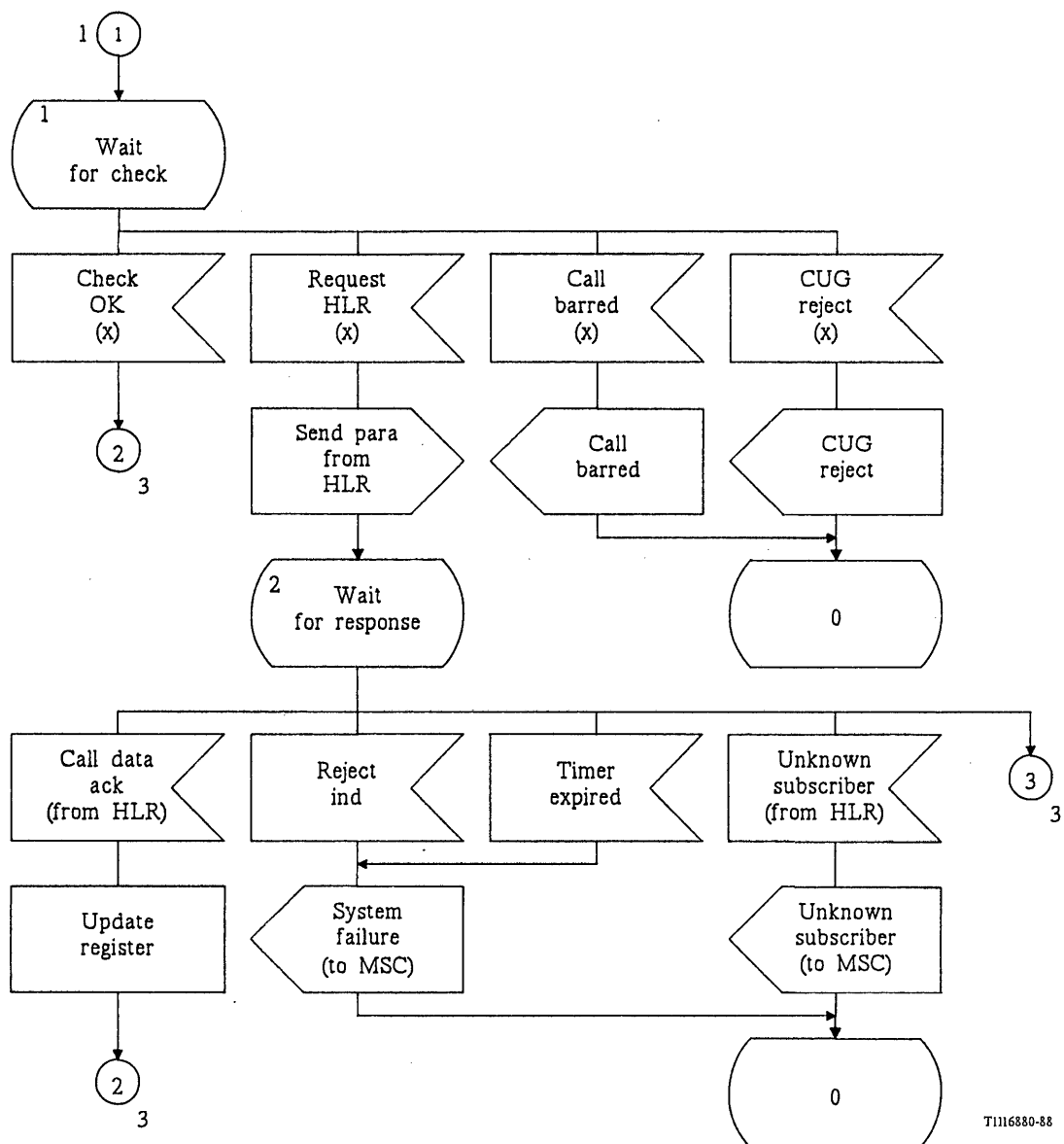


FIGURE 65/Q.1051 (sheet 1 of 3)

Application specific procedure in VLR for retrieval of subscriber data for MS originated call



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FIGURE 65/Q.1051 (sheet 2 of 3)

Application specific procedure in VLR for retrieval of subscriber data for MS originated call

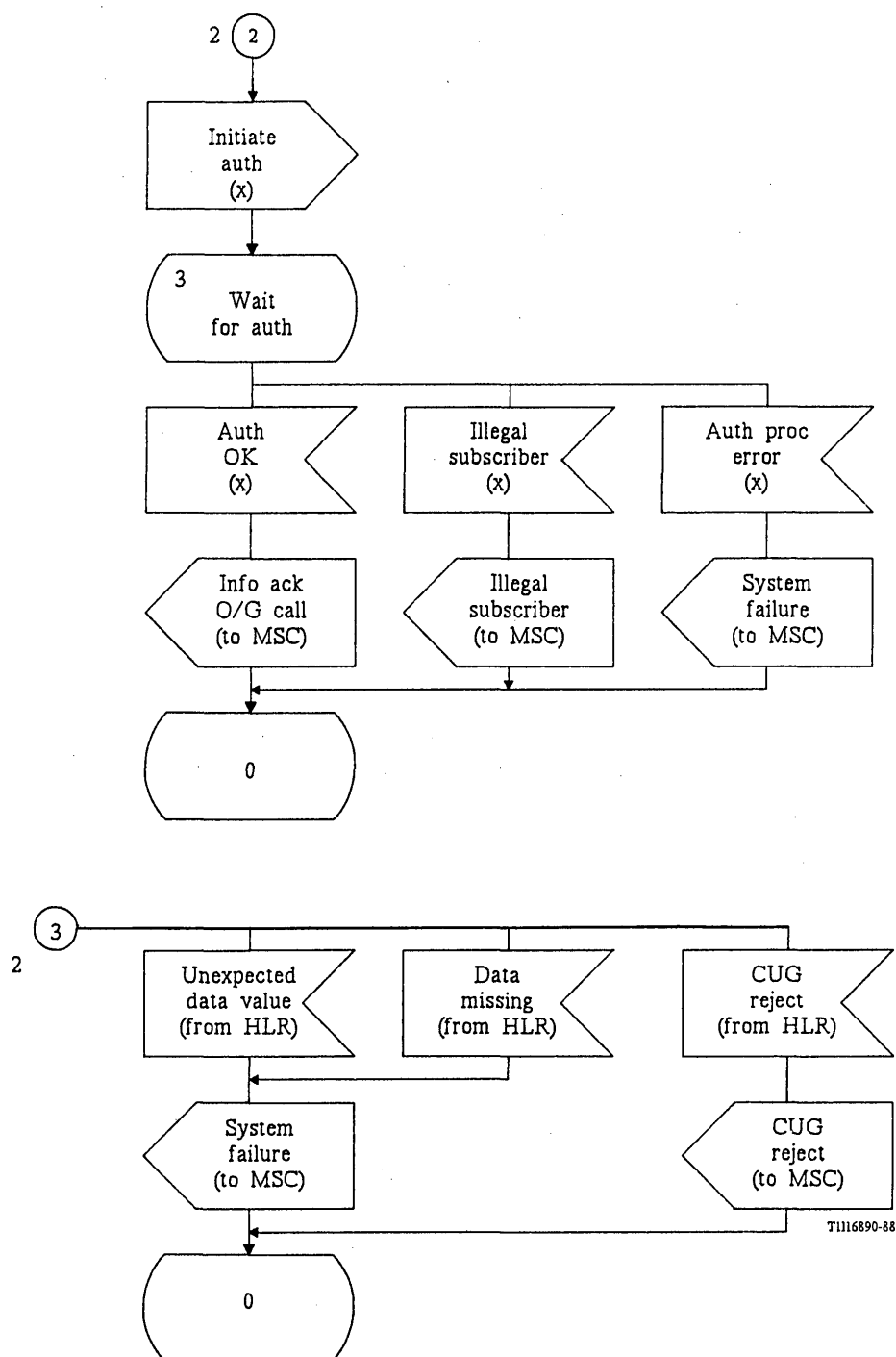


FIGURE 65/Q.1051 (sheet 3 of 3)

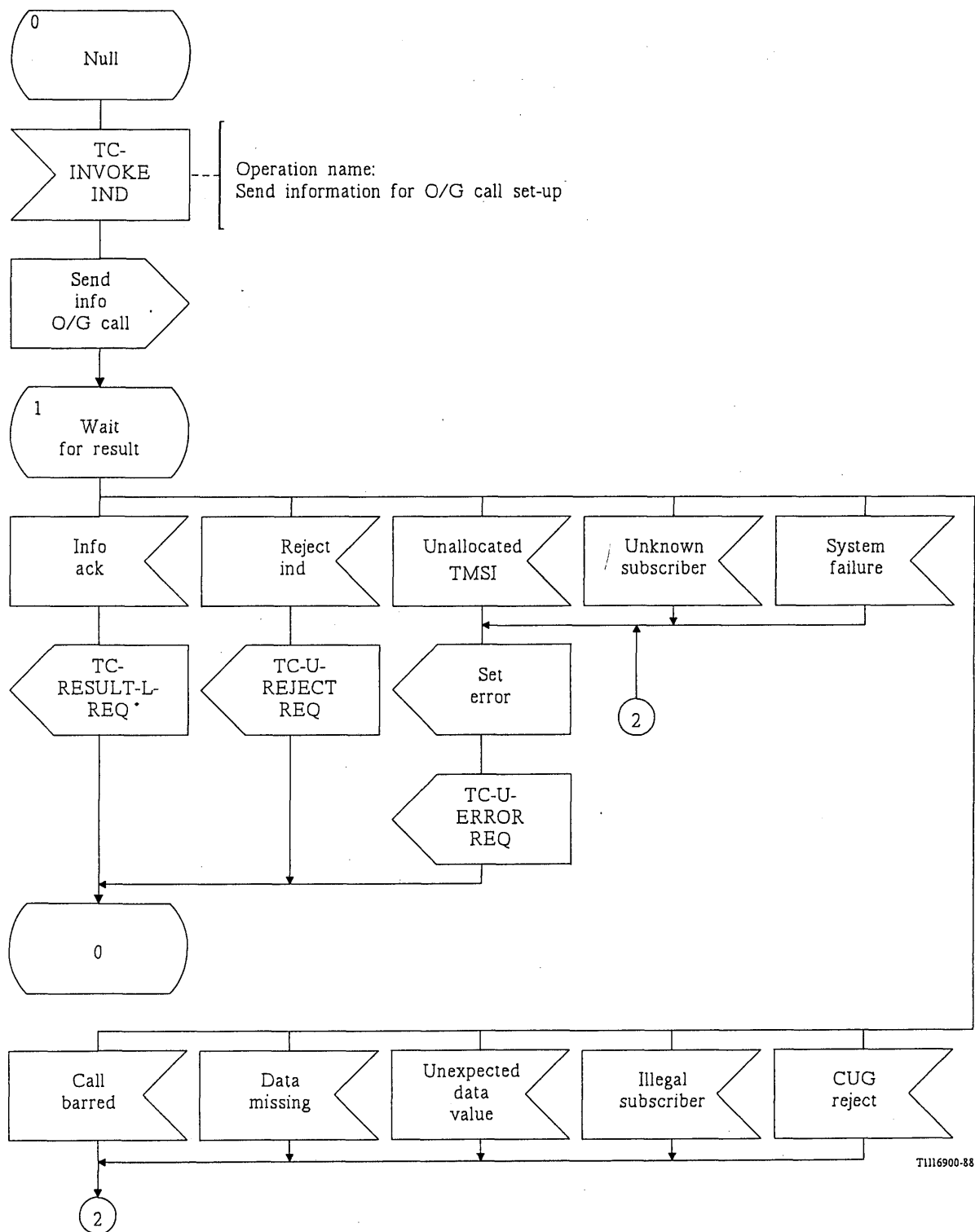
Application specific procedure in VLR for retrieval of subscriber data for MS originated call

At the VLR/MSC interface (Figure 66/Q.1051) *send information request O/G call set-up* message is contained in a TC-INVOKE INDICATION primitive. The outcome of the procedure is sent to the MSC as follows:

- an *information acknowledge O/G call set-up* message is included in a TC-RESULT-L REQUEST primitive;
- a reject indication is sent as a TC-U-REJECT REQUEST primitive;
- negative results are sent in a TC-U-ERROR REQUEST primitive as follows:
  - i) unallocated TMSI;
  - ii) unknown subscriber (unknown IMSI);
  - iii) system failure, i.e. the VLR was not capable of obtaining the required call data from the HLR or the authentication procedure failed;
  - iv) call barred (O/G calls barred);
  - v) data errors (unexpected data value, data missing);
  - vi) CUG reject;
  - vii) illegal subscriber.

At the VLR/HLR interface (Figure 67/Q.1051) the *send parameters from HLR (call data request)* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ph. The outcome of the procedure could be as follows:

- a TC-RESULT-L INDICATION primitive will contain the *call data acknowledge* message;
- a TC-(U)-REJECT INDICATION primitive is used to report procedure errors;
- a TC-L-CANCEL INDICATION primitive is used to report expiry of timer T-ph;
- a TC-U-ERROR INDICATION primitive is used to report a negative result as follows:
  - i) unknown subscriber (i.e. the MS is not registered in the HLR);
  - ii) data missing (in the request);
  - iii) unexpected data value;
  - iv) CUG reject if the HLR performs a CUG check and the MS does not pass the check.



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FIGURE 66/Q.1051

ASE/TCAP VLR/MS interface procedure in VLR for  
retrieval of subscriber data for MS originated call



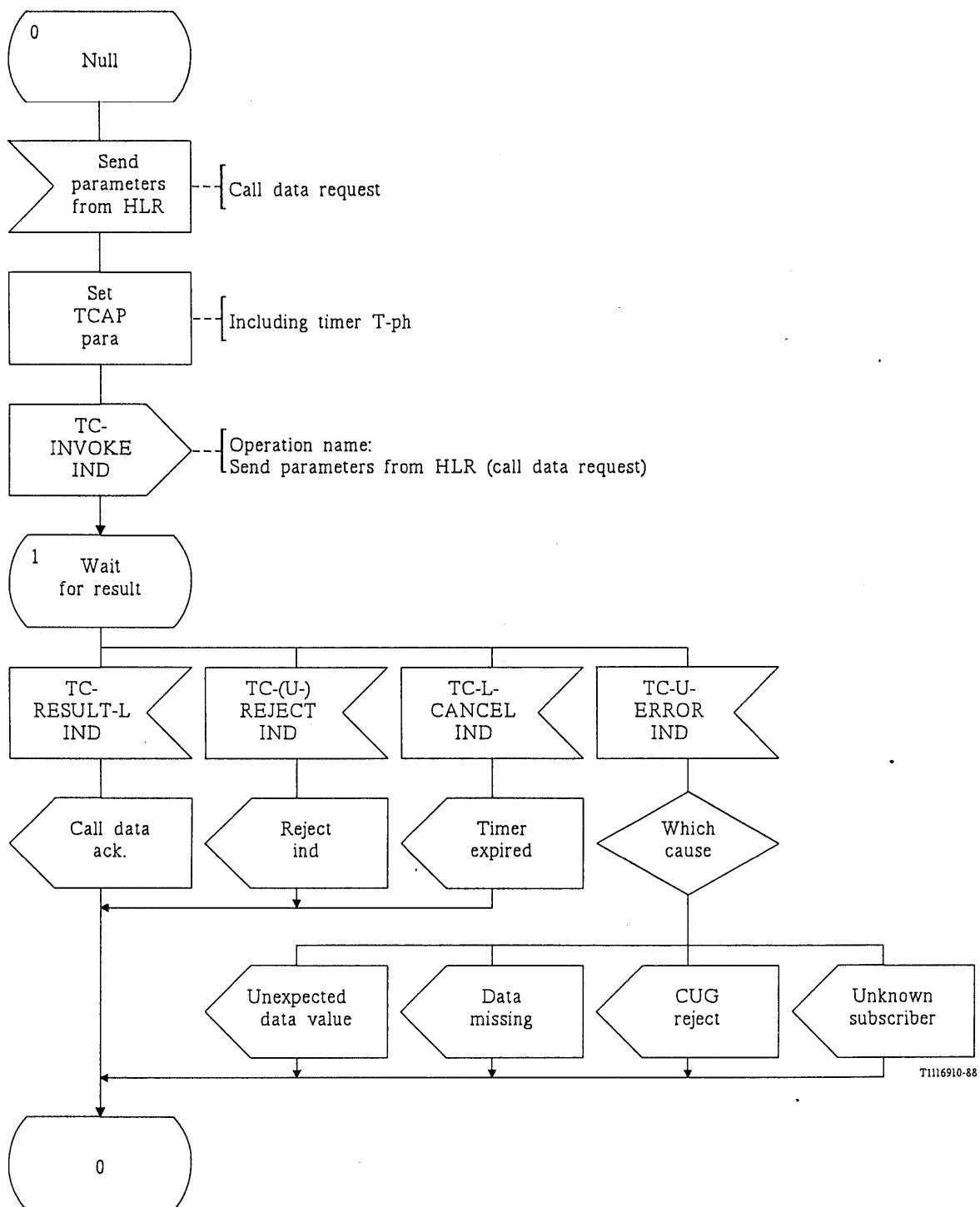


FIGURE 67/Q.1051

ASE/TCAP VLR/HLR interface procedure in VLR for  
retrieval of subscriber data for MS originated call

### 3.4.3.3 Procedure in the HLR

#### 3.4.3.3.1 Procedure for call data request

The application specific procedure is contained in Figure 68/Q.1051 and the ASE/TCAP procedure is contained in Figure 69/Q.1051.

When receiving the *send parameters from HLR (call data request)* message, the HLR will return the *call data acknowledge* message with all required parameters if the MS is registered in the HLR. Otherwise the *unknown subscriber* message is returned. If the *call data request* message is coming from a VLR other than that currently known by the HLR, the information received can be used to update the location of the MS.

If the call is to a CUG, the HLR may perform the CUG check and return the *CUG reject* message if the MS does not pass the CUG check.

The *send parameters from HLR (call data request)* message is received in a TC-INVOKE INDICATION primitive. The outcome is reported as follows:

- the *call data acknowledge* message is sent in a TC-RESULT-L REQUEST primitive;
- procedure errors are reported in a TC-U-REJECT REQUEST primitive;
- negative results are reported in a TC-U-ERROR REQUEST primitive as follows:
  - i) the MS is unknown to the HLR (unknown subscriber);
  - ii) data missing or unexpected data value;
  - iii) CUG reject.

#### 3.4.3.3.2 Procedure for retrieval of routing information

The application specific procedure is contained in Figure 70/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 71/Q.1051.

When receiving a *send routing information* message, the HLR will return information as follows:

- if routing data (i.e. either a mobile station roaming number or a forwarded-to number) can be returned, the required routing information is returned in a *routing information acknowledge* message;
- if the MS is unknown (i.e. the directory number is not allocated), the *unknown subscriber* message is returned;
- if the MS is deregistered, the *absent subscriber* message is returned;
- if there is any supplementary service restriction, it will be reported as follows: if the MS belongs to a CUG without incoming access and the call does not pass the CUG check, the *CUG reject* message is returned; if the MS has the incoming call barred service, the *call barred* message is returned; if a call forwarding service has been activated by the MS and the incoming call has already been forwarded as many times as is allowed, a *forwarding violation* message is returned.

The *send routing information* message is contained in a TC-INVOKE INDICATION primitive. The outcome of the procedure is returned as follows:

- the *routing information acknowledge* message is sent in a TC-RESULT-L REQUEST primitive;
- a reject indication is reported in a TC-U-REJECT REQUEST primitive;
- negative results are reported in a TC-U-ERROR REQUEST primitive as follows:
  - i) unknown subscriber (the directory number is not allocated);
  - ii) the MS is absent;
  - iii) call barred (incoming calls are barred to the MS);
  - iv) CUG reject (the call is rejected as the result of a CUG check);
  - v) forwarding violation (the call is rejected because of call forwarding restrictions).

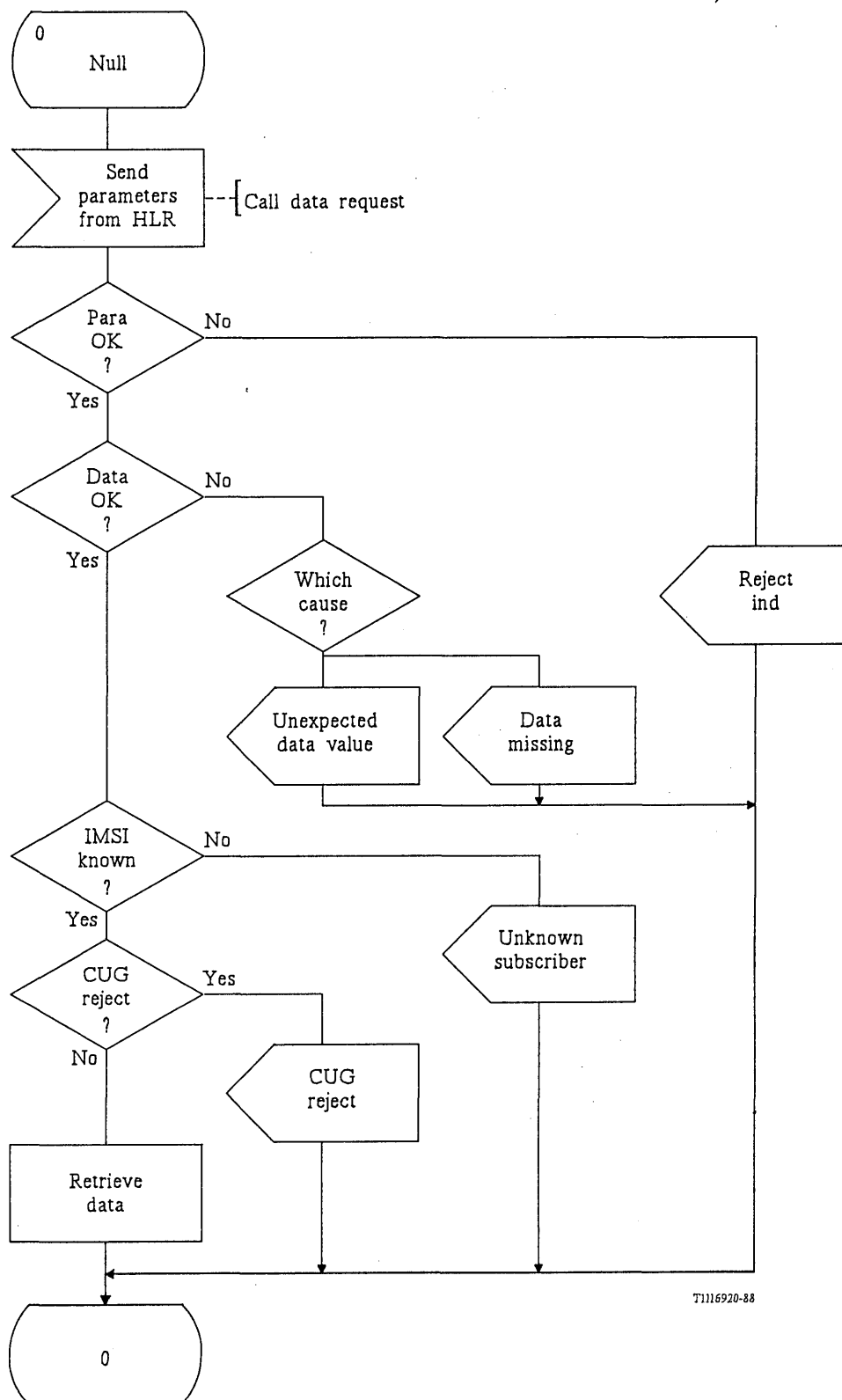


FIGURE 68/Q.1051

Application specific procedure in HLR for call data request

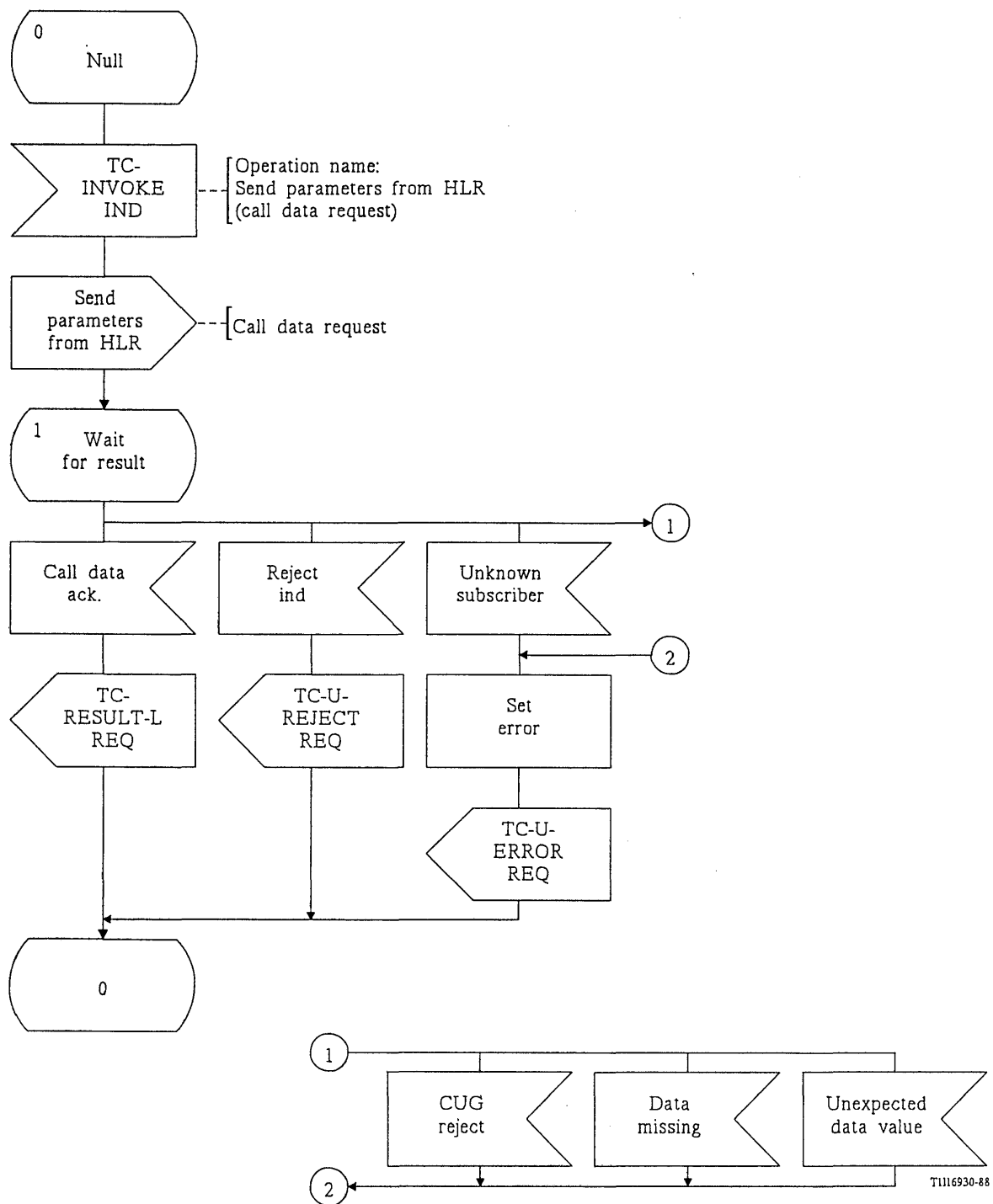


FIGURE 69/Q.1051

ASE/TCAP interface procedure in HLR for call data request

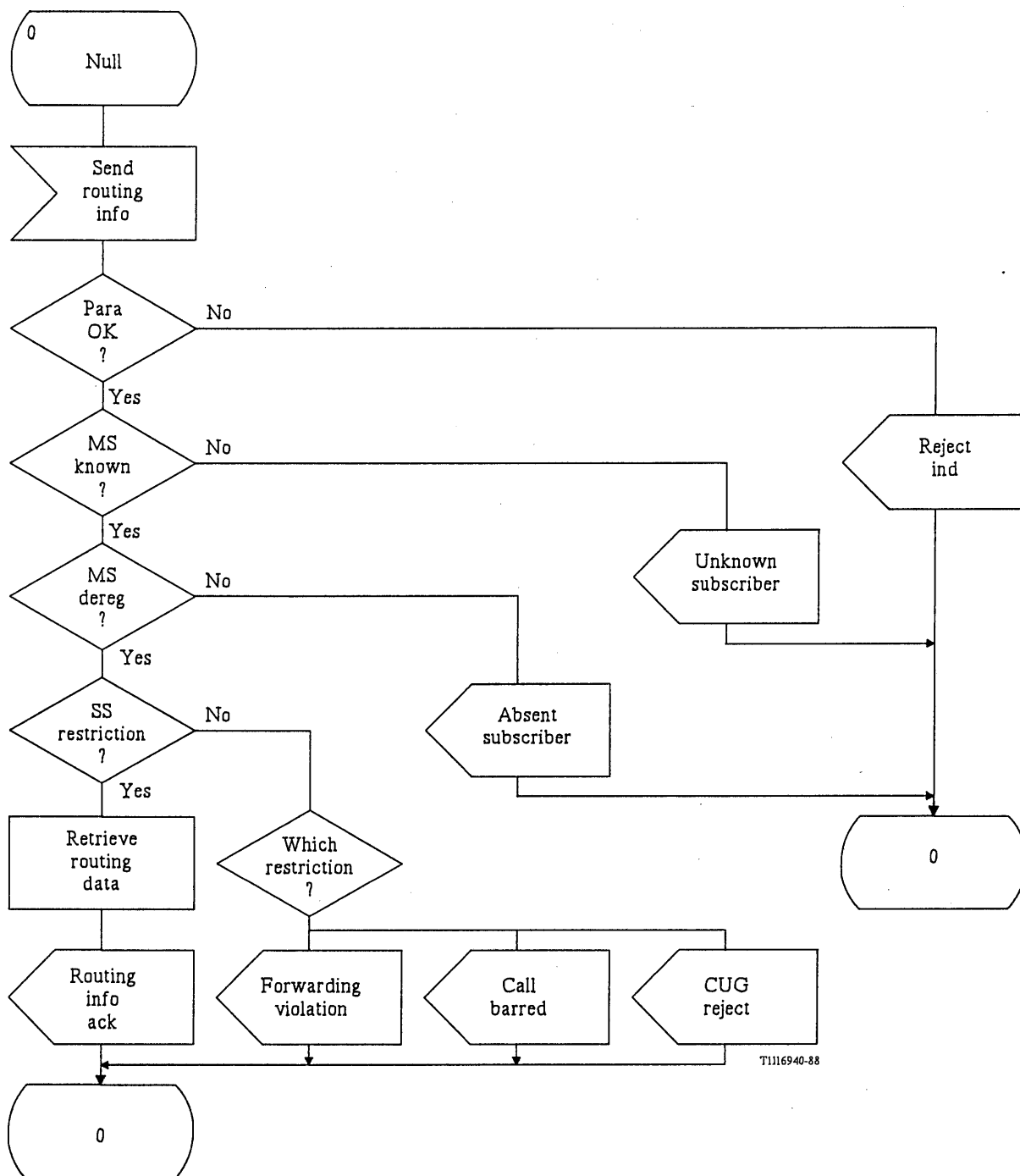
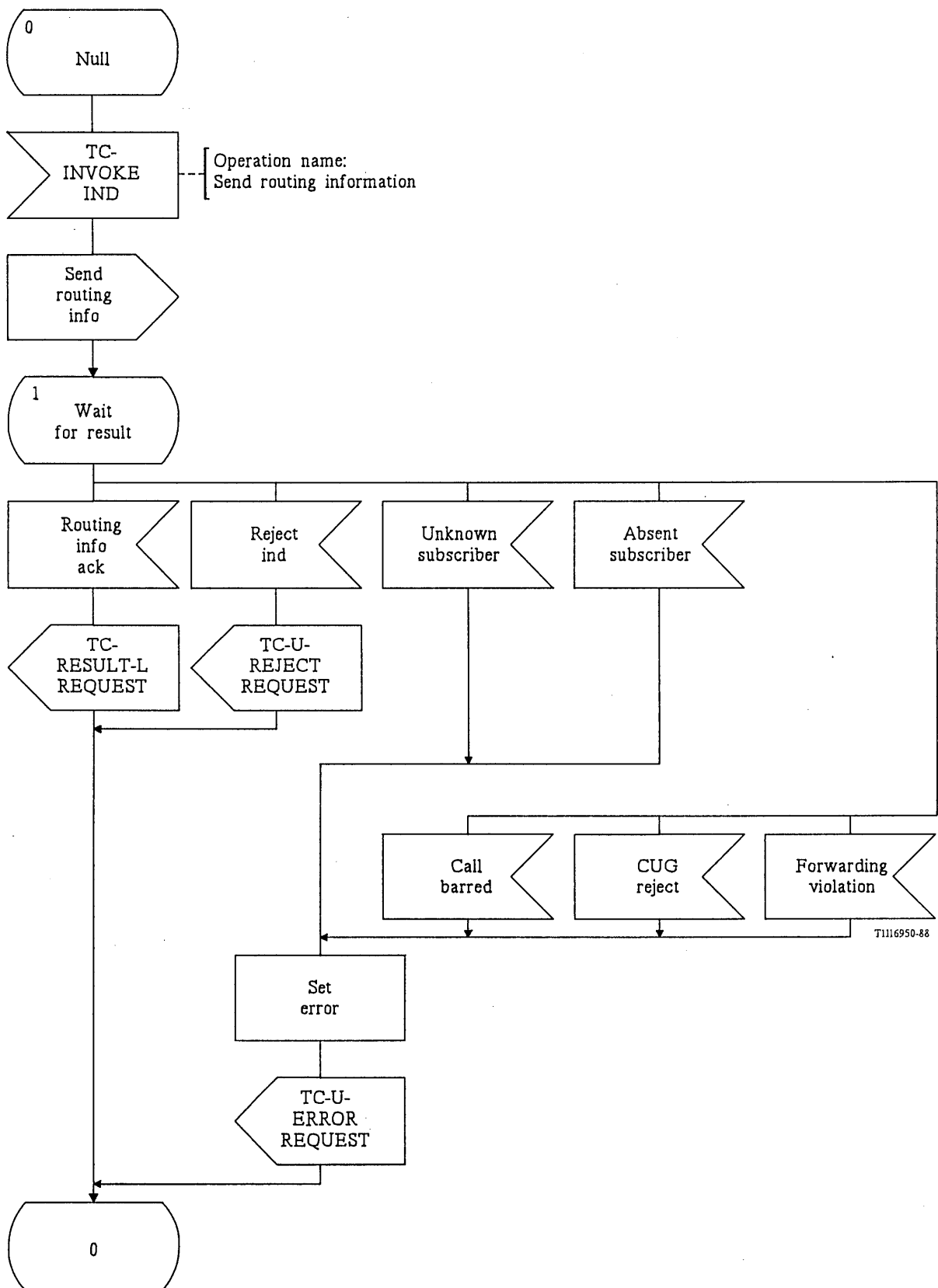


FIGURE 70/Q.1051

**Application specific procedure in HLR for retrieval  
of routing information**



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FIGURE 71/Q.1051

ASE/TCAP interface procedure in HLR for retrieval of routing information

### 3.5 Handover

#### 3.5.1 Definition of interfaces

Figure 72/Q.1051 shows the interfaces involved for handover of calls between MSCs. MSC-A is the MSC on which the call was originally established. This MSC is also referred to as the controlling MSC. MSC-B (or MSC-B') is the MSC to which the call is handed over.

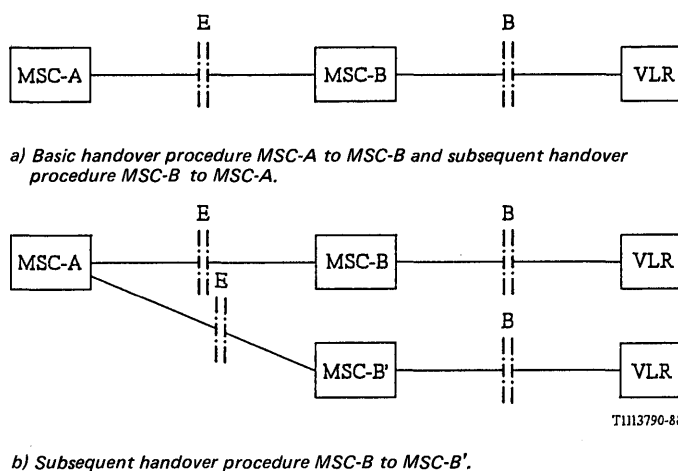


FIGURE 72/Q.1051

#### Interface structure for handover

Three cases need to be considered.

- handover from MSC-A to MSC-B;
- subsequent handover from MSC-B to MSC-A;
- subsequent handover from MSC-B to MSC-B'. After completion of this handover, the connection to MSC-B will be released and MSC-B' will be regarded as the new MSC-B.

These procedures will allow for any sequence of handovers between MSCs.

#### 3.5.2 General overview of procedures

##### 3.5.2.1 List of procedures

The following procedures in MAP are specified in order to support all functions associated with handover:

- procedure for requesting measurements in another MSC;
- basic handover procedure for handover from MSC-A to MSC-B;
- subsequent handover procedure between MSC-B and MSC-A for handover from MSC-B to MSC-A or from MSC-B to MSC-B';
- procedure for providing call control information to the MS;
- procedure for receiving call control information from an MS;
- procedure for obtaining handover number.



*Note* - MSC-B may allocate the handover number. However, this Recommendation describes the case where the VLR allocates this number.

The detailed procedures for handover are contained in Recommendation Q.1002. The description and specification are based on a functional composition of the signalling and call control sub-system of an MSC as shown in Figure 73/Q.1051. A more detailed functional composition of MSCs is given in Recommendation Q.1002.

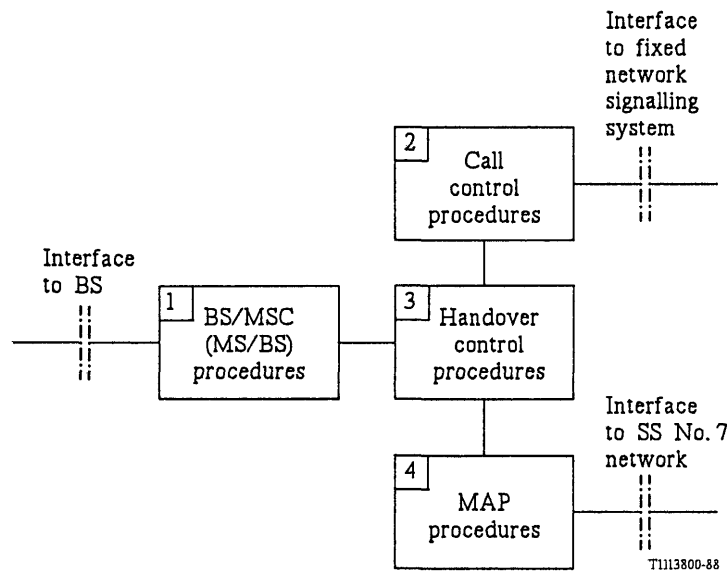


FIGURE 73/Q.1051

#### Functional composition of signalling functions for supporting handover

The modules are:

Module 1 - represents the signalling between the MSC and the MS and the BS.

Module 2 - represents the signalling interface towards the fixed network.

Module 3 - represents the handover control mechanisms in the MSC.

Module 4 - represents the MAP interface to other MSCs and to the VLR.

Below the procedures of functional module 4 only are specified. In the SDL diagrams below, interworking with other modules is indicated by an (X) following the message name.

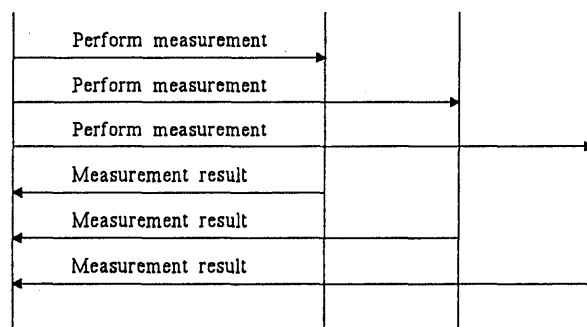
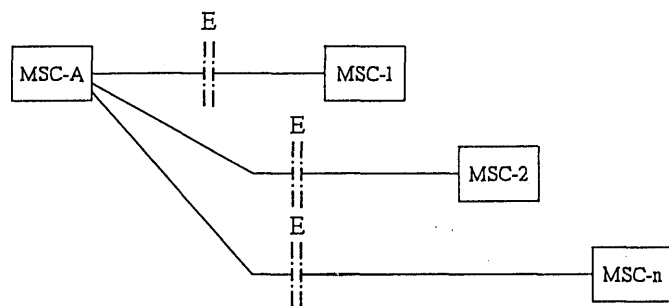
##### 3.5.2.2 Procedure for requesting measurements in another MSC

This procedure is used when the new call has to be determined by measurements in the BS in order to locate the MS. The procedure is shown in Figure 74/Q.1051.

MSC-A sends a *perform measurement* message to each MSC (MSC-1, MSC-2, ..., MSC-*n* in Figure 74/Q.1051) having cells adjacent to the cell in which the MS is located at the time of the call. The message will contain parameters required by the other MSCs to perform the measurement (e.g. channel number, additional parameters concerning the characteristics of the radio path). The requested MSCs will return the *measurement result* message containing parameters indicating the outcome of the measurement. If the measurement cannot be performed for some reason, this is also indicated to MSC-A.

##### 3.5.2.3 Basic handover procedure and procedure for requesting handover number

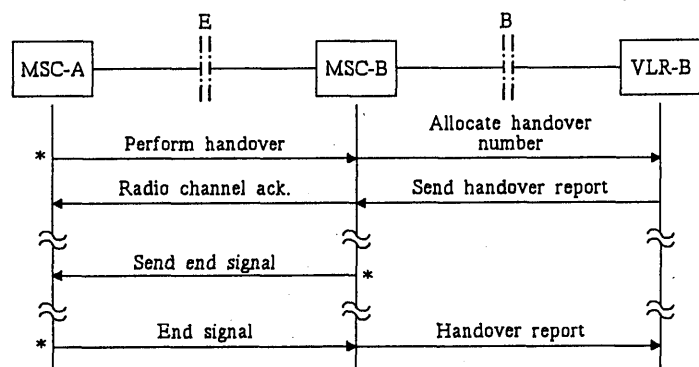
Figure 75/Q.1051 shows the MAP procedures for successful basic handover from the controlling MSC (MSC-A) to MSC-B. In the figure only messages in MAP are shown. Messages which are generated by an internal event in the MSC are indicated by an asterisk (\*).



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FIGURE 74/Q.1051

**Interfaces and procedures for requesting measurements in other MSCs**



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\* Indicates that the signal is sent as a result of another event in the MSC.

FIGURE 75/Q.1051

**Basic handover procedure; successful handover**

The procedure is as follows:

When MSC-A has decided that a call is to be handed over to MSC-B, it sends the message *perform handover* to MSC-B. This message will contain all information required by MSC-B to allocate a radio channel (e.g. base station identification, IMSI, and other information related to the call or the radio path). If handover can be performed (i.e. a radio channel can be assigned within a specified time), MSC-B requests its associate VLR to provide a mobile station roaming number which can be used for establishing the connection between MSC-A and MSC-B. The interaction with the VLR is done by exchange of the messages *allocate handover number* and *send handover report*. MSC-B will return the *radio channel acknowledge* message to MSC-A both when a new radio channel is assigned. The message will contain the new radio channel number, the mobile station roaming number and other information as specified in § 4. If there is no free radio channel, a no channel available indication is given; the handover procedure is then terminated and MSC-A maintains the existing connection with the MS.

If a radio channel has been reserved in MSC-B, MSC-A initiates the establishment of a connection between MSC-A and MSC-B through the fixed network as described in Recommendation Q.1002. The set-up of the radio path then commences.

When the radio path has been established on MSC-B, MSC-B indicates this event to MSC-A by sending the *send end signal* message. MSC-A will then retain the main control of the call until the call clears. MSC-A will then inform MSC-B by sending the *end signal* message.

*Note* - In order to support the call waiting supplementary services, the call clearing instant corresponds to the instant when the last waiting call has been cleared.

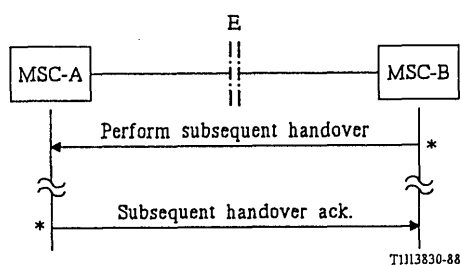
When receiving the *end signal* message, MSC-B sends the *handover report* message to its associated VLR.

MSC-A may abort the handover procedure at any time (e.g. if the call clears). This is indicated to MSC-B by *handover cancellation* message.

#### 3.5.2.4 Subsequent handover procedure

The procedure is shown in Figure 76/Q.1051 and is as follows:

When MSC-B decides that the call is to be handed back to MSC-A or to a third MSC (MSC-B'), MSC-B sends the *perform subsequent handover* message to MSC-A. MSC-A returns the *subsequent handover acknowledge* message when handover can be performed. MSC-A will also indicate if the handover cannot be performed.



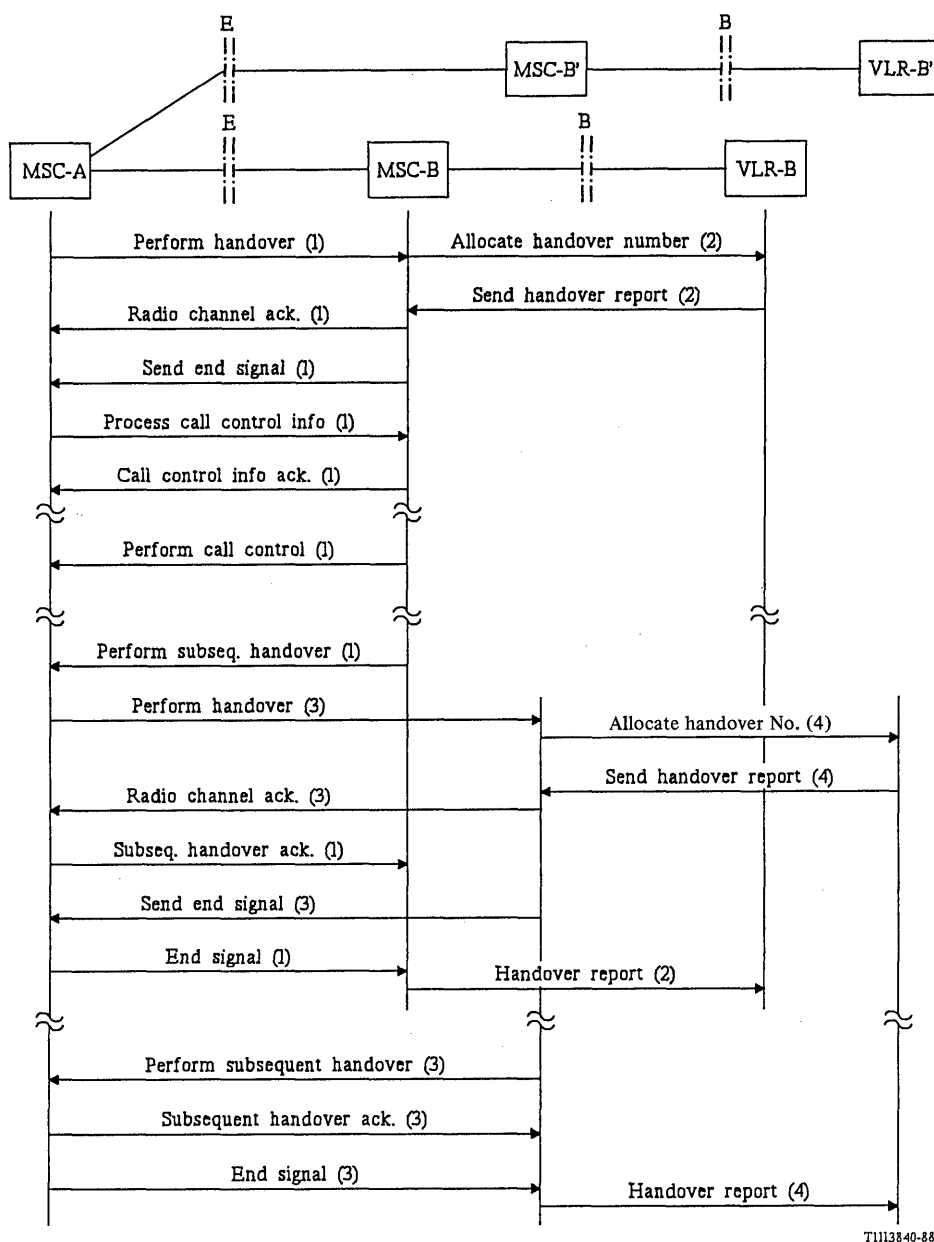
\* See Figure 75/Q.1051.

FIGURE 76/Q.1051

Successful subsequent handover

### 3.5.2.5 Example of the use of the handover procedures

If no subsequent handover takes place after the call has been handed over to MSC-B, only the basic handover procedure will be needed. If, however, a subsequent handover takes place, both the basic handover procedure and the subsequent handover procedure will be required. An example of the overall procedure is shown in Figure 77/Q.1051. In the example a basic (or first) handover is made from MSC-A to MSC-B. Then a subsequent handover is made from MSC-B to MSC-B' which in turn makes a subsequent handover back to MSC-A. This example is chosen to illustrate a sequence of handovers as well as the overlapping of operations between various entities. Messages belonging to the same transaction are indicated by a transaction number.



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FIGURE 77/Q.1051

Example of a sequence of handovers

First MSC-A requests a handover to MSC-B. This involves a basic handover procedure (transaction 1). The allocation of a handover number in VLR-B is then started (transaction 2).

Any call control information subsequently sent between MSC-A and MSC-B also belongs to transaction 1. This would also apply to any authentication messages exchanged during this transaction.

If at some stage MSC-B decides that the call is to be handed over to MSC-B', it starts a subsequent handover procedure which still belongs to transaction 1. MSC-A then initiates a basic procedure to MSC-B' (transaction 3), which in turn initiates allocation of handover number procedure to VLR-B' (transaction 4). Transaction 1 is terminated when the *send end signal* message is received from MSC-B'. MSC-B can then terminate transaction 2 towards VLR-B.

MSC-B' may then at some stage perform further subsequent handovers, e.g. to MSC-A as shown in the figure (transaction 3). A successful subsequent handover to MSC-A terminates transaction 3 (the *end signal* message to MSC-B'), which in turn is used to terminate transaction 4 towards VLR-B'.

### 3.5.2.6 Procedure for receiving call control information from the MS

The procedure is shown in Figure 78/Q.1051 a). If MSC-B receives a request from the MS during the call concerning the operation of a call control function (e.g. a request associated with a supplementary service), MSC-B maps the information received on the BS/MS interface on to a *perform call control* message which is sent to MSC-A. MSC-A does not acknowledge this message. Any response from MSC-A will start a new operation by using the procedure for providing call control information to the MS (§ 3.5.2.7). Some requests may require information retrieval either from the VLR associated with MSC-A or from the HLR of the MS.

The *perform call control* messages may provide for the following functions:

- call control request: activate supplementary service: -x;
- call control request: deactivate supplementary service: -x;
- call control request: interrogate supplementary service: -x;
- call control request: invoke supplementary service: -x;
- call control request: register supplementary service: -x;
- call control request: erase supplementary service: -x;
- call control request: authentication response;
- other, for further study.

### 3.5.2.7 Procedure for providing call control information to the MS

The procedure is shown in Figure 78/Q.1051 b). MSC-A may provide call control information to the MS by sending a *process call control information* message to MSC-B. MSC-B will acknowledge the receipt of this message by returning the *call control information acknowledge* message. MSC-B will then forward the required information to the MS. The *process call control information* message is composed in such a way that the information can be passed transparently to the MS. If the message cannot be passed to the MS, an indication is provided to MSC-A. Any response from the MS will start a new independent operation from MSC-B to MSC-A by returning a *perform call control* message. The procedure is then as in Figure 78/Q.1051 a).

The *process call control information* messages may provide for the following functions:

- call control information: charging data;
- call control information: call waiting indication;
- call control information: authentication;
- call control information: answer to a related supplementary service operation;
- other, for further study.

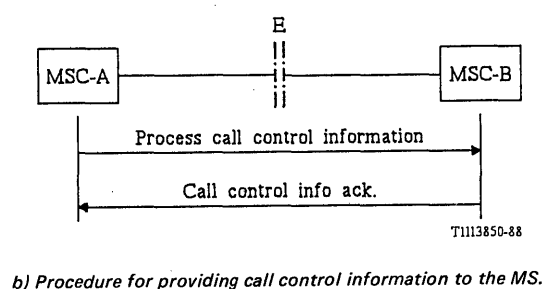
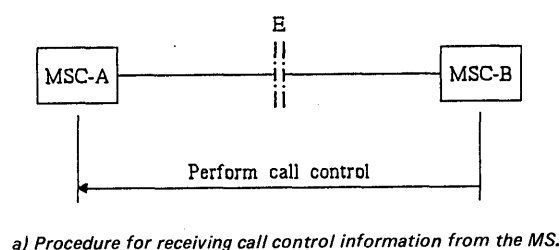


FIGURE 78/Q.1051

### Procedures for call control information transfer during handover

#### 3.5.3 Detailed description of measurement procedure

##### 3.5.3.1 Procedure in the MSC requesting the measurement

The application specific procedure is contained in Figure 79/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 80/Q.1051.

When the MSC finds that quality measurement is required in another MSC in order to initiate a handover, the MSC sends the *perform measurement* message to the other MSC. TCAP is requested to supervise the procedure by timer T-mr. The outcome can be as follows:

- a *measurement result* message is received containing the measurement result;
- a reject indication if procedure failure was detected at the remote end or by TCAP;
- a timer expiry indication if timer T-mr expires;
- a *no result* message if the other MSC cannot perform the measurement.

The *perform measurement* message is contained in a TC-INVOKE REQUEST primitive. The outcome is reported as follows:

- the *measurement result* message is contained in a TC-RESULT-L INDICATION primitive;

- a TC-(U)-REJECT INDICATION primitive will contain the reason for rejecting the operation;
- expiry of timer T-mr is indicated by a TC-L-CANCEL INDICATION primitive;
- negative outcome is reported in a TC-U-ERROR INDICATION primitive as follows:
  - i) no result indicates that the remote MSC was not able to perform the measurement.

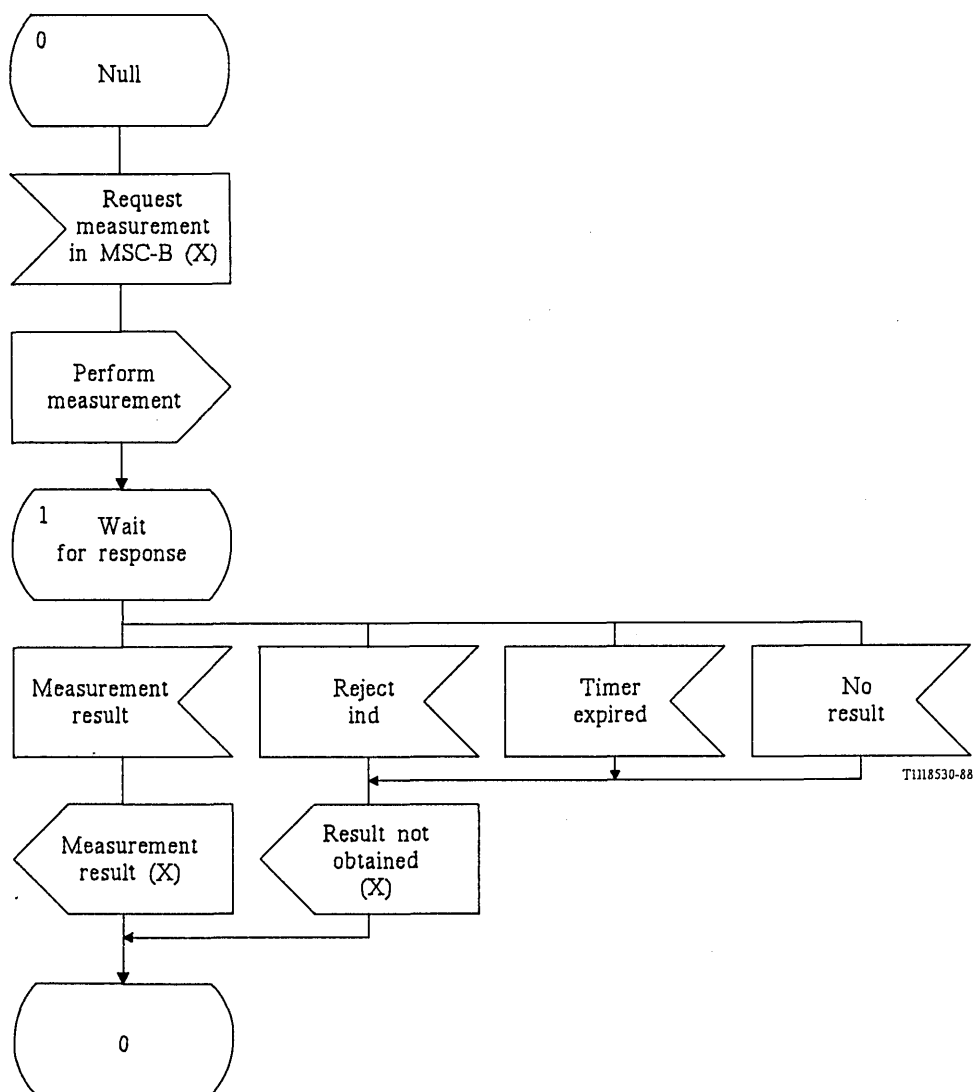


FIGURE 79/Q.1051

**Application specific procedure in the MSC requesting measurement of channel quality**

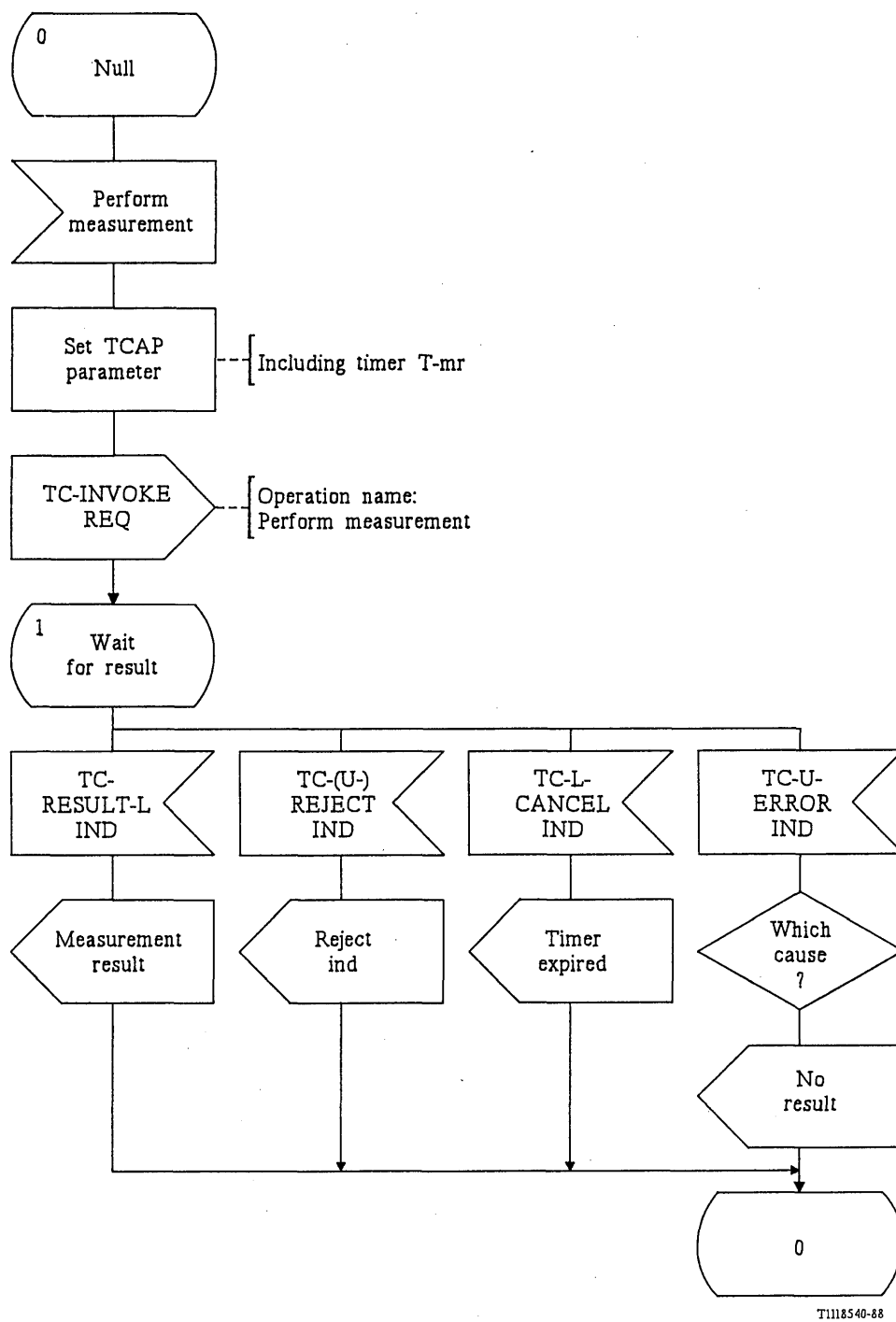


FIGURE 80/Q.1051

ASE/TCAP interface procedure in the MSC requesting measurement of channel quality



### 3.5.3.2 Procedure in the MSC being requested to perform the measurement

The application specific procedure is shown in Figure 81/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 82/Q.1051.

When receiving a *perform measurement* message the MSC will initiate the required function. This will involve functions in the MSC not considered in this Recommendation.

The measurement result is returned in the *measurement result* message. If the MSC cannot perform the measurement (e.g. equipment temporarily not available), a *no result* message is returned.

The *perform measurement* is received in a TC-INVOKE INDICATION primitive. The results are returned as follows:

- the *measurement result* message is sent in a TC-RESULT-L REQUEST primitive;
- a procedure failure is reported in a TC-U-REJECT REQUEST primitive;
- a negative result is sent in a TC-U-ERROR REQUEST primitive as follows:
  - i) no result indicates that the MSC is unable to perform the measurement.

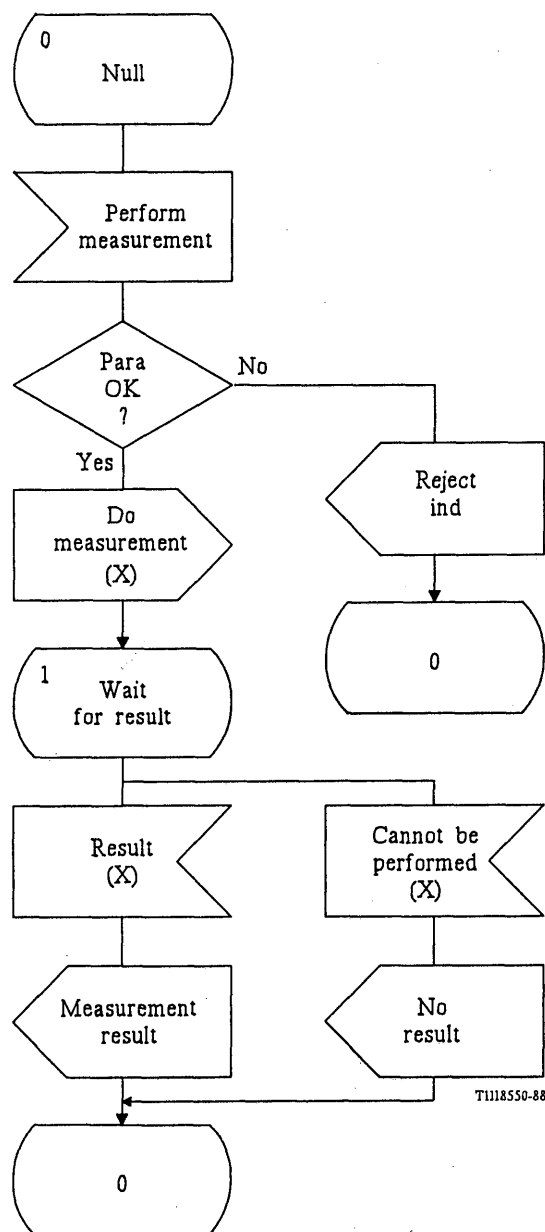


FIGURE 81/Q.1051

Application specific procedure in the MSC being requested to measure the channel quality

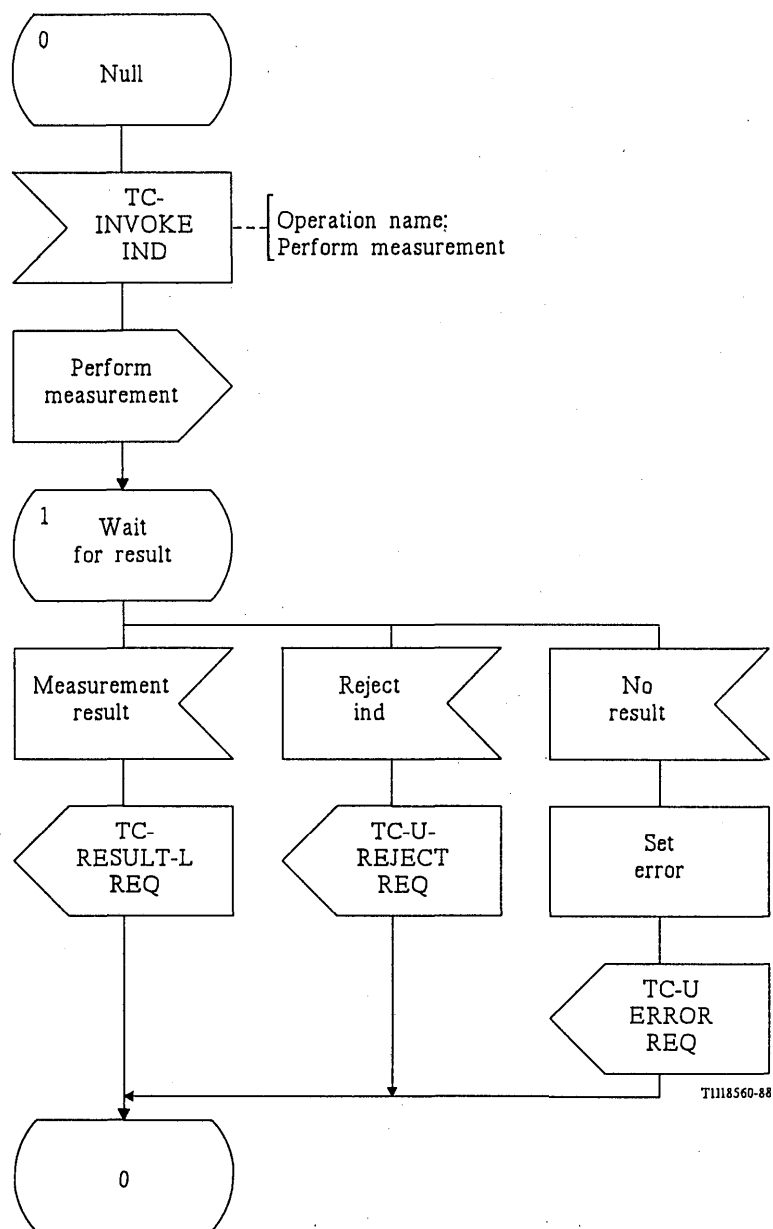


FIGURE 82/Q.1051

**ASE/TCAP interface in the MSC being requested to measure the channel quality**

3.5.4 Detailed procedures for handover

3.5.4.1 Procedures in MSC-A

3.5.4.1.1 Basic handover procedure

The application specific procedure for basic handover is shown in Figure 83/Q.1051. The ASE/TCAP interface procedure is shown in Figure 84/Q.1051.

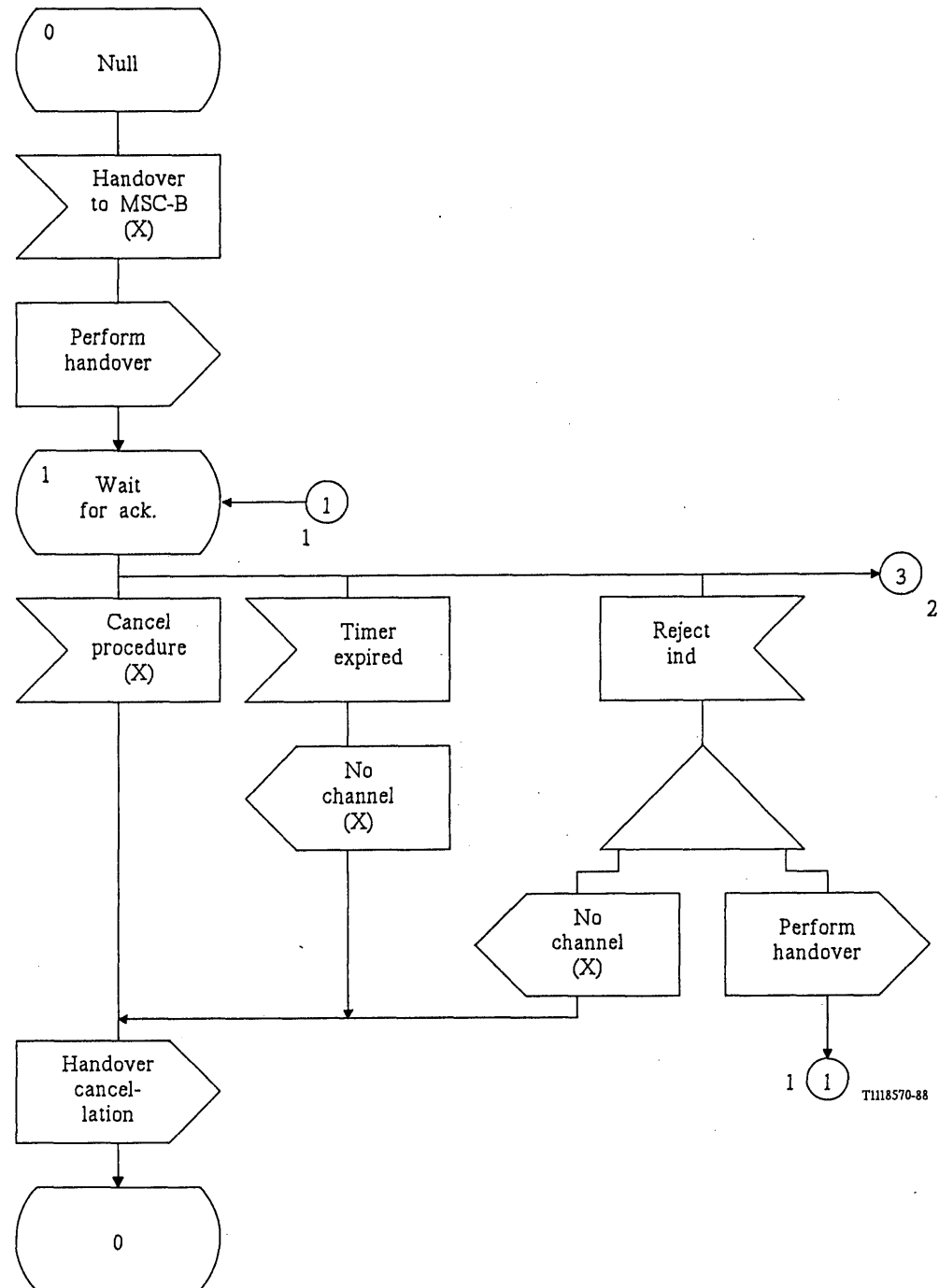


FIGURE 83/Q.1051 (sheet 1 of 3)

Application specific procedure in MSC-A for basic handover

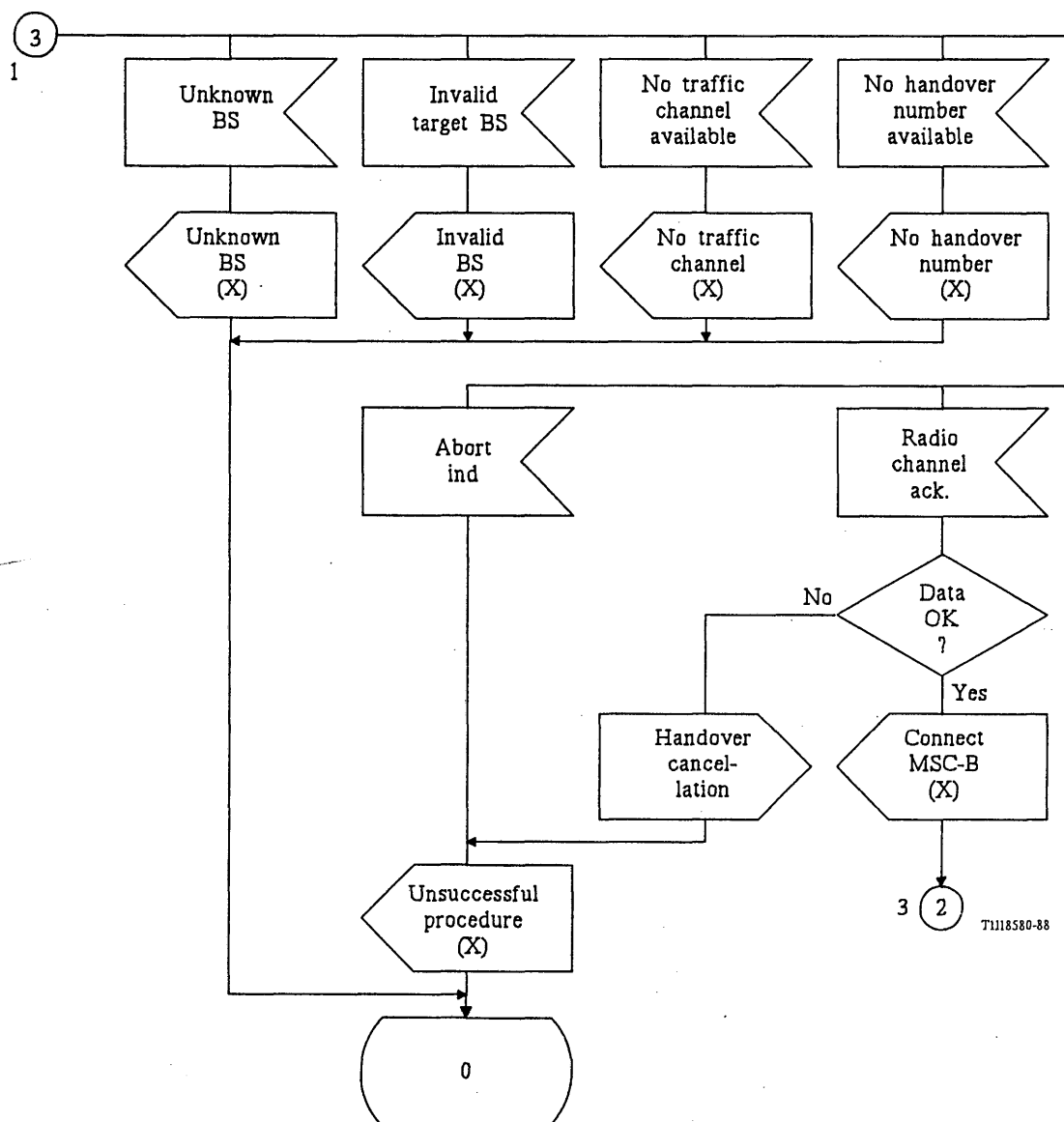


FIGURE 83/Q.1051 (sheet 2 of 3)

Application specific procedure in MSC-A for basic handover

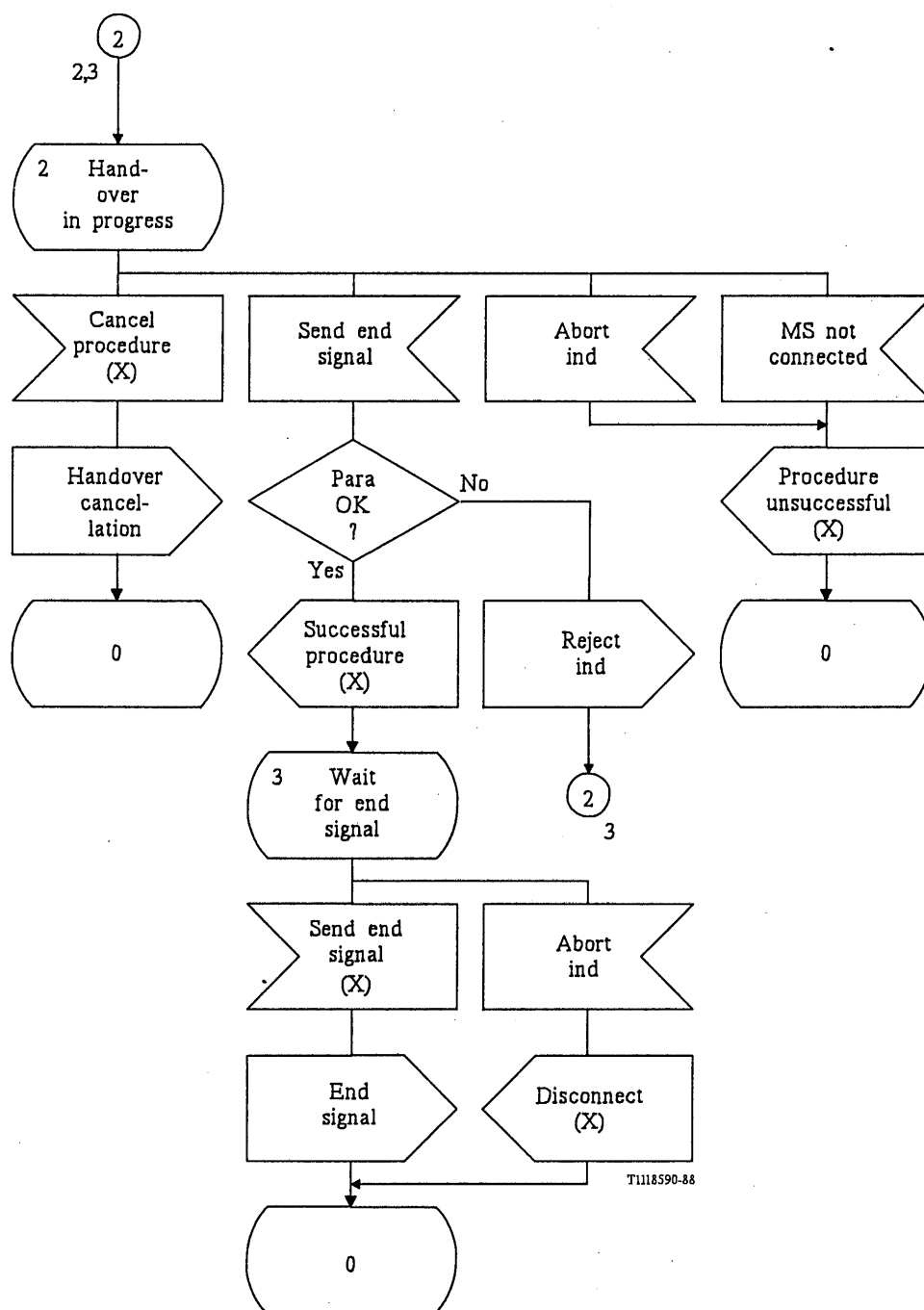


FIGURE 83/Q.1051 (sheet 3 of 3)

Application specific procedure in MSC-A for basic handover

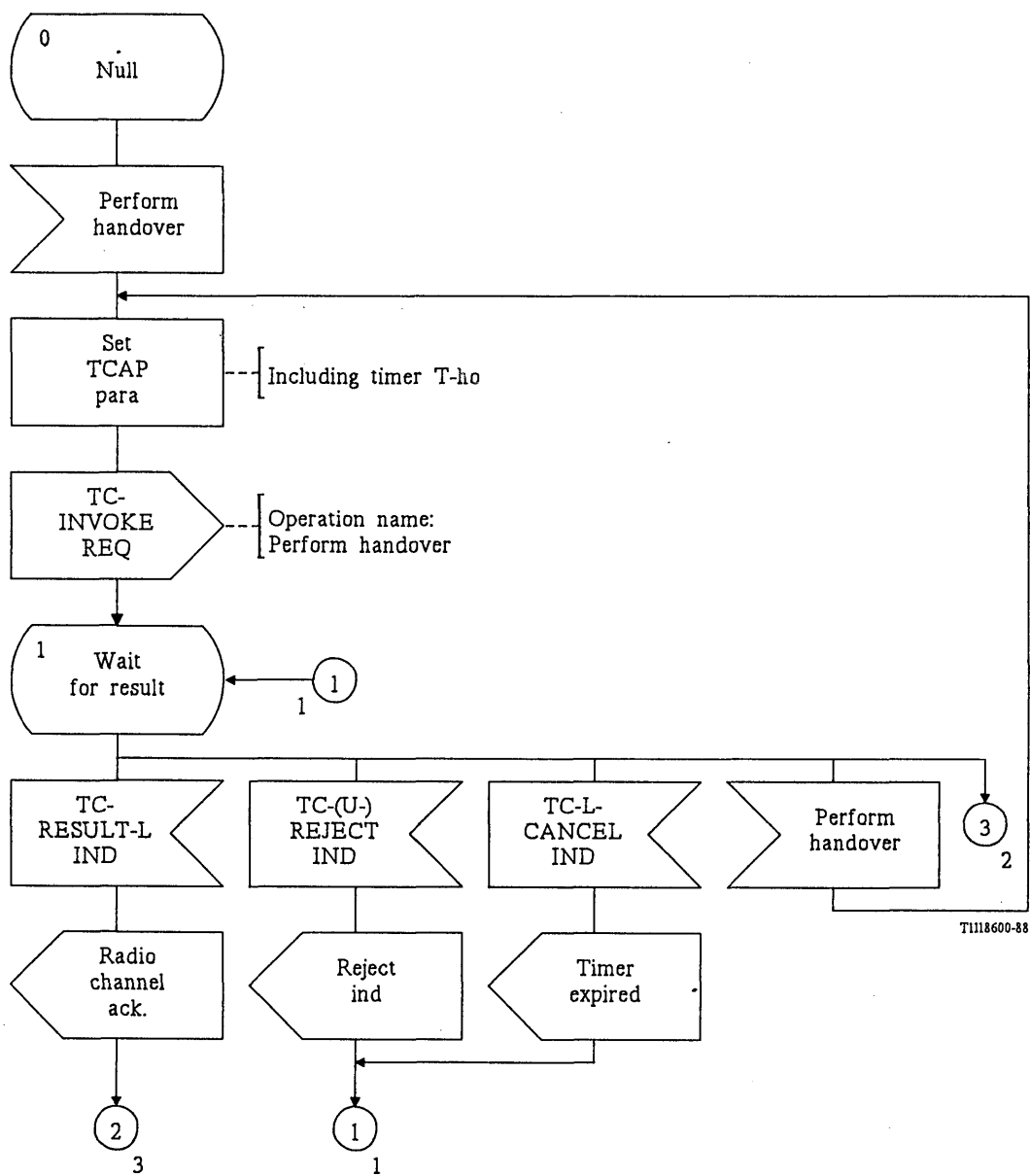


FIGURE 84/Q.1051 (sheet 1 of 3)

ASE/TCAP interface procedure in MSC-A for basic handover

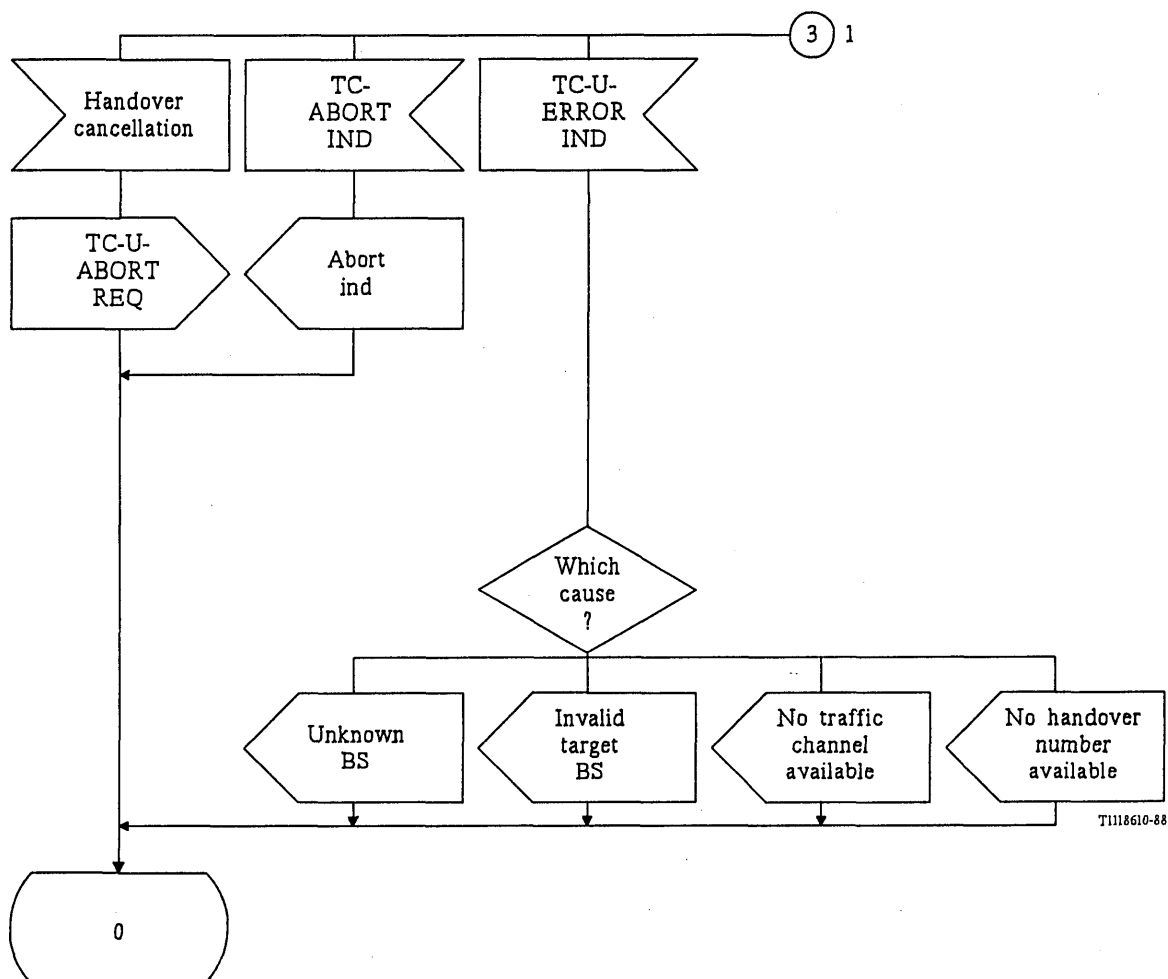


FIGURE 84/Q.1051 (sheet 2 of 3)

ASE/TCAP interface procedure in MSC-A for basic handover



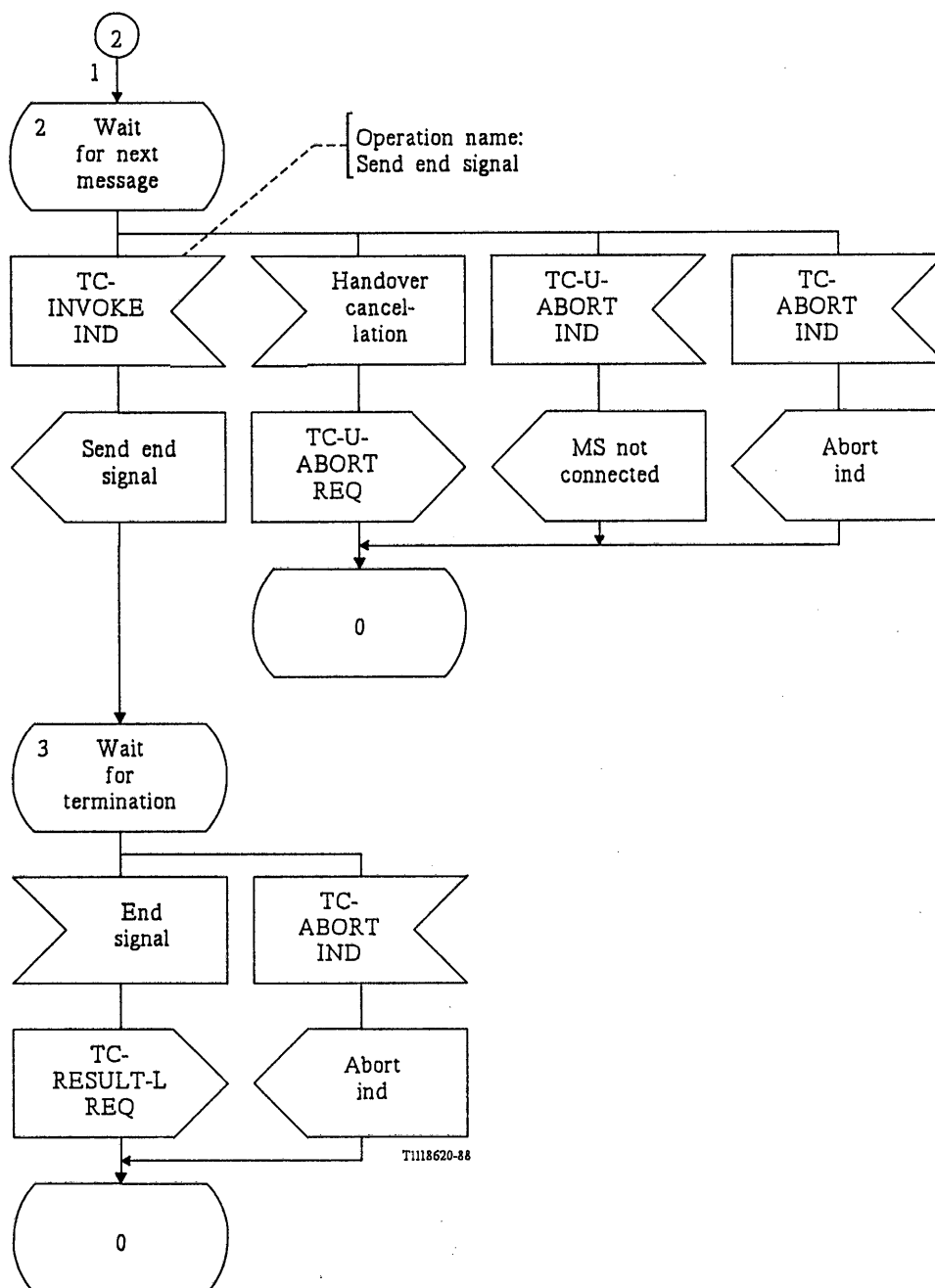


FIGURE 84/Q.1051 (sheet 3 of 3)

#### ASE/TCAP interface procedure in MSC-A for basic handover

The handover control function will initiate the basic handover procedure (handover to MSC-B signal). MSC-A then sends the *perform handover* message to MSC-B. The response can be as follows:

If a *radio channel acknowledge* message is received without parameter errors, the required information is provided to the handover control function in the connect MSC-B(X) signal. If the message contains parameter errors, a *handover cancellation* message is sent to MSC-B and the procedure is terminated.

If a timer expires indication is received, a no channel indication is provided to the handover control function and a *handover cancellation* message is sent to MSC-B.

If a reject indication is received, two alternative procedures are indicated:

- MSC-A may either terminate the operation by sending a *handover cancellation* message to MSC-B; or
- retransmit the *perform handover* message.

Negative results may also be received. If so, the procedure is terminated and the result is provided to the handover control function.

When a radio channel has been allocated in MSC-B, MSC-A waits for the *send end signal* message. If the parameters in this message are accepted, an indication is provided to the handover control function. In case of parameter errors MSC-A sends a reject indication to MSC-B but does not terminate the procedure since MSC-B may retransmit the message.

The *MS not connected* message may also be received. In this case the procedure is terminated.

The procedure is terminated when ASE receives the send end signal indication from the handover control function. Then the *end signal* message is sent to MSC-B. If an abort indication is received in any state, the procedure is terminated.

The *perform handover* message is sent in a TC-INVOKE REQUEST primitive and the *radio channel acknowledge* message is received in a TC-RESULT-L INDICATION primitive. The procedure is supervised by timer T-ho. MSC-A may also receive a TC-(U)-REJECT INDICATION primitive, a TC-ABORT INDICATION primitive, a TC-L-CANCEL INDICATION primitive (including expiry of timer T-ho), or a TC-U-ERROR INDICATION primitive with cause indications as follows:

- i) unknown BS;
- ii) invalid target BS;
- iii) no traffic channel available;
- iv) no handover number available.

The operation will be terminated if a *handover cancellation* message is sent. This message is sent in a TC-U-ABORT REQUEST primitive. The *perform handover* message may also be retransmitted as shown in Figure 84/Q.1051.

The *send end signal* message will be included in a TC-INVOKE INDICATION primitive. The *end signal* message will then be sent as a TC-RESULT-L REQUEST primitive.

*Note* - In the interval between sending of the *perform handover* message and sending of the *end signal* message, the procedures described in §§ 5.5.4.1.2 and 5.5.5 may be required. They will then be sent in TC primitives with TC-CONTINUE primitives for dialogue handling.

#### 3.5.4.1.2 Subsequent handover procedure

The application specific procedure for subsequent handover is shown in Figure 85/Q.1051 and the corresponding ASE/TCAP interface procedure is shown in Figure 86/Q.1051.

When receiving a valid *perform subsequent handover* message, an indication is provided to the handover control function. This indication will include information whether the handover is to MSC-A or to MSC-B'. The result received from the handover function can be:

- send acknowledge (X) which causes the transmission of the *subsequent handover acknowledge* message;
- a negative result indicating either of the following events: unknown MSC, unknown BS, invalid target BS or subsequent handover failure (e.g. no radio channel, mobile station roaming number not allocated or unsuccessful establishment of the connection to MSC-B').

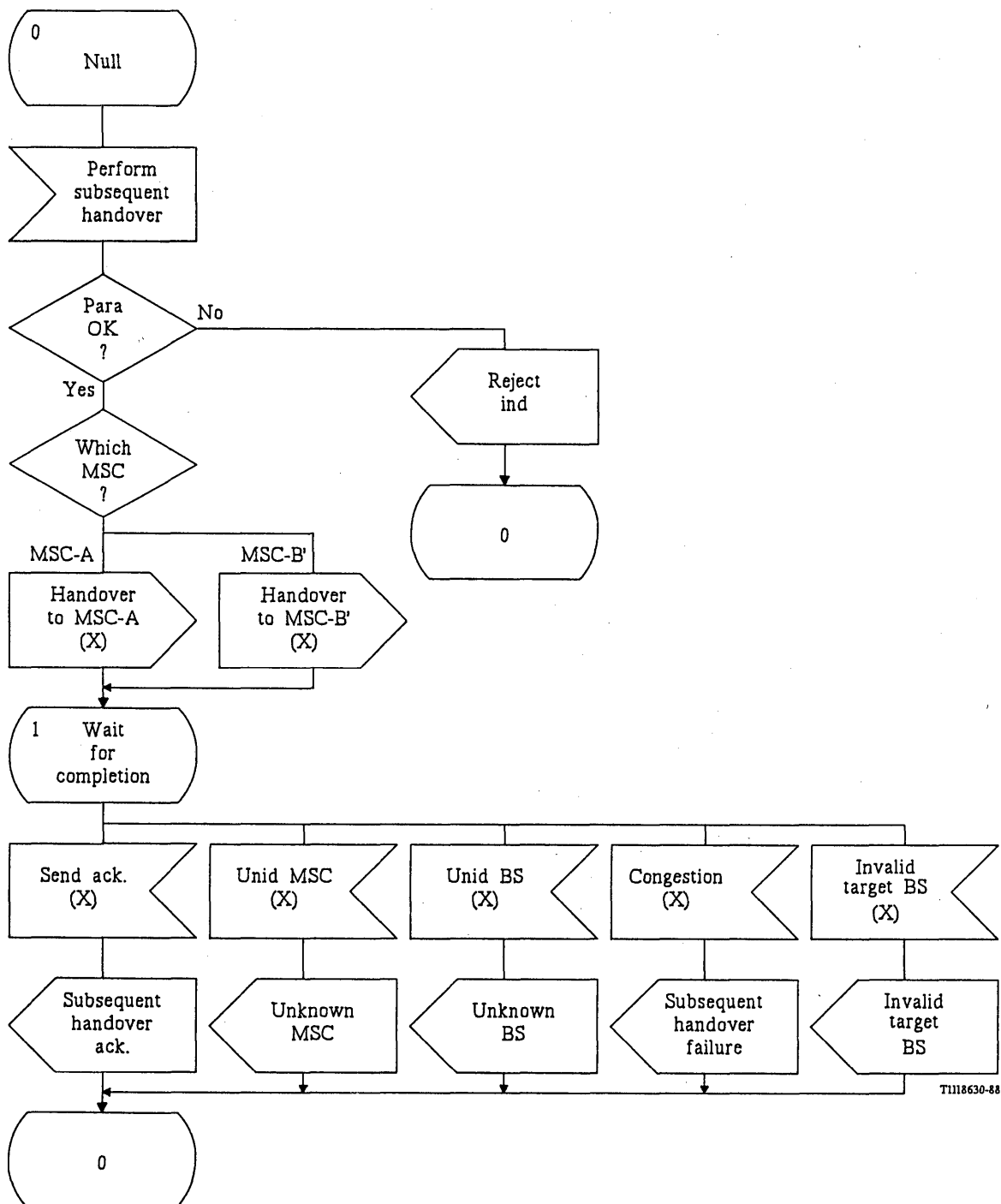


FIGURE 85/Q.1051

Application specific procedure in MSC-A for subsequent handover

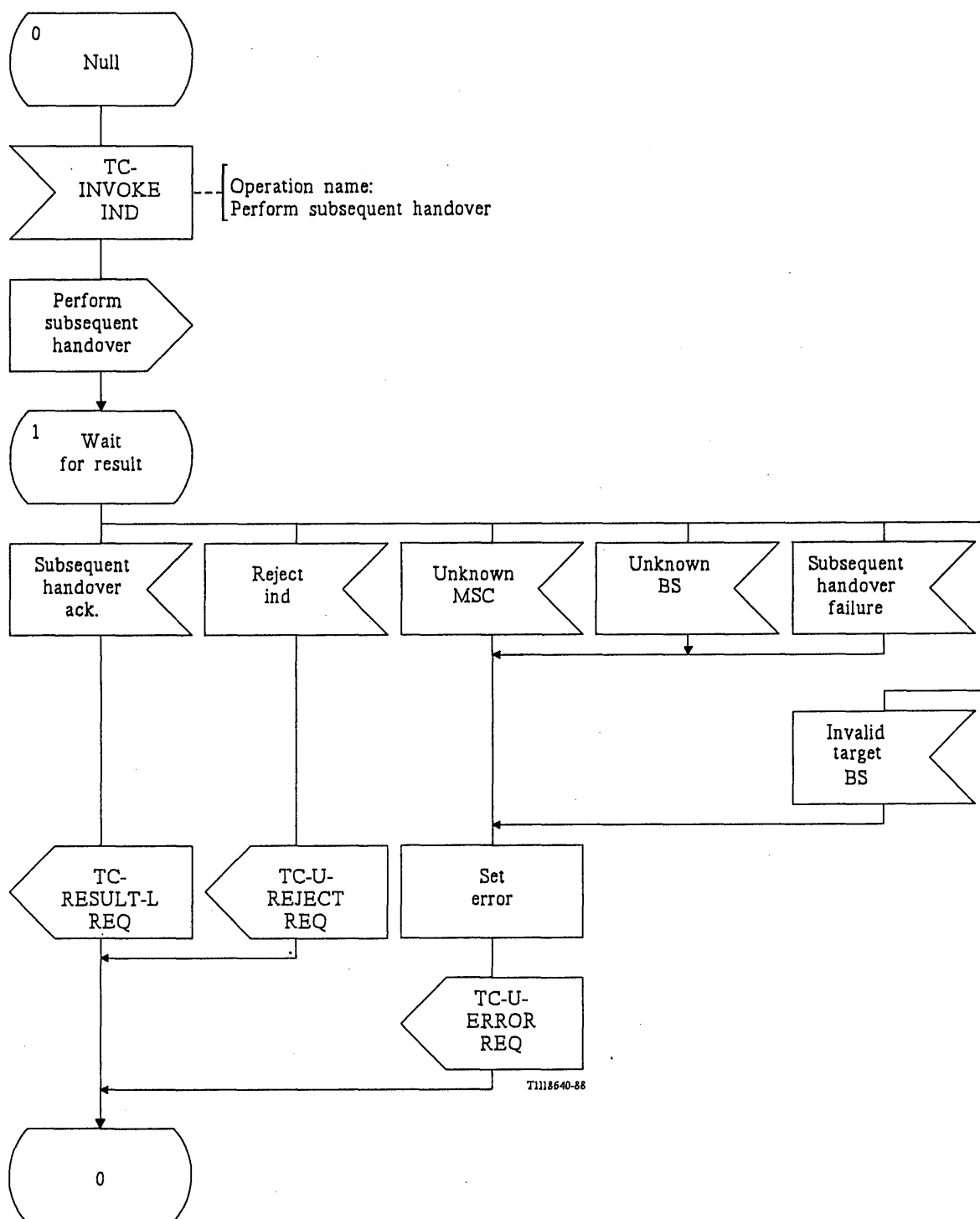


FIGURE 86/Q.1051

ASE/TCAP interface procedure in MSC-A for subsequent handover

The reject indication will also be provided if the subsequent handover request concerns an MS which has no current connections in MSC-A. This is regarded as being part of the parameter checking.

The *perform subsequent handover* message is received in a TC-INVOKE INDICATION primitive. The outcome of the procedure is returned as follows:

- the *subsequent handover acknowledge* message is sent in a TC-RESULT-L REQUEST primitive;
- a reject indication is provided as a TC-U-REJECT REQUEST primitive;
- unsuccessful events are returned in a TC-U-ERROR REQUEST primitive as follows:
  - i) unknown BS, if the BS to which the call is to be handed over does not exist;
  - ii) unknown MSC, when a subsequent handover is requested to an unidentified (or non-existent) MSC;
  - iii) subsequent handover failure indicating no traffic channel, connection to MSC-B' not established or mobile station roaming number not allocated;
  - iv) invalid target BS, if handover is not allowed to the indicated BS.

The dialogue handling primitive is TC-CONTINUE since the subsequent handover procedure uses the same transaction as the basic handover procedure.

#### 3.5.4.2 Procedures in MSC-B

##### 3.5.4.2.1 Basic handover procedure

The application specific procedure is shown in Figure 87/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 88/Q.1051.

The application specific procedure is as follows. When a valid *perform handover* message is received, the handover control function is requested to allocate a radio channel and initiate allocation of handover number. The required information is contained in a send acknowledge (X) signal which is sent to MSC-A in a *radio channel acknowledge* message. Negative results may also be returned (see below under the description of the ASE/TCAP interface).

When an indication that the MS has been connected is received from the handover control function, the *send end signal* message is sent. MSC-B will then wait for the receipt of the *end signal* message from MSC-A. A timer expiry indication may also be received indicating that the overall control procedure between MSC-A and MSC-B have failed. The procedure is then terminated.

At any stage MSC-B may receive a *handover cancellation* message. MSC-B will then terminate the procedure with the appropriate indication provided to the handover control function. The same applies when receiving a reject indication, except in state 3 where the *send end signal* message is retransmitted.

The *perform handover* message is contained in a TC-INVOKE INDICATION primitive. The successful result of this invoke (the *radio channel acknowledge* message) is returned in a TC-RESULT-L REQUEST primitive. Unsuccessful events terminate the procedure and are reported as follows:

- a procedure failure is sent in a TC-U-REJECT REQUEST primitive;
- a negative result is sent in a TC-U-ERROR REQUEST primitive as follows:
  - i) unknown BS, i.e. the BS identity is not used in MSC-B;
  - ii) invalid target BS, i.e. handover is not allowed to the indicated BS;
  - iii) subsequent handover failure, i.e. congestion on the radio path, the VLR of MSC-B was unable to allocate a handover number, or the procedure between MSC-B and the VLR failed.

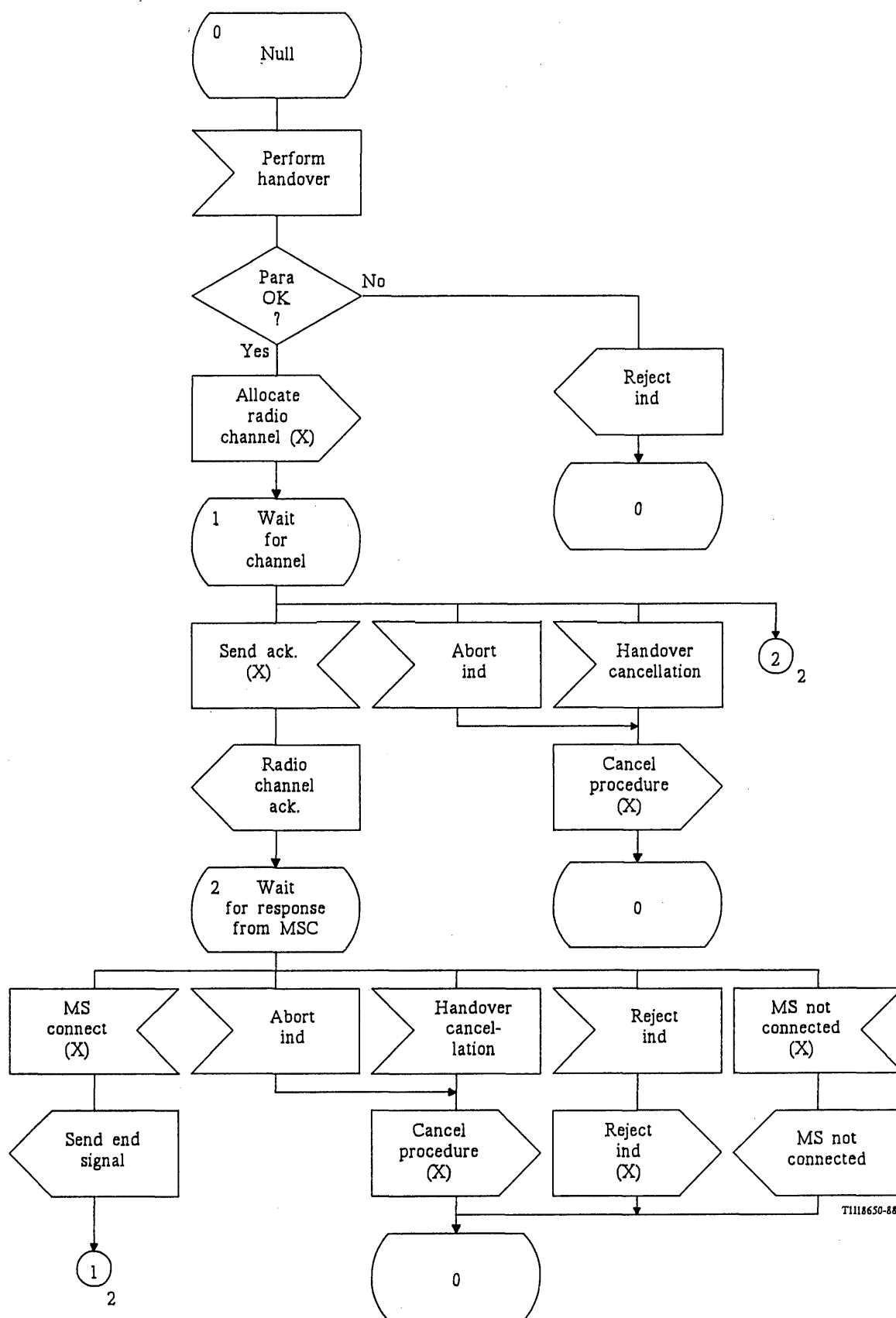


FIGURE 87/Q.1051 (sheet 1 of 2)

Application specific procedure in MSC-B for basic handover

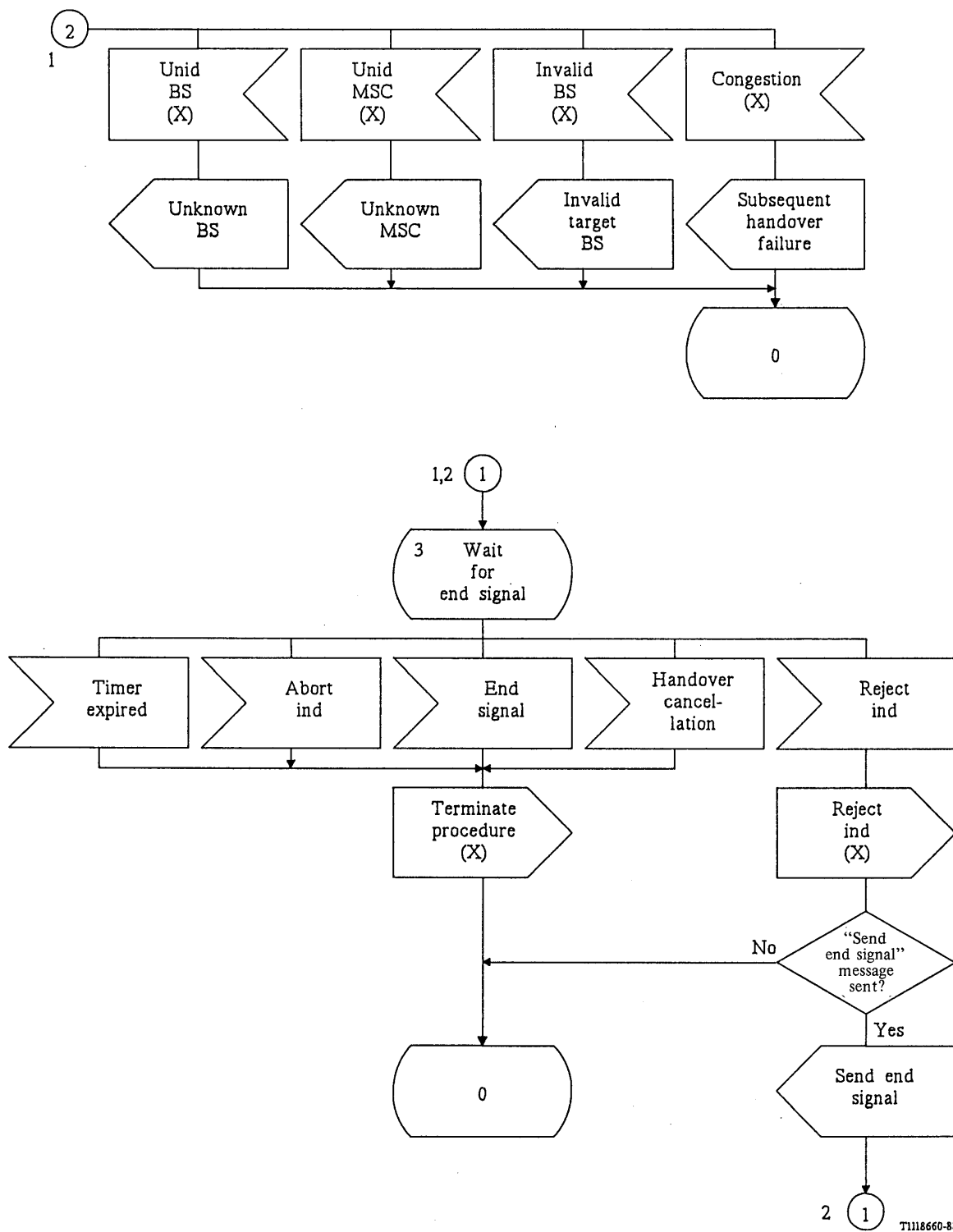
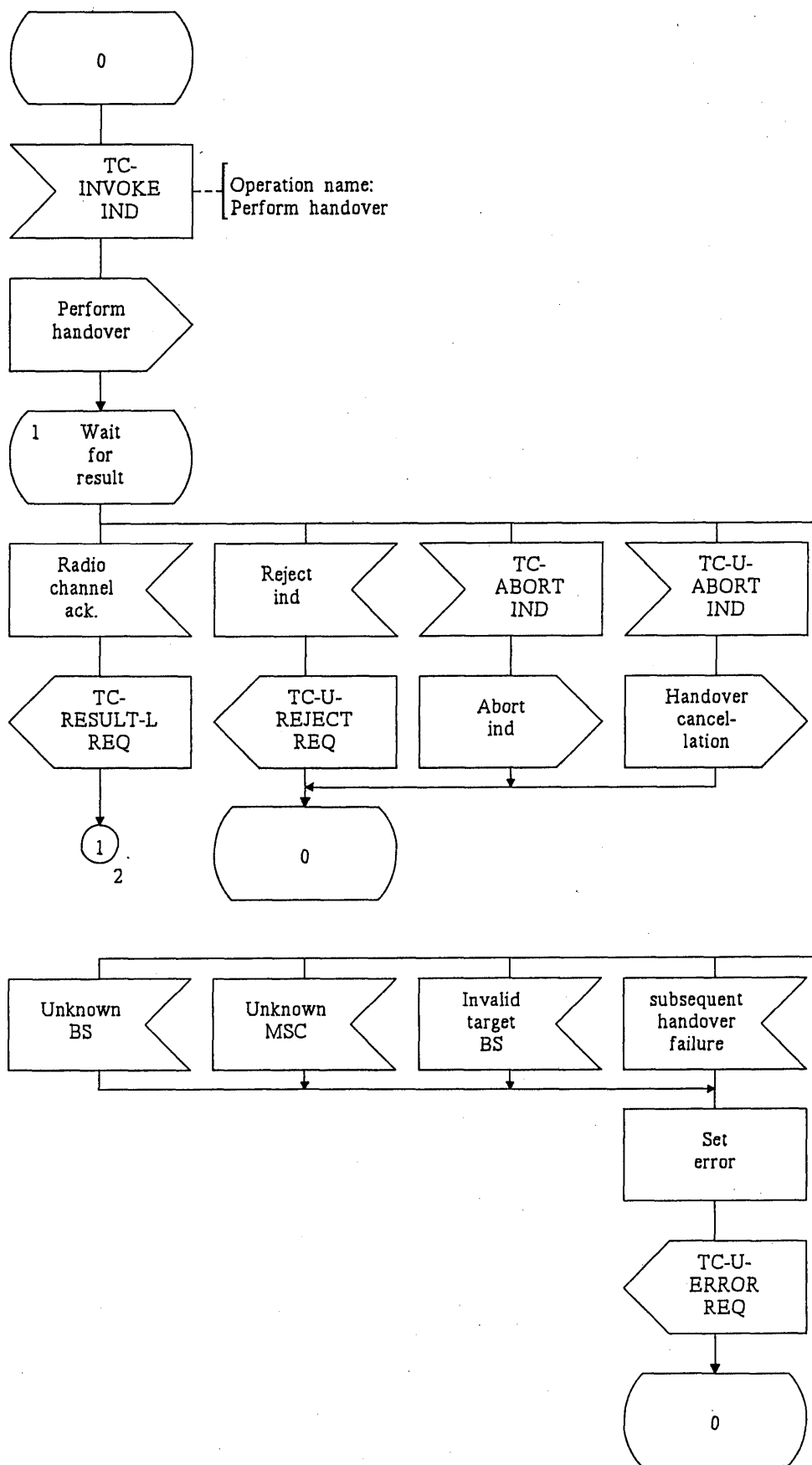


FIGURE 87/Q.1051 (sheet 2 of 2)

Application specific procedure in MSC-B for basic handover



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FIGURE 88/Q.1051 (sheet 1 of 2)

ASE/TCAP interface procedure in MSC-B for basic handover



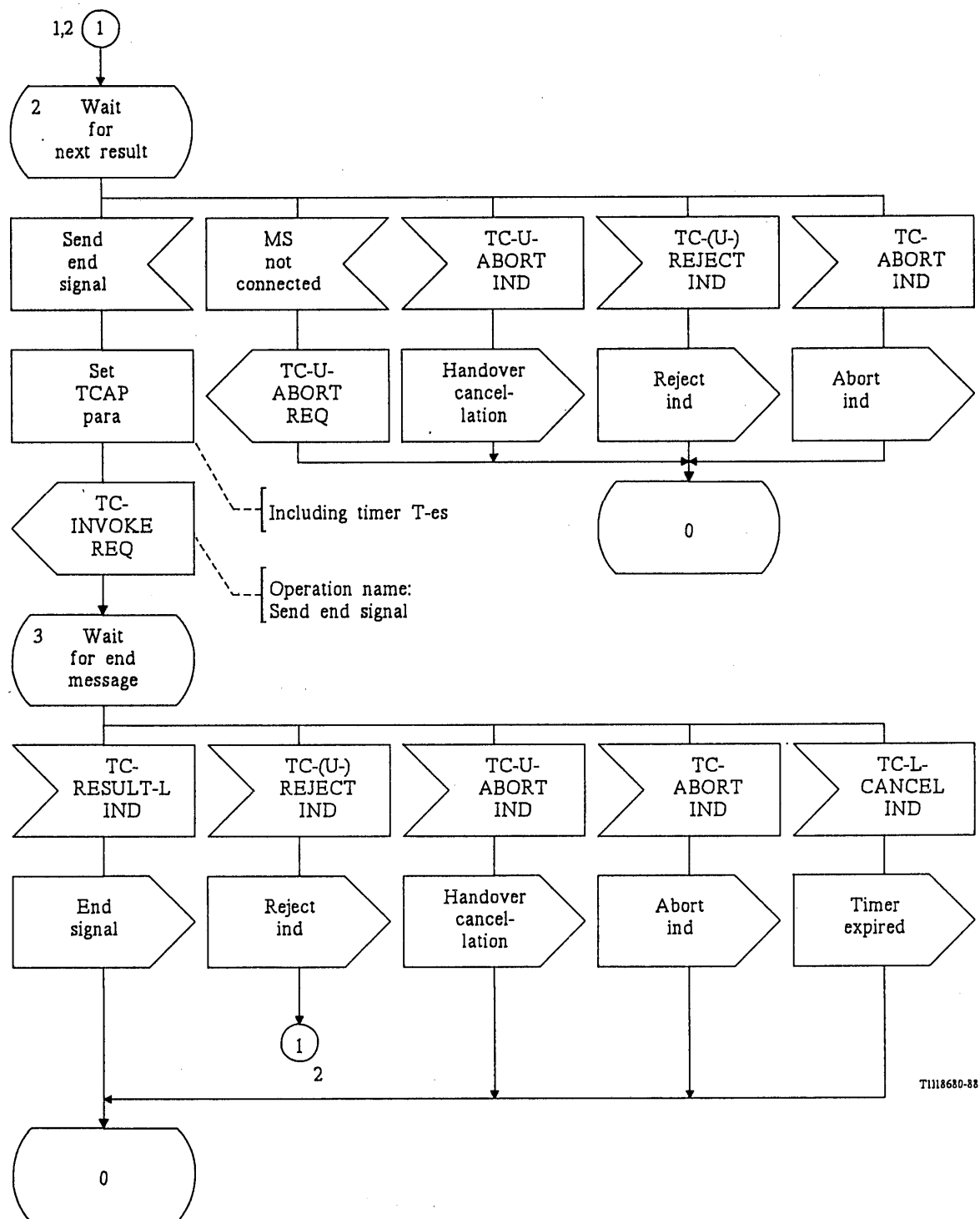


FIGURE 88/Q.1051 (sheet 2 of 2)

ASE/TCAP interface procedure in MSC-B for basic handover

The *send end signal* message is returned in a TC-INVOKE-L REQUEST primitive. The invoke is initiated by a TC-CONTINUE REQUEST primitive. The procedure is supervised by timer T-es which is required to avoid long term blocking of circuits between MSC-A and MSC-B. If MSC-B is unable to connect the MS, the *MS not connected* message is sent in a TC-U-ABORT REQUEST primitive. The *end signal* message is received in a TC-RESULT-L INDICATION primitive. Expiry of timer T-es is reported in a TC-L-CANCEL INDICATION primitive. TC-ABORT INDICATION primitives may also be received.

The *handover cancellation* message is received in a TC-U-ABORT INDICATION primitive.

If a TC-(U)-REJECT INDICATION primitive is received in response to the TC-INVOKE-L REQUEST primitive, MSC-B will retransmit the *send end signal* message as indicated.

#### 3.5.4.2.2 Subsequent handover

The application specific procedure is shown in Figure 89/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 90/Q.1051.

The handover control function will request initiation of the procedure. The *perform subsequent handover* message is sent to MSC-A. This message will contain the identity of the new MSC and the BS to which the call is to be handed over. MSC-B will receive the *subsequent handover acknowledge* message indicating the new radio channel number if the subsequent handover can be performed. If the handover cannot be performed, MSC-B will receive either of the following messages:

- *unknown BS;*
- *unknown MSC;*
- *invalid target BS;*
- *subsequent handover failure.*

If a reject indication or a timer expired indication is received (in TC-(U)-REJECT and TC-L-CANCEL INDICATION primitives, respectively), MSC-B may retransmit the *perform subsequent handover* message.

The *perform subsequent handover* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-sko. The *subsequent handover acknowledge* is received in a TC-RESULT-L INDICATION primitive.

Negative results are received in TC-U-ERROR INDICATION primitives as follows:

- i) unknown BS, i.e. the BS indicated in the *perform subsequent handover* message does not exist;
- ii) unknown MSC, i.e. the indicated MSC does not exist or is unknown to MSC-A;
- iii) subsequent handover failure, i.e. either congestion on the radio path, connection to MSC-B' cannot be established or one of the subsequent procedures failed;
- iv) invalid target BS, i.e. handover is not allowed to the indicated BS.

#### 3.5.4.2.3 Allocation of handover number

The application specific procedure is shown in Figure 91/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 92/Q.1051.

The handover control function will request retrieval of the handover number. The *allocate handover number* message is sent to the VLR. The normal reply from the VLR will be the *send handover report* message. Other events may also occur:

- the *no handover number available* message is received if the VLR cannot allocate a handover number;
- the reject indicator is received if the VLR or TCAP detects procedure errors;

- the request may be cancelled by the handover control function, or timer T-ahn may expire. In both cases a *cancel request* message is sent to the VLR;
- the abort indicator is received. In this case the procedure is terminated.

If the *send handover report* message contains procedure errors, a reject indication is provided to the VLR.

MSC-B will send the *send handover report* message when this is indicated by the handover control function.

The *allocate handover number* message is sent in a TC-INVOKE REQUEST primitive and the *send handover report* message is received in a TC-INVOKE-L INDICATION primitive preceded by a TC-CONTINUE INDICATION primitive. The *handover report* message is then sent in a TC-RESULT-L REQUEST primitive.

TCAP is requested to supervise the procedure by timer T-ahn. If T-ahn expires before the *send handover report* message is received, the procedure is terminated by the *cancel request* message. If T-ahn expires after the *send handover report* message has been received, the event is ignored.

Other events are treated as follows:

- a reject indication from the VLR or TCAP is received in a TC-(U)-REJECT INDICATION primitive;
- a negative result is received in a TC-U-ERROR INDICATION primitive as follows:
  - i) no handover number available;
- a reject indication from MSC-B is sent in a TC-U-REJECT REQUEST primitive;
- a *cancel request* message is sent in a TC-U-ABORT REQUEST primitive;
- an abort indication may be received in a TC-ABORT INDICATION primitive.

#### 3.5.4.3 Procedure in VLR for allocation of handover number

The application specific procedure is contained in Figure 93/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 94/Q.1051.

When receiving the *allocate handover number* message the VLR will return:

- a *send handover report* message if the procedure is successful;
- a *no handover number available* message if there is no number available;
- a reject indicator if there are parameter errors in the message.

The handover number will be removed if either of the following subsequent messages are received from MSC-B:

- the *handover report* message;
- a reject indication (reporting parameter error in the *send handover report* message);
- a *cancel request* message;
- an abort indication;
- a timer expired indication (timer T-hr).

The *allocate handover number* message is received in a TC-INVOKE INDICATION primitive and the *send handover report* message is returned in a TC-INVOKE-L REQUEST primitive with a TC-CONTINUE REQUEST primitive for dialogue handling. TCAP is requested to supervise the procedure by timer T-hr. A reject indication is sent in a TC-U-REJECT REQUEST primitive and the *no handover number available* is sent in a TC-U-ERROR REQUEST primitive.

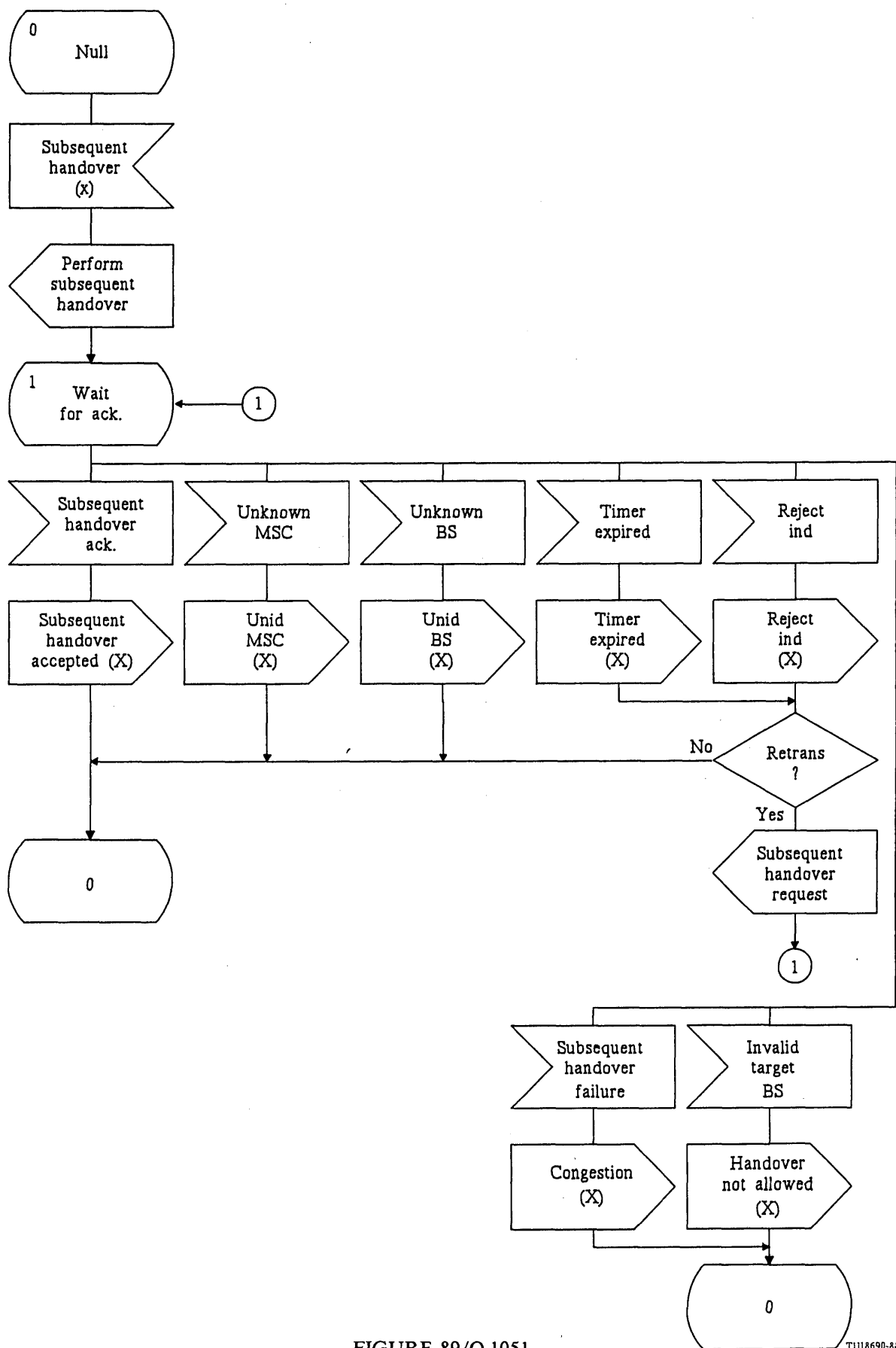


FIGURE 89/Q.1051

Application specific procedure.in MSC-B for subsequent handover

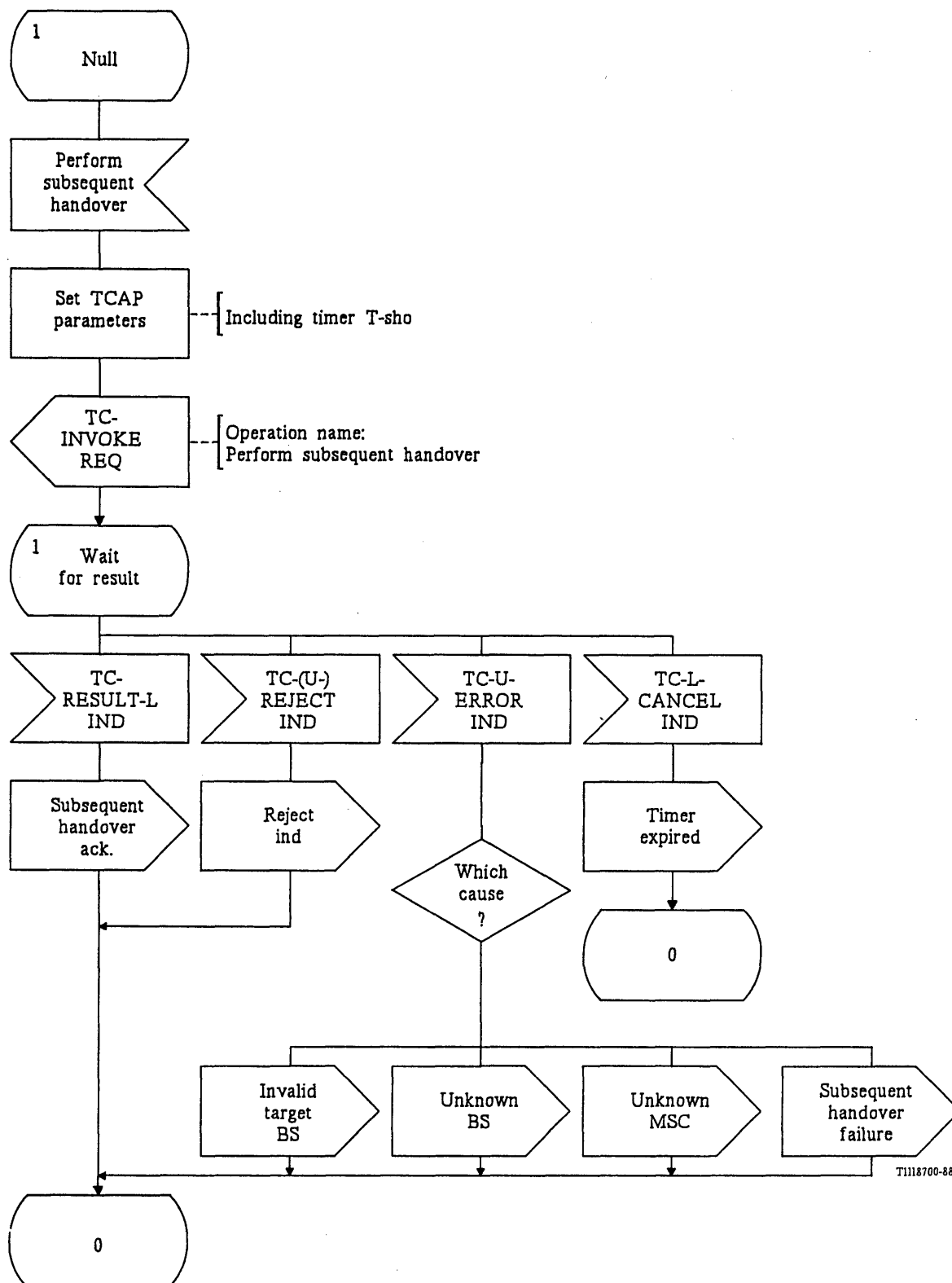
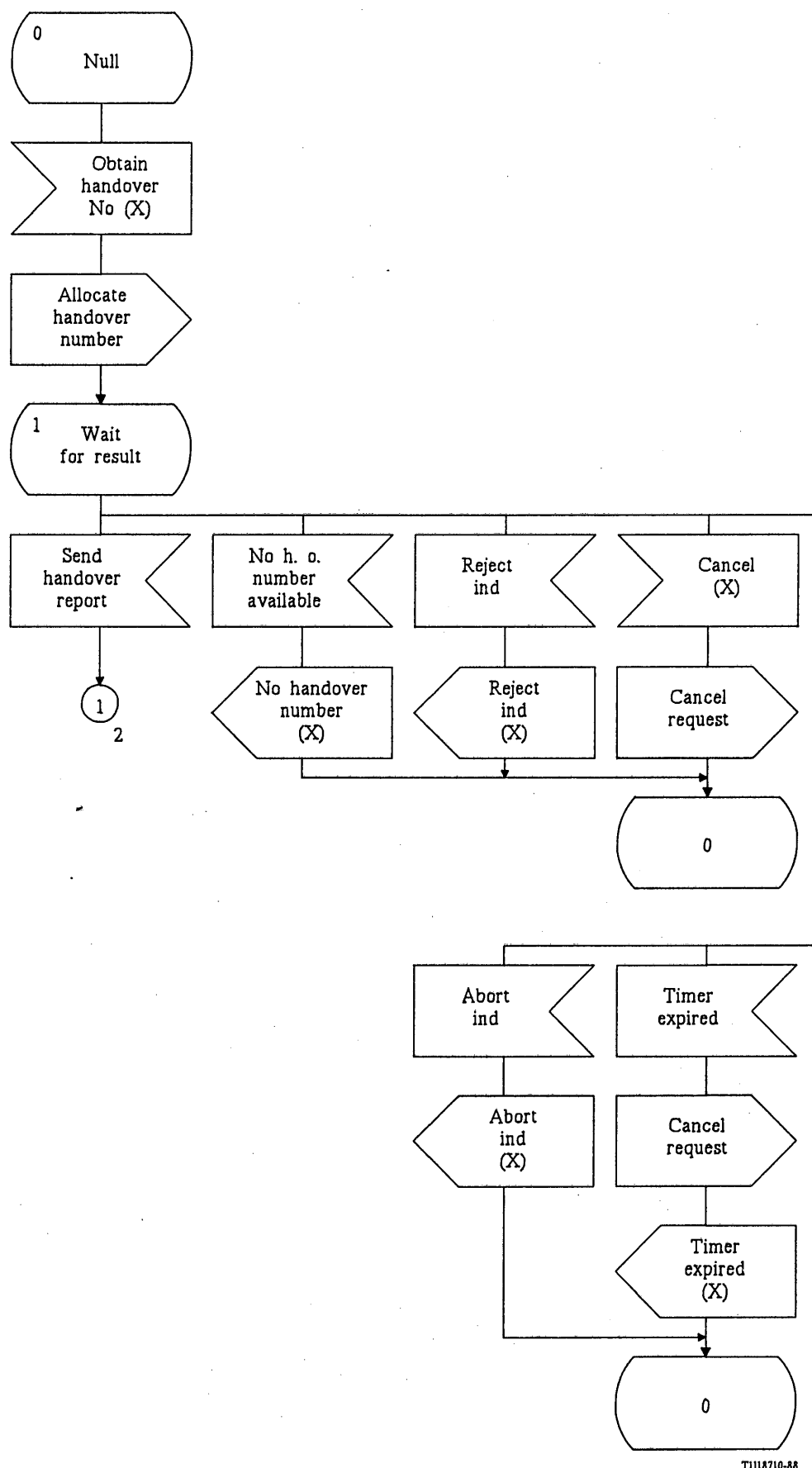


FIGURE 90/Q.1051

ASE/TCAP interface procedure in MCS-B for subsequent handover



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FIGURE 91/Q.1051 (sheet 1 of 2)

Application specific procedure in MSC-B for allocation of handover number

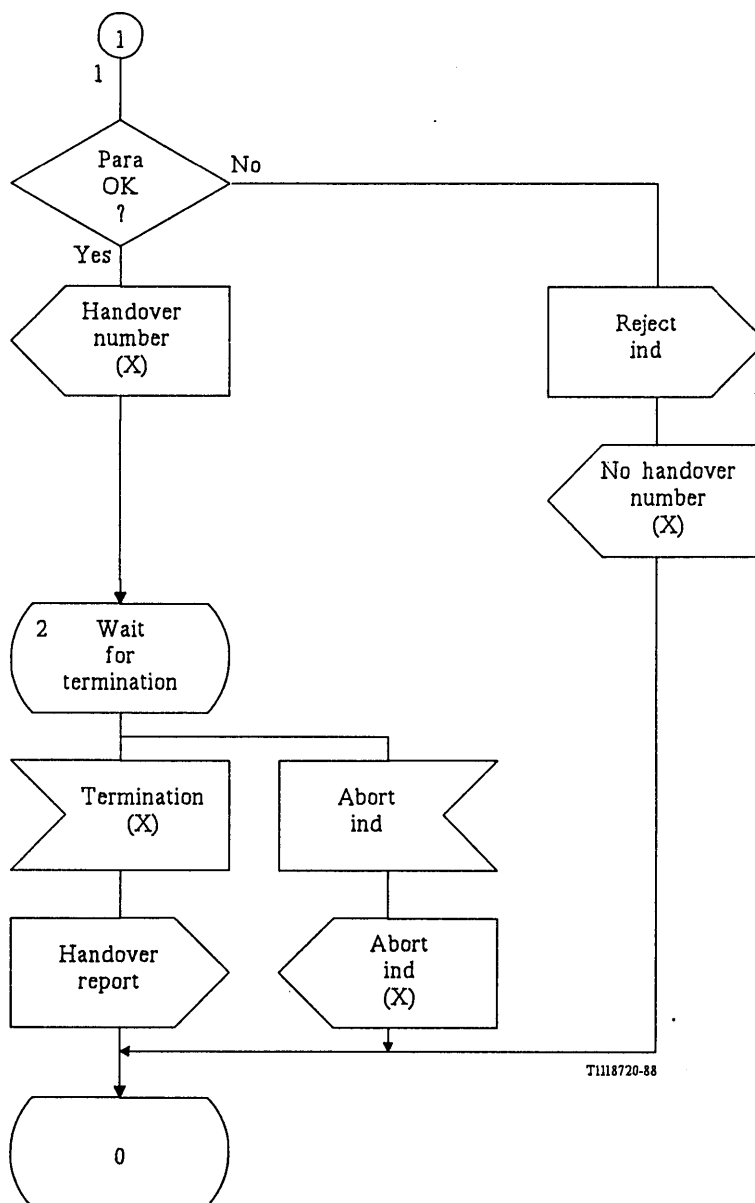


FIGURE 91/Q.1051 (sheet 2 of 2)

Application specific procedure in MSC-B for allocation of handover number

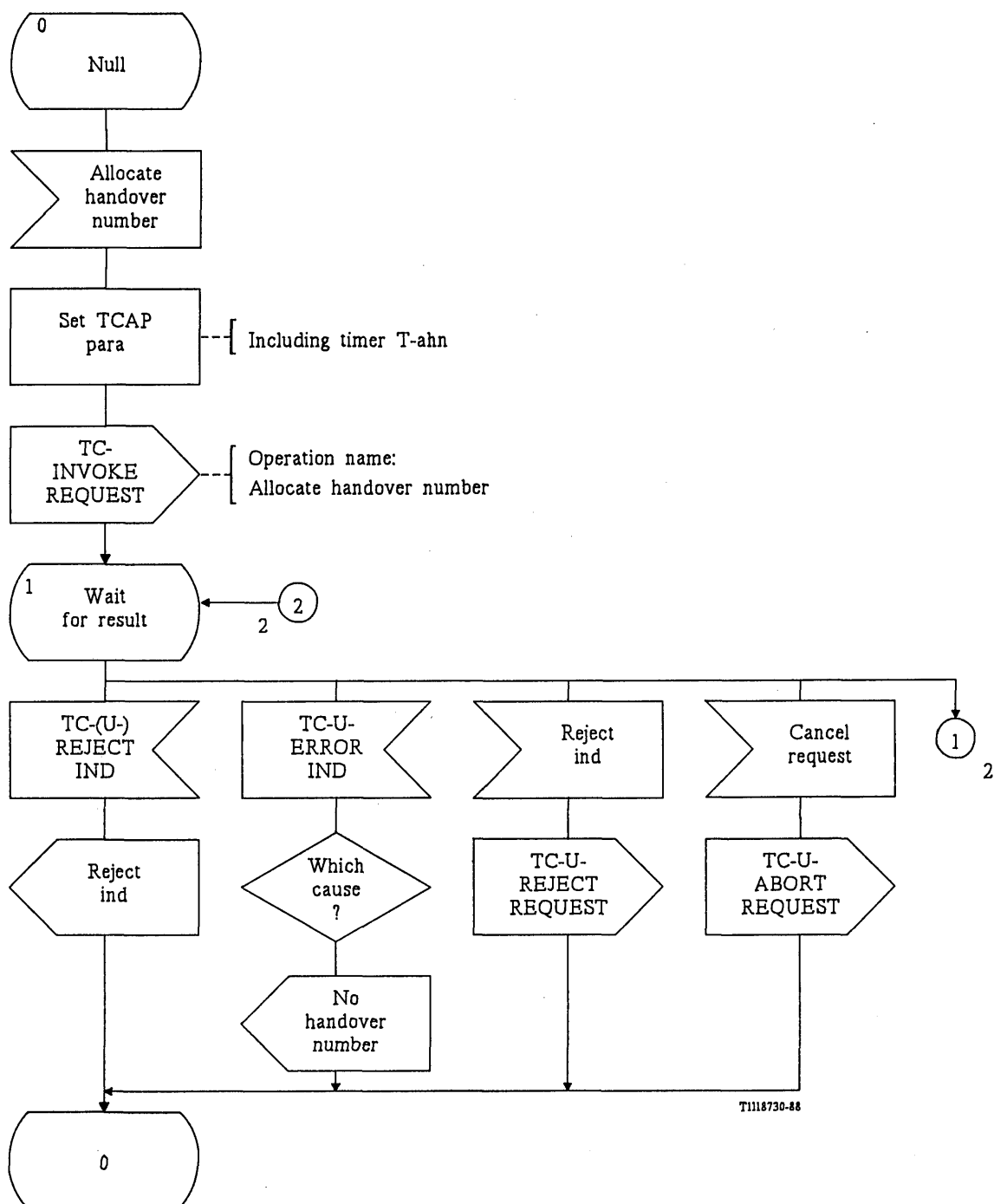


FIGURE 92/Q.1051 (sheet 1 of 2)

ASE/TCAP interface procedure in MSC-B for  
allocation of handover number



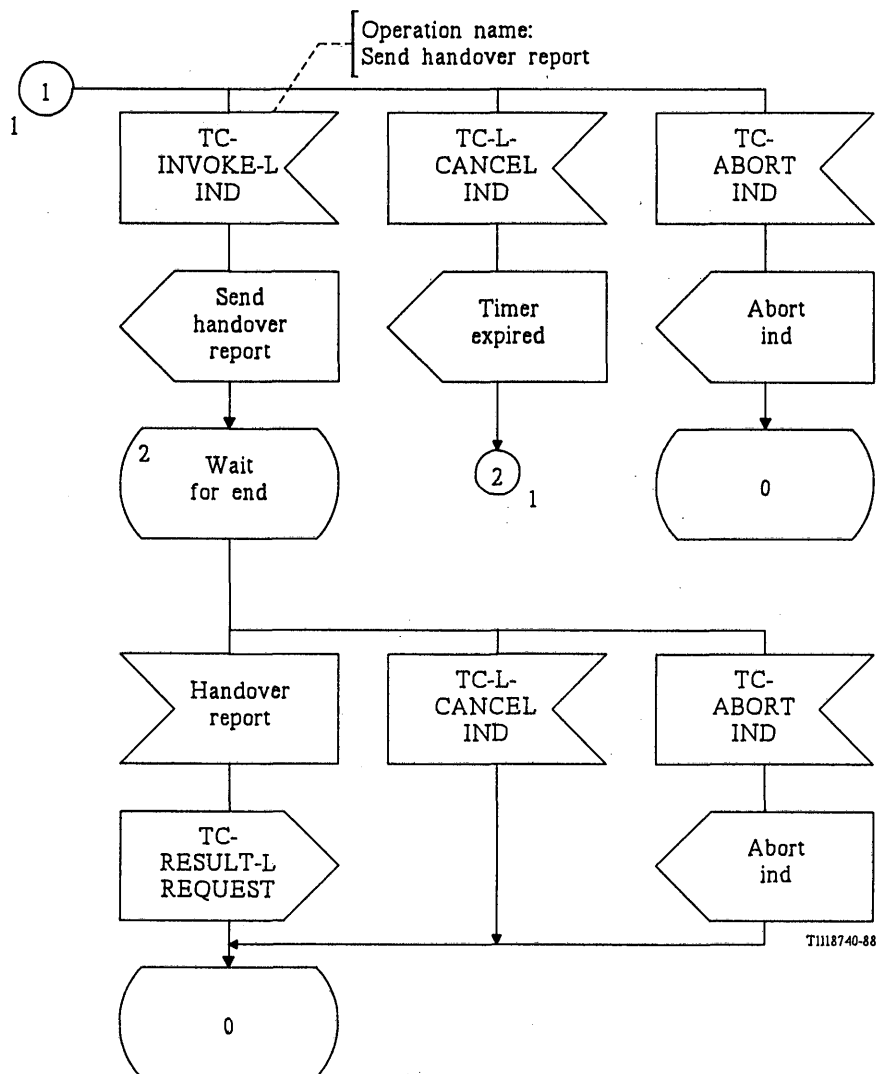


FIGURE 92/Q.1051 (sheet 2 of 2)

ASE/TCAP interface procedure in MSC-B for  
allocation of handover number

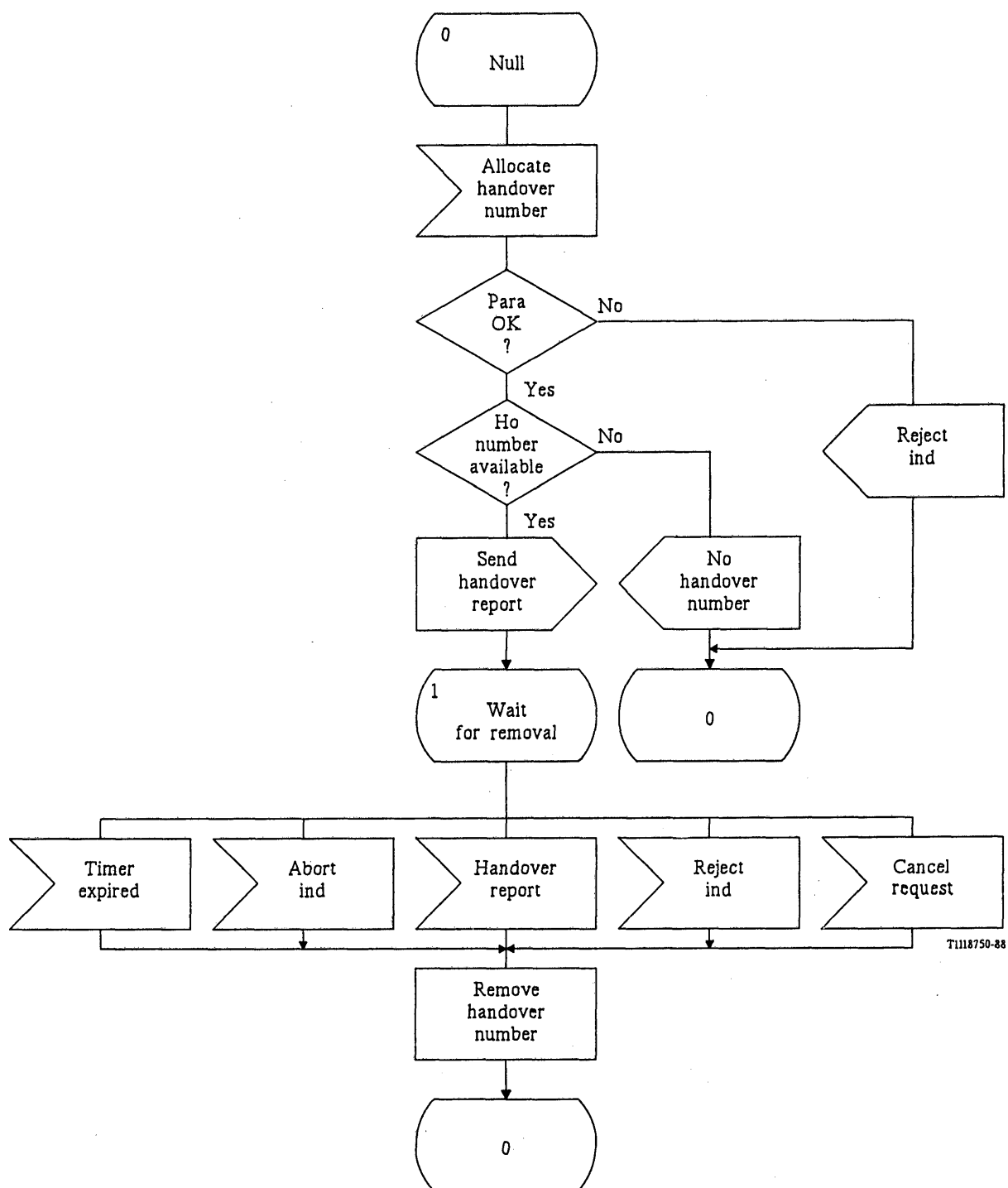


FIGURE 93/Q.1051

Application specific procedure in VLR  
for allocation of handover number

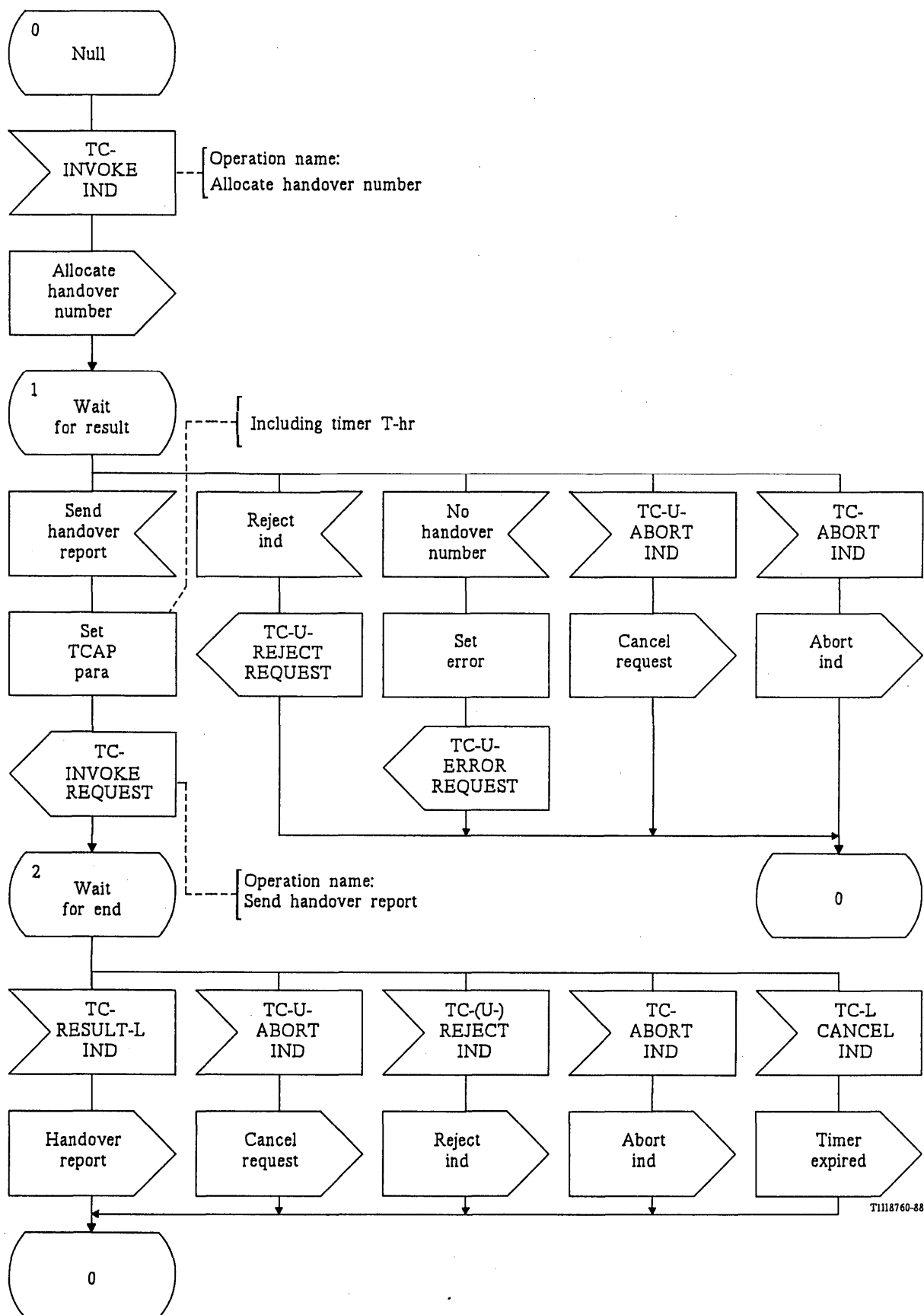


FIGURE 94/Q.1051

ASE/TCAP interface procedure in VLR  
for allocation of handover number

The *cancel request* message is received in a TC-U-ABORT INDICATION primitive and a reject indication reporting procedure errors in the *send handover report* message is received in a TC-(U)-REJECT INDICATION primitive. The timer expired indication is reported in a TC-L-CANCEL INDICATION primitive. A TC-ABORT INDICATION primitive may also be received.

### 3.5.5 Detailed procedures for call handling during handover

#### 3.5.5.1 Procedures for receiving call control information from the MS

The application specific procedure is shown in Figure 95/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 96/Q.1051.

When MSC-B receives a call handling request from the MS which requires operations in MSC-A, MSC-B sends the *perform call control* message to MSC-A. The *perform call control* message contains the information provided by the MS as received on the BS/MSC-B interface.

MSC-B may receive either of the following responses:

- a timer expired indicator if timer T-ccr expires. This is taken to mean that the procedure has been completed and a procedure terminated (X) indication is generated;
- reject indication or a timer expiry indicator if the procedure fails. A message undelivered indication is then provided to the call handling function in MSC-B;
- a *handover state undetermined* message if a subsequent handover is in progress.

The call handling function may also cancel the operation.

The *perform call control* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ccr. The response is received as follows:

- a TC-(U)-REJECT INDICATION primitive will report on procedure error;
- a TC-L-CANCEL INDICATION primitive will report expiry of timer T-ccr;
- a TC-U-ERROR INDICATION primitive will contain the *handover state undetermined* message.

The dialogue handling primitive is TC-CONTINUE since the procedure, when required, is part of the transaction established for the basic handover procedure.

#### 3.5.5.1.2 Procedure in MSC-A

The application specific procedure is shown in Figure 97/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 98/Q.1051.

When receiving the *perform call control* message from MSC-B, the received data are provided to the handover control function in MSC-A. The response from the handover control function is either of the following:

- a terminate procedure (X) indication;
- a handover state undetermined (X) indication if a subsequent handover is in progress.

The *perform call control* message is received in a TC-INVOKE INDICATION primitive and the outcome is returned as follows:

- a reject indication is sent in a TC-U-REJECT REQUEST primitive;
- the *handover state undetermined* message is sent in a TC-U-ERROR REQUEST primitive.

Positive results are not reported and the procedure is terminated locally.

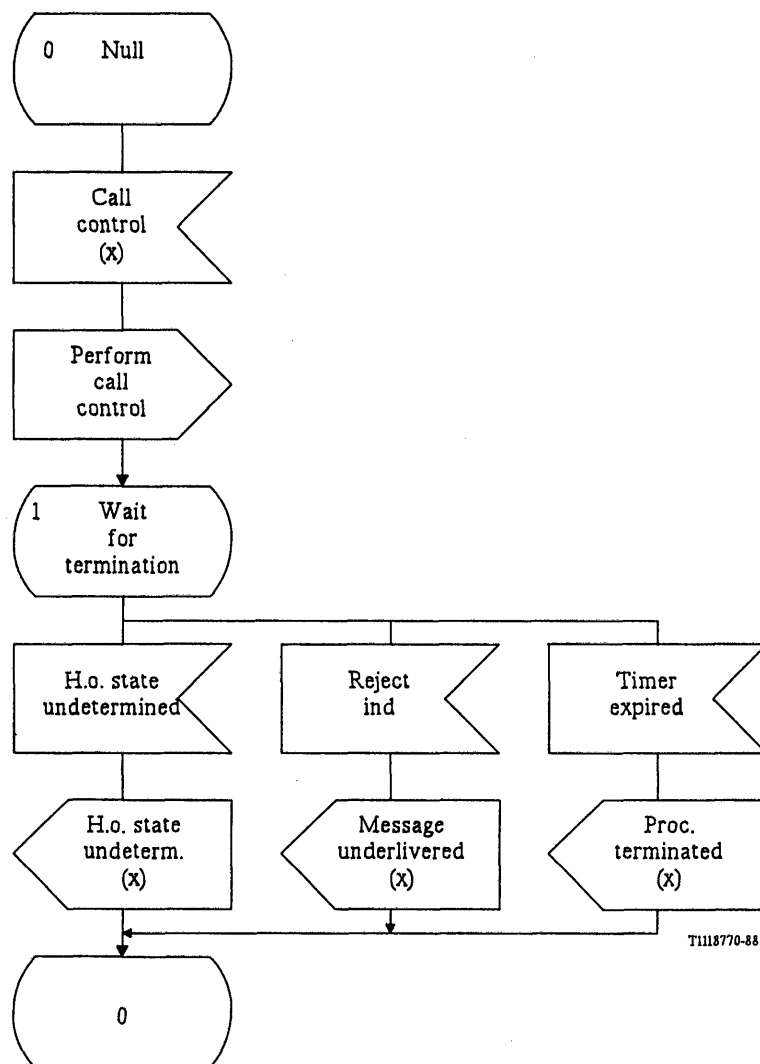


FIGURE 95/Q.1051

**Application specific procedure in MSC-B for handling  
call control requests from the MS**

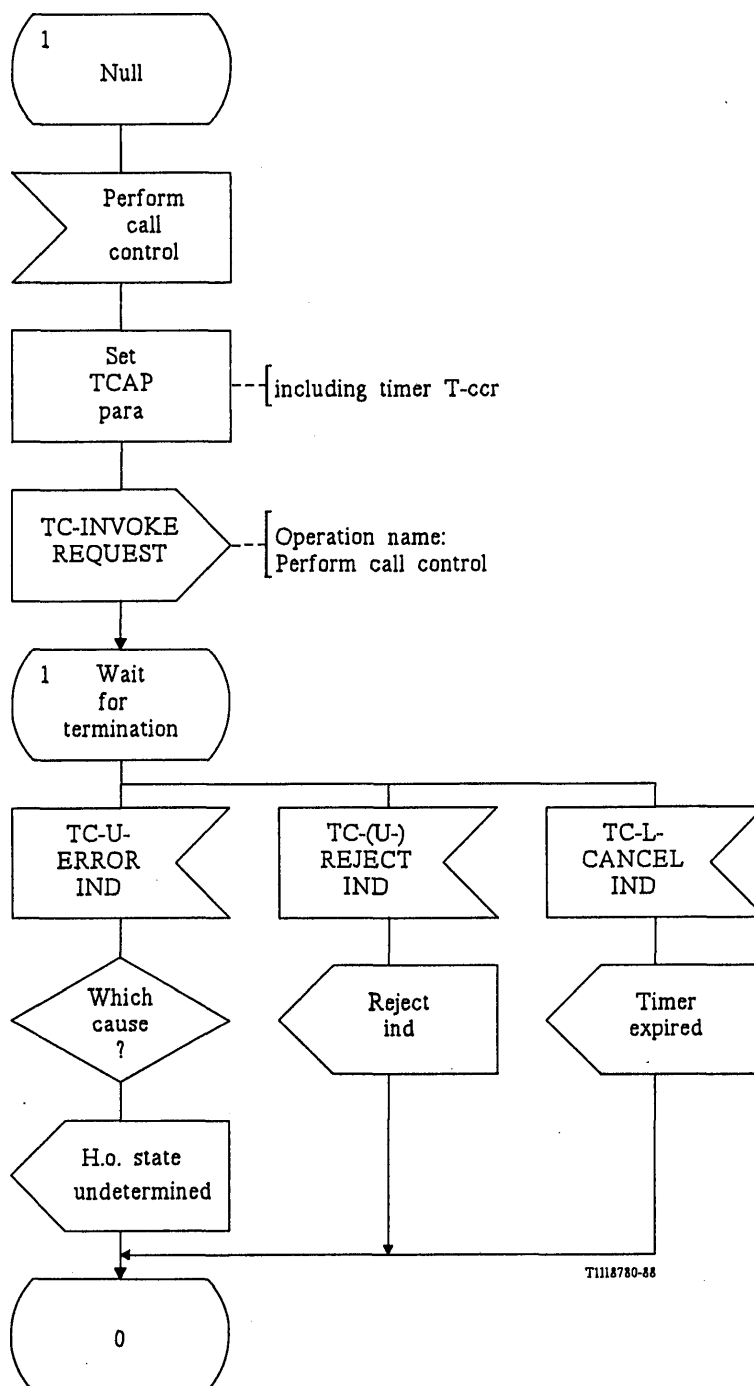


FIGURE 96/Q.1051

ASE/TCAP interface procedure in MSC-B for handling  
of call control request from the MS

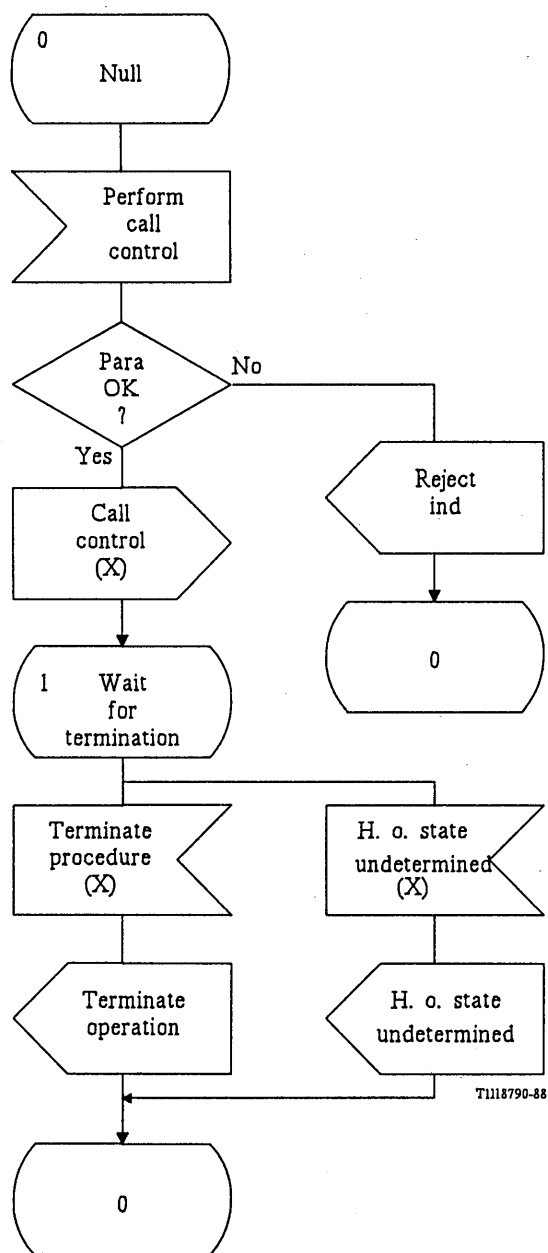


FIGURE 97/Q.1051

**Application specific procedure in MSC-A for handling of call control request from the MS**





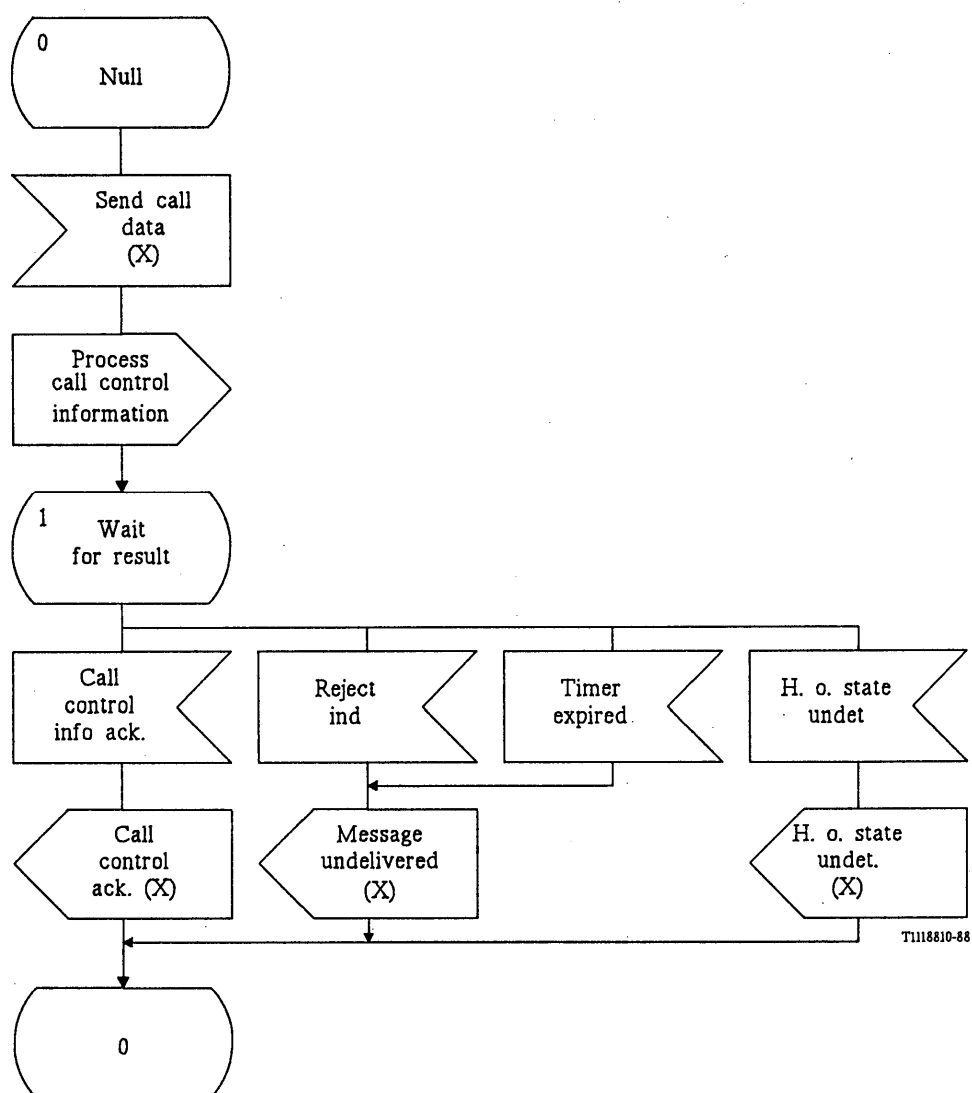


FIGURE 99/Q.1051

Application specific procedure in MSC-A for providing call control information to the MS during handover

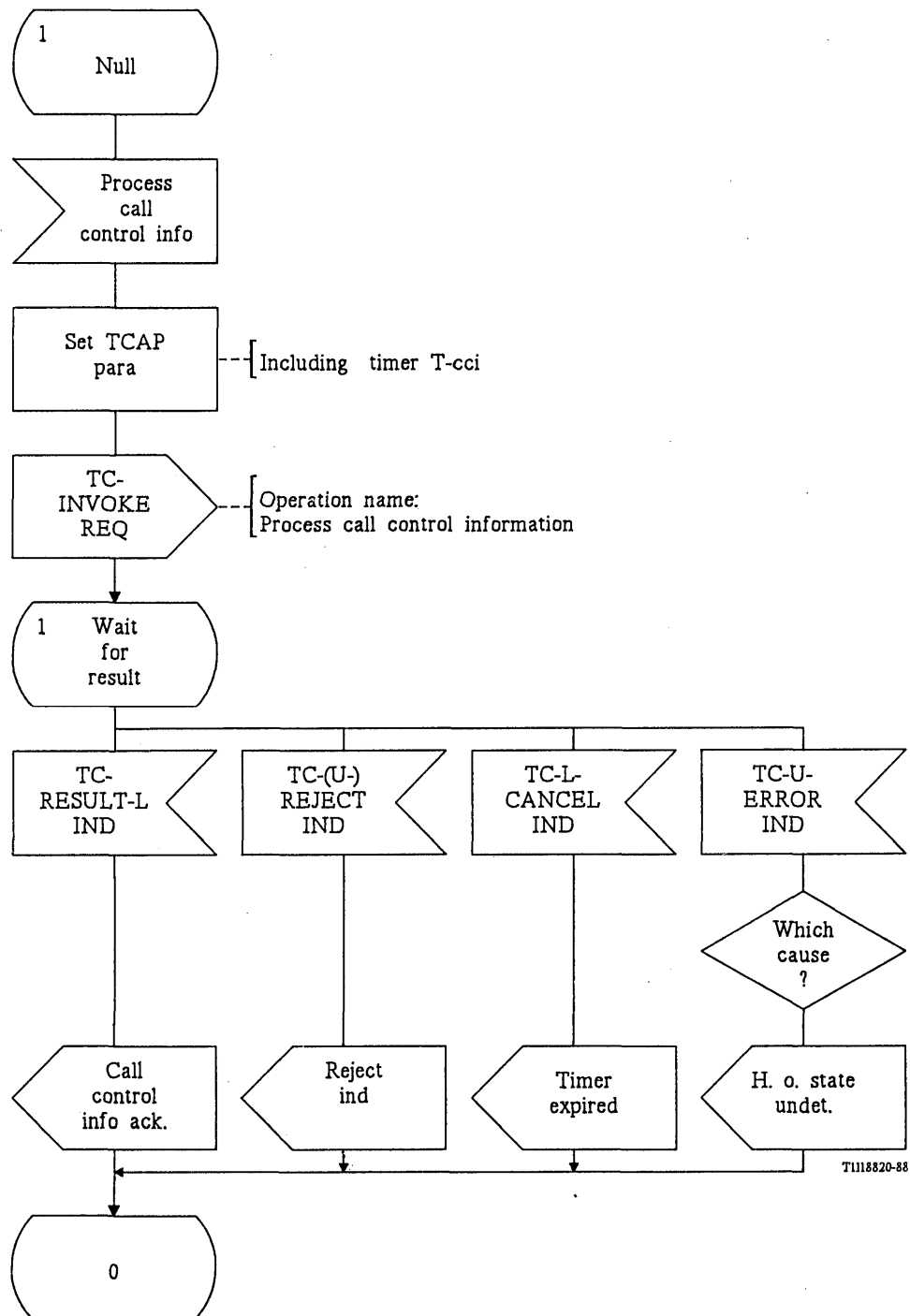


FIGURE 100/Q.1051

ASE/TCAP interface procedure in MSC-A for providing  
call control information to the MS during handover

The handover control function will request sending of call control information to the MS. The information is coded in MSC-A in such a way that it can be passed transparently on the BS/MS interface in MSC-B.

Successful receipt and delivery on the radio path of the message is indicated by a *call control information acknowledge* message. If MSC-B cannot provide the message to the radio path, the *handover state undetermined* message will be received. Any response from the MS will be passed to MSC-A by the procedure of § 3.5.5.1.

A message undelivered (X) indication is provided to the handover control function if the procedure fails (receiving a reject indication or a timer expired indication).

The *process call control information* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-cci. The *call control information acknowledge* message is received in a TC-RESULT-L INDICATION primitive. A TC-(U-)REJECT INDICATION primitive will indicate that the message was refused in MSC-B or TCAP and a TC-L-CANCEL INDICATION primitive will report expiry of timer T-cci. A *handover state undetermined* message will be included in a TC-U-ERROR INDICATION primitive.

The dialogue handling primitive is the TC-CONTINUE primitive since the procedure uses the transaction established for the basic handover procedure.

#### 3.5.5.2.2 Procedures in MSC-B

The application specific procedure is contained in Figure 101/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 102/Q.1051.

When receiving the *process call control information* message, MSC-B will provide the information content to the BS/MS interface. If the information is delivered to the radio path the *call control information acknowledge* message is returned. A *handover state undetermined* message will be provided if the message cannot be delivered on the radio path.

The *process call control information* message is received in a TC-INVOKE INDICATION primitive. The outcome is returned as follows:

- the *call control information acknowledge* message is sent in a TC-RESULT-L REQUEST primitive;
- a reject indication is included in a TC-U-REJECT REQUEST primitive;
- a *handover state undetermined* message is sent in a TC-U-ERROR REQUEST primitive.

### 3.6 Subscriber management

#### 3.6.1 Location information management

##### 3.6.1.1 Definition of interfaces

In this category there are two procedures:

- i) location information request procedure by which a visitor location register may request the home location register to provide the mobile station roaming number for a specific MS;
- ii) location information retrieval procedure by which the home location register may obtain information (e.g., mobile station roaming number) concerning mobile stations temporarily registered in a visited location register.

*Note* - The procedure in ii) may be used after a restart of the home location register (see also § 3.8). It is therefore for further study whether the home location register may request information on several MSs in one message.

Figure 103/Q.1051 shows the interfaces and procedures for the two categories defined above.

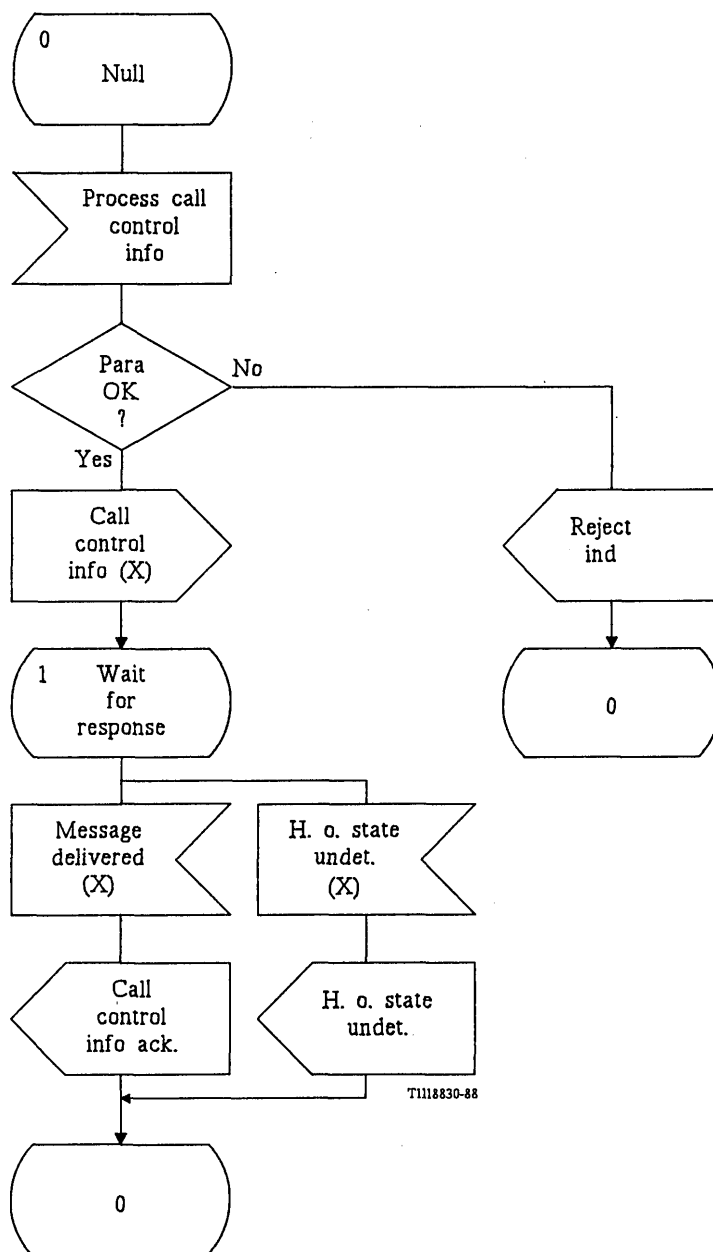


FIGURE 101/Q.1051

**Application specific procedure in MSC-B for providing call control information to the MS during handover**

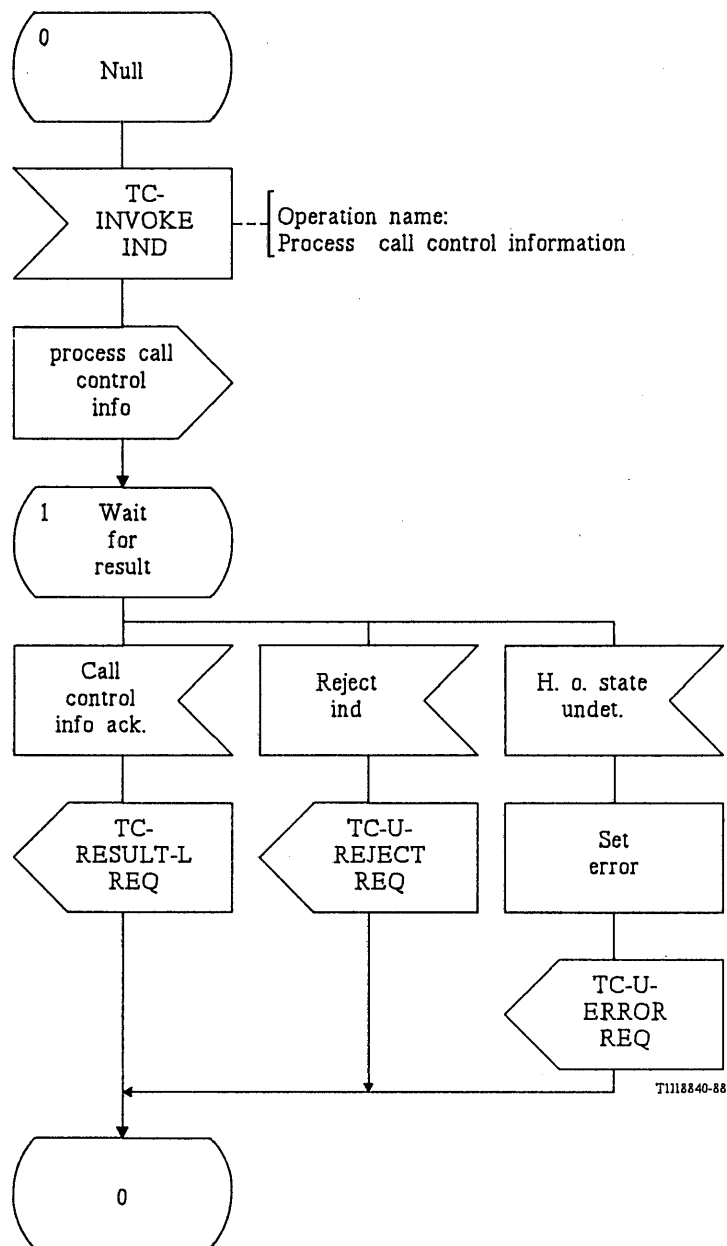


FIGURE 102/Q.1051

**ASE/TCAP interface procedure in MSC-B for providing call control information to the MS during handover**

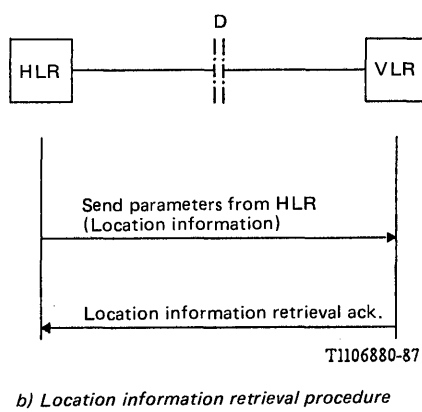
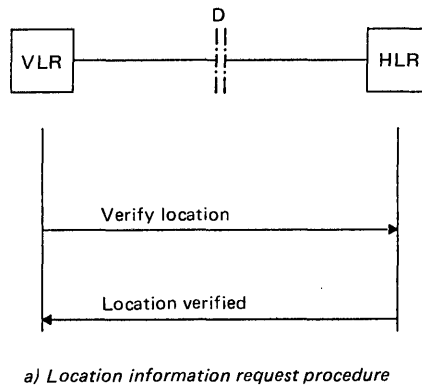


FIGURE 103/Q.1051

### Interfaces and procedure for location information management

#### 3.6.1.2 General description of procedures

In the location information request procedure the visitor location register sends the *verify location* message to the home location register in order to verify the mobile station roaming number stored in the HLR for the indicated MS. The message will contain the identity of the mobile station.

If the MS is still in the VLR, the home location register will return the *location verified acknowledge* message containing the mobile station roaming number stored in that MS. If the MS is in another VLR, the VLR will receive a *cancel location* message.

In the location information retrieval procedure the home location register sends the *send parameters from VLR: location information* message to the visitor location register. The visitor location register will then provide the mobile station roaming number in the *location information retrieval acknowledge* message.

#### 3.6.1.3 Detailed description of location information request procedure

##### 3.6.1.3.1 Procedure in the VLR

The application specific procedure is shown in Figure 104/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 105/Q.1051.

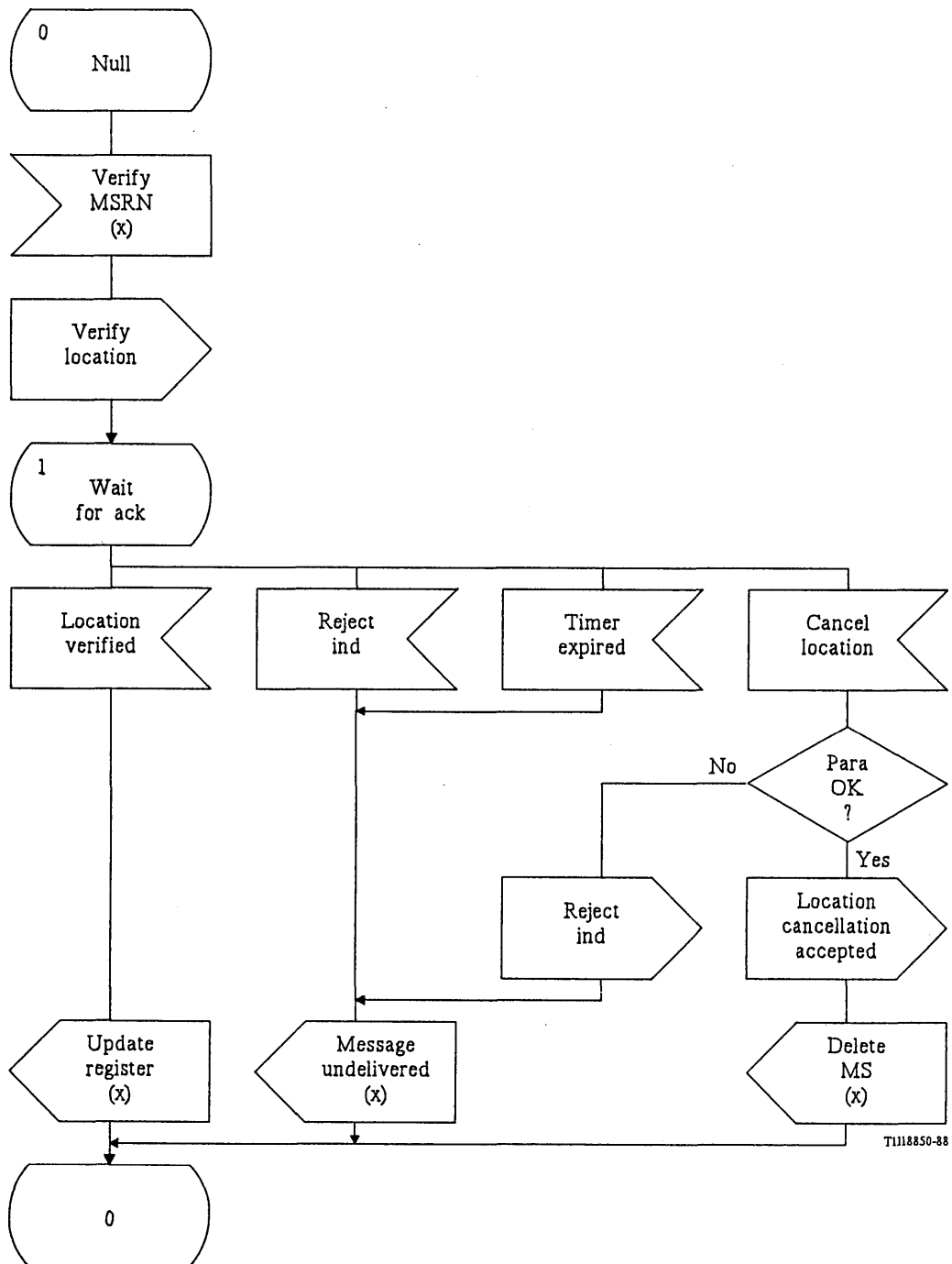


FIGURE 104/Q.1051

Application specific procedure in VLR for information request

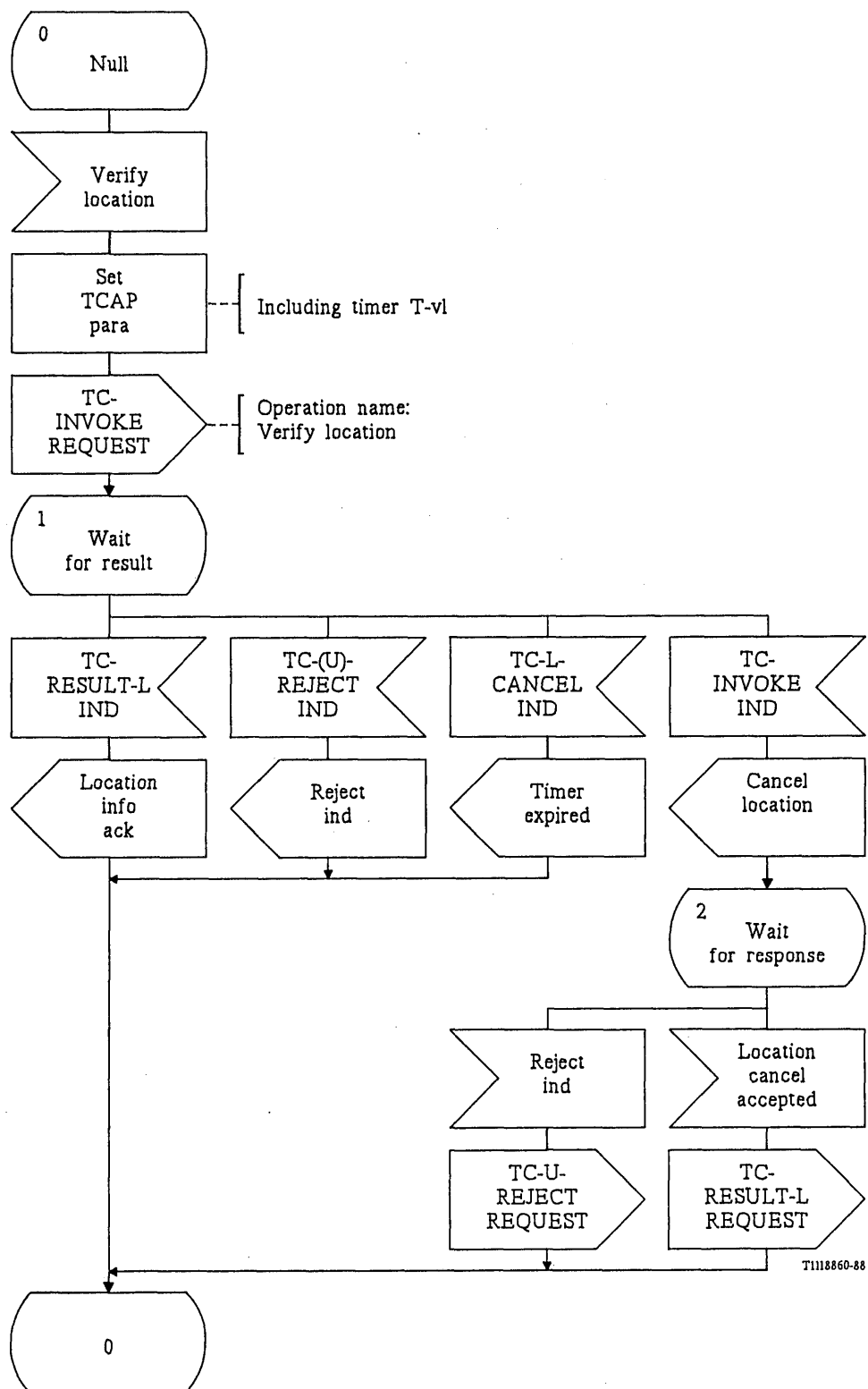


FIGURE 105/Q.1051

ASE/TCAP interface procedure for information request



A VLR may request the HLR to verify the mobile station roaming number for a mobile station at any time. However, the procedure can be a tool for recovering after a restart of the VLR.

The *verify location* message is sent to the HLR and TCAP is requested to supervise the procedure by timer T-vl. The response to this message is either of the following:

- the *location verified* message is received if the MS is still to be registered in the VLR. The message will contain the mobile station roaming number stored in the HLR as well as status of supplementary services that need to be known in the VLR;
- a reject indication or timer expired indication reporting procedure error. The message is then undelivered;
- a *cancel location* message indicating that the MS is no longer in the VLR. This corresponds to the cancellation procedure in § 3.2.2. The MS is then deleted in the VLR.

The *verify location* message is sent in a TC-INVOKE REQUEST primitive. The outcome of the procedure is received as follows:

- the *location verified* message is received in a TC-RESULT-L primitive;
- a reject indication is included in a TC-(U-)REJECT INDICATION primitive and a timer expiry is reported by a TC-L-CANCEL INDICATION primitive;
- a *cancel location* message is received in a TC-INVOKE INDICATION primitive as described in § 3.2.2. The action on this message is as defined in § 3.2.2.

#### 3.6.1.3.2 Procedure in the HLR

The application specific procedure is shown in Figure 106/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 107/Q.1051.

When receiving the *verify location* message, the HLR will go through an analysis as follows:

- if the MS is unknown, deregistered or in another VLR the location cancellation procedure of § 3.2.2 is initiated;
- if the MS is in the VLR requesting the information, the *location verified* message is returned. This message will include all parameters required in the VLR (including the mobile station roaming number).

The *verify location* message is received in a TC-INVOKE REQUEST primitive and the *location information acknowledge* message is returned in a TC-RESULT-L REQUEST primitive. The reject indication is reported in a TC-U-REJECT REQUEST primitive.

#### 3.6.1.4 Detailed description of information retrieval procedure

##### 3.6.1.4.1 Procedure in HLR

The application specific procedure is shown in Figure 108/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 109/Q.1051.

When the HLR requires location information (e.g., after a restart), it sends a *send parameters from VLR (location information)* message to the VLR where the MS is expected to be located. The result received can be as follows:

- a *location information acknowledge* message containing the roaming number of the MS if the MS is in the VLR. The message may also contain status of supplementary services;
- an *unknown subscriber* message if the MS is not in the VLR;
- a reject indication or timer expired indication if the procedure fails.

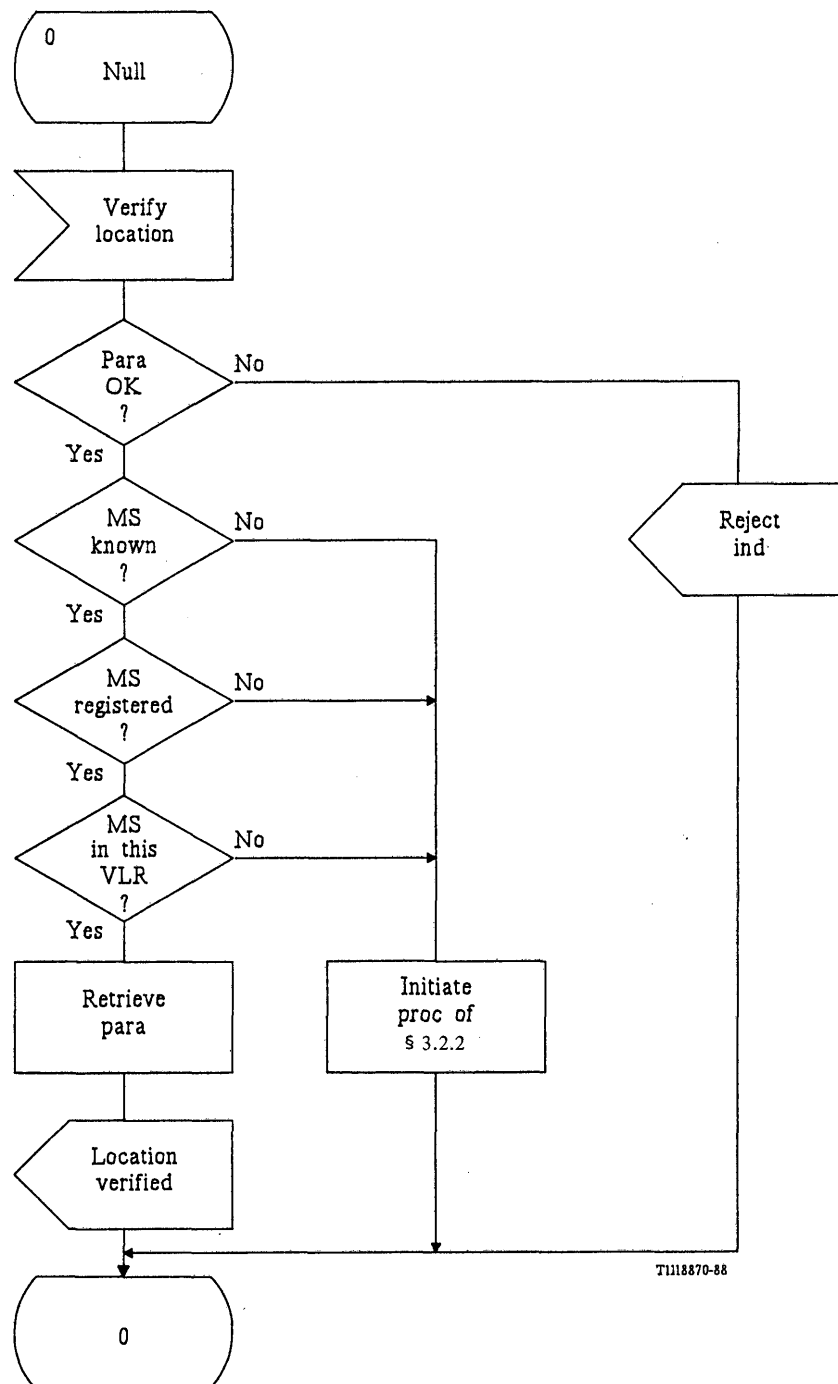


FIGURE 106/Q.1051

Application specific procedure in HLR for information request

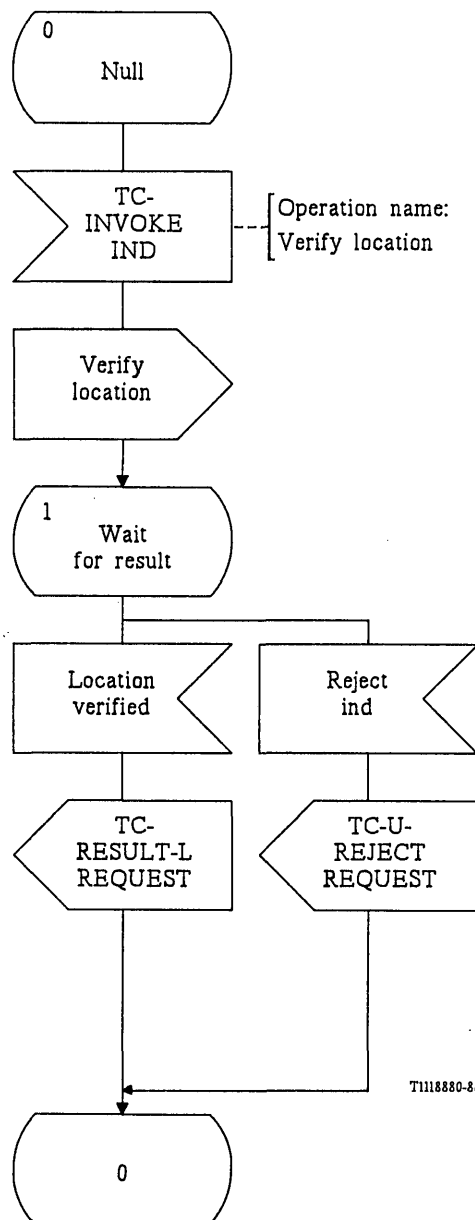


FIGURE 107/Q.1051

ASE/TCAP interface procedure in HLR for information request

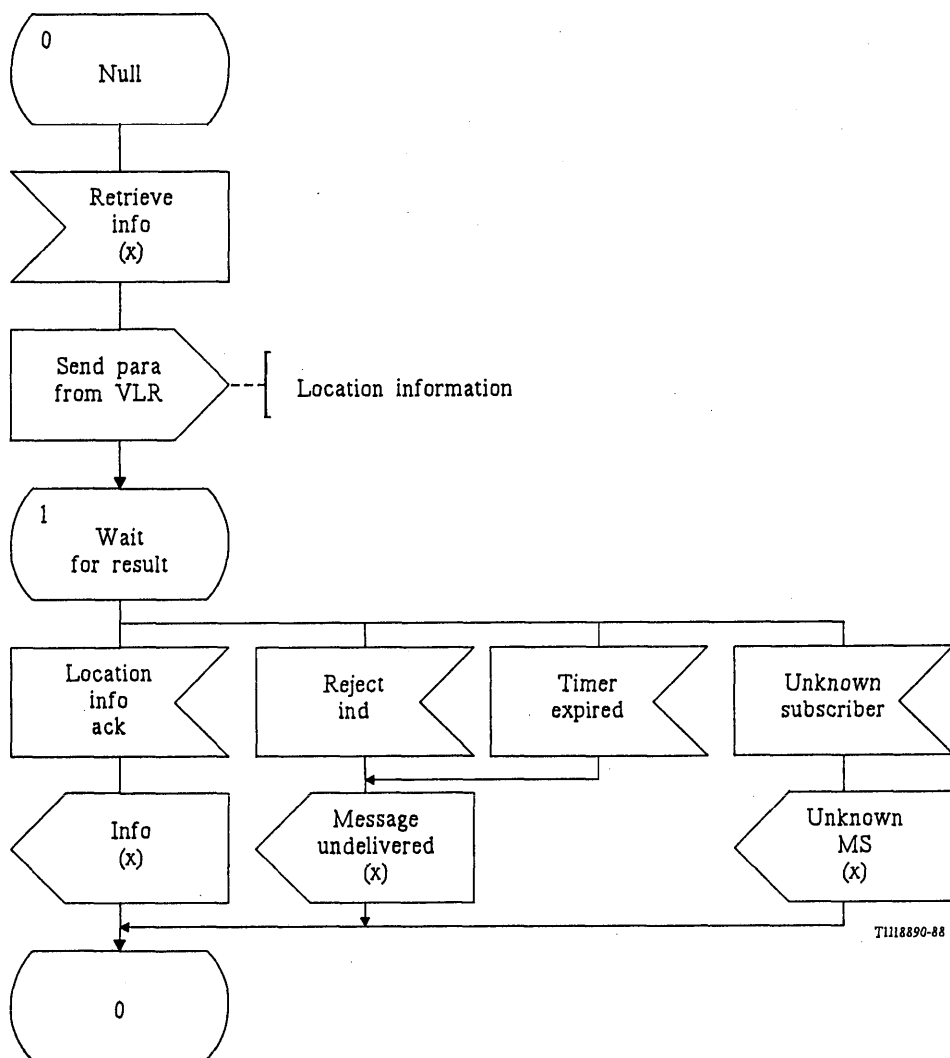


FIGURE 108/Q.1051

Application specific procedure in HLR for retrieving  
information from a VLR

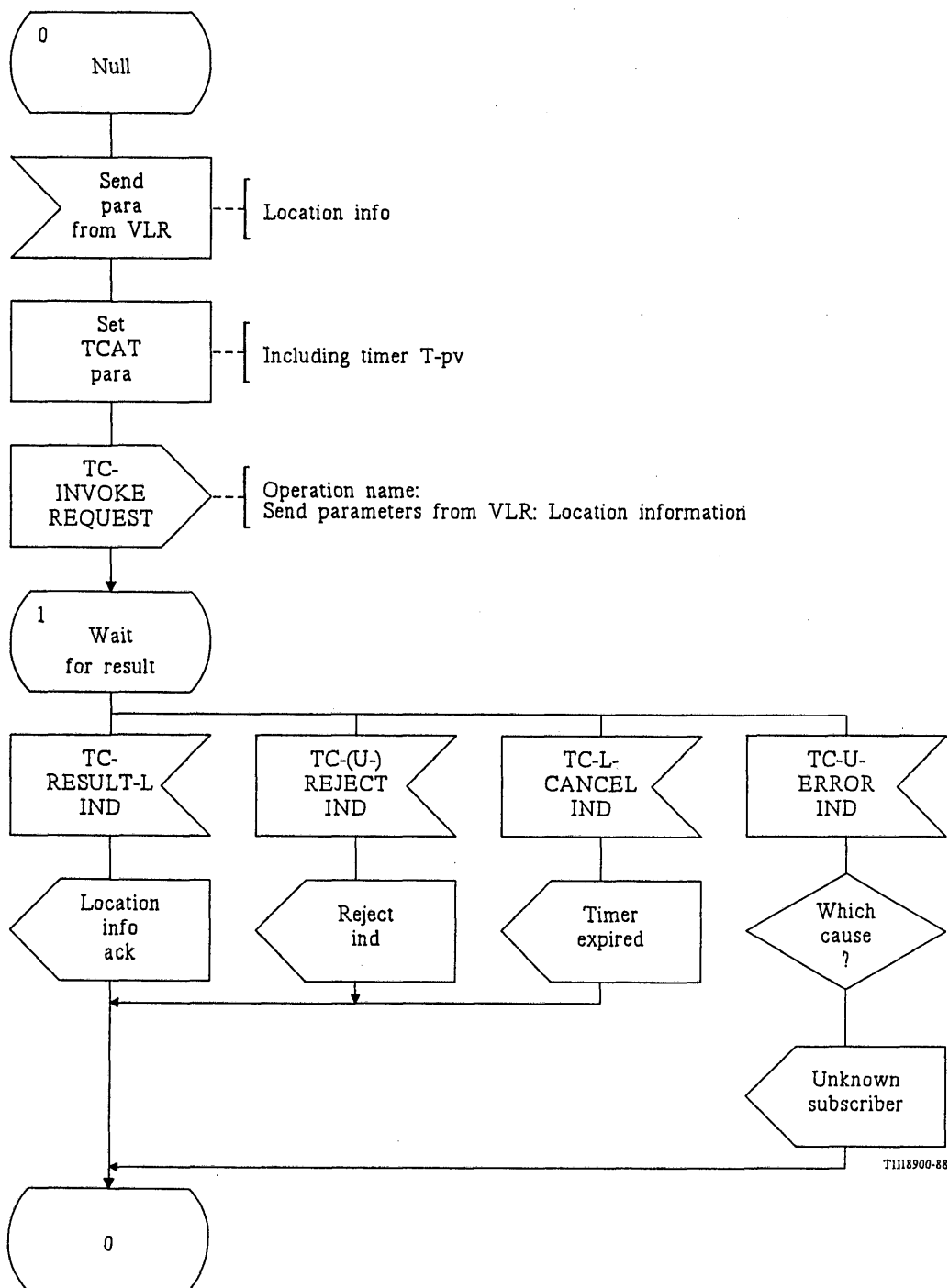


FIGURE 109/Q.1051

ASE/TCAP interface procedure in HLR for  
retrieving information from a VLR

The *send parameters from VLR (location information)* message is sent in a TC-INVOKE REQUEST primitive. TCAP is required to supervise the procedure by timer T-pv. The *location information acknowledge* message is received in a TC-RESULT-L INDICATION primitive.

A reject indication is received in a TC-(U-)REJECT INDICATION primitive and a TC-L-CANCEL INDICATION primitive reports expiry of timer T-pv. A TC-U-ERROR INDICATION primitive reports negative results as follows:

- i) unknown subscriber.

#### 3.6.1.4.2 Procedure in VLR

The application specific procedure is contained in Figure 110/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 111/Q.1051.

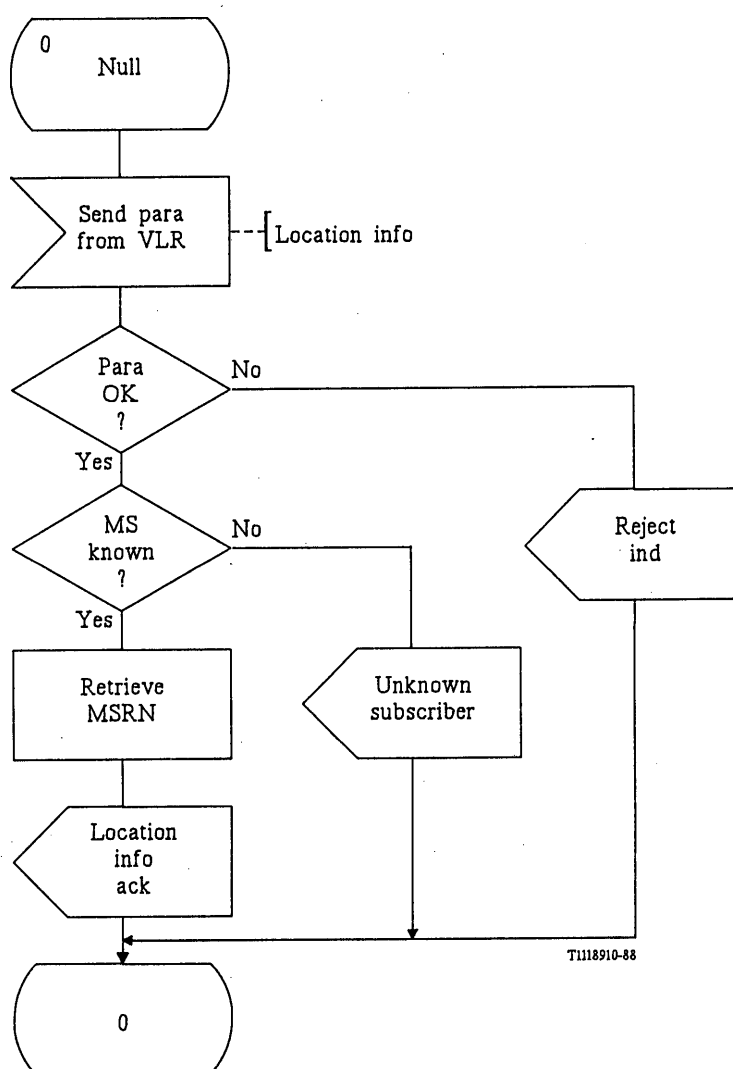


FIGURE 110/Q.1051

**Application specific procedure in VLR  
for retrieving information**

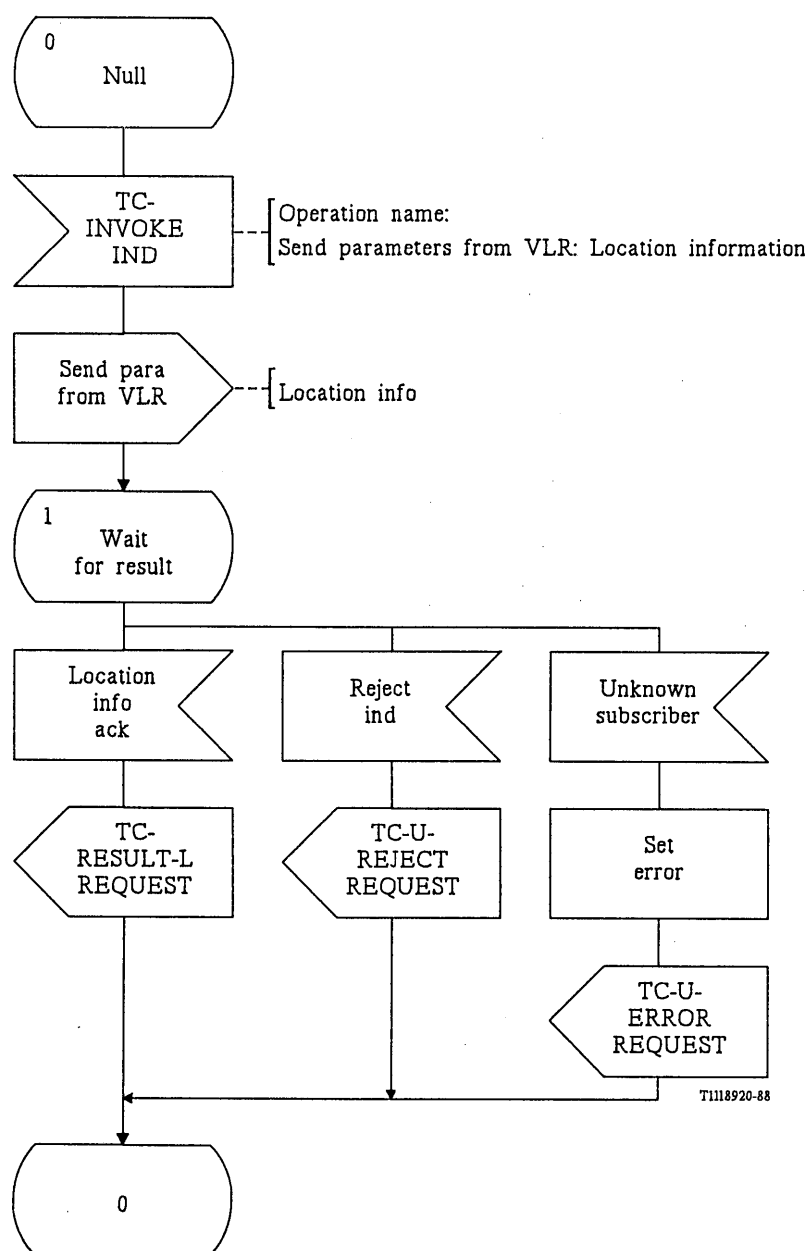


FIGURE 111/Q.1051

**ASE/TCAP interface procedure in VLR  
for retrieving information**

When receiving a valid *send parameters from VLR (location information)* message, the VLR will return the *location information acknowledge* message with the mobile station roaming number (MSRN) and possibly also the status of supplementary services. Otherwise the *unknown subscriber* message is returned.

The *send parameters from VLR (location information)* message is contained in a TC-INVOKE INDICATION primitive and the *location information acknowledge* message is returned in a TC-RESULT-L REQUEST primitive. The *unknown subscriber* message sent in a TC-U-ERROR REQUEST primitive.

### 3.6.2 Management of subscriber parameters

The following procedures are identified:

- i) updating of visited location register with regard to changes in subscriber parameters (e.g., IMSI, authentication parameters). The procedure is defined in § 3.3.2.1;
- ii) updating of home location register (e.g., re-allocation of mobile station roaming number). The procedure is defined in § 3.2.1.4.
- iii) allocation of additional mobile station roaming numbers, e.g. for supporting analogue data services. The procedure is defined in § 3.6.2.1. The procedure may be used as a stand-alone procedure by an HLR to request a VLR to allocate mobile station roaming numbers. It may also be used as part of the location updating procedure as shown in § 3.2.1.

#### 3.6.2.1 General description of the procedure for allocation of additional roaming numbers

The procedure is shown in Figure 112/Q.1051. When the HLR requires additional *mobile station* roaming numbers, the message *allocate additional roaming numbers* is sent to the VLR. In the successful case the VLR will respond with the *additional roaming numbers acknowledge* message.

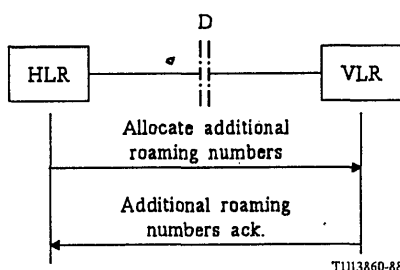


FIGURE 112/Q.1051

**Interface and procedure for requesting a VLR  
to allocate mobile station roaming numbers**

#### 3.6.2.2 Detailed description of the procedure

##### 3.6.2.2.1 Procedure in the HLR

The application specific procedure (as stand-alone procedure) is shown in Figure 113/Q.1051 (see § 3.2.1 for the case where the procedure is used in conjunction with location registration) and the ASE/TCAP interface procedure is shown in Figure 114/Q.1051.

When the HLR requires allocation of additional mobile station roaming numbers (indicated by the request allocation of MSRN (X) signal), the *allocate additional roaming numbers* is sent to the VLR. The message contains a list of the bearer services requiring separate MSRN.



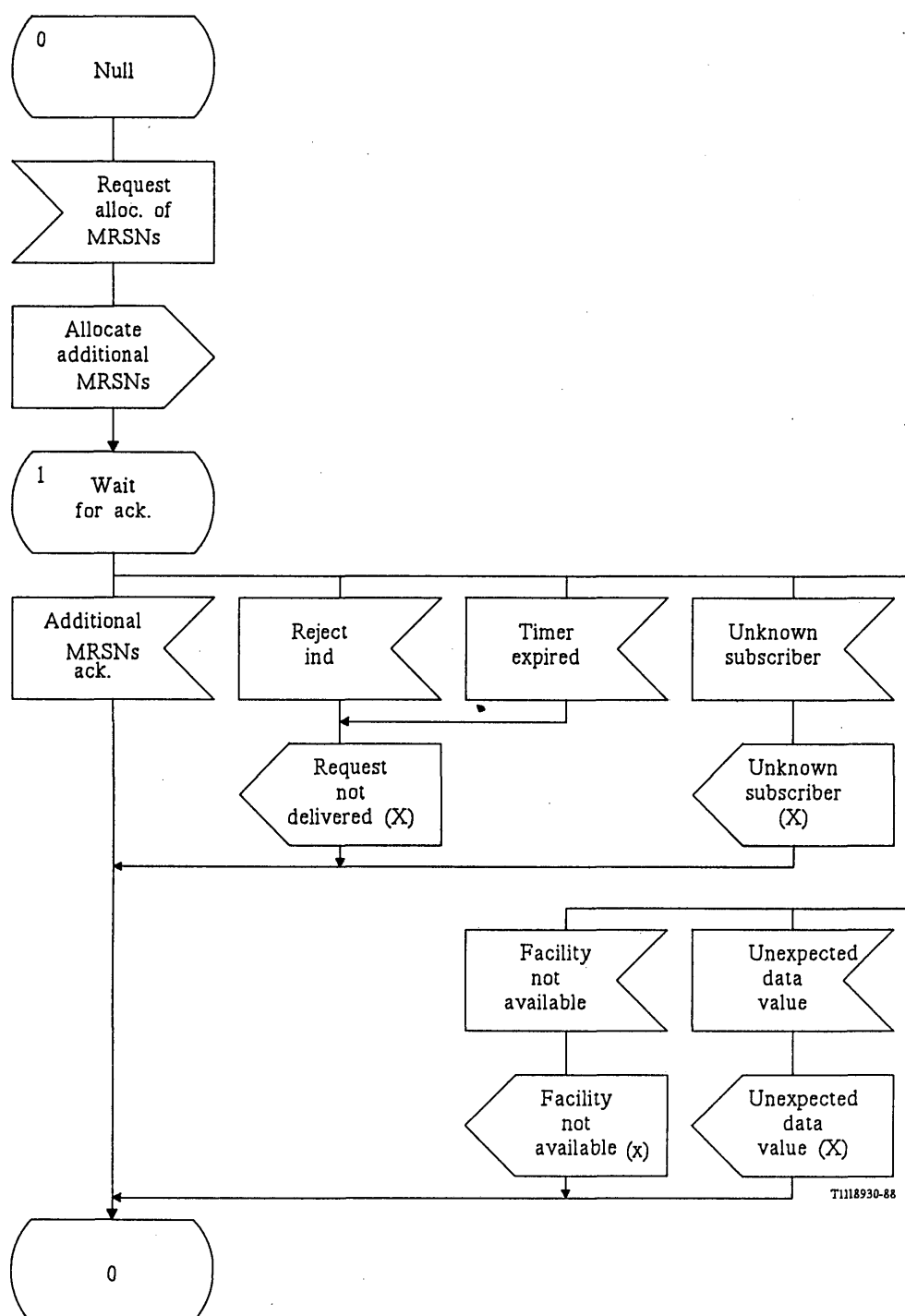


FIGURE 113/Q.1051

Application specific procedure in the HLR for  
requesting additional roaming numbers

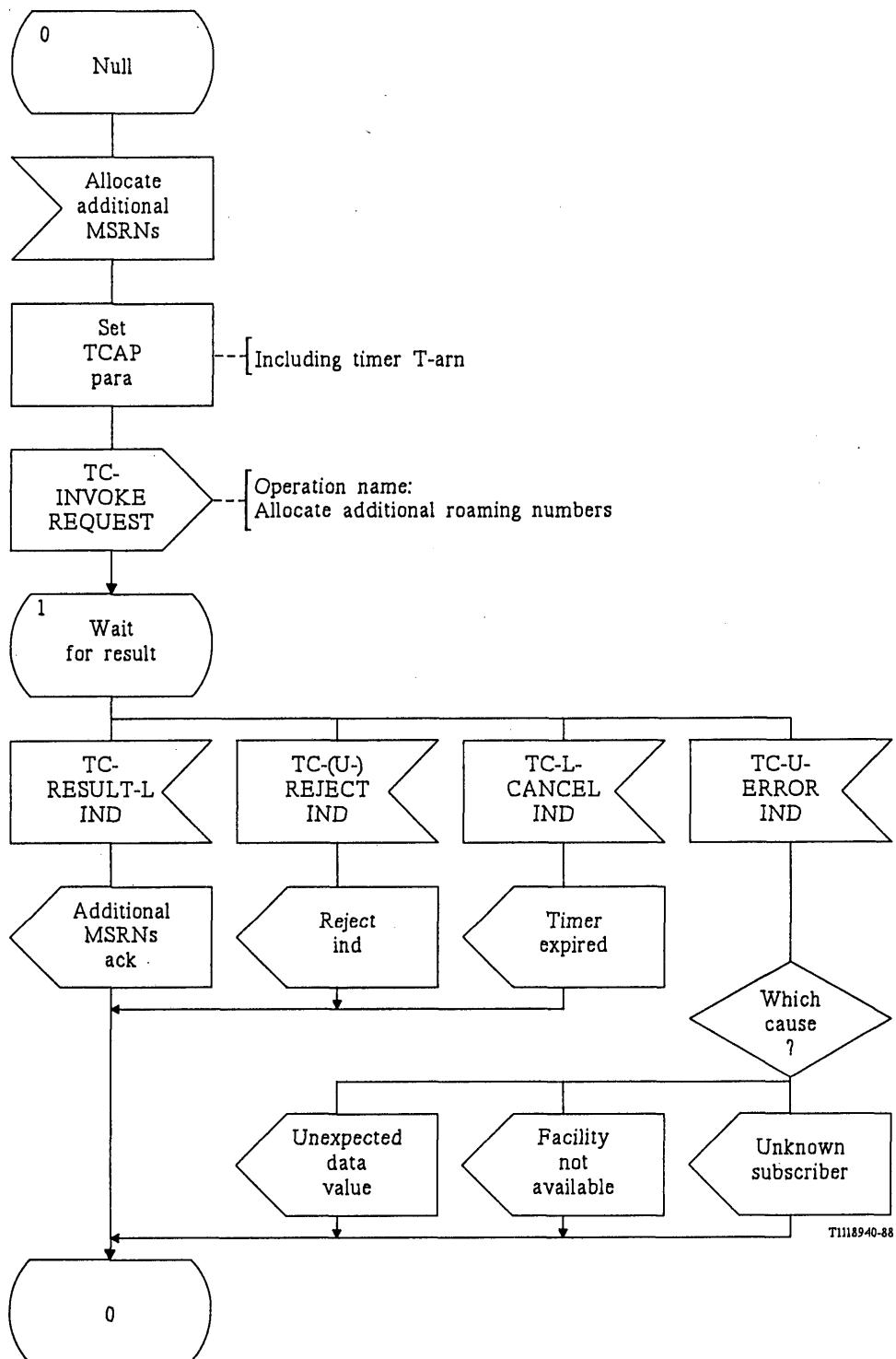


FIGURE 114/Q.1051

ASE/TCAP interface procedure in the HLR for  
requesting additional roaming numbers

The following responses may be received:

- the *additional roaming numbers acknowledge* message containing a set of mobile station roaming numbers. This information is then sent to a function in the HLR responsible for updating and management of the location tables (indicated by the signal MSRN (X));
- an *unknown subscriber*, an *unexpected data value* or a *facility not available* message indicating that the VLR has not activated the required function. The *unknown subscriber* message also indicates that the data contained in the HLR (or the VLR) may be wrong. In all cases the cause of unsuccessful operation is provided to the function in the HLR responsible for management of location tables;
- a reject indication or a timer expired indication may also be received indicating that the request was not delivered at the peer entity in the VLR.

The *allocate additional roaming numbers* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-arn.

Results are received as follows:

- the *additional roaming numbers acknowledged* message is received in a TC-RESULT-L INDICATION primitive;
- a reject indication and a timer expired indication is received in TC-(U-)REJECT INDICATION and TC-L-CANCEL INDICATION primitives, respectively;
- *unknown subscriber*, *unexpected data value* and *facility not available* messages are received in a TC-U-ERROR INDICATION primitive.

### 3.6.2.3 Detailed procedures in the VLR

The application specific procedure as stand-alone procedure is shown in Figure 115/Q.1051 (see § 3.2.2 for the case where the procedure is used as part of location updating) and the ASE/TCAP interface procedure is shown in Figure 116/Q.1051.

When receiving the *allocate additional roaming numbers* message, the VLR performs the following sequence of analysis:

- if there are parameter errors in the message, a reject indication is returned;
- if there are data errors, the *unexpected data value* message is returned;
- if the facility of allocating additional mobile station roaming numbers is not supported in the VLR, the *facility not available* message is returned;
- otherwise the *additional roaming numbers acknowledge* message is returned and the VLR updates itself with regard to MSRN and associated bearer services (or other service marking).

The *allocate additional roaming numbers* message is received in a TC-INVOKE INDICATION primitive. The *additional roaming numbers acknowledge* message is returned in a TC-RESULT-L REQUEST primitive, a reject condition is reported in a TC-U-REJECT REQUEST primitive and *facility not available*, *unexpected data value* and *unknown subscriber* messages are sent in a TC-U-ERROR REQUEST primitive.

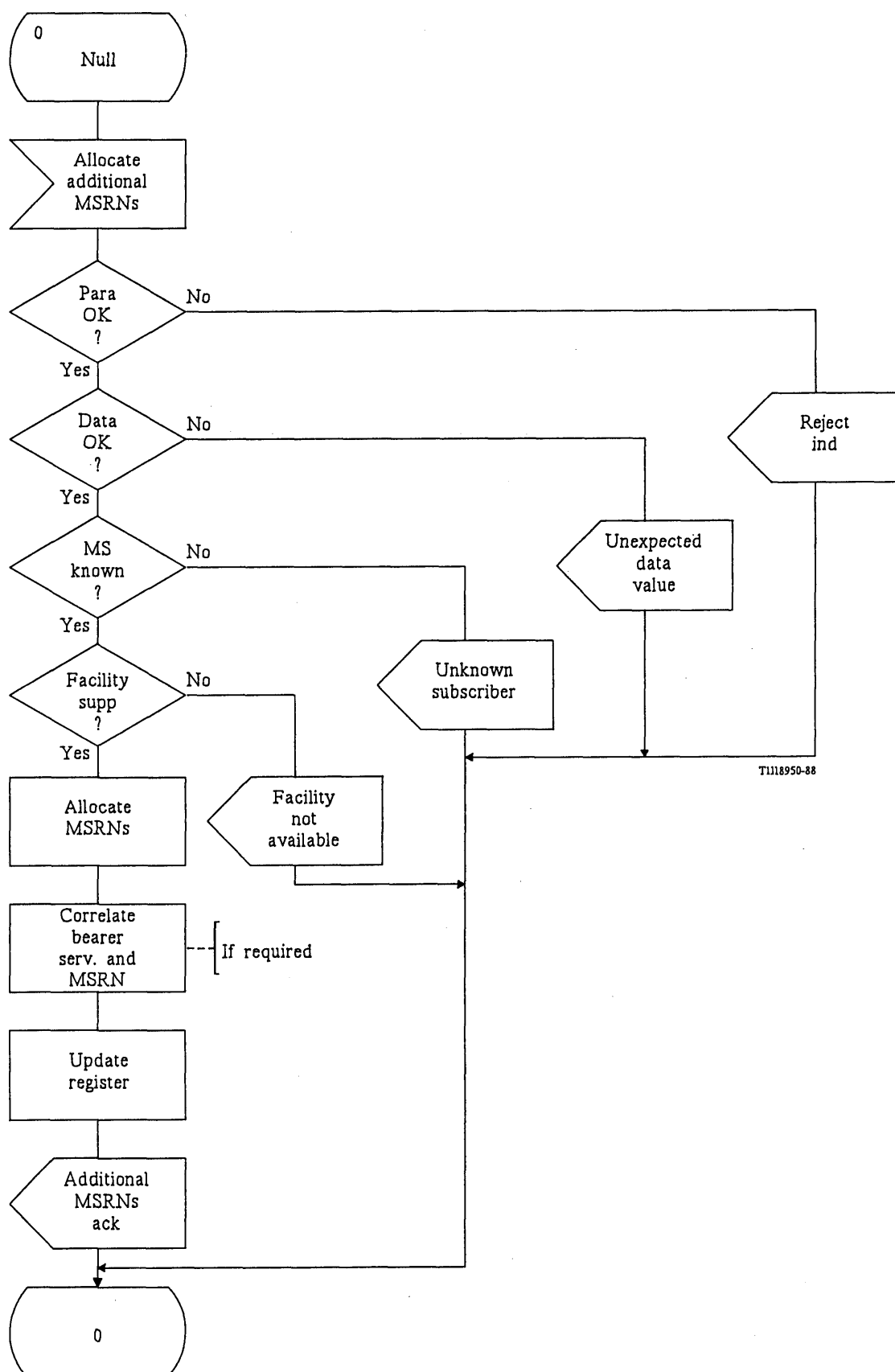


FIGURE 115/Q.1051

Application specific procedure in VLR for  
allocation of additional roaming numbers

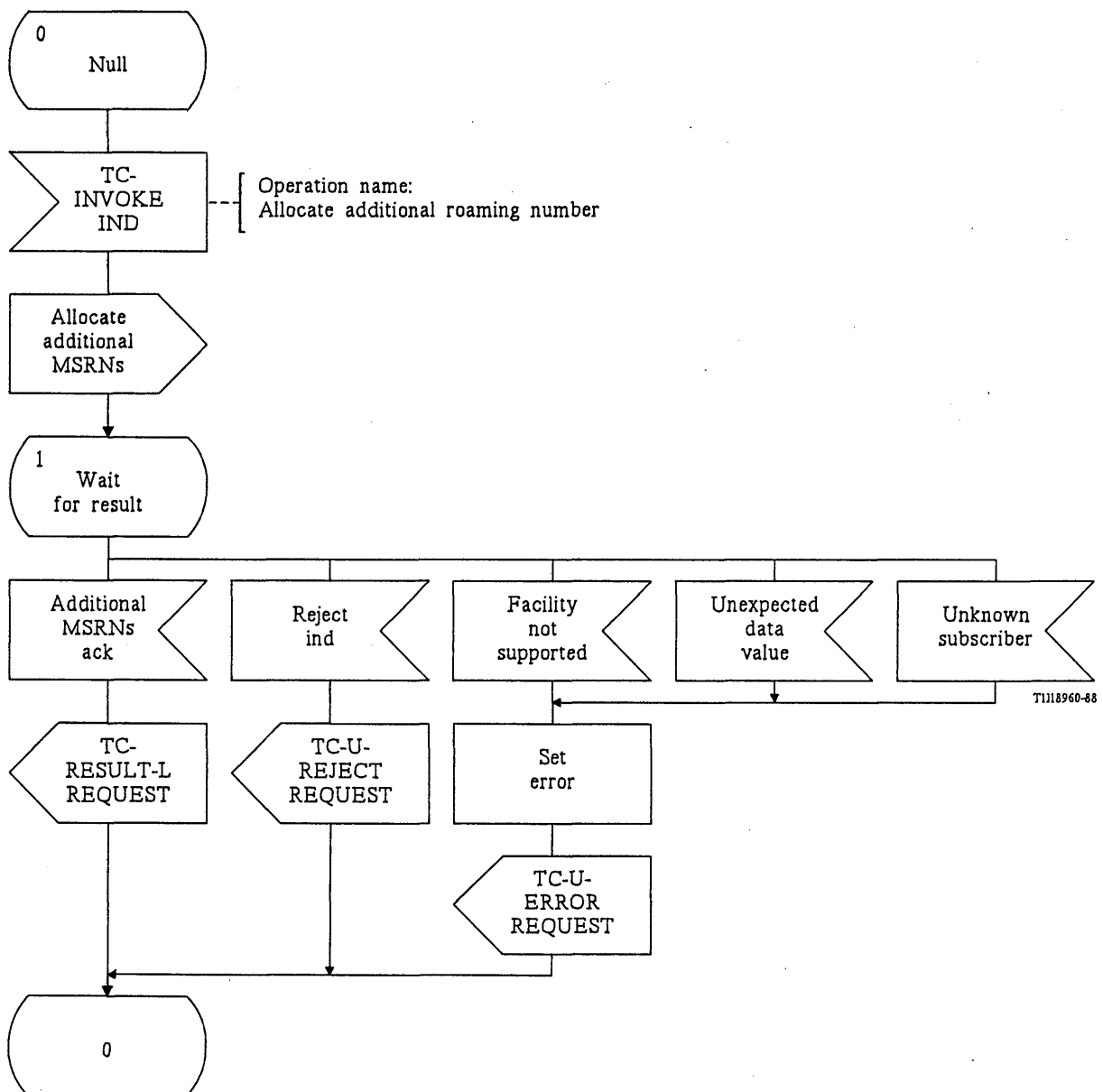


FIGURE 116/Q.1051

ASE/TCAP interface procedure in VLR for  
allocation of additional roaming numbers

### 3.7 Operation and maintenance

#### 3.7.1 Transfer of charging information

##### 3.7.1.1 Definition of interfaces

The charging information related to mobile station originated calls may be transferred from the MSC to the home location register for billing purposes by using MAP (Figure 117/Q.1051).

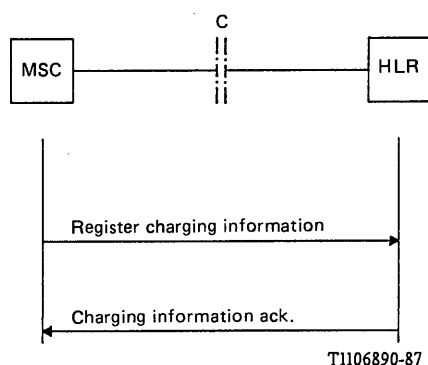


FIGURE 117/Q.1051

#### Interface and procedure for transfer of charging information

##### 3.7.1.2 General description of procedures

The procedure for transfer of charging information is shown in Figure 117/Q.1051. At the end of each mobile originated call the MSC will collect all information required by the home location register for billing the mobile station. The information is sent in the *register charging information* message. The receipt of this message is acknowledged by the *charging information acknowledge* message. This message will indicate that the charging information is accepted by the home location register. If the information is not accepted, the reason will be reported to the MSC.

*Note* - The procedure can also be used for transfer of charging information for mobile terminating calls when part of the charge or the full charge is to be billed to the mobile subscriber.

##### 3.7.1.3 Detailed description of the procedure for transfer of charging information

###### 3.7.1.3.1 Procedure in the MSC

The application specific procedure is shown in Figure 118/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 119/Q.1051.

When sending a *register charging information* message to the HLR, the following response can be received in the MSC:

- a *charging information acknowledge* message indicating that the charging information has been stored in the HLR;
- a reject indicator indicating that the message contained parameter errors. The type of error is indicated (e.g., a parameter with wrong value) so that the message may be retransmitted. The reject indication may also be used to indicate that the HLR does not support the procedure;
- a timer expired indication. In this case also the message may be retransmitted;
- an *unknown subscriber* indication;
- a *data missing* or *unexpected data value* message may also be returned.

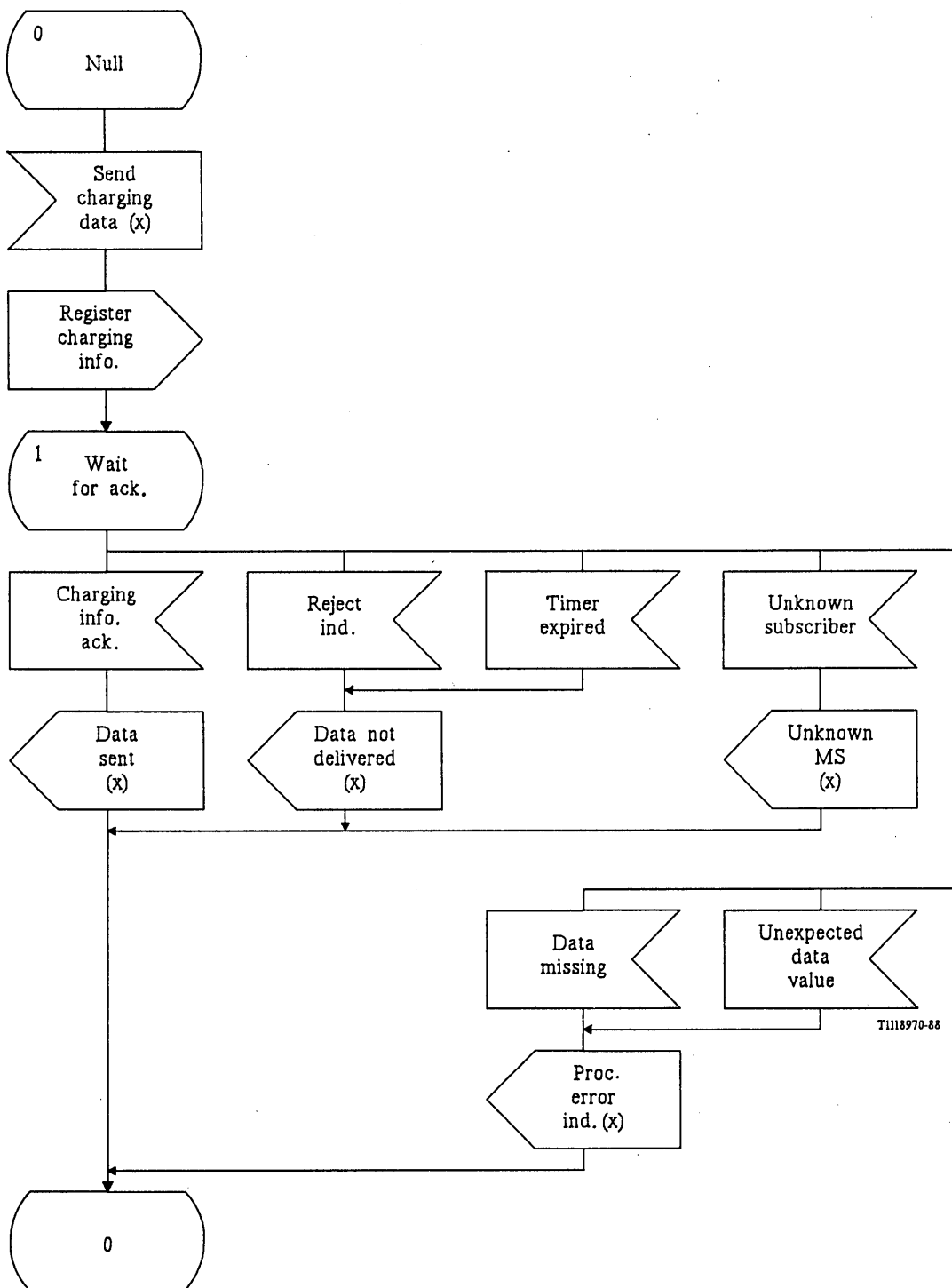


FIGURE 118/Q.1051

Application specific procedure in MSC for sending charging information

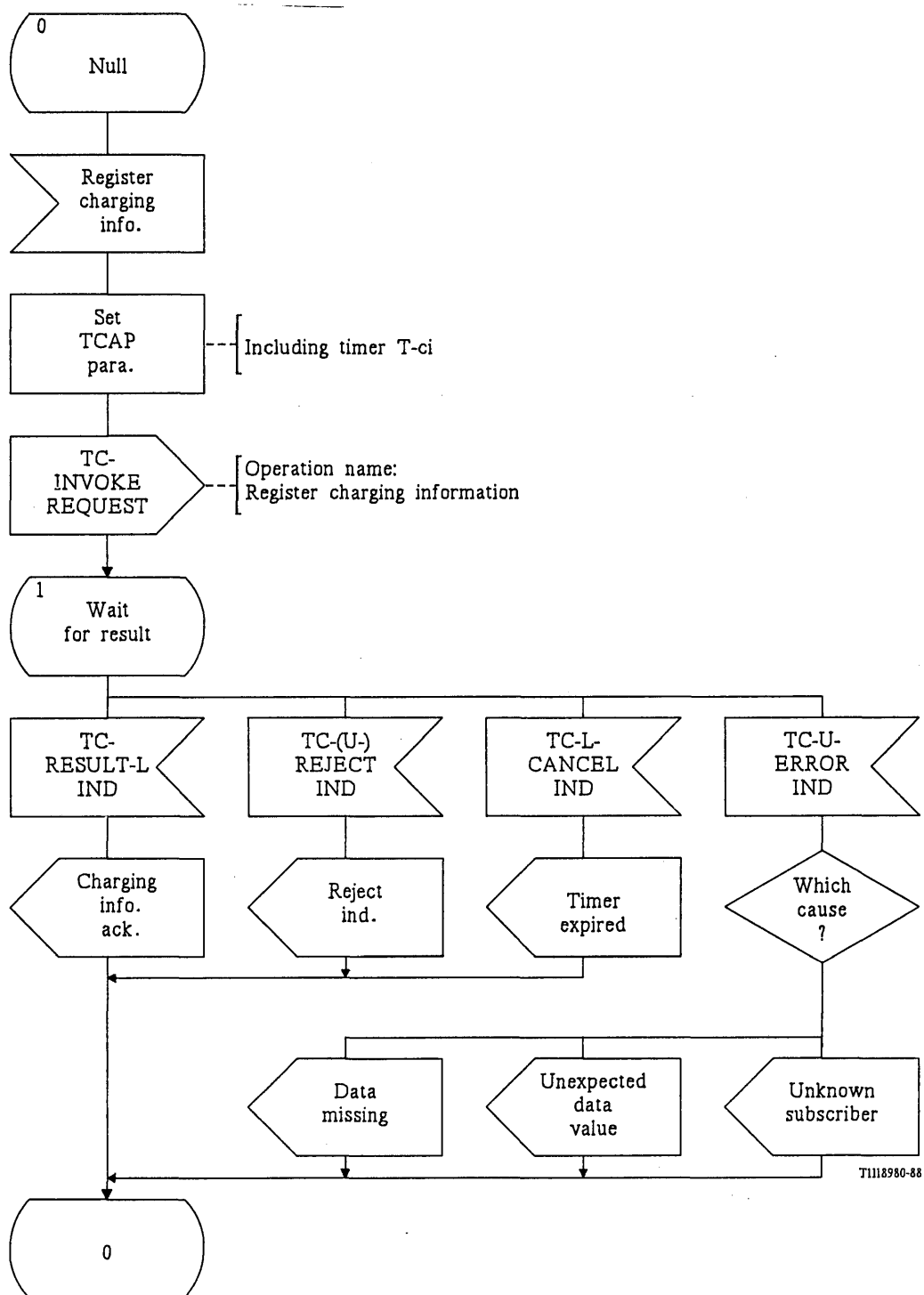


FIGURE 119/Q.1051

ASE/TCAP interface procedure in MSC for sending charging information



The *register charging information* message is sent in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-ci. The *charging information acknowledge* message is received in a TC-RESULT-L INDICATION primitive.

The reject indication and the timer expired indication are received in TC-(U-)REJECT INDICATION and TC-L-CANCEL INDICATION primitives, respectively.

The *unknown subscriber*, *data missing* or *unexpected data value* message is received in a TC-U-ERROR INDICATION primitive.

#### 3.7.1.3.2 Procedure in HLR

The application specific procedure is shown in Figure 120/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 121/Q.1051.

When receiving the *register charging information* message, the HLR will return:

- the *charging information acknowledge* message if the message is accepted;
- the *unknown subscriber* message if the MS is not registered in the HLR;
- the *data missing* and *unexpected data value* messages are used if the HLR cannot make use of the data in the form they are presented;
- the reject indication if the HLR cannot interpret some parameters or does not support the operation.

The *register charging information* message is received in a TC-INVOKE INDICATION primitive and the *charging information acknowledge* message is returned in a TC-RESULT-L REQUEST primitive. The reject indication is sent in a TC-U-REJECT REQUEST primitive and the *unknown subscriber*, *data missing* and *unexpected value* messages sent in a TC-U-ERROR REQUEST primitive.

#### 3.7.2 Other operation and maintenance procedures

For further study.

### 3.8 Fault recovery of location registers

#### 3.8.1 Requirements

Below follows a description of Mobile Application Part procedures required for restoration of location registers.

#### 3.8.2 Definition of interfaces

For restoration of the visitor location register both the interface to the MSC and the home location register are involved (Figure 122/Q.1051 a)). The procedures across the two interfaces are described below.

Interfaces to several visitor location registers may be involved for restoration of the home location register (Figure 122/Q.1051 b)).

#### 3.8.3 Procedures for restoration of VLR

After a restart, the VLR will mark all MSs with a restoration indication. This indication is removed for an MS when the VLR has received information that the MS is in the area controlled by the VLR.

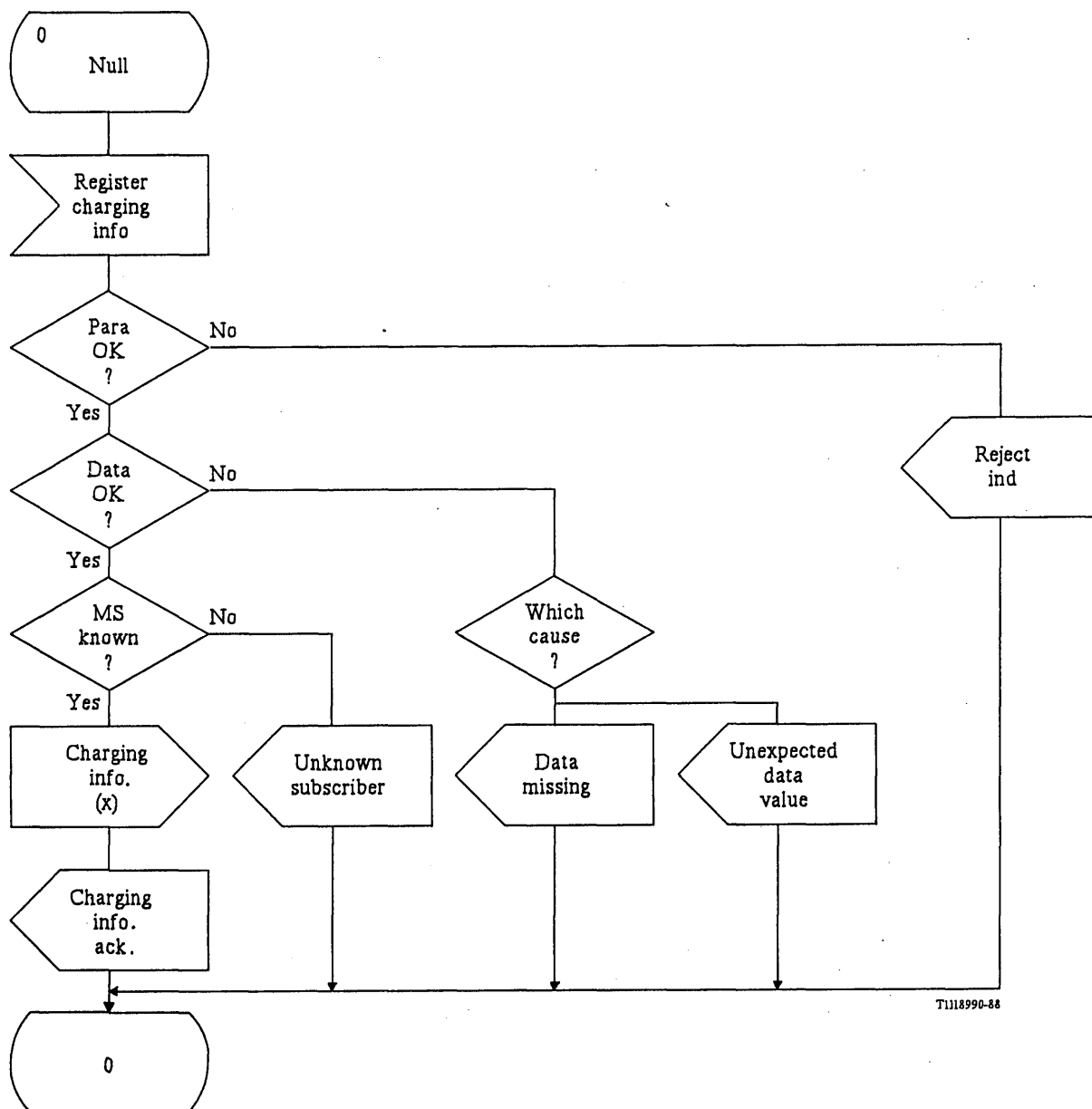


FIGURE 120/Q.1051

Application specific procedure in HLR for receiving charging information

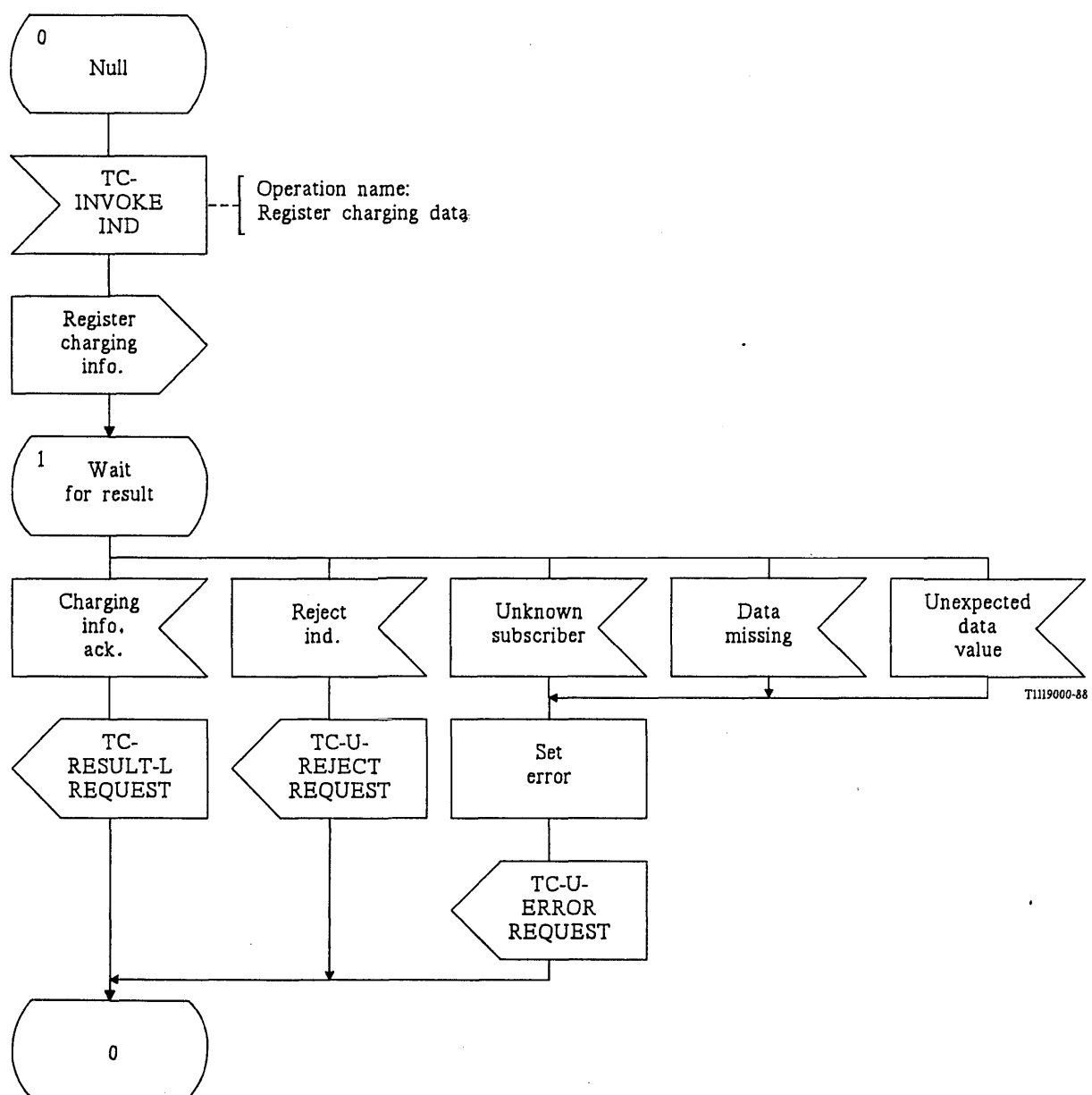
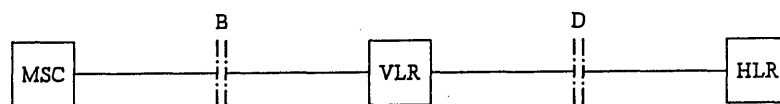
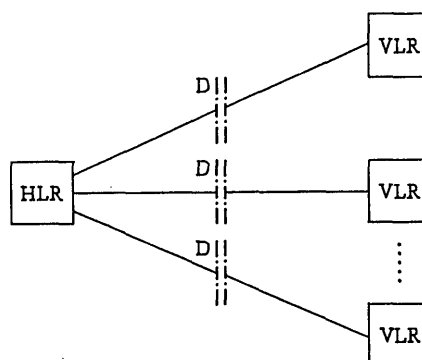


FIGURE 121/Q.1051

ASE/TCAP interface procedure in HLR for receiving charging information



a) Interfaces for restoration of VLR



b) Interfaces for restoration of HLR

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FIGURE 122/Q.1051

### Interfaces related to restoration of location

The procedures involved are shown in Figure 123/Q.1051 and are as follows:

- a) the following Mobile Application Part messages received from the MSC will indicate that the MS is in the area controlled by the VLR: *update location area* message, *attach/detach IMSI* message, *operate supplementary services* message, and *send information for O/G call set-up* message (MS originating call);
- b) receiving a *cancel location* message from the HLR enables the VLR to delete the MS and receiving an *update category/supplementary services* message indicates that the MS shall be retained in the VLR;
- c) the VLR may use the interrogation procedure defined in § 3.6.1 in order to obtain location information from the HLR;
- d) when receiving a *send information for I/C call set-up* message concerning an MS terminating call to an MS which is known by the VLR, the VLR sends a *search for MS* message to the MSC. This message indicates that the MSC may search for the MS on all BSs connected to the MSC (provided that the MSC covers more than one location area). The MSC returns the location information in the *search acknowledge* message. If the MS does not respond to the search, this will be indicated. In that case the VLR will delete the MS from memory and notify the HLR by the procedure defined in § 3.2.1.4. The VLR may also use the search procedure in order to page MSs which have not made or responded to calls for a long time;
- e) the VLR may also receive an *initiate authentication* message from the MSC indicating that a call in progress is handed over.

An overview of the procedures is shown in Figure 124/Q.1051 using SDL description.

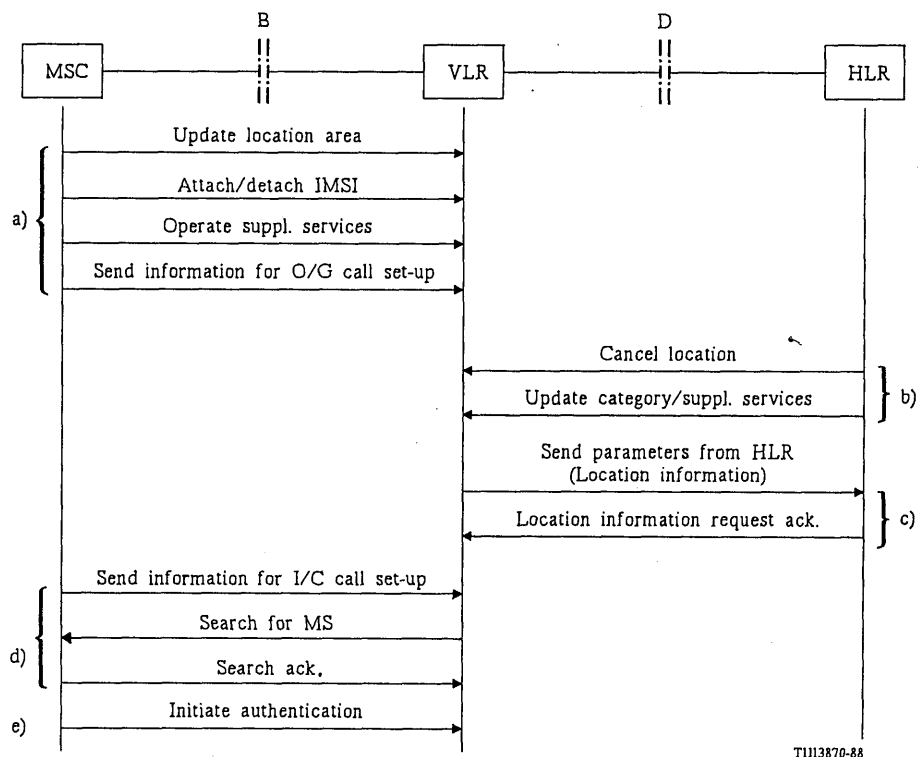
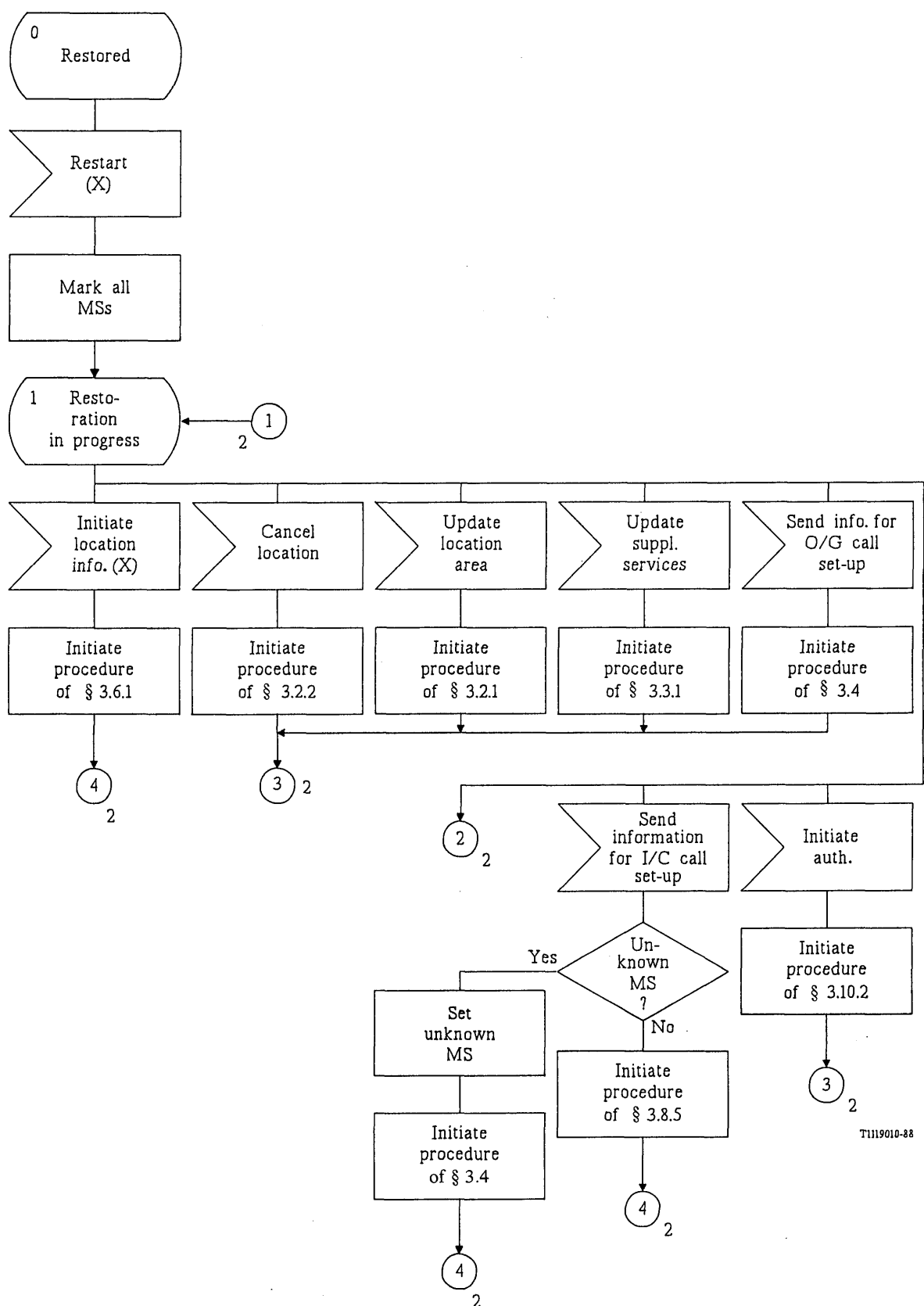


FIGURE 123/Q.1051

Procedures related to restoration of VLR



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FIGURE 124/Q.1051 (sheet 1 of 2)

Logic procedure for restoration of visited location register

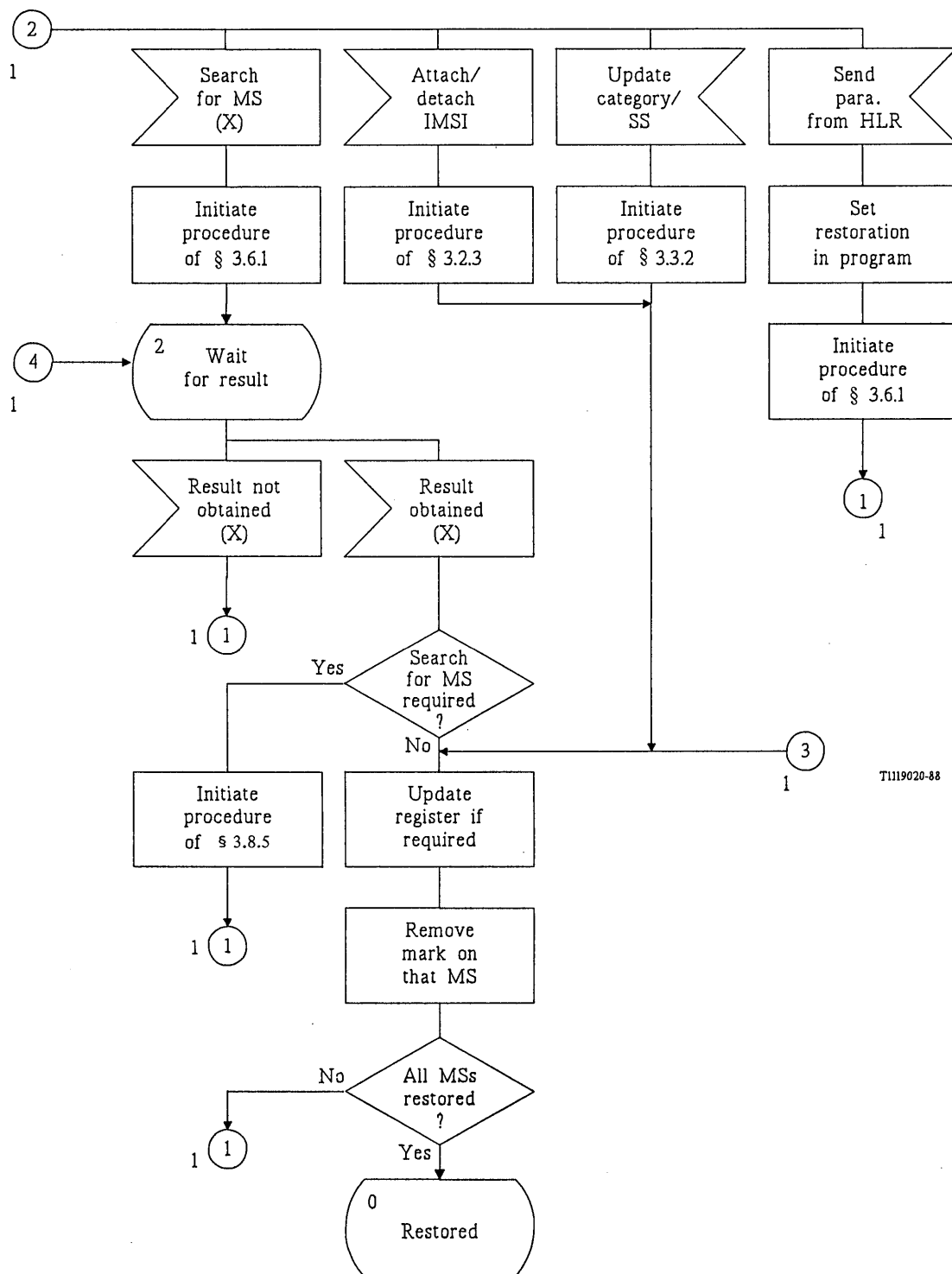


FIGURE 124/Q.1051 (sheet 2 of 2)

Logic procedure for restoration of visited location register

### 3.8.4 Procedures for restoration of HLR

After a restart of the home location register, the register will send a *reset* message to VLRs (see Figure 125/Q.1051). This message may be sent to all VLRs of the system or only to VLRs with which the HLR has regular information exchange.

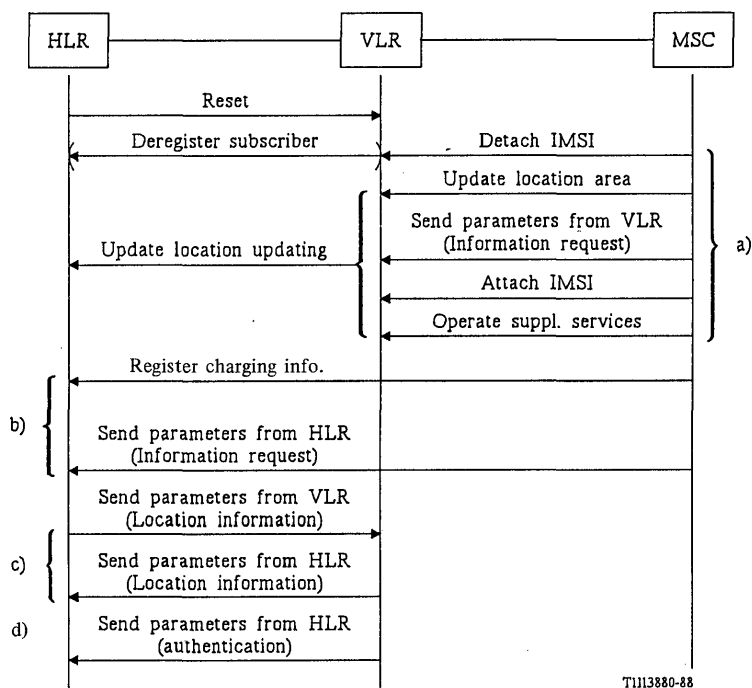


FIGURE 125/Q.1051

#### Procedures related to restoration of HLR

When receiving a *reset* message, the VLR will mark all MSs of that HLR. If the VLR receives a message from an MSC concerning any such MS (i.e., *update location area*, *attach/detach IMSI*, *send parameters* and *operate supplementary services*), the VLR will initiate location updating of the HLR. This corresponds to a) in Figure 125/Q.1051.

The HLR may receive messages directly from the MSC also indicating that an MS is in a particular VLR (i.e., *register charging information*, *operate supplementary services*, *send parameters*). This corresponds to b) in Figure 125/Q.1051.

The HLR may also request location information from a VLR as indicated in c) of Figure 125/Q.1051. This procedure corresponds to that defined in § 3.6.1.

The HLR may also receive a *send parameters from HLR (authentication)* message from the VLR as indicated in d) in Figure 125/Q.1051.

The procedures outlined above are shown in Figures 126/Q.1051 and 127/Q.1051 for the HLR and the VLR, respectively, using SDL description.



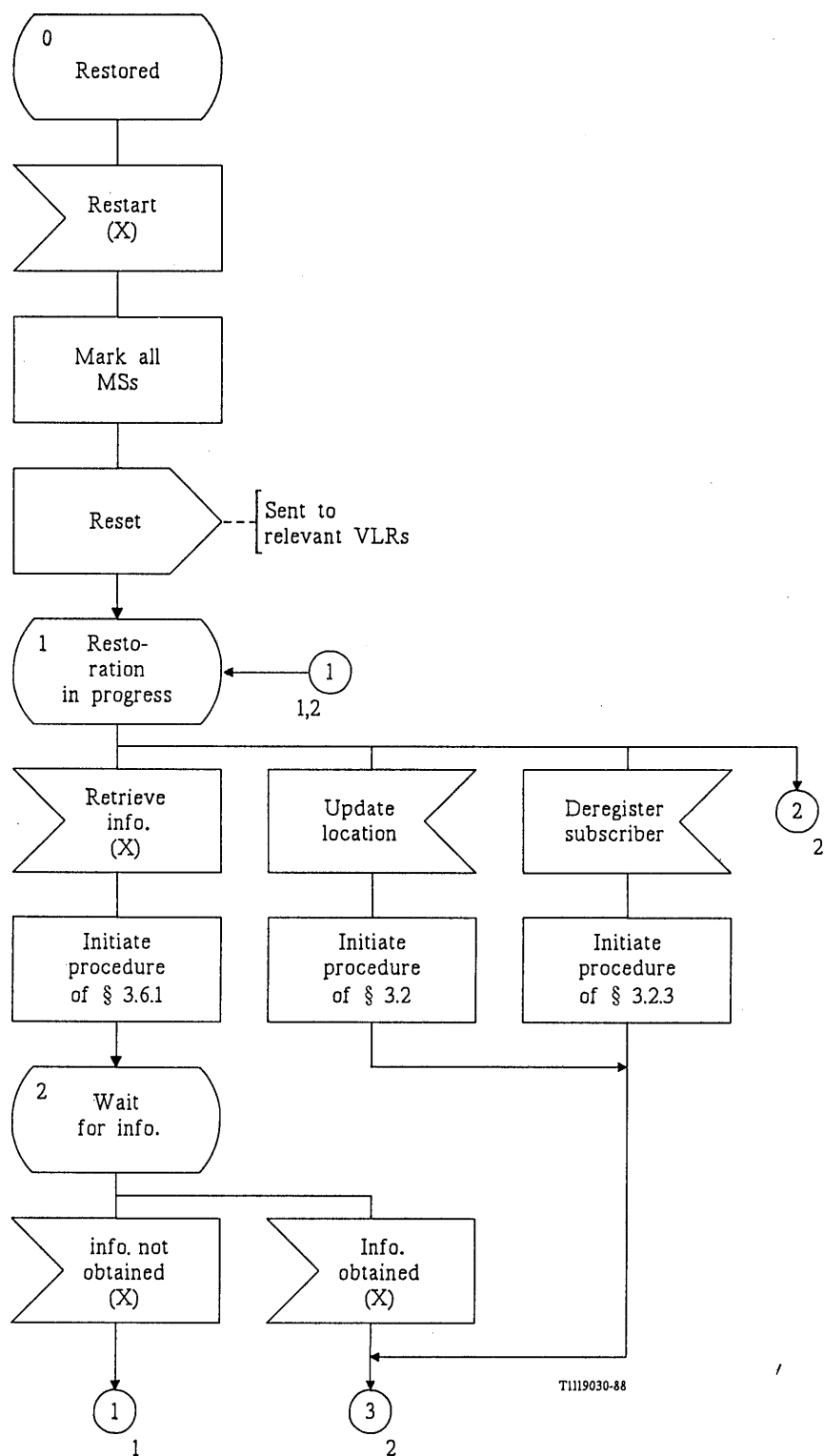


FIGURE 126/Q.1051 (sheet 1 of 2)

Logic procedure for restoration of home location register

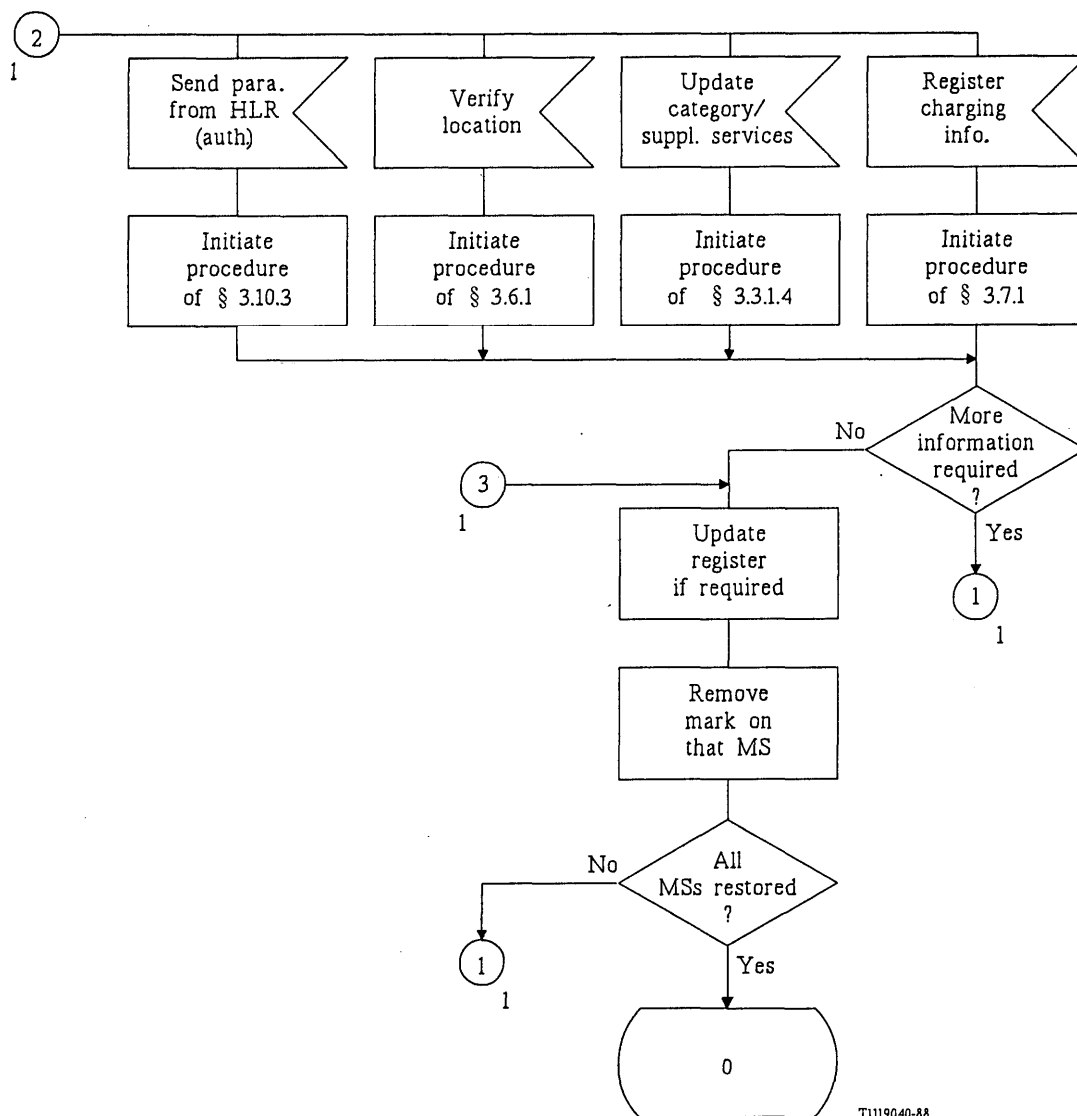


FIGURE 126/Q.1051 (sheet 2 of 2)

Logic procedure for restoration of home location register

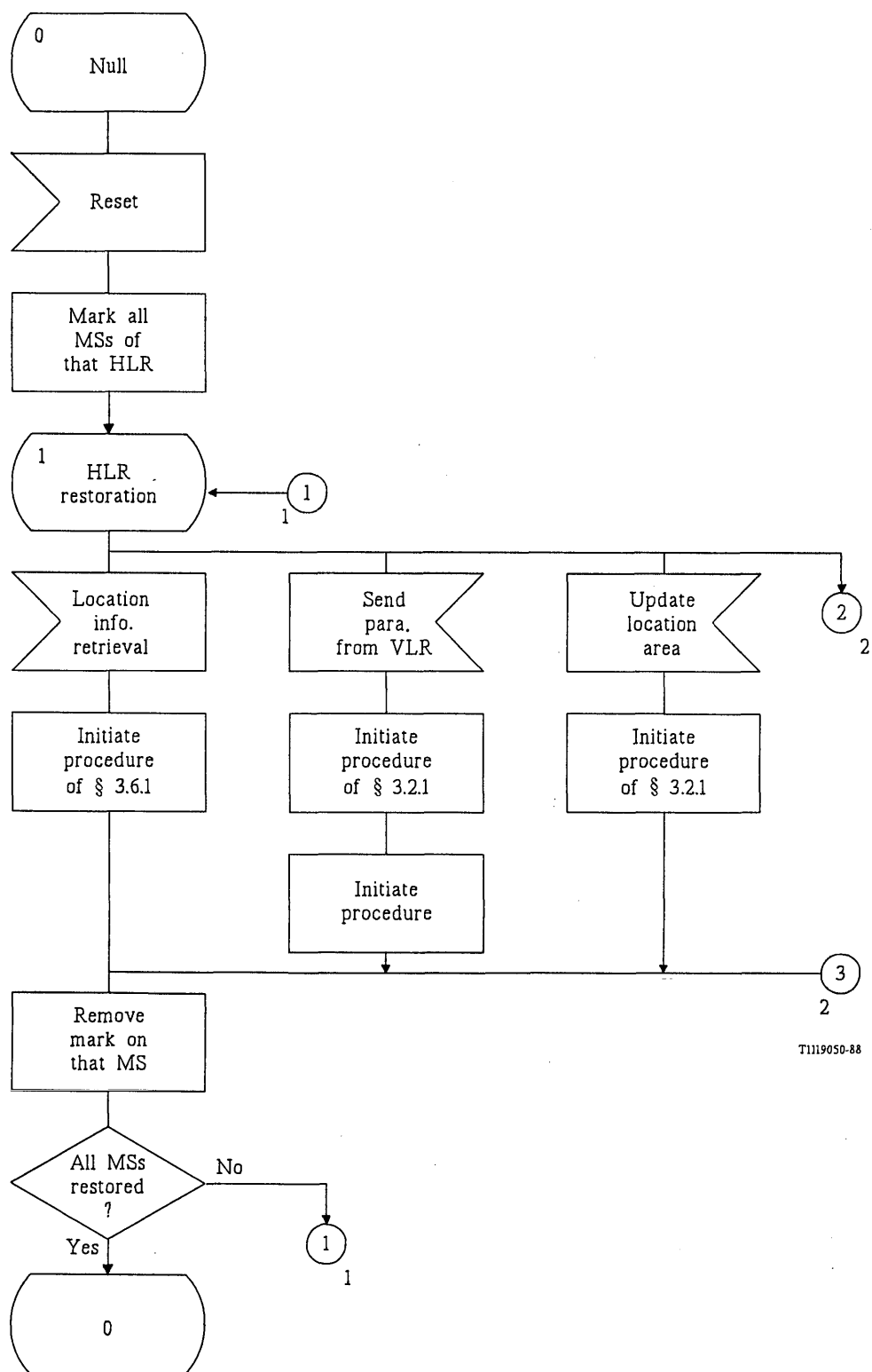


FIGURE 127/Q.1051 (sheet 1 of 2)

Logic procedure in a visited location register when receiving a reset message from a home location register

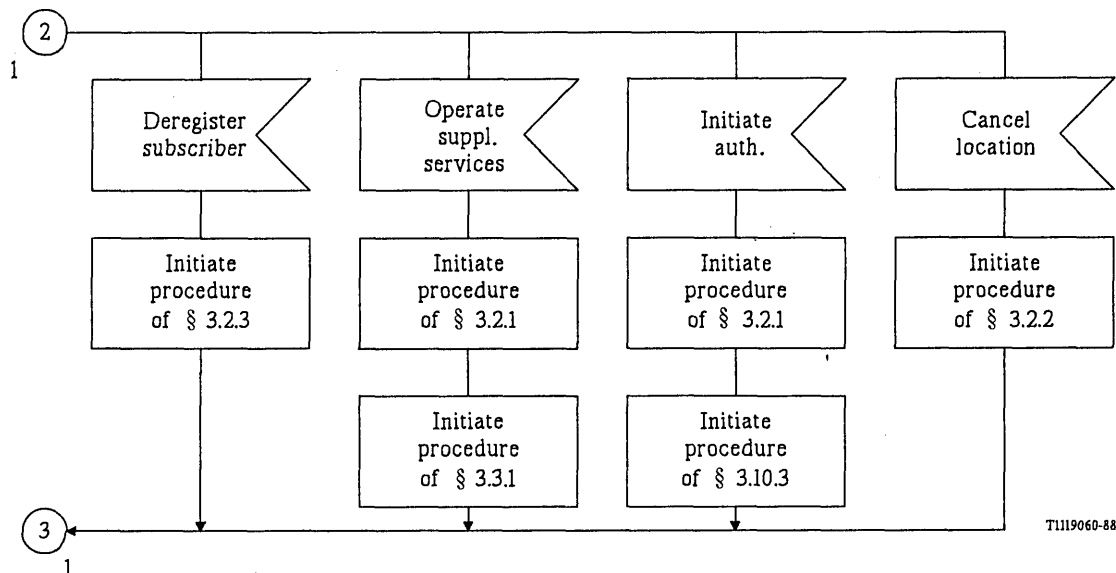


FIGURE 127/Q.1051 (sheet 2 of 2)

**Logic procedure in a visited location register when receiving  
a reset message from a home location register**

### 3.8.5 Detailed description of search procedure

#### 3.8.5.1 Procedure in VLR

The application specific procedure is shown in Figure 128/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 129/Q.1051.

When an indication is received that search is required, the VLR sends a *search for MS* message to the MSC. The message is sent in a TC-INVOKE REQUEST primitive. Results are received as follows:

- a *search acknowledge* message is received if the MS responds. This message is contained in a TC-RESULT-L INDICATION primitive;
- if the procedure fails a reject indication or a timer expired indication is received;
- an *absent subscriber* message will indicate that the MS did not respond to the search.

The *absent subscriber* message is received in a TC-U-ERROR INDICATION primitive. The reject indication is reported in a TC-(U-)REJECT INDICATION primitive.

TCAP is requested to supervise the procedure by timer T-sms. If the timer expires, a TC-L-CANCEL INDICATION primitive is received.

#### 3.8.5.2 Procedure in MSC

The application specific procedure is shown in Figure 130/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 131/Q.1051.

The *search for MS* message is received in a TC-INVOKE REQUEST primitive. The MSC will initiate the necessary paging procedure in order to locate the MS. If the MS is located, the *search acknowledge* message is returned in a TC-RESULT-L REQUEST primitive.

If the MS is not located the *absent subscriber* message is returned in a TC-U-ERROR REQUEST primitive.

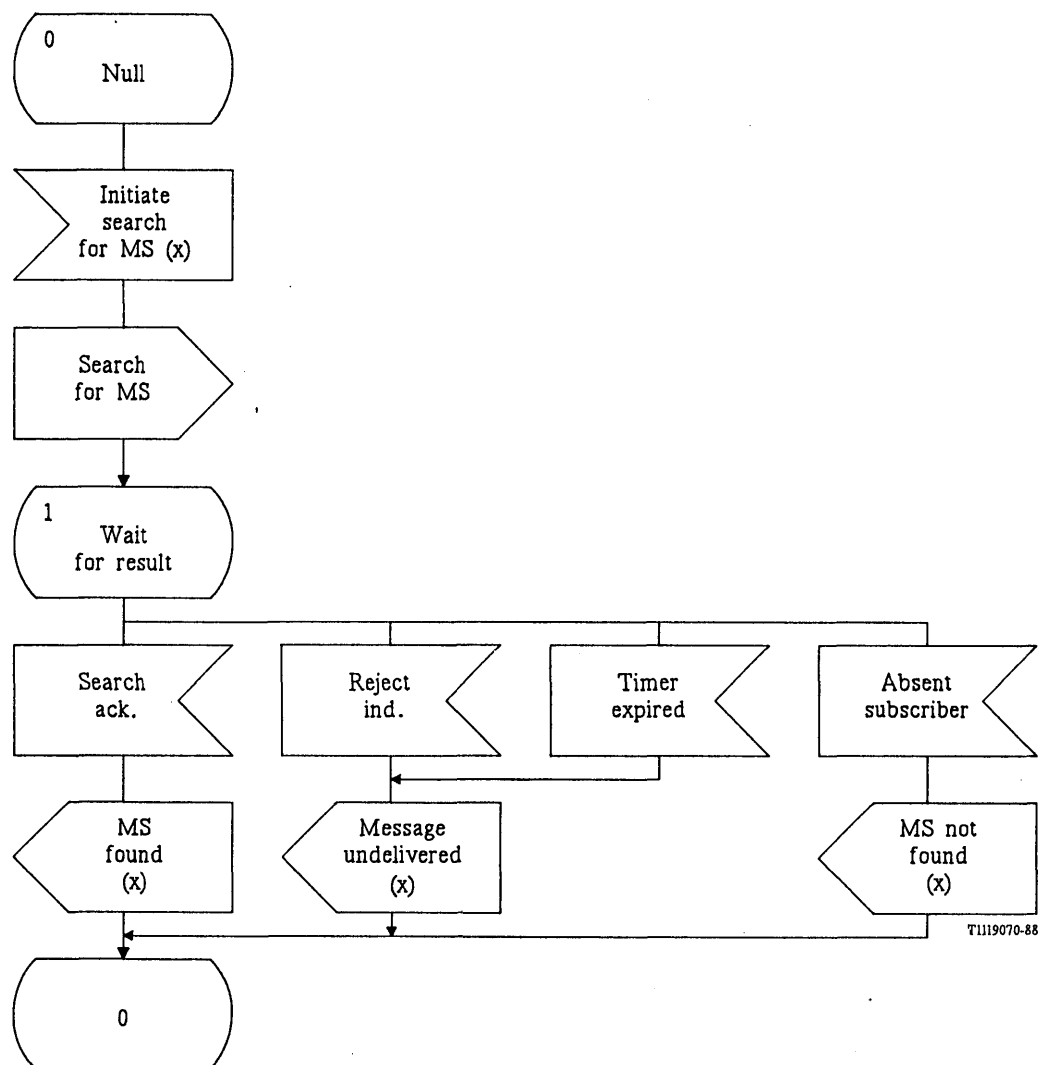


FIGURE 128/Q.1051

**Application specific procedure in VLR for  
initiating the search procedure**

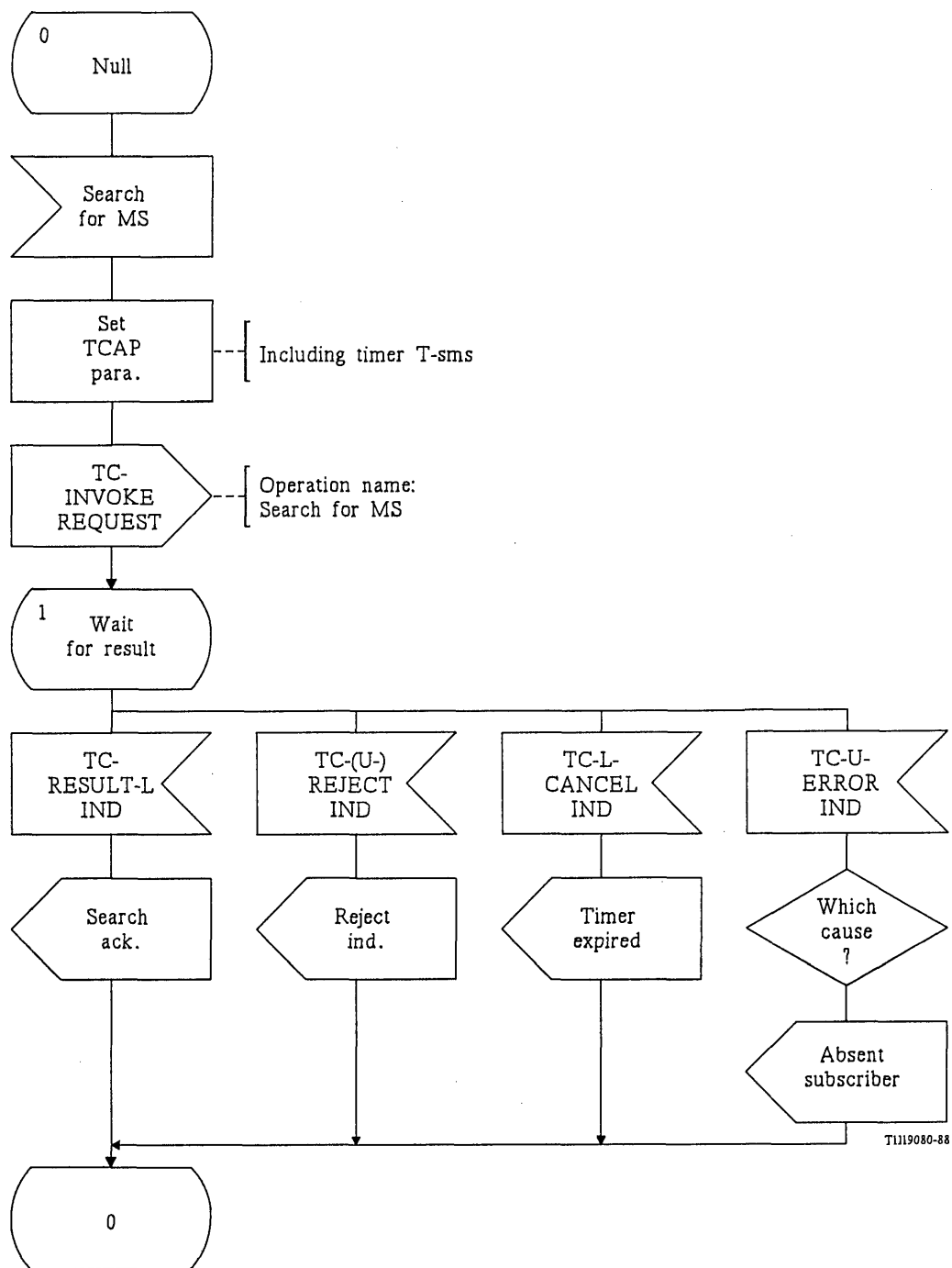


FIGURE 129/Q.1051

ASE/TCAP interface procedure in VLR for  
initiating the search procedure

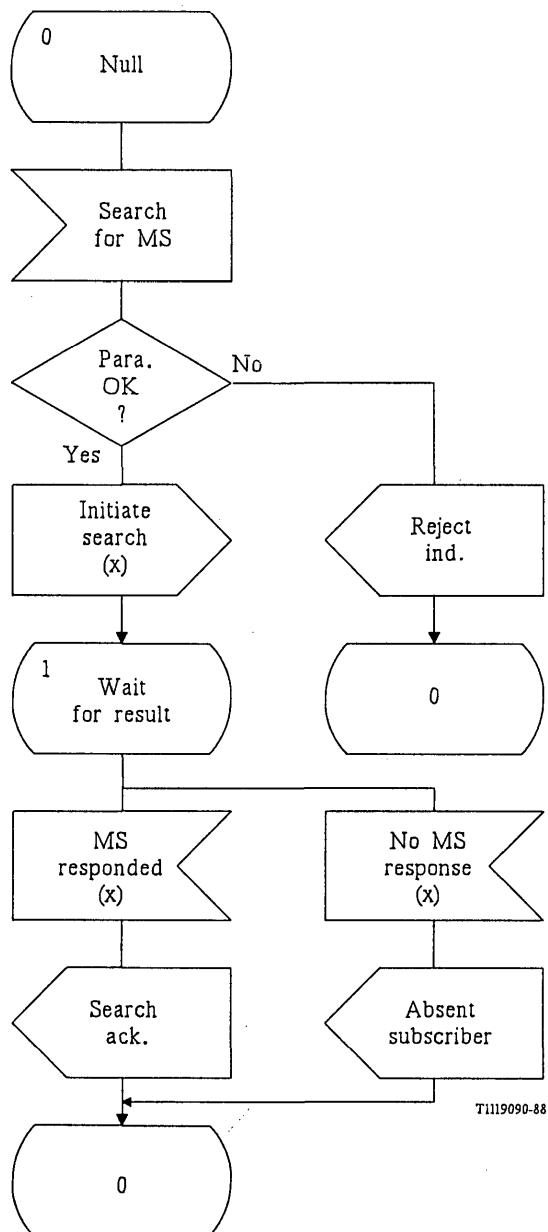


FIGURE 130/Q.1051

**Application specific procedure in MSC for initiating the search procedure**

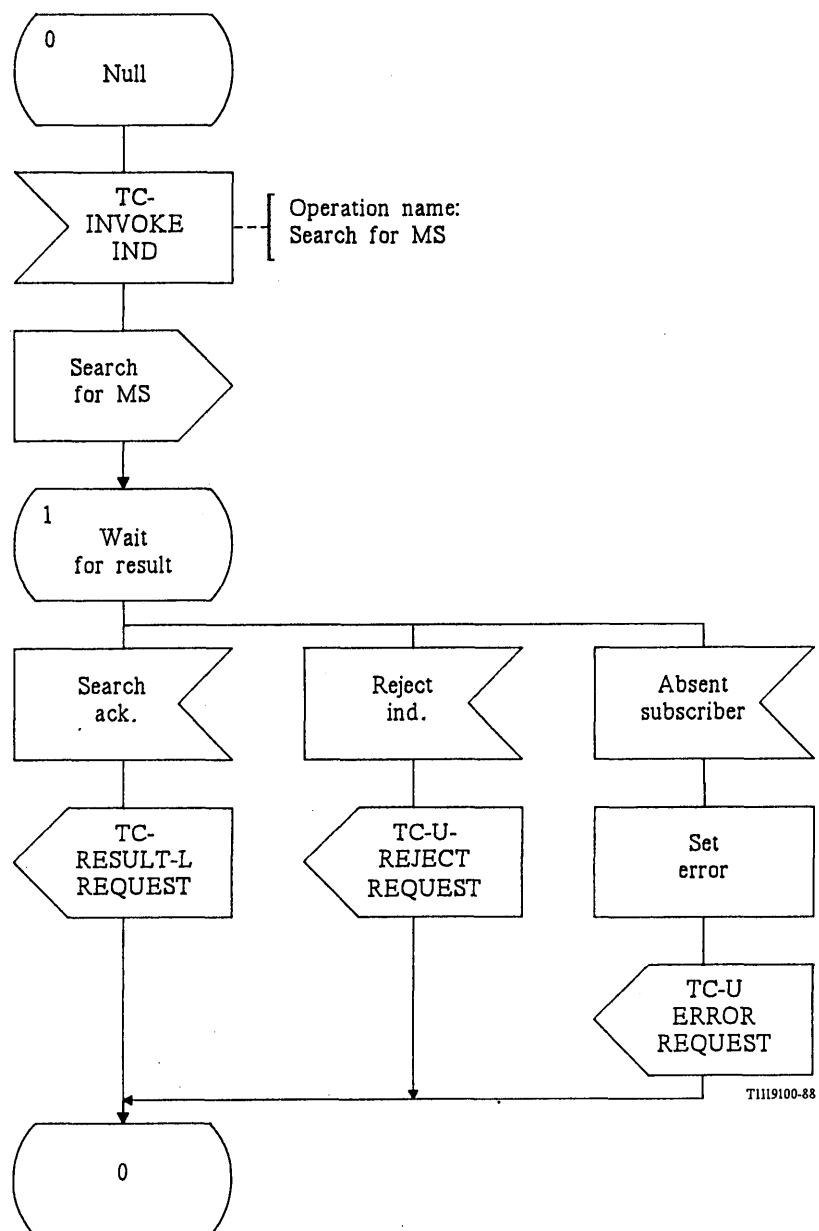


FIGURE 131/Q.1051

**ASE/TCAP interface procedure in MSC for initiating the search procedure**



### 3.8.6 Detailed description of reset procedure

#### 3.8.6.1 Procedure in HLR

The application specific procedure is shown in Figure 132/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 133/Q.1051.

The *reset* message is sent to selected VLRs, with one separate transaction for each VLR. The *reset* message is sent in a TC-INVOKE REQUEST primitive with pre-arranged termination of the procedure. The termination is done by use of timer supervision (T-res) and expiry of the timer indicates the termination of the procedure (TC-L-CANCEL INDICATION primitive).

#### 3.8.6.2 Procedure in VLR

The application specific procedure is shown in Figure 134/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 135/Q.1051. The VLR will receive the *reset* message in the TC-INVOKE INDICATION primitive. An internal operation in the VLR will then take place in order to mark the MSs of that HLR.

### 3.9 Management of international mobile equipment identities

#### 3.9.1 Definition of interfaces

The international mobile equipment identities (IMEI) are stored in a functional unit denoted equipment identity register (EIR). MSCs may interface the register by use of MAP (interface F) as shown in Figure 136/Q.1051.

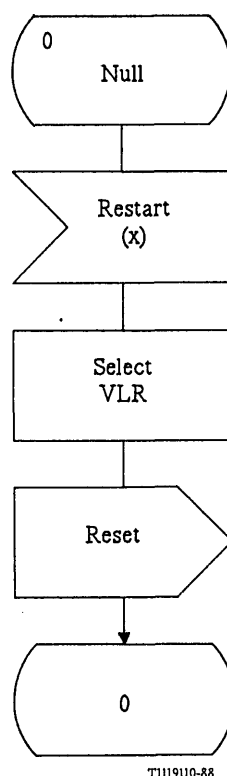


FIGURE 132/Q.1051

Application specific procedure in HLR for sending the reset message

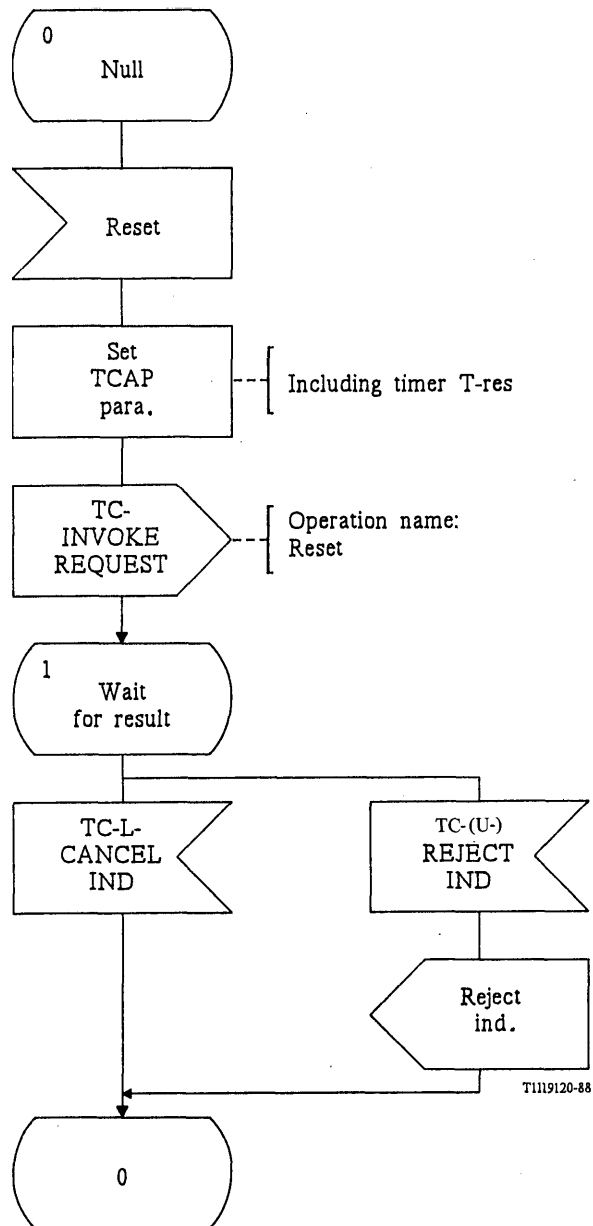


FIGURE 133/Q.1051

ASE/TCAP procedure in HLR for sending the reset message

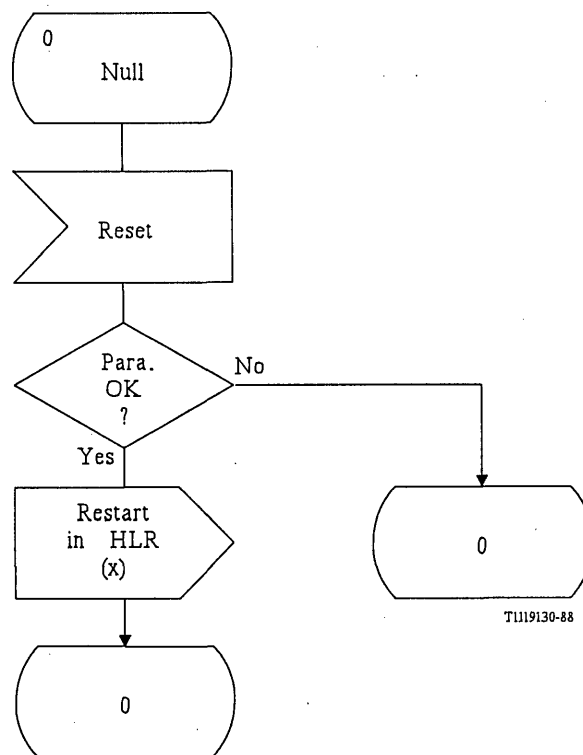


FIGURE 134/Q.1051

Application specific procedure in VLR receiving a reset message

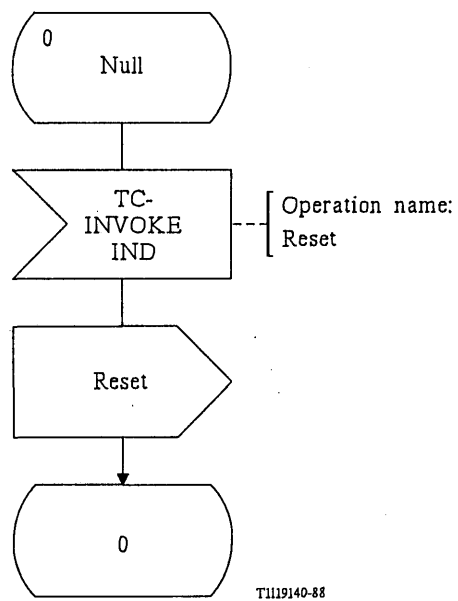


FIGURE 135/Q.1051

ASE/TCAP interface in VLR receiving a reset message

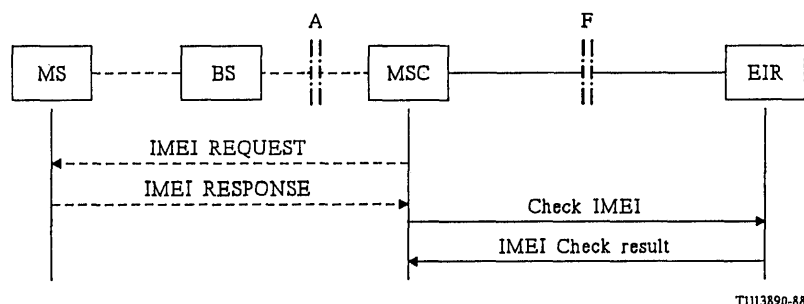


FIGURE 136/Q.1051

### Interface and procedures for checking the equipment identity (IMEI)

#### 3.9.2 General description of procedures

The procedure is shown in Figure 136/Q.1051. It is initiated by the MSC requesting an MS to provide its IMEI by signalling procedures on the radio path. When the IMEI is received in the MSC, the MSC sends a *check IMEI* message to the EIR.

The EIR responds by returning a *IMEI check result* message. The further actions taken by the MSC depends on the result received from the EIR.

#### 3.9.3 Detailed description of the IMEI management procedure

##### 3.9.3.1 Procedure in the MSC

The application specific procedure is contained in Figure 137/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 138/Q.1051.

When an IMEI is to be checked, the MSC sends the *check IMEI* message to the equipment identity register (EIR) in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-cim.

The *IMEI check result* is received in a TC-RESULT-L INDICATION primitive. If the IMEI is not known in the EIR, the message *IMEI unknown* will be received in a TC-U-ERROR INDICATION primitive.

##### 3.9.3.2 Procedure in the EIR

The application specific procedure is contained in Figure 139/Q.1051 and the ASE/TCAP interface procedure is contained in Figure 140/Q.1051.

The EIR will receive the *check IMEI* message in a TC-INVOKE INDICATION primitive. If the IMEI is not in the list contained in the EIR, the *IMEI unknown* message is returned in a TC-U-ERROR REQUEST primitive. If the IMEI is contained in the list, the information contained in the list (see § 4) is returned in a TC-RESULT-L REQUEST primitive.

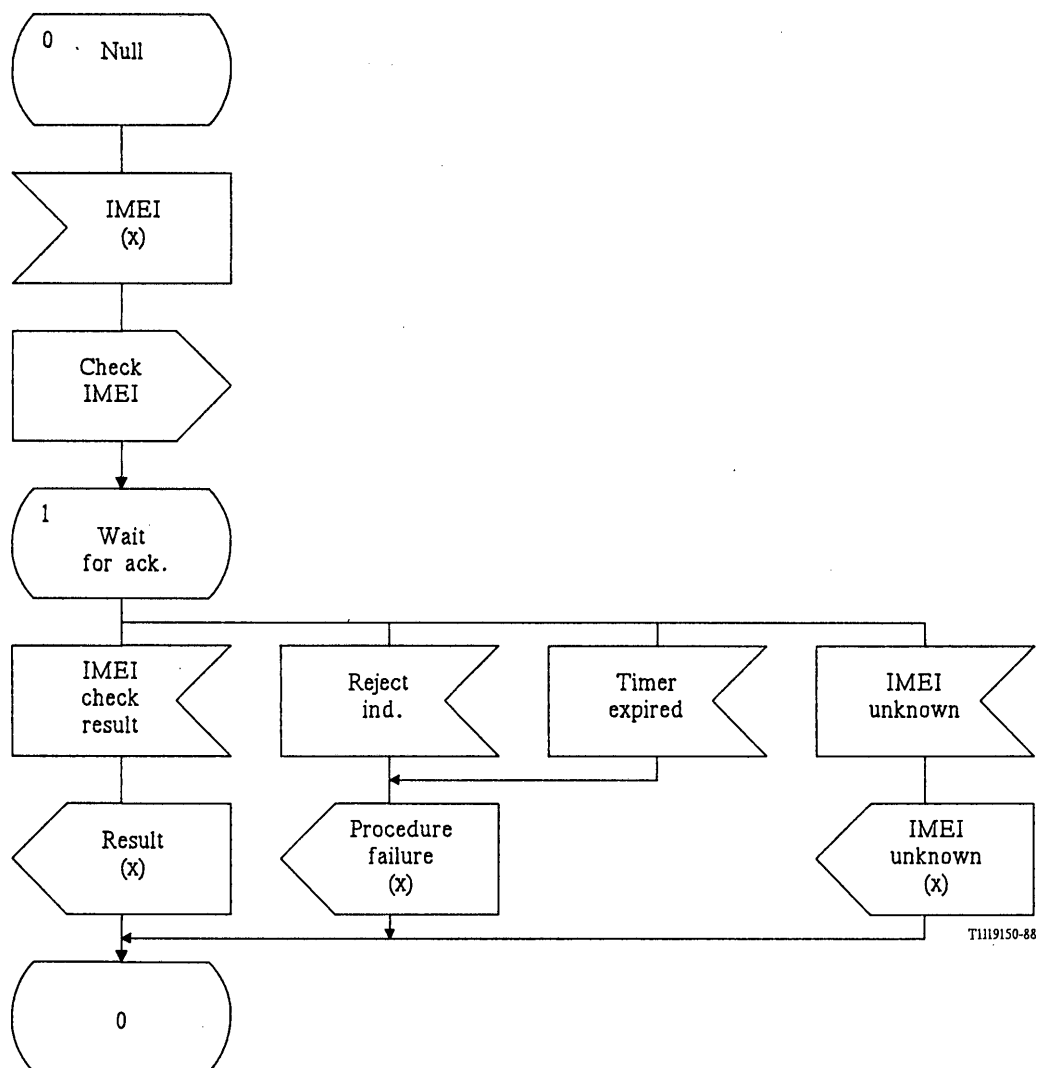


FIGURE 137/Q.1051

Application specific procedure in MSC for checking IMEI

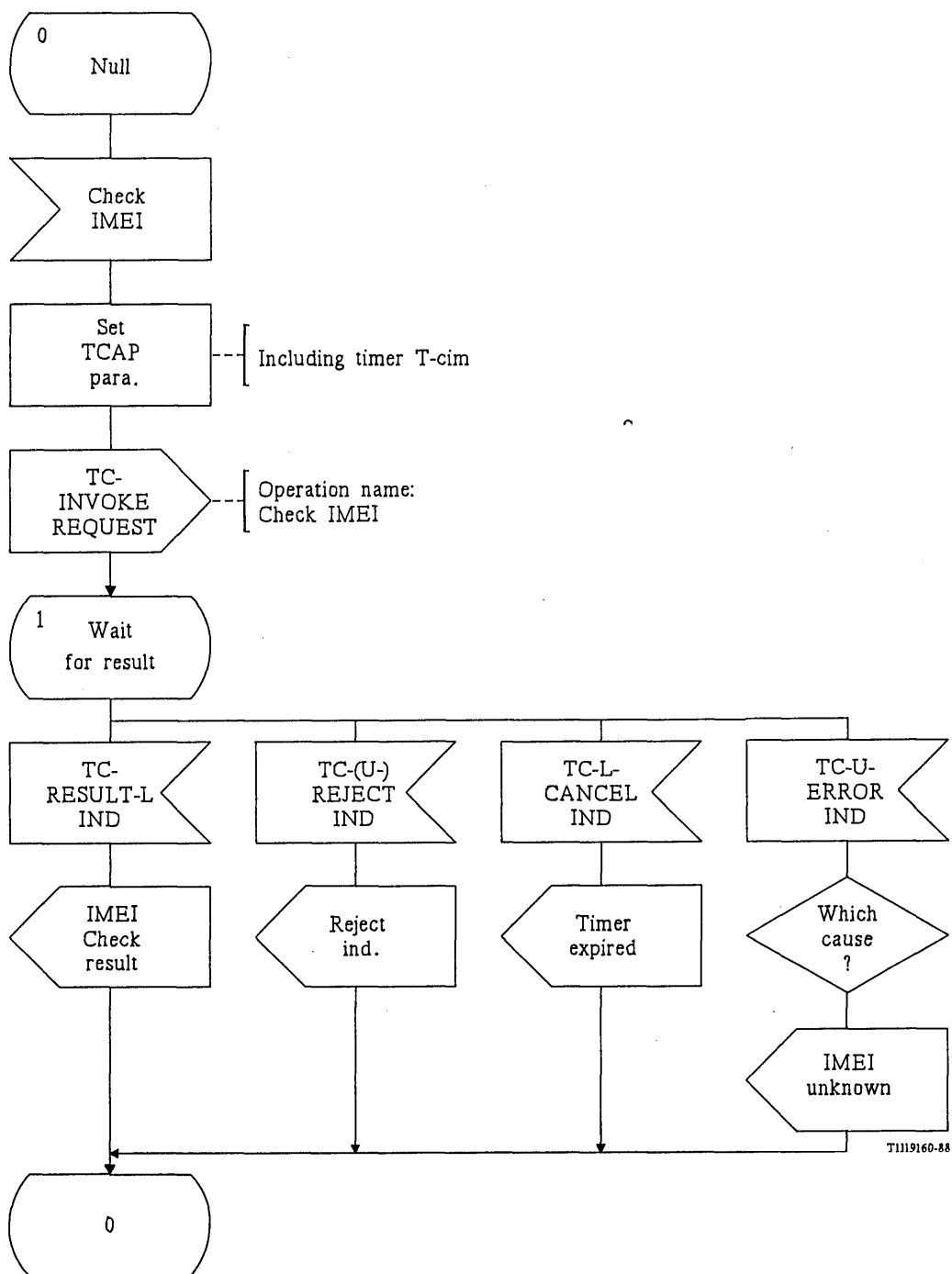


FIGURE 138/Q.1051

ASE/TCAP interface procedure in MSC for checking IMEI

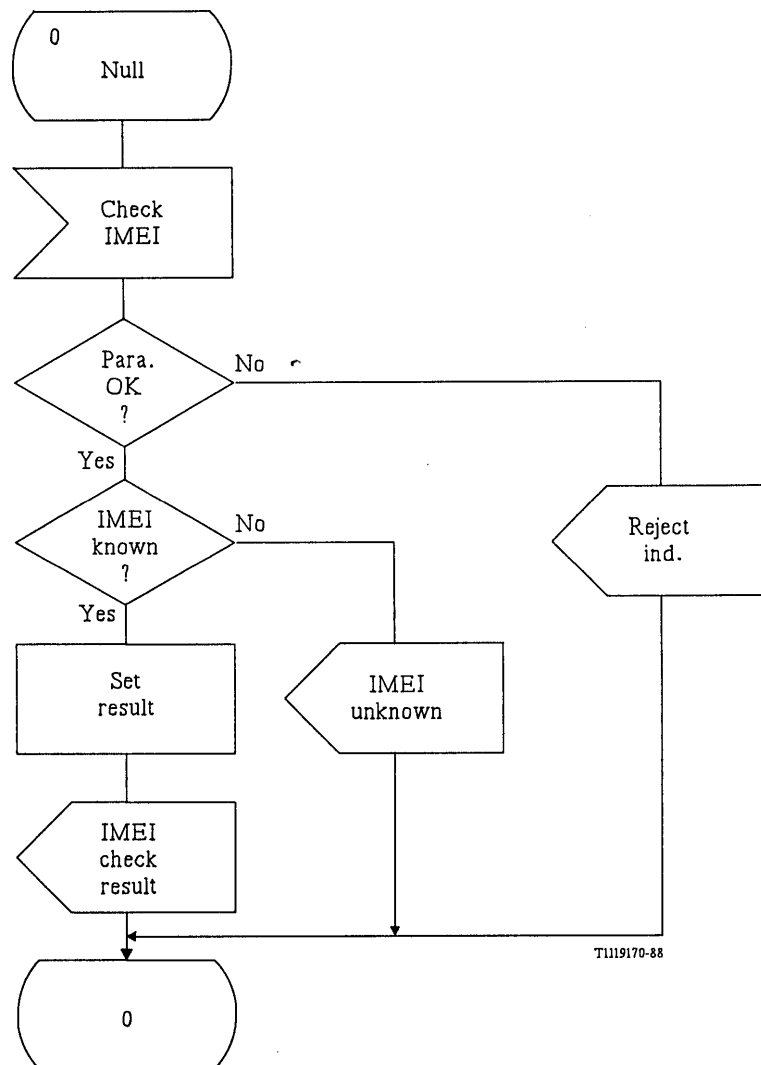


FIGURE 139/Q.1051

Application specific procedure in EIR for checking IMEI

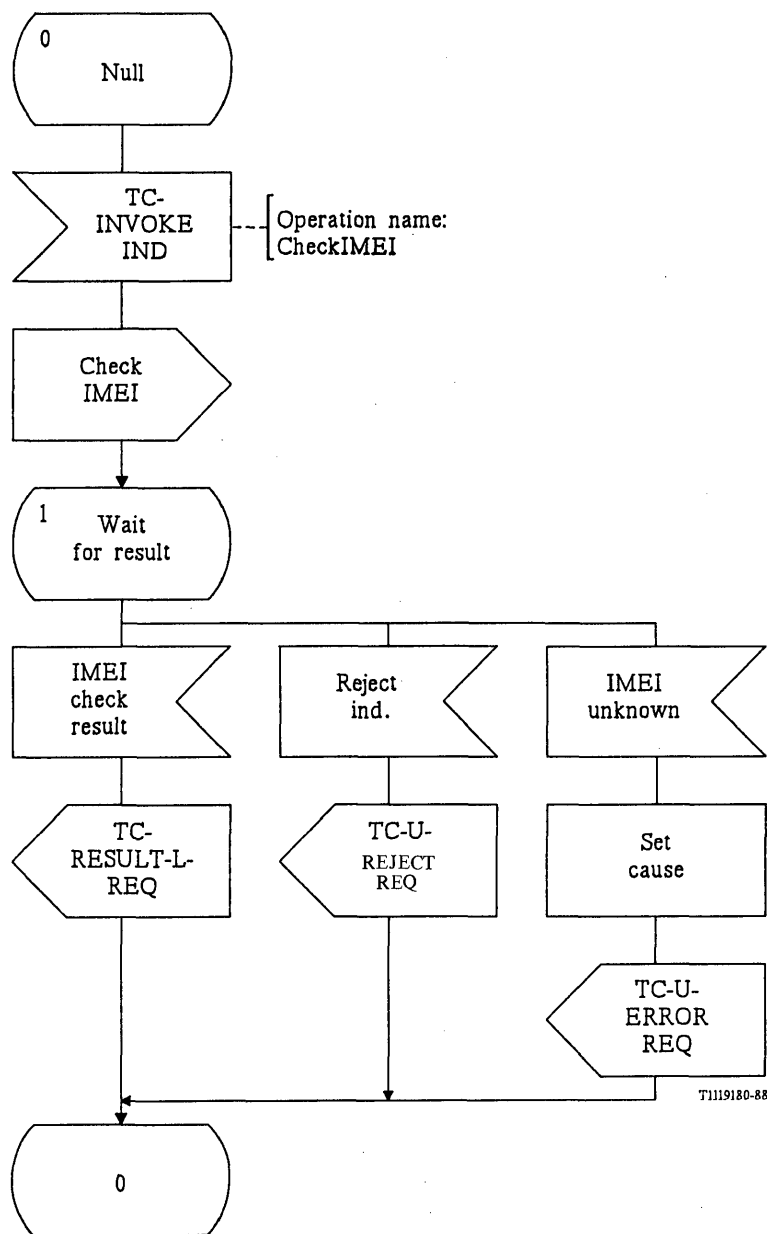


FIGURE 140/Q.1051

ASE/TCAP interface procedure in EIR for checking IMEI



### 3.10 Authentication

#### 3.10.1 Definition of interfaces

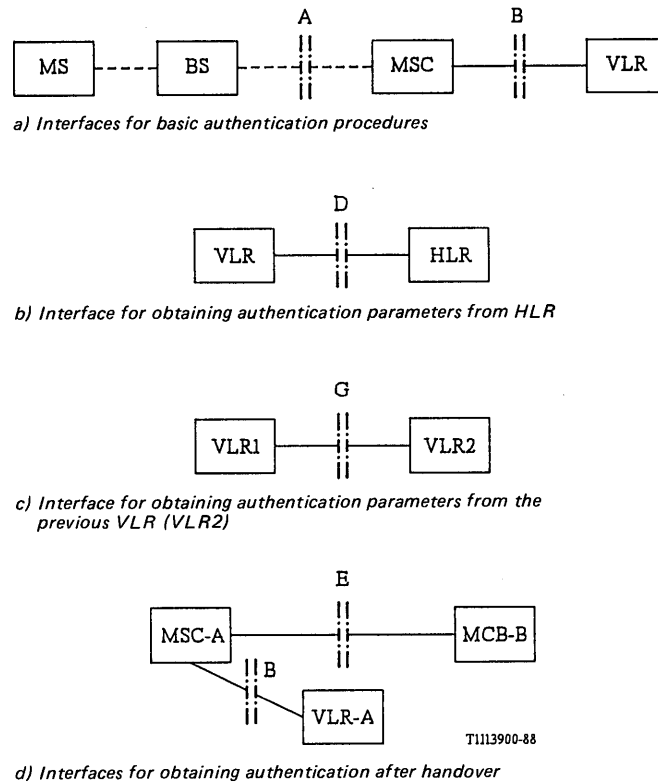


FIGURE 141/Q.1051

#### Interfaces related to authentication

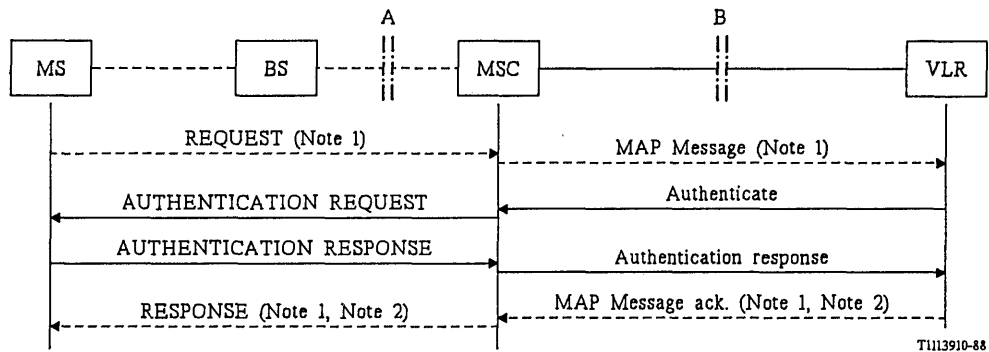
Figure 141/Q.1051 shows the interfaces and system components involved in authentication of mobile stations. The various cases are:

- the interface for the basic authentication procedure where the authentication check is done by the VLR for authentication at call set-up, location registration and operation of supplementary services (Figure 141/Q.1051 a));
- the interface between the VLR and the HLR for transfer of authentication parameters to the VLR (Figure 141/Q.1051 b));
- the interface between the new VLR (VLR1) and the previous VLR (VLR2) for transfer of authentication parameters at location registration (Figure 141/Q.1051 c));
- the interfaces between the controlling MSC (MSC-A) and its associated VLR (VLR-A) for authentication at handover, i.e. (Figure 141/Q.1051 d));
- interface between MSC-A and MSC-B. This interface is only required for handover between MSC-A and MSC-B and for subsequent handover between BSs of MSC-B when the call is maintained on MSC-B (Figure 141/Q.1051 d)).

#### 3.10.2 Basic authentication procedure

##### 3.10.2.1 General description of the procedure

The procedure is shown in Figure 142/Q.1051.



Note 1 - REQUEST/RESPONSE/MAP message and MAP message ack indicate a message associated with call set-up, location registration, operation of a supplementary service or any other event requiring authentication.

Note 2 - These messages will contain the new TMSI, if required.

FIGURE 142/Q.1051

### Basic authentication procedure

The procedure is initiated when the VLR receives a MAP message from the MSC concerning a location registration, call set-up, operation of a supplementary service or a request from the MSC for initiating authentication (see § 3.10.5). If the MS is unknown to the VLR, the VLR may obtain authentication parameters from the HLR by the procedure described in § 3.10.3 or from the previous VLR by the procedure described in § 3.10.4.

The VLR performs the authentication by sending the *authenticate* message to the MSC. This message contains the authentication parameter (AP) to be sent to the MS. This parameter is then sent to the MS in the AUT-REQUEST message. The MS responds by returning the authentication result parameter in the AUT-RESPONSE message.

The authentication result parameter (AR) is then sent to the VLR in the *authentication response* message for authenticity checking.

The authenticity of the MS is established by the VLR.

The negative authentication check result is returned as part of the procedure that initiated the authentication procedure, see §§ 3.2.1.3.1, 3.3.1.3.1, 3.4.3.1.1 and 3.4.3.1.2 and 3.10.5.2.1 for authentication at location registration, at operation of supplementary services and at incoming/outgoing call set-up respectively.

Authentication at handover is not part of the basic or subsequent handover procedures since authentication takes place after the handover procedures have been completed. The way of providing negative results for authentication at handover is defined in § 3.10.5.2.1 below.

#### 3.10.2.2 Detailed description of the basic authentication procedure

##### 3.10.2.2.1 Procedure in the VLR

The application specific procedure is shown in Figure 143/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 144/Q.1051.

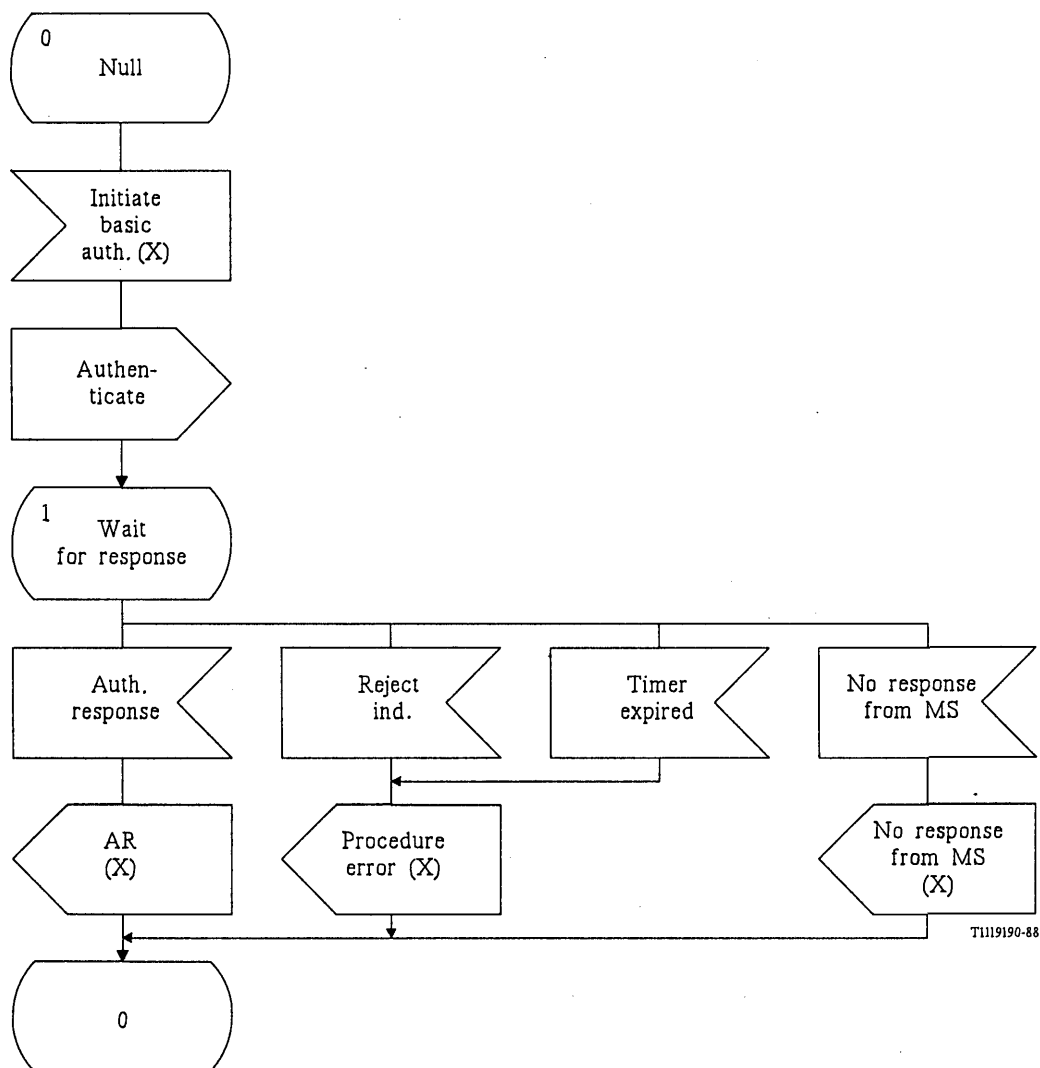


FIGURE 143/Q.1051

**Application specific procedure for the basic authentication procedure in the VLR**

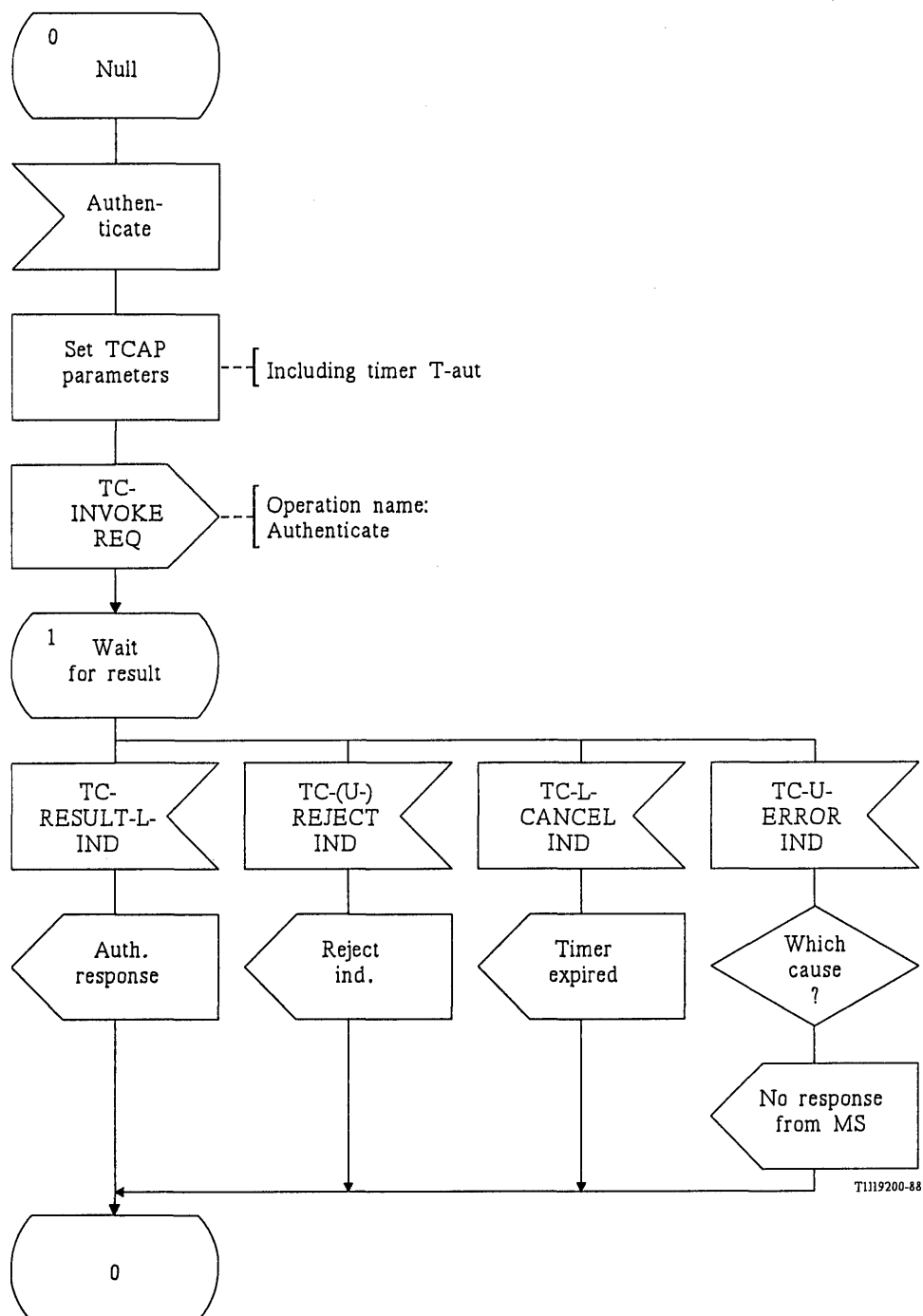


FIGURE 144/Q.1051

**ASE/TCAP interface procedure for the basic authentication procedure in VLR**

When an indication is given that authentication is required, the VLR send the *authenticate* message to the MSC in a TC-INVOKE REQUEST primitive. TCAP is requested to supervise the procedure by timer T-aut. Results are received as follows:

- the *authentication response* message is contained in a TC-RESULT-L INDICATION primitive. The authentication result parameter contained in this message is passed to the authentication check mechanism in the VLR;
- a procedure error is indicated in a TC-(U-)REJECT INDICATION primitive and expiry of timer T-aut is indicated in a TC-L-CANCEL INDICATION primitive. Either of these events are indicated to the authentication check mechanism (procedure error (x));
- a *no response from MS* message is received in a TC-U-ERROR INDICATION primitive. This message indicates that authentication was not performed because of problems on the radio path. The event is also indicated to the authentication check mechanism.

#### 3.10.2.2.2 Procedures in the MSC

The application specific procedure is contained in Figure 145/Q.1051 and the ASE/TCAP procedure is contained in Figure 146/Q.1051.

The MSC will receive the *authenticate* message in a TC-INVOKE INDICATION primitive. If there is no parameter errors, the MSC will initiate the authentication of the MS (illustrated by the AUT-REQ (x) message). The response from the MS (in the AUT-RESPONSE (x) message) is returned to the VLR in a TC-RESULT-L REQUEST primitive.

If there is no response from the MS, the *no response from MS* message is returned in a TC-U-ERROR REQUEST primitive.

Procedure errors are indicated in a TC-U-REJECT REQUEST primitive.

#### 3.10.3 Procedure for transferring authentication parameters from HLR to VLR

##### 3.10.3.1 General description of the procedure

The VLR may be provided with either of the following authentication information:

- i) the authentication key;
- ii) a set of AP/AR vectors.

The procedure is initiated by the VLR. For method i) the procedure is initiated when an unknown MS registers in the VLR, i.e. either by a location registration procedure or by a call set-up or supplementary services request. For method ii) the procedure is initiated in the same cases as identified for case i) and when the number of AP/AR vectors contained in the VLR is below a certain threshold.

The procedure is shown in Figure 147/Q.1051 and consists in the exchange of the messages *send parameters from HLR (authentication) information request* and *authentication parameters*.

##### 3.10.3.2 Detailed description of the procedure

###### 3.10.3.2.1 Procedure in the VLR

The application specific procedure is shown in Figure 148/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 149/Q.1051.

The authentication management entity in the VLR will indicate that authentication parameters are required (the obtained authentication parameters (x) signal). The indication may also include what type of parameters are required, see § 3.10.3.1. This may also be default in the PLMN, e.g. method ii) is always used; or method i) is used if the HLR and the VLR is in the same PLMN and method ii) is used if the request is to a HLR of another PLMN.

TCAP is requested to supervise the procedure by timer T-ph.

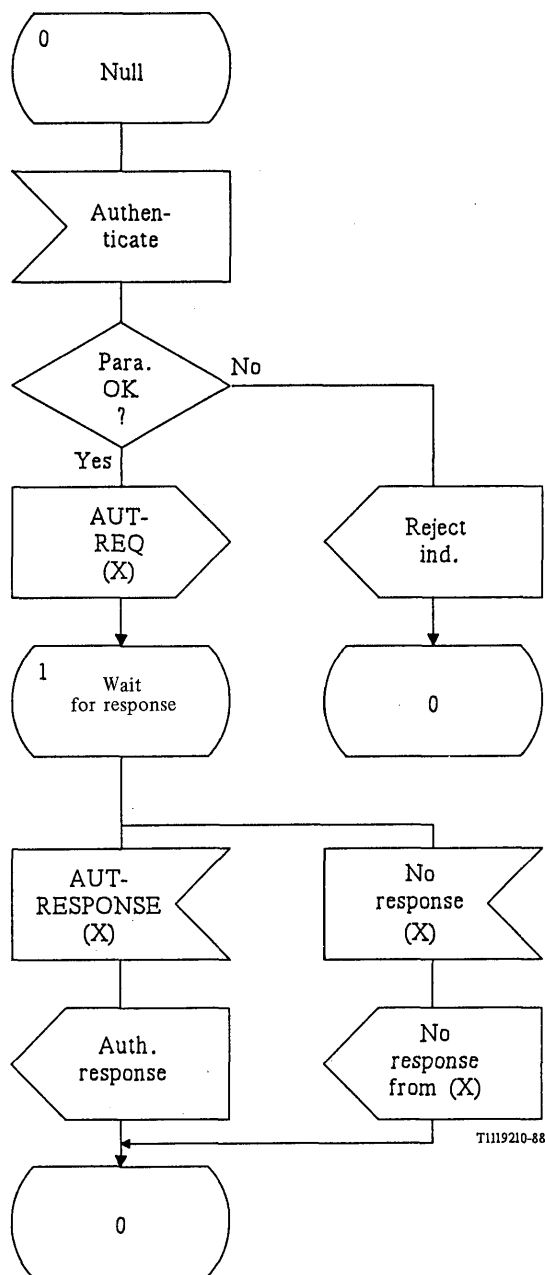


FIGURE 145/Q.1051

Application specific procedure for the basic authentication procedure in the MSC

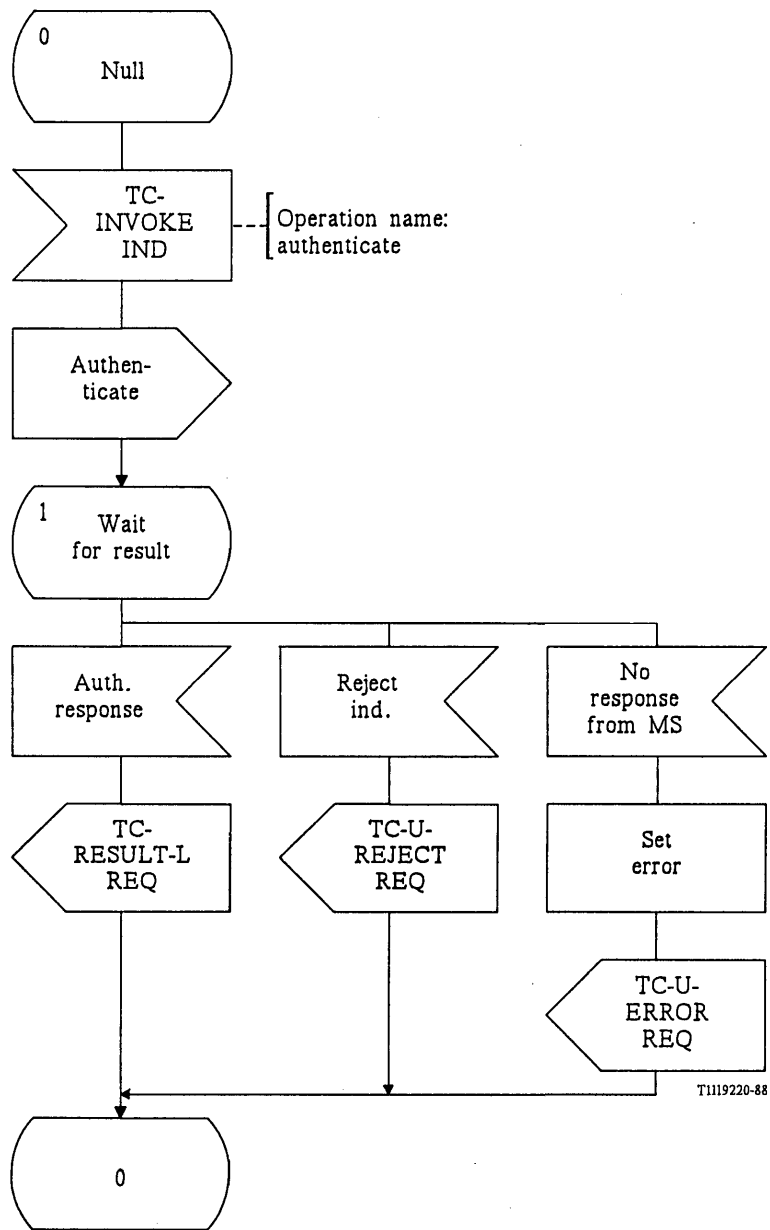


FIGURE 146/Q.1051

ASE/TCAP interface procedure for the basic authentication procedure in the MSC

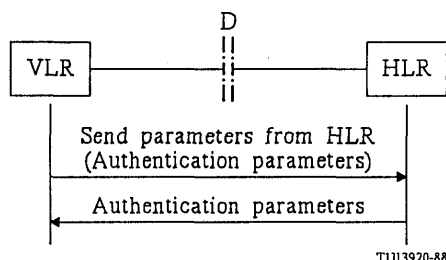


FIGURE 147/Q.1051

#### Procedure for transferring authentication parameters HLR to VLR

The *send parameters from HLR (authentication)* message is sent in a TC-INVOKE REQUEST primitive. Results are received as follows:

- the *authentication parameters* message is received in a TC-RESULT-L INDICATION primitive. The authentication parameters are provided to the authentication management of the VLR;
- expiry of timer T-ph is indicated in a TC-L-CANCEL INDICATION primitive;
- procedure errors are indicated in a TC-(U-)REJECT INDICATION primitive;
- negative results are reported in a TC-U-ERROR INDICATION primitive as follows:
  - i) *unknown subscriber* if the identity of the MS is not known in the HLR.

#### 3.10.3.2.2 Procedures in the HLR

The application specific procedure is shown in Figure 150/Q.1051 and the ASE/TCAP interface procedure is shown in Figure 151/Q.1051.

The *send parameters from HLR (authentication)* message is received in a TC-INVOKE INDICATION primitive. The HLR will perform analysis and return results as follows:

- the *authentication parameters* message will be returned in a TC-RESULT-L REQUEST primitive. This message will contain either the authentication key or a set of AP/AR vectors, see § 3.10.3.1;
- if the MS is not known in HLR, the *unknown subscriber* message is returned in a TC-U-ERROR REQUEST primitive.

#### 3.10.4 Procedure for obtaining authentication parameters from the previous VLR

Authentication parameters are obtained from the previous VLR by the *send IMSI* operation described in § 3.2.1.3. The authentication parameters are then contained in the *IMSI response* message. If the message does not contain authentication parameters then the VLR will use the procedure of § 3.10.3 to obtain them from the HLR.



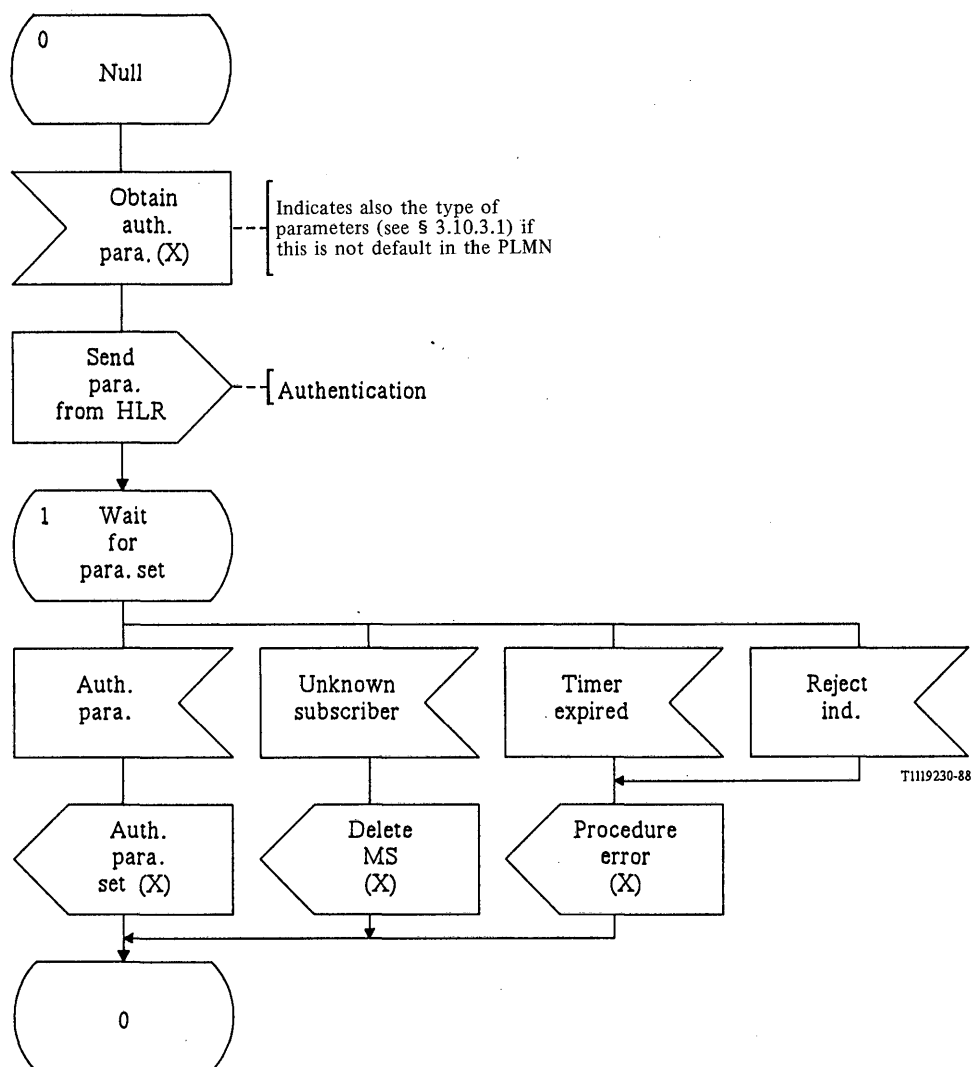


FIGURE 148/Q.1051

Application specific procedure in VLR for obtaining authentication parameters from HLR

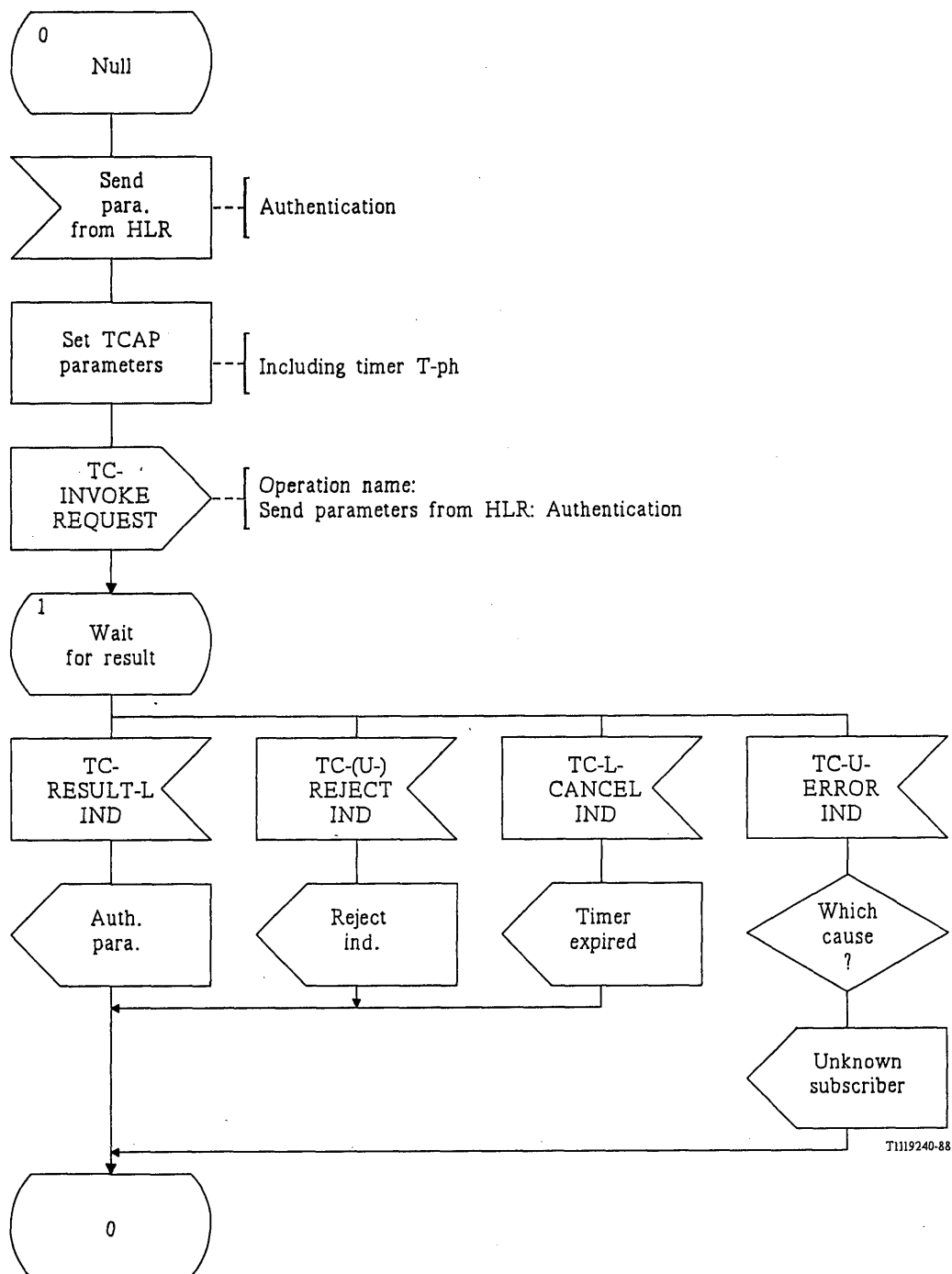


FIGURE 149/Q.1051

ASE/TCAP interface procedure in VLR for obtaining authentication parameters from HLR

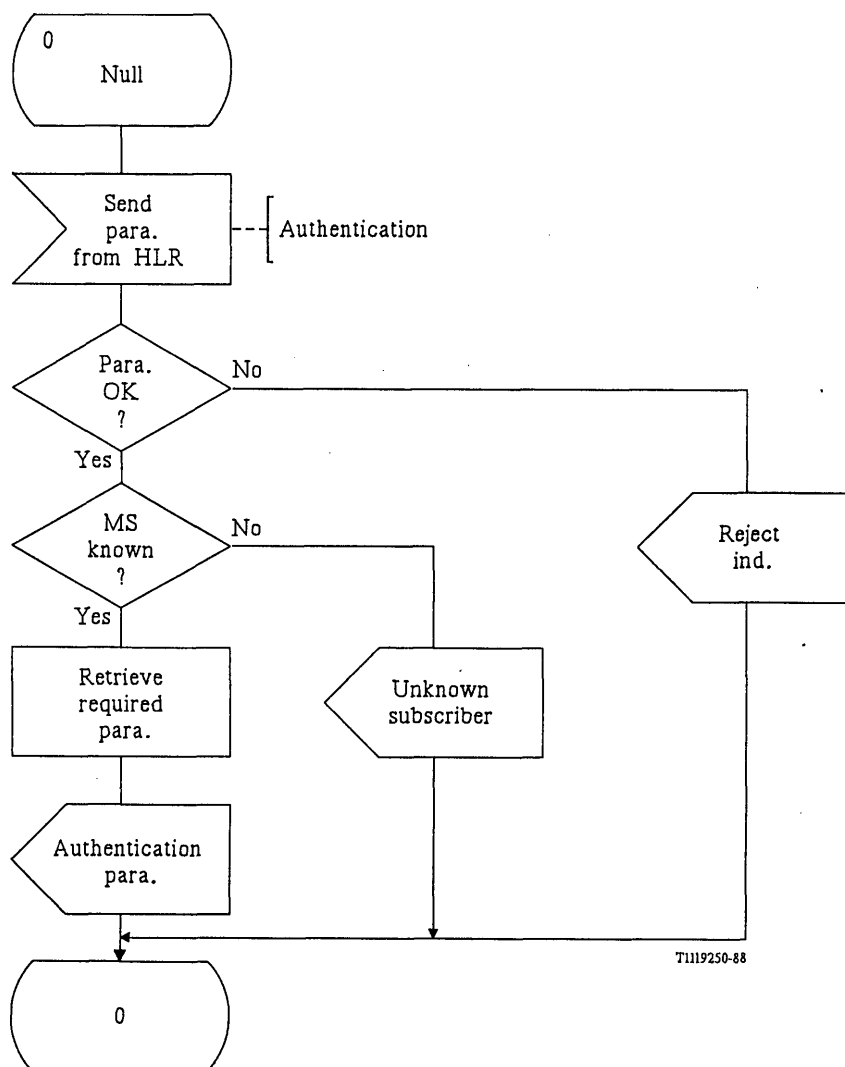


FIGURE 150/Q.1051

Application specific procedure in HLR for providing authentication parameters to VLR

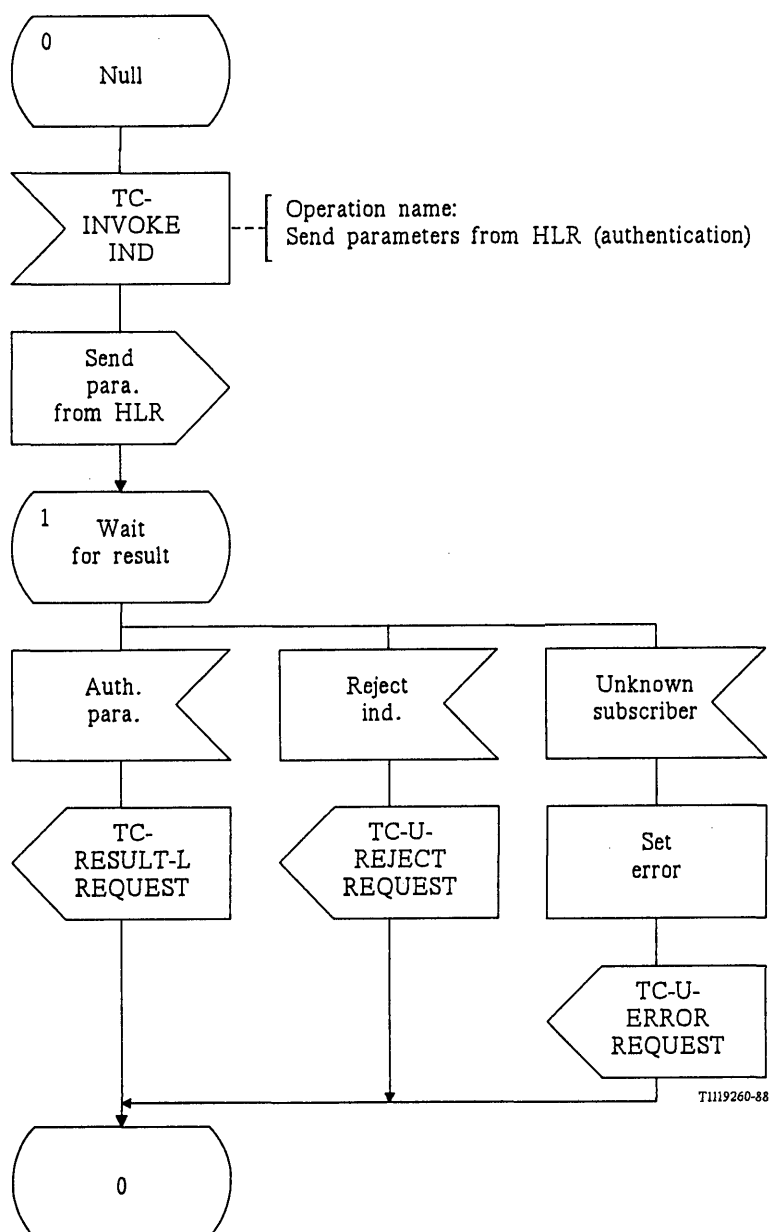


FIGURE 151/Q.1051

**ASE/TCAP interface procedure in HLR for providing authentication parameters to VLR**

3.10.5 Procedures for authentication at handover

3.10.5.1 General description of the procedures

Four procedures are required for authentication at handover (see Figure 152/Q.1051):

- i) procedure for initiation of the basic authentication procedure in the VLR associated with the controlling MSC (1 in the figure);
- ii) the basic authentication procedure (2 in the figure);

- iii) procedure for passing authentication requests from MSC-A to MSC-B (3 in the figure);
- iv) procedure for passing authentication responses from MSC-B and MSC-A (4 in the figure);
- v) procedure for initiation of authentication when a subsequent handover takes place in the area controlled by MSC-B (5 in the figure).

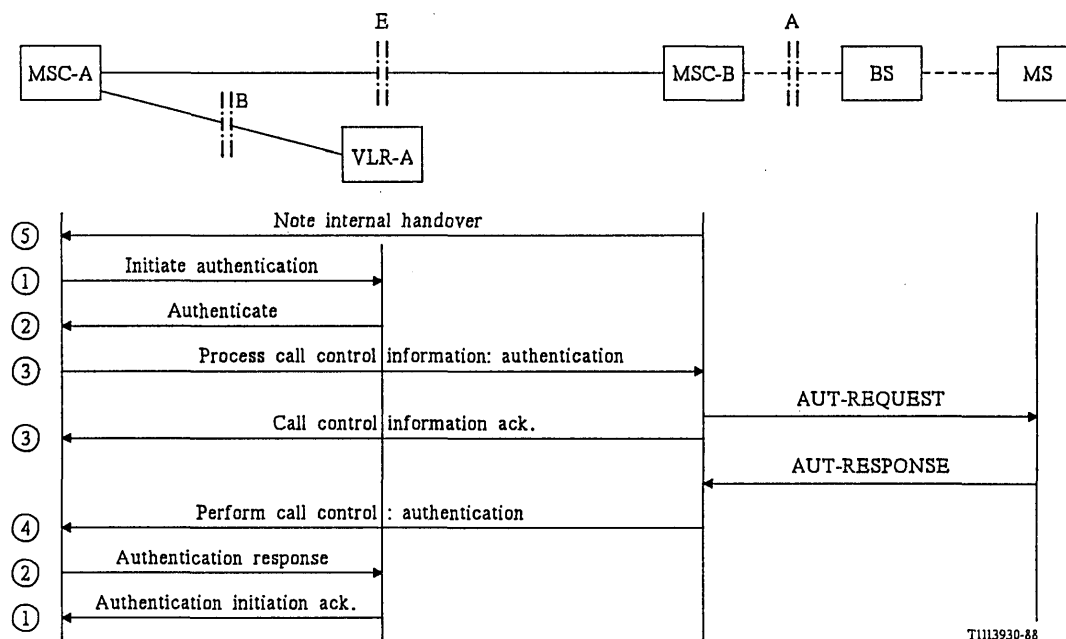


FIGURE 152/Q.1051

### Procedures for authentication at handover

Sequencing of the messages and interworking of the procedures are required in each functional entity as shown in Figure 152/Q.1051. Procedures i) and ii) use the same transaction between MSC-A and VLR-A. Procedures iii), iv) and v) use the transaction established for the basic handover between MSC-A and MSC-B.

The procedures in iii) and iv) are only required if the call is handed over to another MSC.

The procedures are as follows: when the call has been handed over to another BS in MSC-A, MSC-A requests its associated VLR to initiate authentication of the MS (the message *initiate authentication*). When receiving this message, the VLR initiates the basic authentication procedure of § 3.10.2 (the messages *authenticate* and *authentication response*). After the basic authentication procedure has been terminated, the MSC sends the *authentication initiation acknowledge* message to the MSC in order to indicate the result of the authentication.

If the call is handed over to another MSC (MSC-B) (including subsequent handover to a third MSC), the *authenticate* message is to be passed to MSC-B. This is done in a *process call control information: authentication* message which is acknowledged by MSC-B by the *call control acknowledge* message. This operation is defined in § 3.5.5.2. The AUT-RESPONSE from the MS is returned in a *perform call control authentication* message. The operation is described in § 3.5.5.1.

If a subsequent handover takes place to another BS in MSC-B, then an indication must be given to MSC-A in order to initiate procedures i), ii) and iii). This is done by MSC-B by sending the message *note internal handover*. This message is not acknowledged by MSC-A.

Procedures i) and v) are described in §§ 3.10.5.2.2 and 3.10.5.2.3 below, respectively.

### 3.10.5.2 Detailed description of the procedures

#### 3.10.5.2.1 Procedures in the MSC requesting authentication

The application specific and the ASE/TCAP procedures in the controlling MSC are shown in Figures 153/Q.1051 and 154/Q.1051, respectively.

At the appropriate instant during a handover, the controlling MSC will request its associated VLR to initiate the basic authentication procedures of § 3.10.2 (the signal authentication at handover (x)). If a handover takes place in MSC-B, MSC-A will receive the *note internal handover* message from MSC-B. The controlling MSC will then send the *initiate authentication* message to its associated VLR in a TC-INVOKE REQUEST primitive. TCAP is also requested to supervise the procedure by timer T-aur. The value of T-aur must be chosen in such a way that the VLR gets ample time for performing a basic authentication procedure before the *initiate authentication* message is acknowledged (see Figure 152/Q.1051).

The following responses may be received at the MSC:

- the *authentication initiation acknowledge* message will indicate that the authentication check successfully established the authenticity of the MS. The message is received in a TC-RESULT-L INDICATION primitive;
- the *system failure* message may indicate either the expiry of timer T-aur (received as a TC-L-CANCEL INDICATION primitive) or a reject condition in the peer procedure (received as a TC-(U-)REJECT INDICATION primitive);
- negative results may be received in a TC-U-ERROR INDICATION primitive as follows:
  - i) a *system failure* message indicating a procedure error in the basic authentication procedure;
  - ii) an *illegal subscriber* message indicating that the authenticity of the MS was not established;
  - iii) a *no response from MS* message indicating that the VLR (or MSC) has not received a response to the authentication procedure on the radio path, see the basic authentication procedure (§ 3.10.2).

All of the above messages are provided to the handover control mechanism in the MSC as shown in Figure 153/Q.1051.

The *note internal handover* message is received in a TC-INVOKE INDICATION primitive with implicit termination of the procedure (Figure 155/Q.1051).

#### 3.10.5.2.2 Procedure in the VLR when requested to perform authentication

The application specific and the ASE/TCAP interface procedures are given in Figures 156/Q.1051 and 157/Q.1051, respectively.

The VLR will receive the *initiate authentication* message in a TC-INVOKE INDICATION primitive. An indication that the basic authentication procedure be initiated is provided to the authentication mechanism in the VLR (indicated by the signal initiated basic authentication procedure (X)). The following events may be reported by the authentication mechanism:

- the authentication OK (X) signal is returned as an *authentication initiation acknowledge* message in a TC-RESULT-L REQUEST primitive;
- negative results are reported as follows and returned in a TC-U-ERROR REQUEST primitive:
  - i) the procedure error (X) signal indicates some procedure error in the basic authentication procedure. This indication is returned as a *system failure* message;
  - ii) the illegal subscriber (X) signal indicates that the authenticity of the MS was not established. The indication is returned as an *illegal subscriber* message;
  - iii) the no response from MS (X) signal indicates that the MS did not respond to the basic authentication procedure. The indication is returned as a *no response from MS* message.

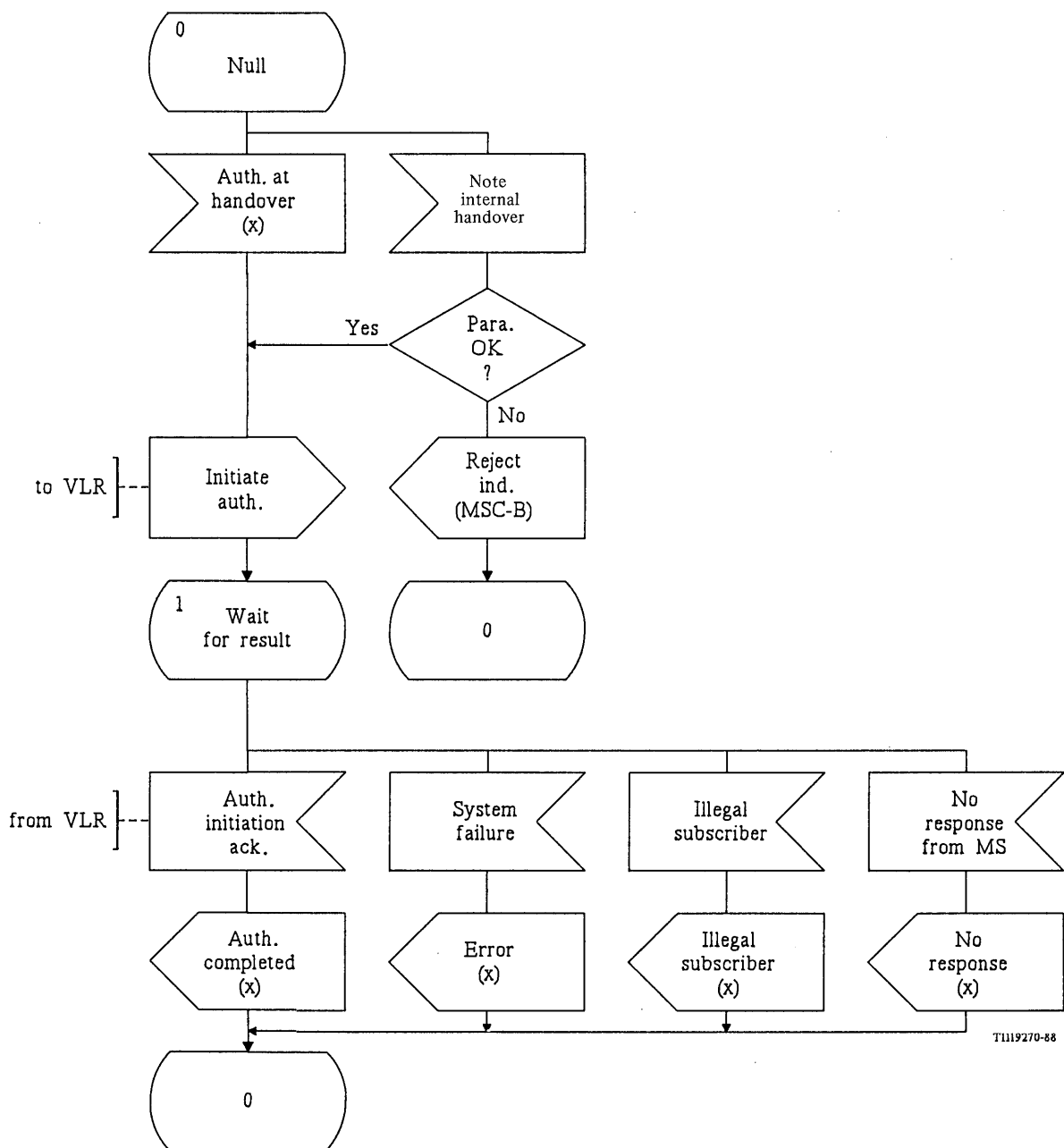


FIGURE 153/Q.1051

Application specific procedure in the controlling MSC  
for requesting authentication

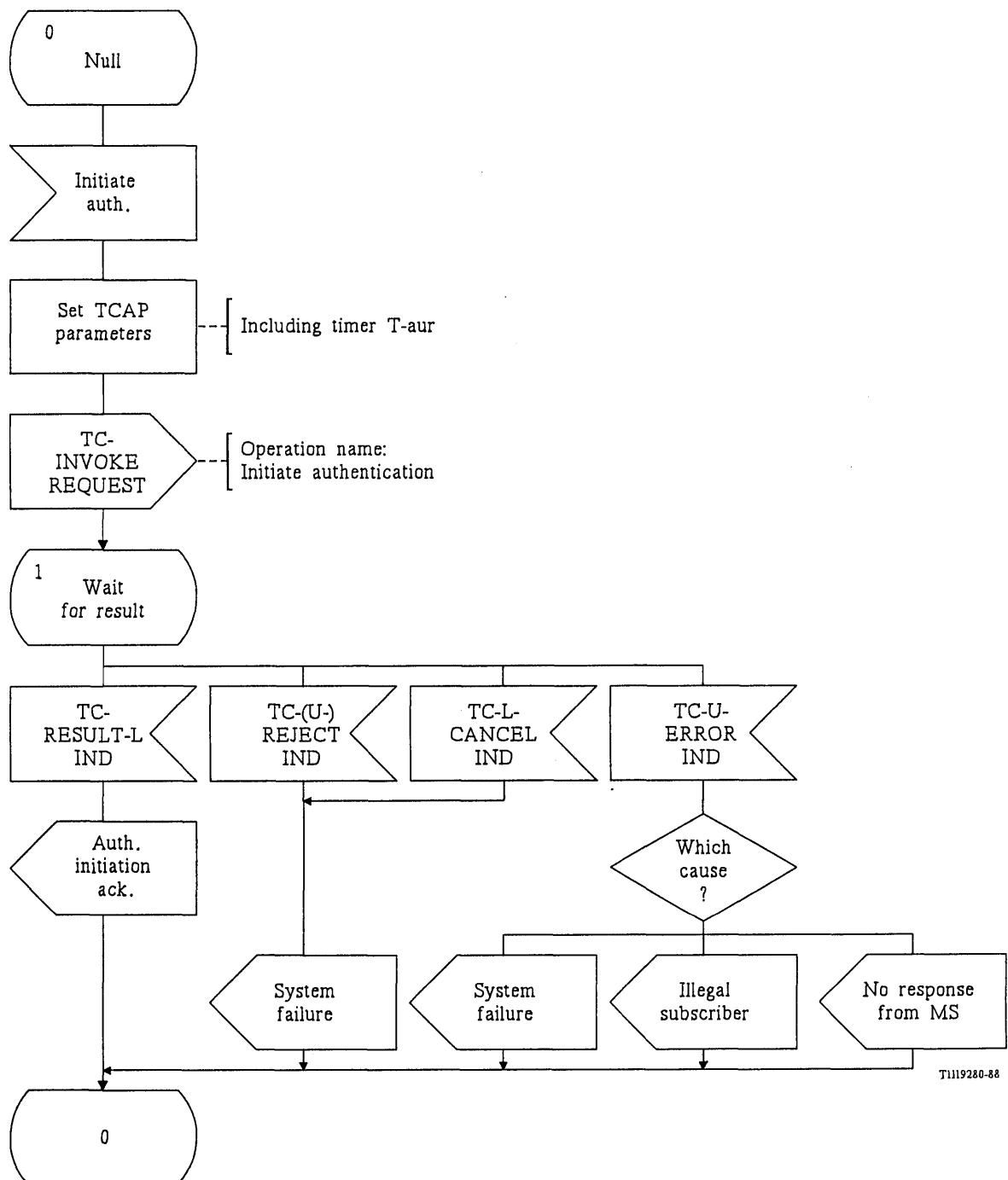


FIGURE 154/Q.1051  
 ASE/TCAP interface procedure in MSC for  
 requesting authentication



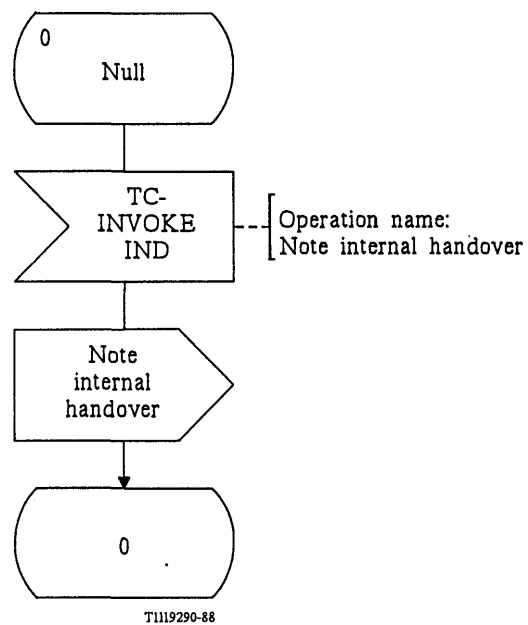


FIGURE 155/Q.1051

**ASE/TCAP interface procedure in MSC-A when MSC-B is requesting initiation of authentication**

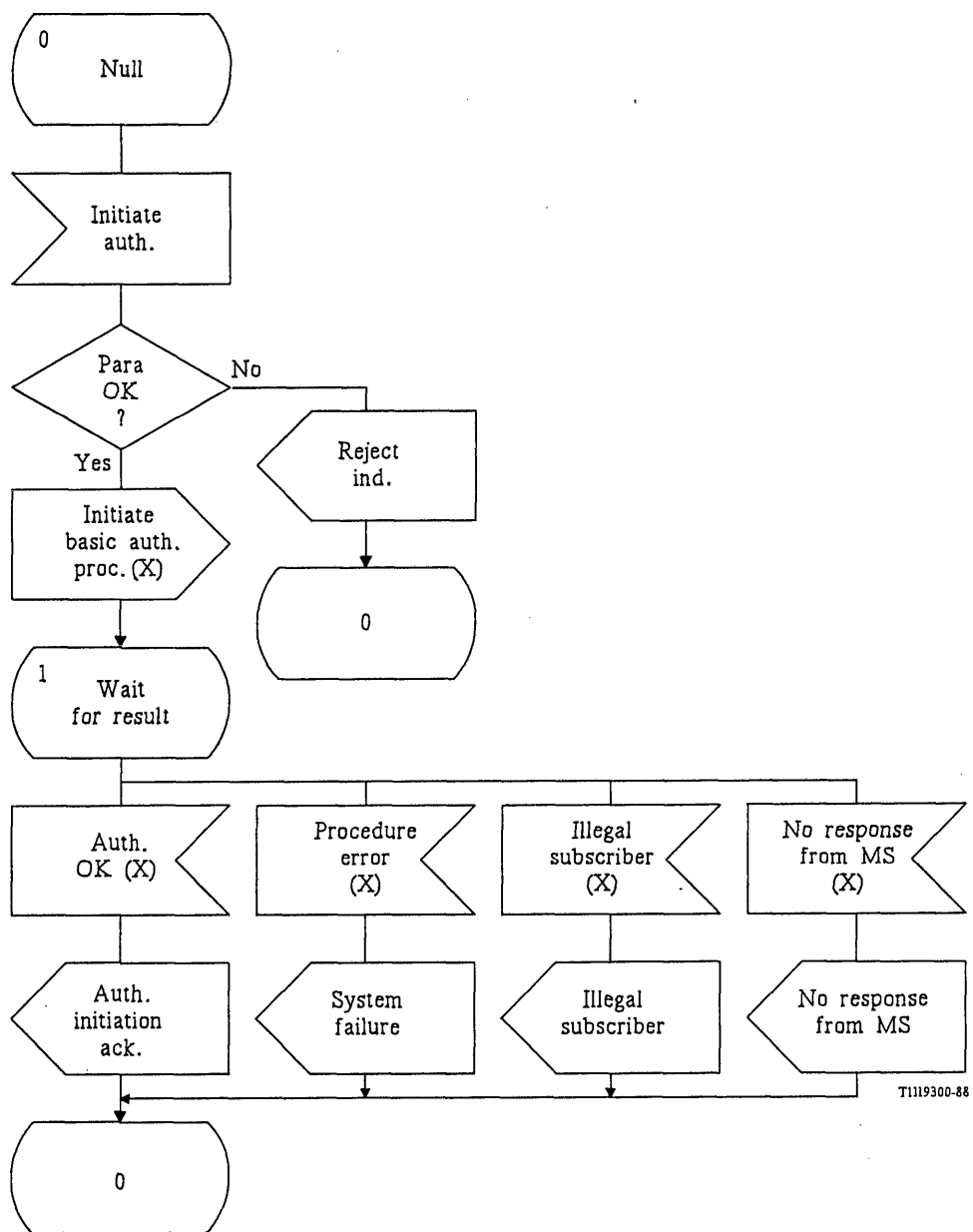


FIGURE 156/Q.1051

Application specific procedure in VLR for initiation  
of basic authentication procedure

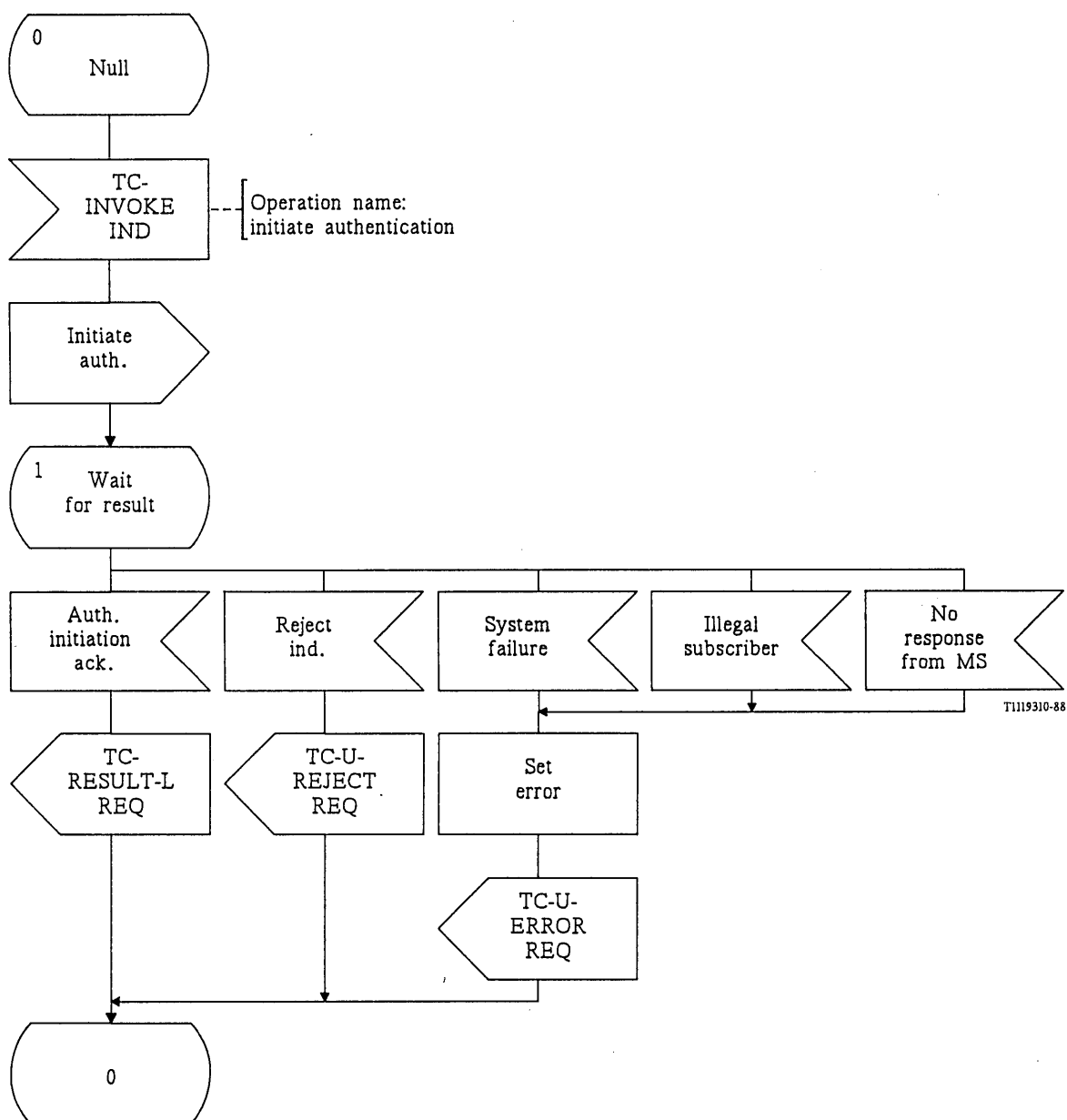


FIGURE 157/Q.1051

**ASE/TCAP interface procedure in VLR for initiation of basic authentication procedure**

### 3.10.5.2.3 Procedure in MSC-B for requesting authentication

The application specific and ASE/TCAP interface procedures are shown in Figures 158/Q.1051 and 159/Q.1051 respectively.

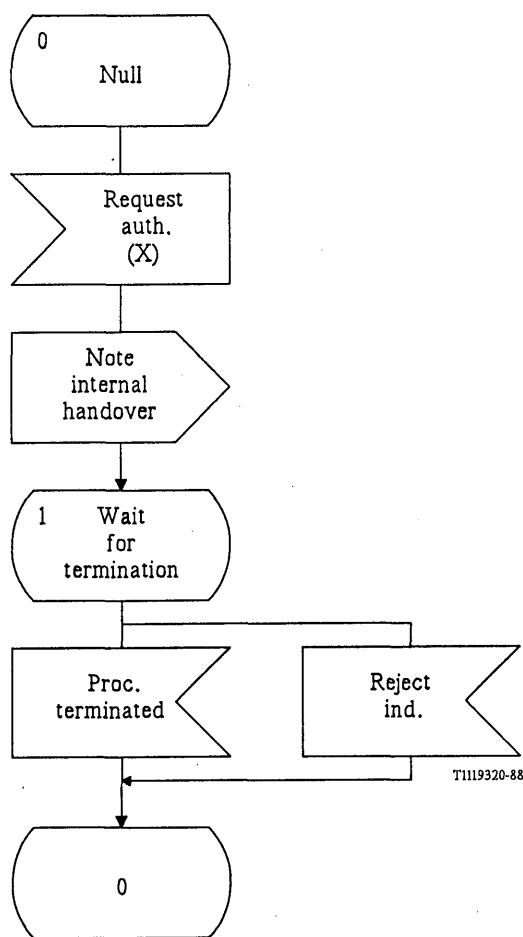


FIGURE 158/Q.1051

**Application specific procedure in MSC-B for requesting initiation of authentication**

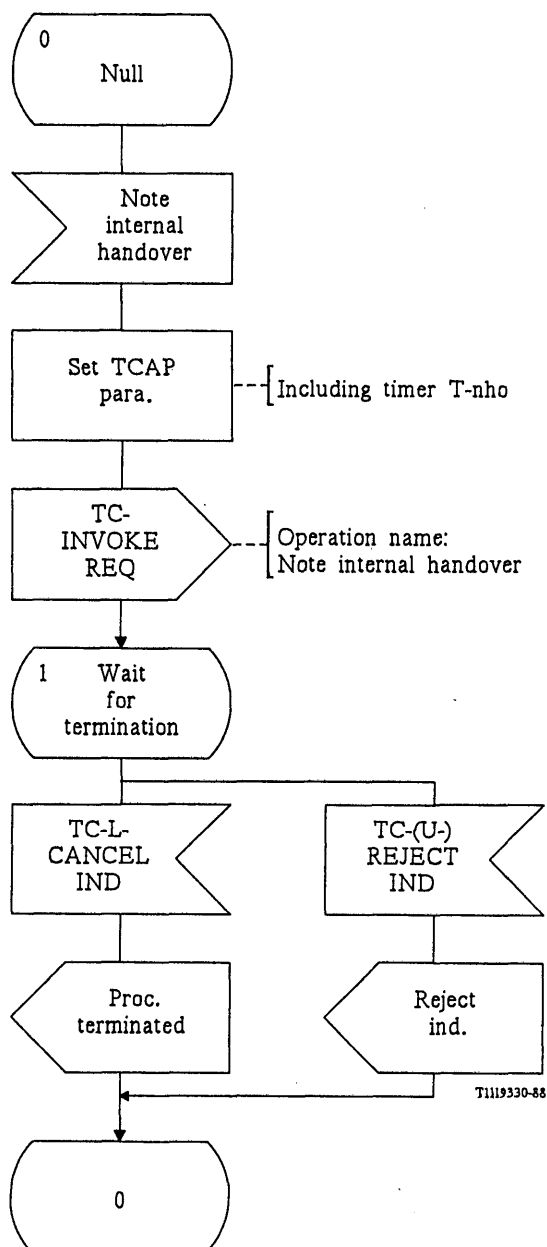


FIGURE 159/Q.1051

**ASE/TCAP interface procedure in MSC-B for requesting initiation of authentication**

When MSC-B has performed a subsequent handover between BSs of MSC-B, MSC-B may request initiation of the basic authentication procedure. MSC-B then sends the *note internal hand-over* message to the controlling MSC (MSC-A) in a TC-INVOKE REQUEST primitive. Implicit termination of the procedure is used by time-out supervision (timer T-nho) where the termination of the procedure is indicated by a TC-L-CANCEL INDICATION primitive.

### 3.11 Management of security related functions

The encryption keys or other information (e.g. TMSI) are transferred as parameters in the MAP messages defined above (e.g., the *location updating accepted* message, the *authentication information response* message).

Other security related functions are for further study.

## 4 Information contents

### 4.1 Application service elements

The application service elements defined for the Mobile Application Part are constructed using operations, parameters and errors belonging to the following lists.

#### 4.1.1 List of parameters

##### *Numbering and identification parameters*

- SubscriberId	§ 5.3.1.1
- IMSI	§ 5.3.1.2
- TMSI	§ 5.3.1.3
- IMEI	§ 5.3.1.4
- LocAreaId	§ 5.3.1.5
- TargetLocAreaId	§ 5.3.1.6
- BaseStationId	§ 5.3.1.7
- BaseStationCode	§ 5.3.1.8
- TargetBaseStationId	§ 5.3.1.9
- TargetMscId	§ 5.3.1.10
- CallControlMscId	§ 5.3.1.11
- HlrId	§ 5.3.1.12
- MSIsdn	§ 5.3.1.13
- RoutingNumber	§ 5.3.1.14
- RoamingNumber	§ 5.3.1.15
- HandoverNumber	§ 5.3.1.16
- ForwardedToNumber	§ 5.3.1.17
- CalledNumber	§ 5.3.1.18
- CallingNumber	§ 5.3.1.19
- AdditionalRoamingInfo	§ 5.3.1.20

##### *Subscriber management parameters*

- Category	§ 5.3.2.1
- EquipStatus	§ 5.3.2.2
- SleepMode	§ 5.3.2.3
- DetachFlag	§ 5.3.2.4
- SpeechCodec	§ 5.3.2.5
- BearerService	§ 5.3.2.6
- Teleservice	§ 5.3.2.7
- BasicService	§ 5.3.2.8
- AnalogueDataInfo	§ 5.3.2.9
- AnalogueDataService	§ 5.3.2.10
- BearerCapability	§ 5.3.2.11

##### *Supplementary services parameters*

- SS-Information	§ 5.3.3.1
- SS-Data	§ 5.3.3.2
- SS-Code	§ 5.3.3.3
- SS-ActivationStatus	§ 5.3.3.4
- SS-RegistrationStatus	§ 5.3.3.5

- SS-Rest	§ 5.3.3.6
- SS-Request	§ 5.3.3.7
- SS-SubscriptionOptions	§§ 5.3.3.8 to 5.3.3.19
- NoReplyConditionTime	§ 5.3.3.20
- CallBarringPassword	§ 5.3.3.21
- CUG-Interlock	§ 5.3.3.22
- CUG-Index	§ 5.3.3.23
- NumberOfConferences	§ 5.3.3.24
- InterrogationType	§ 5.3.3.25
- CUG-RejectCause	§ 5.3.3.26

#### *Call parameters*

- CallReference	§ 5.3.4.1
- ChargeType	§ 5.3.4.2
- SS-ChargingInfo	§ 5.3.4.3
- CallDuration	§ 5.3.4.4
- CallDateTime	§ 5.3.4.5
- ChargingUnit	§ 5.3.4.6
- RadioCharge	§ 5.3.4.7
- NetworkCharge	§ 5.3.4.8
- SS-Charge	§ 5.3.4.9
- NumberOfForwarding	§ 5.3.4.10

#### *Radio parameters*

- ChannelId	§ 5.3.5.1
- TargetChannelId	§ 5.3.5.2
- FrequencyHoppingInformation	§ 5.3.5.3
- HandoverReference	§ 5.3.5.4
- ChannelNumber	§ 5.3.5.5
- MeasurementValue	§ 5.3.5.6
- ChannelType	§ 5.3.5.7

#### *Authentication parameters*

- AuthenticationSet	§ 5.3.6.1
- Rand	§ 5.3.6.2
- Sres	§ 5.3.6.3
- K1	§ 5.3.6.4
- Ki	§ 5.3.6.5
- Ks	§ 5.3.6.6

#### *Others*

- BSPDU	§ 5.3.7.1
- ASParameter_Id	§ 5.3.7.2
- NetworkResource	§ 5.3.7.3

### 4.1.2 *List of operations*

#### *Location registration/cancellation*

- Update location area	§ 4.2.1
- Update location	§ 4.2.2
- Cancel location	§ 4.2.3
- Detach IMSI	§ 4.2.4
- Attach IMSI	§ 4.2.5
- Deregister mobile subscriber	§ 4.2.6

#### *Handling of supplementary services*

- Register supplementary service to HLR § 4.2.7
- Erase supplementary service to HLR § 4.2.8
- Activate supplementary service to HLR § 4.2.9
- Deactivate supplementary service to HLR § 4.2.10
- Interrogate supplementary service to HLR § 4.2.11
- Register supplementary service to VLR § 4.2.12
- Erase supplementary service to VLR § 4.2.13
- Activate supplementary service to VLR § 4.2.14
- Deactivate supplementary service to VLR § 4.2.15
- Interrogate supplementary service to VLR § 4.2.16
- Invoke supplementary service § 4.2.17
- Update category and supplementary services § 4.2.18

#### *Retrieval of subscriber parameters during call set-up*

- Send information for incoming call set-up § 4.2.19
- Send information for outgoing call set-up § 4.2.20
- Send routing information § 4.2.21

#### *Handover*

- Perform measurement § 4.2.22
- Perform handover § 4.2.23
- Send end signal § 4.2.24
- Perform subsequent handover § 4.2.25
- Allocate handover number § 4.2.26
- Send handover report § 4.2.27
- Perform call control § 4.2.28
- Process call control information § 4.2.29
- Note internal handover § 4.2.30

#### *Operation and maintenance*

- Register charging information § 4.2.31

#### *Fault recovery*

- Search for mobile subscriber § 4.2.32
- Reset § 4.2.33

#### *Authentication*

- Initiate authentication § 4.2.34
- Authenticate § 4.2.35

#### *Management of equipment identity*

- Check IMEI § 4.2.36

#### *Data management*

- Send parameters from VLR § 4.2.37
- Send parameters from HLR § 4.2.38
- Allocate additional roaming numbers § 4.2.39
- Verify location § 4.2.40

### **4.1.3 List of application errors**

#### *Identification and numbering errors*

- UnknownSubscriber § 4.3.1
- UnknownBaseStation § 4.3.2



- UnknownMSC § 4.3.3
- UnknownLocArea § 4.3.4
- UnallocatedTMSI § 4.3.5
- UnallocatedRoamingNumber § 4.3.6

#### *Subscriber behaviour*

- Absent subscriber § 4.3.7
- RoamingNotAllowed § 4.3.8
- IllegalMS § 4.3.9
- BearerServiceNotProvisioned § 4.3.10
- TeleservicenotProvisioned § 4.3.11
- InsufficientBearerCapabilities § 4.3.12

#### *Supplementary services*

- CallBarred § 4.3.13
- ForwardingViolation § 4.3.14
- CUG-Reject § 4.3.15
- IllegalSS-Operation § 4.3.16
- SS-ErrorStatus § 4.3.17
- SS-NotAvailable § 4.3.18
- SS-SubscriptionViolation § 4.3.19
- SS-Incompatibility § 4.3.20
- FacilityNotSupported § 4.3.21

#### *Handover*

- InvalidTargetBaseStation § 4.3.22
- NoRadioResourceAvailable § 4.3.23
- NoHandoverNumberAvailable § 4.3.24
- HandoverStateUndetermined § 4.3.25
- NetworkConnectionFailure § 4.3.26
- SubsequentHandoverFailure § 4.3.27
- NoResult § 4.3.28

#### *Others*

- SystemFailure § 4.3.29
- DataMissing § 4.3.30
- UnexpectedDataValue § 4.3.31
- InvalidPasswordFormat § 4.3.32
- BadPasswordSupplied § 4.3.33
- UnknownEquipment § 4.3.34

## 4.2 *Definition of the operations*

For each operation, this recommendation provides:

- A brief prose description.
- In table form, the operation code, the operation class, the timeout value, the parameters passed with the invocation of the operation and those which are returned with a successful outcome, linked operations, errors reported in case of unsuccessful outcome.
- An ASN.1 macro-definition of the operation.

The M(andatory) indication for a parameter means that the component cannot be processed if this parameter is missing.

The O(ptional) indication for a parameter means that it is not required in all the situations.

When in an invoke component, a Mandatory parameter is missing or when an Optional parameter is missing while it is required by the context, the DataMissing Error is returned.

When several parameters are sent in a component, they follow the UNIVERSAL SEQUENCE TAG, then the order shown in this specification is significant.

#### 4.2.1 Update location area (MSC → VLR)

This operation is invoked by a MSC to request its associated VLR for location area updating.

Update Location Area	Timer = T-lau	Class = 1	Code = 00000001
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
LocAreaId		M	§ 5.3.1.5
TargetLocAreaId		M	§ 5.3.1.6
SleepMode		M	§ 5.3.2.3
SEQUENCE OF BearerCapability		M	§ 5.3.2.11
<i>Parameters With Return Result</i>		Opt/Man	Reference
TMSI		O	§ 5.3.1.3
K1		O	§ 5.3.6.4
<i>Linked Operation</i>			
Not applicable			
<i>Errors</i>			Reference
UnallocatedTMSI			§ 4.3.5
UnknownSubscriber			§ 4.3.1
UnknownLocArea			§ 4.3.4
RoamingNotAllowed			§ 4.3.8
IllegalMS			§ 4.3.9
SystemFailure			§ 4.3.29

#### ASN.1 FORMAL DESCRIPTION

UpdateLocationArea  
PARAMETERS

OPERATION  
SEQUENCE{  
SubscriberId,  
LocAreaId,  
TargetLocAreaId,  
SleepMode,  
SEQUENCE OF BearerCapability}

RESULT

SEQUENCE {  
TMSI OPTIONAL  
K1 OPTIONAL} OPTIONAL

ERRORS

{UnallocatedTMSI,  
UnknownSubscriber,  
UnknownLocArea,  
RoamingNotAllowed,  
IllegalMS,  
SystemFailure}

::= 1

#### 4.2.2 Update location (VLR → HLR)

This operation is invoked by a VLR to update location in the HLR of the mobile subscriber.

Update Location	Timer = T-lu	Class = 1	Code = 00000010
<i>Parameters With Invoke</i>		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
RoamingNumber		M	§ 5.3.1.15
<i>Parameters With Return Result</i>		Opt/Man	Reference
Category		M	§ 5.3.2.1
MSIsdn		M	§ 5.3.1.13
SEQUENCE OF BearerService		M	§ 5.3.2.6
SEQUENCE OF Teleservice		M	§ 5.3.2.7
SEQUENCE OF SS-Information		O	§ 5.3.3.1
SEQUENCE OF AuthenticationSet		O	§ 5.3.6.1
Ki		O	§ 5.3.6.5
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
RoamingNotAllowed			§ 4.3.8

#### ASN.1 FORMAL DESCRIPTION

UpdateLocation  
PARAMETERS

OPERATION  
SEQUENCE{  
IMSI,  
RoamingNumber}

RESULT

SEQUENCE{  
Category,  
MSIsdn,  
ProvisionedBearerServices  
SEQUENCE OF BearerService,  
ProvisionedTeleservices  
SEQUENCE OF Teleservice,  
SEQUENCE OF SS-Information OPTIONAL,  
SEQUENCE OF SS-AuthenticationSet OPTIONAL,  
Ki OPTIONAL}

ERRORS

{UnknownSubscriber,  
RoamingNotAllowed}

::= 2

#### 4.2.3 Cancel location (HLR → VLR)

This operation is invoked by a HLR to request a VLR to delete a mobile subscriber from the list of visiting MSs.

Cancel Location	Timer = T-lc	Class = 1	Code = 00000011
Parameters With Invoke		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
Parameters With Return Result		Opt/Man	Reference
Empty			
Linked Operations			
Not applicable			
Errors			Reference
UnknownSubscriber			§ 4.3.1

##### ASN.1 FORMAL DESCRIPTION

CancelLocation  
PARAMETERS

OPERATION  
{IMSI  
}

RESULT

Empty

ERRORS

{UnknownSubscriber  
}

::= 3

#### 4.2.4 Detach IMSI (MSC → VLR)

This operation is invoked by a MSC to request its associated VLR to set an IMSI detach flag for a given mobile subscriber.

Detach IMSI	Timer = T-id	Class = 4	Code = 00000100
Parameters With Invoke		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1

##### ASN.1 FORMAL DESCRIPTION

DetachImsi  
PARAMETERS

OPERATION  
{SubscriberId  
}

::=4

#### 4.2.5 Attach IMSI (MSC → VLR)

This operation is invoked by a MSC to request its associated VLR to remove the IMSI detach flag for a given mobile subscriber.

Attach IMSI	Timer = T-iar	Class = 1	Code = 00000101
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
<i>Parameters With Return Result</i>		Opt/Man	Reference
Empty			
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnallocatedTMSI			§ 4.3.5
UnknownSubscriber			§ 4.3.1

#### ASN.1 FORMAL DESCRIPTION

AttachImsi  
PARAMETERS

OPERATION  
{SubscriberId,  
}

RESULT

Empty

ERROR

{UnallocatedTMSI,  
UnknownSubscriber }

::= 5

#### 4.2.6 Deregister mobile subscriber (VLR → HLR)

This operation is invoked by a VLR to request the HLR to mark as subscriber as deregistered.

Deregister Mobile Subscriber	Timer = T-dr	Class = 1	Code = 00000110
<i>Parameters With Invoke</i>		Opt/Man	Reference
MSIsdn		M	§ 5.3.1.13
<i>Parameters With Return Result</i>		Opt/Man	Reference
Empty			
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
AbsentSubscriber			§ 4.3.7
UnknownSubscriber			§ 4.3.1
FacilityNotSupported			§ 4.3.21

#### ASN.1 FORMAL DESCRIPTION

DeregisterMobileSubscriber  
PARAMETERS

RESULT

ERROR

OPERATION

{MSIsdn  
}

Empty

{AbsentSubscriber,  
UnknownSubscriber,  
FacilityNotSupported}

::= 6

#### 4.2.7 Register supplementary service to HLR (VLR → HLR)

This operation is invoked by the VLR to register data related to a supplementary service in the HLR. When no BasicService parameter is provided, the registration applies to all provisioned basic services.

Register SS to HLR	Timer = T-ssi	Class = 1	Code = 00000111
<i>Parameters With Invoke</i>		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
ForwardedToNumber		O	§ 5.3.1.17
NoReplyConditionTimer		O	§ 5.3.3.20
CallBarringPassword		O	§ 5.3.3.21
<i>Parameters With Return Result</i>		Opt/Man	Reference
SEQUENCE OF SS-Information		O	§ 5.3.3.1
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
SS-NotAvailable			§ 4.3.18
BearerServiceNotProvisioned			§ 4.3.10
TeleserviceNotProvisioned			§ 4.3.11
SS-SubscriptionViolation			§ 4.3.19
DataMissing			§ 4.3.30
SS-Incompatibility			§ 4.3.20
UnexpectedDataValue			§ 4.3.31
SystemFailure			§ 4.3.29
InvalidPasswordFormat			§ 4.3.32

#### ASN.1 FORMAL DESCRIPTION

RegisterSS-ToHLR  
PARAMETERS

OPERATION  
SEQUENCE{  
IMSI,  
SS-Code,  
BasicService OPTIONAL,  
ForwardedToNumber OPTIONAL,  
NoReplyConditionTimer OPTIONAL,  
CallBarringPasswork OPTIONAL}

RESULT

SEQUENCE OF SS-Information OPTIONAL

ERRORS

{UnknownSubscriber,  
IllegalSS-Operation,  
SS-ErrorStatus,  
SS-NotAvailable,  
BearerServiceNotProvisioned,  
TeleserviceNotProvisioned,  
SS-SubscriptionViolation.  
DataMissing,  
SS-Incompatibility,  
UnexpectedDataValue  
SystemFailure,  
InvalidPasswordFormat}

::= 7

4.2.8 Erase supplementary service to HLR (VLR → HLR)

This operation is invoked by a VLR to erase data related to a supplementary service in the HLR. When no BasicService parameter is provided, the erasure applies to all provisioned basic services.

Erase SS to HLR	Timer = T-ssi	Class = 1	Code = 00001000
Parameters With Invoke		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
Parameters With Return Result		Opt/Man	Reference
SEQUENCE OF SS-Information		0	§ 5.3.3.1
Linked Operations			
Not applicable			
Errors			Reference
UnknownSubscriber			§ 4.3.1
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
UnexpectedDataValue			§ 4.3.31
SystemFailure			§ 4.3.29

ASN.1 FORMAL DESCRIPTION

EraseSS-ToHLR  
PARAMETERS

OPERATION  
SEQUENCE  
{IMSI,  
SS-Code,  
BasicService OPTIONAL}

RESULT

SEQUENCE OF SS-Information OPTIONAL

ERRORS

{UnknownSubscriber,  
IllegalSS-Operation,  
SS-ErrorStatus,  
UnexpectedDataValue,  
SystemFailure}



#### 4.2.9 Activate supplementary service to HLR (VLR → HLR)

This operation is invoked by a VLR to request the HLR to activate a supplementary service. When no BasicService parameter is provided, the activation applies to all provisioned basic services.

Activate SS to HLR	Timer = T-ssi	Class = 1	Code = 00001001
<i>Parameters With Invoke</i>		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
<i>Parameters With Return Result</i>		Opt/Man	Reference
Empty			
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
SS-NotAvailable			§ 4.3.18
SS-SubscriptionViolation			§ 4.3.19
DataMissing			§ 4.3.30
UnexpectedDataValue			§ 4.3.31
SS-Incompatibility			§ 4.3.20
SystemFailure			§ 4.3.29

#### ASN.1 FORMAL DESCRIPTION

ActivateSS-ToHLR  
PARAMETERS

OPERATION  
SEQUENCE  
{IMSI,  
SS-Code,  
BasicService OPTIONAL}

RESULTS

Empty

ERRORS

{UnknownSubscriber,  
IllegalSS-Operation,  
SS-ErrorStatus,  
SS-NotAvailable,  
SS-SubscriptionViolation,  
DataMissing,  
UnexpectedDataValue  
SS-Incompatibility  
SystemFailure

::= 9

#### 4.2.10 Deactivate supplementary service to HLR (VLR → HLR)

This operation is invoked by a VLR to request the HLR to deactivate a supplementary service. When no BasicService parameter is provided, the deactivation applies to all provisioned basic services.

Deactivate SS in HLR	Timer = T-ssi	Class = 1	Code = 00001010
Parameters With Invoke		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
CallBarringPassword		O	§ 5.3.3.21
Parameters With Return Result		Opt/Man	Reference
Empty			
Linked Operations			
Not Applicable			
Errors			Reference
UnknownSubscriber			§ 4.3.1
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
BadPasswordSupplied			§ 4.3.33
UnexpectedDataValue			§ 4.3.31
SystemFailure			§ 4.3.29

#### ASN.1 FORMAL DESCRIPTION

DeactivateSS-ToHLR  
PARAMETERS

OPERATION  
SEQUENCE  
{IMSI,  
SS-Code,  
BasicService OPTIONAL,  
CallBarringPassword OPTIONAL}

RESULT

Empty

ERRORS

{UnknownSubscriber,  
IllegalSS-Operation,  
SS-ErrorStatus,  
BadPasswordSupplied,  
UnexpectedDataValue,  
SystemFailure}

::= 10

4.2.11 Interrogate supplementary service to HLR (VLR → HLR)

This operation is invoked by a VLR to get information from the HLR about the status of a supplementary service. When no BasicService parameter is provided, the interrogation applies to all provisioned basic services.

Interrogate SS to HLR	Timer = T-ssi	Class = 1	Code = 00001011
Parameters With Invoke		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
InterrogationType <sup>1)</sup>		M	§ 5.3.3.25
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
Parameters With Return Result		Opt/Man	Reference
SEQUENCE OF SS-Information		O	§ 5.3.3.1
Linked Operations			
Not Applicable			
Errors			Reference
UnknownSubscriber			§ 4.3.1
IllegalSS-Operation			§ 4.3.16
SS-NotAvailable			§ 4.3.18
UnexpectedDataValue			§ 4.3.31
SystemFailure			§ 4.3.29

ASN.1 FORMAL DESCRIPTION

InterrogateSS-ToHLR	OPERATION
PARAMETERS	SEQUENCE
	{IMSI,
	InterrogationType <sup>1)</sup>
	SS-Code,
	BasicService OPTIONAL}
RESULT	SEQUENCE OF SS-Information OPTIONAL
ERRORS	{UnknownSubscriber,
	IllegalSS-Operation,
	SS-NotAvailable,
	UnexpectedDataValue,
	SystemFailure}

::= 11

4.2.12 Register supplementary service to VLR (MSC → VLR)

This operation is invoked by a MSC to register data related to a supplementary service in the VLR. When no BasicService parameter is provided, the registration applies to all provisioned basic services.

<sup>1)</sup> The need for such a parameter has to be checked.

Register SS to VLR	Timer = T-ss	Class = 1	Code = 00001100
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
ForwardedToNumber		O	§ 5.3.1.17
NoReplyConditionTimer		O	§ 5.3.3.20
CallBarringPassword		O	§ 5.3.3.21
<i>Parameters With Return Result</i>		Opt/Man	Reference
TMSI		O	§ 5.3.1.3
K1		O	§ 5.3.6.4
SEQUENCE OF SS-Information		O	§ 5.3.3.1
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
SS-NotAvailable			§ 4.3.18
BearerServiceNotProvisioned			§ 4.3.10
TeleserviceNotProvisioned			§ 4.3.11
SS-SubscriptionViolation			§ 4.3.19
DataMissing			§ 4.3.30
SS-Incompatibility			§ 4.3.20
UnexpectedDataValue			§ 4.3.31
IllegalMS			§ 4.3.9
SystemFailure			§ 4.3.29
InvalidPasswordFormat			§ 4.3.32

## 1SN.1 FORMAL DESCRIPTION

RegisterSS-ToVLR  
PARAMETERS

OPERATION  
SEQUENCE  
{SubscriberId,  
SS-Code,  
BasicService OPTIONAL,  
ForwardedToNumber OPTIONAL,  
NoReplyConditionTimer OPTIONAL,  
CallBarringPassword OPTIONAL}

RESULT

SEQUENCE(  
TMSI OPTIONAL,  
K1 OPTIONAL,  
SEQUENCE OF SS-Information  
OPTIONAL) OPTIONAL

ERRORS

{UnknownSubscriber,  
UnallocatedTMSI,  
IllegalSS-Operation,  
SS-ErrorStatus,  
SS-NotAvailable,  
BearerServiceNotProvisioned,  
TeleserviceNotProvisioned,  
SS-SubscriptionViolation,  
DataMissing,  
SS-Incompatibility,  
UnexpectedDataValue  
IllegalMS,  
SystemFailure,  
InvalidPasswordFormat}

::= 12

4.2.13 Erase supplementary service to VLR (MSC → VLR)

This operation is invoked by a MSC to erase data related to a supplementary service in the VLR. When no BasicService parameter is provided, the erasure applies to all provisioned basic services.

Erase SS to VLR	Timer = T-ss	Class = 1	Code = 00001101
Parameters With Invoke		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
Parameters With Return Result		Opt/Man	Reference
TMSI		O	§ 5.3.1.3
K1		O	§ 5.3.6.4
SEQUENCE OF SS-Information		O	§ 5.3.3.1
Linked Operations			
Not applicable			
Errors			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
UnexpectedDataValue			§ 4.3.31
IllegalMS			§ 4.3.9
SystemFailure			§ 4.3.29

ASN.1 FORMAL DESCRIPTION

EraseSS-ToVLR  
PARAMETERS

OPERATION  
SEQUENCE  
{SubscriberId,  
SS-Code,  
BasicService OPTIONAL}

RESULT

SEQUENCE{  
TMSI OPTIONAL,  
K1 OPTIONAL,  
SEQUENCE OF SS-Information  
OPTIONAL} OPTIONAL

ERRORS

{UnknownSubscriber,  
UnallocatedTMSI,  
IllegalSS-Operation,  
SS-ErrorStatus,  
UnexpectedDataValue,  
IllegalMS,  
SystemFailure}

#### 4.2.14 Activate supplementary service to VLR (MSC → VLR)

This operation is invoked by a MSC to request its associated VLR for a supplementary service activation. When no BasicService parameter is provided, the activation applies to all provisioned basic services.

Activate SS to HLR	Timer = T-ss	Class = 1	Code = 00001110
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
<i>Parameters With Return Result</i>		Opt/Man	Reference
TMSI		O	§ 5.3.1.3
KI		O	§ 5.3.6.4
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
SS-NotAvailable			§ 4.3.18
SS-SubscriptionViolation			§ 4.3.19
DataMissing			§ 4.3.30
UnexpectedDataValue			§ 4.3.31
SS-Incompatibility			§ 4.3.20
IllegalMS			§ 4.3.9
SystemFailure			§ 4.3.29

#### ASN.1 FORMAL DESCRIPTION

ActivateSS-ToVLR  
PARAMETERS

OPERATION  
SEQUENCE(  
SubscriberId,  
SS-Code,  
BasicService OPTIONAL)

RESULT

SEQUENCE( TMSI OPTIONAL  
KI OPTIONAL) OPTIONAL

ERRORS

{UnknownSubscriber,  
UnallocatedTMSI,  
IllegalSS-Operation,  
SS-ErrorStatus,  
SS-NotAvailable,  
SS-SubscriptionViolation,  
DataMissing,  
UnexpectedDataValue,  
SS-Incompatibility,  
IllegalMS,  
SystemFailure}

:= 14

#### 4.2.15 Deactivate Supplementary Service to VLR (MSC → VLR)

This operation is invoked by a MSC to request its associated VLR for a supplementary service activation. When no BasicService parameter is provided, the deactivation applies to all provisioned basic services.

Deactivate SS to VLR	Timer = T-ss	Class = 1	Code = 00001111
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId	M		§ 5.3.1.1
SS-Code	M		§ 5.3.3.3
BasicService	O		§ 5.3.2.8
CallBarringPassword	O		§ 5.3.3.21
<i>Parameters With Return Result</i>		Opt/Man	Reference
TMSI	O		§ 5.3.1.3
K1	O		§ 5.3.6.4
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
IllegalMS			§ 4.3.9
BadPasswordSupplied			§ 4.3.33
UnexpectedDataValue			§ 4.3.31
SystemFailure			§ 4.3.29

#### ASN.1 FORMAL DESCRIPTION

DeactivateSS-ToVLR  
PARAMETERS

OPERATION  
SEQUENCE{  
SubscriberId,  
SS-Code,  
BasicService OPTIONAL,  
CallBarringPassword OPTIONAL}

RESULT

{newTMSI TMSI OPTIONAL,  
K1 OPTIONAL}

ERRORS

{UnknownSubscriber,  
UnallocatedTMSI,  
IllegalSS-Operation,  
SS-ErrorStatus,  
IllegalMS,  
BadPasswordSupplied,  
UnexpectedDataValue,  
SystemFailure}

::= 15

#### 4.2.16 Interrogate supplementary service to VLR (MSC → VLR)

This operation is invoked by a MSC to request its associated VLR for a supplementary service interrogation. When no BasicService parameter is provided, the interrogation applies to all provisioned basic services.

Interrogate SS to VLR	Timer = T-ss	Class = 1	Code = 00010000
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
InterrogationType <sup>1)</sup>		M	§ 5.3.3.25
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
<i>Parameters With Return Result</i>		Opt/Man	Reference
SEQUENCE OF SS-Information		O	§ 5.3.3.1
TMSI		O	§ 5.3.1.3
KI		O	§ 5.3.6.4
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
IllegalSS-Operation			§ 4.3.16
SS-NotAvailable			§ 4.3.18
UnexpectedDataValue			§ 4.3.31
IllegalMS			§ 4.3.9
SystemFailure			§ 4.3.29

#### ASN.1 FORMAL DESCRIPTION

InterrogateSS-ToVLR  
PARAMETERS

OPERATION  
SEQUENCE(  
SubscriberId,  
InterrogationType <sup>1)</sup>  
SS-Code,  
BasicService OPTIONAL)

RESULT

CHOICE {SEQUENCE OF SS-Information,  
{SEQUENCE OF SS-Information  
TMSI OPTIONAL,  
KI OPTIONAL}}

ERRORS

{UnknownSubscriber,  
UnallocatedTMSI,  
IllegalSS-Operation,  
SS-NotAvailable,  
UnexpectedDataValue,  
IllegalMS,  
SystemFailure}

::= 16

<sup>1)</sup> The need for such a parameter has to be checked.



#### 4.2.17 *Invoke supplementary service (MSC → VLR)*

This operation is invoked by a MSC to request its associated VLR for supplementary service invocation.

Invoke Supplementary Service	Timer = T-ss	Class = 1	Code = 00010001
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
SS-Code		M	§ 5.3.3.3
BasicService		O	§ 5.3.2.8
CUG-Index		O	§ 5.3.3.23
NumberOfConferncees		O	§ 5.3.3.24
<i>Parameters With Return Result</i>		Opt/Man	Reference
TMSI		O	§ 5.3.1.3
KI		O	§ 5.3.6.4
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
IllegalSS-Operation			§ 4.3.16
SS-ErrorStatus			§ 4.3.17
SS-NotAvailable			§ 4.3.18
SS-SubscriptionViolation			§ 4.3.19
DataMissing			§ 4.3.30
UnexpectedDataValue			§ 4.3.31
SS-Incompatibility			§ 4.3.20
IllegalMS			§ 4.3.9
SystemFailure			§ 4.3.29

#### ASN.1 FORMAL DESCRIPTION

InvokeSupplementaryService  
PARAMETERS

OPERATION  
SEQUENCE(  
SubscriberId,  
SS-Code,  
BasicService OPTIONAL,  
CUG-Index OPTIONAL,  
NumberOfconferncees OPTIONAL)

RESULT

SEQUENCE(  
TMSI OPTIONAL  
KI OPTIONAL) OPTIONAL

ERRORS

{UnknownSubscriber,  
UnallocatedTMSI,  
IllegalSS-Operation,  
SS-ErrorStatus,  
SS-NotAvailable,  
SS-SubscriptionViolation,  
DataMissing,  
UnexpectedDataValue,  
SS-Incompatibility,  
IllegalMS,  
SystemFailure}

::= 17

#### 4.2.18 Update category and supplementary services (HLR → VLR)

This operation is invoked by a HLR to inform the VLR about possible changes in subscription, category, directory numbers or supplementary services.

Update Category and SS	Timer = T-csu	Class = 1	Code = 00010010
<i>Parameters With Invoke</i>		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
MSIsdn		0	§ 5.3.1.13
Category		0	§ 5.3.2.1
SEQUENCE OF BearerService		0	§ 5.3.2.6
SEQUENCE OF Teleservice		0	§ 5.3.2.7
SEQUENCE OF SS-Information		0	§ 5.3.3.1
SEQUENCE OF AnalogueDataInfo		0	§ 5.3.2.9
<i>Parameters With Return Result</i>		Opt/Man	Reference
Empty			
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
DataMissing			§ 4.3.30
UnexpectedDataValue			§ 4.3.31

#### ASN.1 FORMAL DESCRIPTION

UpdateCategoryAndSupplServ.  
PARAMETERS

OPERATION  
SEQUENCE{  
IMSI,  
MSIsdn OPTIONAL,  
Category OPTIONAL,  
ProvisionedbearerServices  
SEQUENCE OF BearerService OPTIONAL,  
ProvisionedTeleservices  
SEQUENCE OF Teleservice OPTIONAL,  
SEQUENCE OF SS-Information OPTIONAL,  
SEQUENCE OF AnalogueDataInfo OPTIONAL}

RESULT

Empty

ERRORS

{UnknownSubscriber,  
DataMissing,  
UnexpectedDataValue}

::= 18

#### 4.2.19 Send information for incoming call set-up (MSC → VLR)

This operation is invoked by a MSC receiving an incoming call (call to mobile subscriber) to request the VLR for the required informations.

Send Information for I/C call	Timer = T-ir	Class = 1	Code = 00010011
<i>Parameters With Invoke</i>		Opt/Man	Reference
RoamingNumber		M	§ 5.3.1.15
MSIsdn (Received from partner network)		0	§ 5.3.1.13
BearerService		0	§ 5.3.2.6
Teleservice		0	§ 5.3.2.7
CUG-interlock		0	§ 5.3.3.22
NumberOfForwarding		0	§ 5.3.4.10
<i>Parameters With Return Result</i>		Opt/Man	Reference
SubscriberId		0	§ 5.3.1.1
LocAreaId		0	§ 5.3.1.5
DetachFlag		0	§ 5.3.2.4
SleepMode		0	§ 5.3.2.3
Category		0	§ 5.3.2.1
MSIsdn		0	§ 5.3.1.13
AnalogueDataService		0	§ 5.3.2.10
SEQUENCE OF SS-Information		0	§ 5.3.3.1
K1		0	§ 5.3.6.4
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnallocatedRoamingNumber			§ 4.3.6
InsufficientBearerCapabilities			§ 4.3.12
BearerServiceNotProvisioned			§ 4.3.10
TeleserviceNotProvisioned			§ 4.3.11
AbsentSubscriber			§ 4.3.7
IllegalMS			§ 4.3.9
CUG-Reject			§ 4.3.15
ForwardingViolation			§ 4.3.14
CallBarred			§ 4.3.13
UnexpectedDataValue			§ 4.3.31

#### ASN.1 FORMAL DESCRIPTION

SendInformationForI/C-Call  
PARAMETERS

OPERATION  
SEQUENCE(  
RoamingNumber,  
dialledNumber MSIsdn OPTIONAL,  
BearerService OPTIONAL,  
Teleservice OPTIONAL,  
CUG-Interlock OPTIONAL,  
NumberOfForwarding)

RESULT

SEQUENCE(  
SubscriberId OPTIONAL,  
LocAreaId OPTIONAL,  
DetachFlag OPTIONAL,  
SleepMode OPTIONAL,  
Category OPTIONAL,  
MSIsdn OPTIONAL,  
AnalogueDataService OPTIONAL,  
SEQUENCE OF SS-Information OPTIONAL,  
K1 OPTIONAL)

## ERRORS

{UnallocatedRoamingNumber,  
UnsufficientBearerCapabilities,  
BearerServiceNotProvisioned,  
TeleserviceNotProvisioned,  
AbsentSubscriber,  
IllegalMS,  
CUG-Reject,  
ForwardingViolation,  
CallBarred,  
UnexpectedDataValue}

::= 19

### 4.2.20 Send information for outgoing call set-up (MSC → VLR)

This operation is invoked by a MSC receiving an outgoing call (call from mobile subscriber) to request the VLR for the required informations.

Send Information for O/G call	Timer = T-ir	Class = 1	Code = 00010100
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
BearerService		O	§ 5.3.2.6
Teleservice		O	§ 5.3.2.7
SEQUENCE OF SS-information		O	§ 5.3.3.1
<i>Parameters With Return Result</i>		Opt/Man	Reference
Category		M	§ 5.3.2.1
MSIsdn		O	§ 5.3.1.13
SEQUENCE OF SS-Information		O	§ 5.3.3.1
TMSI		O	§ 5.3.1.3
K1		O	§ 5.3.6.4
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
BearerServiceNotProvisioned			§ 4.3.10
TeleserviceNotProvisioned			§ 4.3.11
InsufficientBearerCapabilities			§ 4.3.12
IllegalMS			§ 4.3.9
CUG-Reject			§ 4.3.15
CallBarred			§ 4.3.13
DataMissing			§ 4.3.30
UnexpectedDataValue			§ 4.3.31
SystemFailure			§ 4.3.29

### ASN.1 FORMAL DESCRIPTION

SendInformationForO/G-Call  
PARAMETERS

OPERATION  
SEQUENCE{  
SubscriberId,  
BearerService OPTIONAL,  
Teleservice OPTIONAL,  
SEQUENCE OF SS-Information OPTIONAL}

RESULT

SEQUENCE{  
Category,  
MSIsdn OPTIONAL,  
SEQUENCE OF SS-Information OPTIONAL,  
TMSI OPTIONAL,  
K1 OPTIONAL}

## ERRORS

{UnknownSubscriber,  
UnallocatedTMSI,  
BearerServiceNotProvisioned,  
TeleserviceNotProvisioned,  
InsufficientBaeraerCapabilities,  
IllegalMS,  
CUG-Reject,  
DataMissing,  
UnexpectedDataValue,  
SystemFailure}

::= 20

### 4.2.21 Send routing information (GMSC → HLR)

This operation is invoked by a gateway MSC to perform the interrogation of the HLR in order to route a call towards a mobile station.

Send Routing Information	Timer = T-rd	Class = 1	Code = 00010101
<i>Parameters With Invoke</i>		Opt/Man	Reference
MSIsdn		M	§ 5.3.1.13
CUG-Interlock		O	§ 5.3.3.22
NumberOfForwarding		O	§ 5.3.4.10
BearerService		O	§ 5.3.2.6
Teleservice		O	§ 5.3.2.7
<i>Parameters With Return Result</i>		Opt/Man	Reference
RoutingNumber		M	§ 5.3.1.14
SEQUENCE OF SS-Information		O	§ 5.3.3.1
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
CallBarred			§ 4.3.13
CUG-Reject			§ 4.3.15
BearerServiceNotProvisioned			§ 4.3.10
TeleserviceNotProvisioned			§ 4.3.11
FacilityNotSupported			§ 4.3.21
AbsentSubscriber			§ 4.3.7
ForwardingViolation			§ 4.3.14
UnexpectedDataValue			§ 4.3.31

### ASN.1 FORMAL DESCRIPTION

SendRoutingInformation  
PARAMETERS

OPERATION  
CHOICE {MSIsdn,  
SEQUENCE{MSIsdn,  
CUG-Interlock OPTIONAL,  
NumberOfForwarding OPTIONAL,  
BearerService OPTIONAL,  
Teleservice OPTIONAL}}

RESULT

SEQUENCE{  
RoutingNumber,  
SEQUENCE OF SS-Information OPTIONAL}

ERRORS

{UnknownSubscriber,  
CallBarred,  
CUG-Reject,  
BearerServiceNotProvisioned,  
TeleserviceNotProvisioned,  
AbsentSubscriber,  
ForwardingViolation,  
UnexpectedDataValue}

::= 21

4.2.22 Perform measurements (MSC-A → Adjacents MSCs)

This operation is invoked by a call control MSC to request adjacent MSCs to perform measurements in their area, and to retransmit the results.

Perform measurements	Timer = T-mr	Class = 1	Code = 00010110
Parameters With Invoke		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
ChannelId (current)		M	§ 5.3.5.1
FFS			
Parameters With Return Result		Opt/Man	Reference
MeasurementValues		M	§ 5.3.5.6
Linked Operations			
Not applicable			
Errors			Reference
AbsentSubscriber			§ 4.3.7
NoResult			§ 4.3.28
SystemFailure			§ 4.3.29

ASN.1 FORMAL DESCRIPTION

SendMeasurementInformation  
PARAMETERS

OPERATION  
SEQUENCE {SubscriberId,  
CurrentChannel ChannelId,  
FFS}

RESULT

{MeasurementValues}

ERROR

{AbsentSubscriber,  
NoResult,  
SystemFailure}

::= 22

4.2.23 Perform handover (MSC-A → MSC-B)

This operation is invoked by a MSC to request the new MSC for performing handover.

Perform Handover	Timer = T-ho	Class = 1	Code = 00010111
Parameters With Invoke		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
LocAreaId		M	§ 5.3.1.5
ChannelId		M	§ 5.3.5.1
TargetBaseStationId		M	§ 5.3.1.9
SpeechCodec		M	§ 5.3.2.5
BearerService		M	§ 5.3.2.6
FrequencyHoppingInformation		M	§ 5.3.5.3
Kl		O	§ 5.3.6.4
Ks		O	§ 5.3.6.6
Parameters With Return Result		Opt/Man	Reference
TargetChannelId		M	§ 5.3.5.2
HandoverNumber		M	§ 5.3.1.16
FrequencyHoppingInformation		M	§ 5.3.5.3
HandoverReference		M	§ 5.3.5.4
Linked Operations			
Not applicable			
Errors			Reference
UnknownBaseStation			§ 4.3.2
UnknownLocArea			§ 4.3.4
InvalidTargetBaseStation			§ 4.3.22
NoRadioResourceAvailable			§ 4.3.23
NoHandoverNumberAvailable			§ 4.3.24
NetworkConnectionFailure			§ 4.3.26

ASN.1 FORMAL DESCRIPTION

PerformHandover  
PARAMETERS

OPERATION  
SEQUENCE{  
SubscriberId,  
LocAreaId,  
ChannelId,  
TargetBaseStationId,  
SpeechCodec,  
BearerService,  
FrequencyHoppingInformation,  
Kl OPTIONAL,  
Ki OPTIONAL}

RESULT

SEQUENCE{TargetChannelId,  
HandoverNumber,  
FrequencyHoppingInformation,  
HandoverReference}

ERROR

{UnknownBaseStation,  
UnknownLocArea,  
InvalidTargetBaseStation,  
NoRadioRessourceAvailable,  
NoHandoverNumberAvailable,  
NetworkConnectionFailure}

#### 4.2.24 Send end signal (MSC-B → MSC-A)

This operation requests the MSC-A to send the end signal when the communication is released.

Send End Signal	Timer = T-es	Class = 3	Code = 00011000
<i>Parameters With Invoke</i>		Opt/Man	Reference
Empty			
<i>Parameters With Return Result</i>		Opt/Man	Reference
Empty			

#### ASN.1 FORMAL DESCRIPTION

SendEndSignal  
PARAMETERS

OPERATION  
Empty

RESULT

Empty

::= 24

#### 4.2.25 Perform subsequent handover (MSC-B → MSC-A)

This operation is invoked by a MSC to request the call controlling MSC for a radio channel and for performing handover with a third MSC. (The new MSC can be MSC-A.)

Perform Subsequent Handover	Timer = T-sho	Class = 1	Code = 00011001
<i>Parameters With Invoke</i>		Opt/Man	Reference
TargetBaseStationId		M	§ 5.3.1.9
TargetMscId		M	§ 5.3.1.10
<i>Parameters With Return Result</i>		Opt/Man	Reference
TargetChannelId		M	§ 5.3.5.2
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownBaseStation			§ 4.3.2
UnknownMSC			§ 4.3.3
InvalidTargetBaseStation			§ 4.3.22
SubsequentHandoverFailure			§ 4.3.27



ASN.1 FORMAL DESCRIPTION

PerformSubsequentHandover  
PARAMETERS

RESULT

ERROR

OPERATION  
SEQUENCE {TargetBaseStationId,  
TargetMscId}

TargetChannelId

{UnknownBaseStation,  
InvalidTargetBaseStation,  
UnknownMSC,  
SubsequentHandoverFailure}

::= 25

4.2.26 Allocate handover number (MSC → VLR)

This operation is invoked by a MSC where a call has to be handed over, to request its associated VLR for an handover number.

Allocate Handover Number	Timer = T-ahn	Class = 2	Code = 00011010
Parameters With Invoke		Opt/Man	Reference
Empty			
Linked Operations			
Send Handover Report			
Errors			Reference
NoHandoverNumberAvailable			§ 4.3.24

ASN.1 FORMAL DESCRIPTION

AllocateHandoverNumber  
PARAMETERS

LINKED OPERATION

ERROR

OPERATION  
Empty

SendHandoverReport

{NoHandoverNumberAvailable  
}

::= 26

4.2.27 Send handover report (VLR → MSC)

This operation is invoked by a VLR after receiving a handover number request.

Send Handover Report	Timer = T-hr	Class = 3	Code = 00011011
Parameters With Invoke		Opt/Man	Reference
HandoverNumber		M	§ 5.3.1.16
Parameters With Return Result		Opt/Man	Reference
Empty			
Linked Operations			
Not applicable			

ASN.1 FORMAL DESCRIPTION

SendHandoverReport  
PARAMETERS

RESULT

OPERATION  
Empty

Empty

::= 27

#### 4.2.28 Perform call control (MSC-B → MSC-A)

This operation is invoked by MSC-B when it receives a call handling request from the MS. The request is transmitted transparently.

Perform Call Control	Timer = T-ccr	Class = 2	Code = 00011100
<i>Parameters With Invoke</i>		Opt/Man	Reference
BSPDU		M	§ 5.3.7.1
<i>Errors</i>			Reference
HandoverStateUndetermined			§ 4.3.25

#### ASN.1 FORMAL DESCRIPTION

PerformCallControl  
PARAMETERS

OPERATION  
{BSPDU}

ERROR

{HandoverStateUndetermined  
}

::= 28

#### 4.2.29 Process call control information (MSC-A → MSC-B)

This operation is invoked by MSC-A when it needs to provide information to the MS. The MSC-B is transparent to the information.

Process Call Control Information	Timer = T-cci	Class = 1	Code = 00011101
<i>Parameters With Invoke</i>		Opt/Man	Reference
BSPDU		M	§ 5.3.7.1
<i>Parameters With Return Result</i>		Opt/Man	Reference
Empty			
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
HandoverStateUndetermined			§ 4.3.25
AbsentSubscriber			§ 4.3.7

#### ASN.1 FORMAL DESCRIPTION

ProcessCallControlInformation  
PARAMETERS

OPERATION  
{BSPDU}

RESULT

Empty

ERROR

{HandoverStateUndetermined,  
AbsentSubscriber}

::= 29

#### 4.2.30 Note internal handover

This operation is invoked by a MSC-B to inform MSC-A that a handover has been performed between to BS in MSC-B area (i.e., for authentication initiation).

Note Internal Handover	Timer = T-rho	Class = 4	Code = 00011110
Parameters With Invoke		Opt/Man	Reference
Empty			

#### ASN.1 FORMAL DESCRIPTION

NoteInternalHandover

OPERATION

PARAMETERS

Empty

::= 30

#### 4.2.31 Register charging information (MSC → HLR)

This operation is invoked by a MSC to transmit the charging information to the HLR.

Register Charging Information	Timer = T-ci	Class = 1	Code = 00011111
Parameters With Invoke		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
CallControlMscId		M	§ 5.3.1.11
CallReference		M	§ 5.3.4.1
ChargeType		M	§ 5.3.4.2
BearerService		O	§ 5.3.2.6
Teleservice		O	§ 5.3.1.7
CalledNumber		O	§ 5.3.1.18
CallingNumber		O	§ 5.3.1.19
CallDateTime		M	§ 5.3.4.5
CallDuration		M	§ 5.3.4.4
ChargingUnit		O	§ 5.3.4.6
RadioCharge		O	§ 5.3.4.7
NetworkCharge		O	§ 5.3.4.8
SS-ChargingInfo		O	§ 5.3.4.9
Parameters With Return Result		Opt/Man	Reference
Empty			
Linked Operations			
Not applicable			
Errors			Reference
UnknownSubscriber			§ 4.3.1
DataMissing			§ 4.3.30
UnexpectedDtaValue			§ 4.3.31

ASN.1 FORMAL DESCRIPTION

RegisterChargingInformation  
PARAMETERS

OPERATION  
SEQUENCE{ IMSI,  
CallControlMscId,  
CallReference,  
ChargeType,  
BearerService OPTIONAL,  
Teleservice OPTIONAL,  
CalledNumber OPTIONAL,  
CallingNumber OPTIONAL,  
CallDateTime,  
CallDuration,  
ChargingUnit OPTIONAL,  
RadioCharge OPTIONAL,  
NetworkCharge OPTIONAL,  
SS-ChargingInfo OPTIONAL}

RESULT

Empty

ERROR

{UnknownSubscriber,  
DataMissing,  
UnexpectedDataValue  
}

::= 31

4.2.32 Search for mobile subscriber (VLR → MSC)

This operation is invoked by a VLR to request the MSC to search for a mobile subscriber in its area.

Search For Mobile Subscriber	Timer = T-sms	Class = 1	Code = 00100000
Parameters With Invoke		Opt/Man	Reference
SubSubscriberId		M	§ 5.3.1.1
LocAreaId		O	§ 5.3.1.5
Parameters With Return Result		Opt/Man	Reference
LocAreaId		M	§ 5.3.1.5
Linked Operations			
Not applicable			
Errors			Reference
AbsentSubscriber			§ 4.3.7

ASN.1 FORMAL DESCRIPTION

SearchForMobileSubscriber  
PARAMETERS

OPERATION  
SEQUENCE{ SubscriberId,  
StoredLocationAreaId LocAreaId  
}

RESULT

{CurrentLocationAreaId LocAreaId  
}

ERROR

{AbsentSubscriber  
}

::= 32

#### 4.2.33     *Reset (HLR → VLRs)*

This operation is invoked by a HLR, after a restart, to request the VLRs to mark all its mobile stations.

Reset	Timer = T-res	Class = 4	Code = 00100001
<i>Parameters With Invoke</i>		Opt/Man	Reference
HlrId		M	§ 5.3.1.12

#### ASN.1 FORMAL DESCRIPTION

Reset  
PARAMETERS

OPERATION  
{HlrId  
}

::= 33

#### 4.2.34     *Initiate authentication (MSC → VLR)*

This operation is invoked by a MSC to request its associated VLR to initiate the basic authentication procedure.

Initiate Authentication	Timer = T-aur	Class = 1	Code = 00100010
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		M	§ 5.3.1.1
<i>Parameters With Return Result</i>		Opt/Man	Reference
Empty			
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
IllegalMS			§ 4.3.9

#### ASN.1 FORMAL DESCRIPTION

InitiateAuthenticationProcedure  
PARAMETERS

OPERATION  
{SubscriberId}

RESULT

Empty

ERROR

{IllegalMS}

::= 34

4.2.35      *Authenticate (VLR → MSC)*

This operation is invoked by a VLR to request a subscriber for authentication.

Authenticate	Timer = T-aut	Class = 1	Code = 00100011
<i>Parameters With Invoke</i>		Opt/Man	Reference
SubscriberId		O	§ 5.3.1.1
LocAreaId		O	§ 5.3.1.5
SleepMode		O	§ 5.3.2.3
Rand		M	§ 5.3.6.2
<i>Parameters With Return Result</i>		Opt/Man	Reference
Sres		M	§ 5.3.6.3
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
AbsentSubscriber			§ 4.3.7

*ASN.1 FORMAL DESCRIPTION*

Authenticate  
PARAMETERS

OPERATION  
CHOICE {Rand,  
SEQUENCE {SubscriberId OPTIONAL,  
LocAreaId OPTIONAL,  
SleepMode OPTIONAL,  
Rand}  
}

RESULT

{Sres}

ERROR

{AbsentSubscriber}

::= 35

*Note* - As the authentication request is part of a procedure (location updating, supplementary service activation, handover initiation ...), a transaction is running and the transaction number identifies the subscriber, then there is no need to provide the TMSI/LocAreaId or the IMSI, except for the transaction related to incoming call set-up.

#### 4.2.36 Check IMEI (MSC → EIR)

This operation is invoked by a MSC to request the EIR for checking the equipment identity used by a mobile subscriber.

Check Equipment Identity	Timer = T-cim	Class = 1	Code = 00100100
<i>Parameters With Invoke</i>		Opt/Man	Reference
IMEI other parameters FFS		M	§ 5.3.1.4
<i>Parameters With Return Result</i>		Opt/Man	Reference
EquipStatus		M	§ 5.3.2.2
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
SystemFailure			§ 4.3.29
UnknownEquipment			§ 4.3.34

#### ASN.1 FORMAL DESCRIPTION

CheckIMEI  
PARAMETERS

OPERATION  
{IMEI}

RESULT

{EquipStatus}

ERROR

{SystemFailure,  
UnknownIMEI}

::= 36

#### 4.2.37 Send parameters from VLR

This operation is invoked by any network entity to request a VLR for one or several parameters related to a subscriber.

The list of requested parameters is sent in the invoke component, using the relevant ASN.1 context-specific tag values.

If several parameters match an ASParameter-Id, the result contains a SEQUENCE OF parameter including all the relevant parameters.

When one parameter cannot be obtained, while the subscriber is known, the parameter is returned with null value in the return result component (the original tag is used).

Send Parameters From VLR	Timer = T-prv	Class = 1	Code = 00100101
<i>Parameters With Invoke</i>		Opt/Man	Reference
Subscriber_Id		M	§ 5.3.1.1
SEQUENCE OF ASParameter_id		M	§ 5.3.7.2
<i>Parameters With Return Result</i>		Opt/Man	Reference
SEQUENCE OF ANY Application parameter		M	Any
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
UnexpectedDataValue			§ 4.3.31
SytemFailure			§ 4.3.29

## ASN.1 FORMAL DESCRIPTION

SendParameterFromVLR  
PARAMETERS

OPERATION  
SEQUENCE{  
SubscriberId,  
SEQUENCE OF ASParameter\_id}

RESULT

SEQUENCE OF ANY --- Any MAP parameter  
--- matching the tags  
--- included in the  
--- request.

ERROR

{UnknownSubscriber,  
UnallocatedTMSI,  
UnexpectedDataValue,  
SystemFailure}

::= 37

### 4.2.38 Send parameters from HLR

This operation is invoked by any network entity to request a HLR for one or several parameters related to a subscriber.

The list of requested parameters is sent in the invoke component, using the relevant ASN.1 context-specific tag values.

If several parameters match an ASParameter\_Id, the result contains a SEQUENCE OF parameter including all the relevant parameters.

When one parameter cannot be obtained, while the subscriber is known, the parameter is returned with null value in the return result component (the original tag is used).

Send Parameters From HLR	Timer = T-prv	Class = 1	Code = 00100110
<i>Parameters With Invoke</i>		Opt/Man	Reference
Subscriber_id	M		§ 5.3.1.1
SEQUENCE OF ASParameter_id	M		§ 5.3.7.2
<i>Parameters With Return Result</i>		Opt/Man	Reference
SEQUENCE OF ANY Application parameter		M	Any
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
UnallocatedTMSI			§ 4.3.5
UnexpectedDataValue			§ 4.3.31
SystemFailure			§ 4.3.29

## ASN.1 FORMAL DESCRIPTION

SendParameterFromHLR  
PARAMETERS

OPERATION  
SEQUENCE{  
SubscriberId,  
SEQUENCE OF ASParameter\_id}

RESULT

SEQUENCE OF ANY --- Any MAP parameter  
--- matching the tags  
--- included in the  
--- request.



ERROR

{UnknownSubscriber,  
UnallocatedTMSI,  
UnexpectedDataValue,  
SystemFailure}

== 38

*Note* - If an HLR is request for the roaming number of a deregistered subscriber (ASParamater\_Id = 12), no error is reported but a roaming number parameter with null value is returned in the result component.

#### 4.2.39 Allocate additional roaming numbers

This operation is invoked by a HLR to request the VLR to allocate roaming numbers to each subscribed analogue data services.

Allocate Additional Roaming Numbers	Timer = T-arn	Class = 1	Code = 00100111
<i>Parameters With Invoke</i>		Opt/Man	Reference
SEQUENCE OF AnalogueDataInfo IMSI		M O	§ 5.3.2.9 § 5.3.1.2
<i>Parameters With Return Result</i>		Opt/Man	Reference
SEQUENCE OF AdditionalRoamingInfo		M	§ 5.3.1.20
<i>Linked Operations</i>			
Not applicable			
<i>Errors</i>			Reference
UnknownSubscriber			§ 4.3.1
FacililtyNotSupported			§ 4.3.21
UnexpectedDataValue			§ 4.3.31

#### ASN.1 FORMAL DESCRIPTION

AllocateAdditionalRoamingNumbers  
PARAMETERS

OPERATION  
CHOICE{SEQUENCE OF AnalogueDataInfo,  
SEQUENCE{SEQUENCE OF AnalogueDataInfo,  
IMSI OPTIONAL}}

RESULT

SEQUENCE OF AdditionalRoamingInfo

ERROR

{UnknownSubscriber,  
FacilityNotSupported,  
UnexpectedDataValue}

== 39

#### 4.2.40 Verify location

This operation is invoked by a VLR to request a HLR to verify that a mobile subscriber has to be kept in the register. If not, the cancellation location procedure is triggered.

Verify Location	Timer = T-vl	Class = 3	Code = 00101000
<i>Parameters With Invoke</i>		Opt/Man	Reference
IMSI		M	§ 5.3.1.2
<i>Parameters With Return Result</i>		Opt/Man	Reference
RoamingNumber		M	§ 5.3.1.15

#### ASN.1 FORMAL DESCRIPTION

VerifyLocation  
PARAMETERS

OPERATION  
IMSI

RESULT

StoredRoamingNumber  
RoamingNumber

::= 40

#### 4.3 Application errors definition

##### 4.3.1 UnknownSubscriber

This error is returned by a location register, when it is requested to perform an operation concerning an unknown subscriber (≠ deregistered).

UnknownSubscriber	Code = 00000001	
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

UnknownSubscriber  
PARAMETERS

ERROR  
Empty

::= 1

##### 4.3.2 UnknownBaseStation

This error is returned by an MSC when it is requested to perform an operation concerning an unknown base station.

UnknownBaseStation	Code = 00000010	
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

UnknwonBaseStation  
PARAMETERS

ERROR  
Empty

::= 2

#### 4.3.3 UnknownMSC

This error is returned by an MSC when it is requested to perform an operation concerning an unknown MSC.

UnknownMSC		Code = 00000011
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

UnknownMSC                      ERROR  
PARAMETERS                    Empty

::= 3

#### 4.3.4 UnknownLocArea

This error is returned by a network entity when it is requested to perform an operation related to an unknown location area.

UnknownLocArea		Code = 00000100
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

UnknownLocArea                ERROR  
PARAMETERS                    Empty

::= 4

#### 4.3.5 UnallocatedTMSI

This error is returned by an VLR when it receives a request concerning a temporary identity that is not allocated in the relevant location area.

UnallocatedTMSI		Code = 00000101
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

UnallocatedTMSI                ERROR  
PARAMETERS                    Empty

::= 5

#### 4.3.6 *UnallocatedRoamingNumber*

This error is returned by a VLR when it receives a request concerning a roaming number that is not allocated.

UnallocatedRoamingNumber		Code = 00000110
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

UnallocatedRoamingNumber      ERROR  
PARAMETERS                      Empty

::= 6

#### 4.3.7 *AbsentSubscriber*

This error is returned by any network entity requested to perform an operation concerning a subscriber which is deregistered or not reachable.

AbsentSubscriber		Code = 00000111
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

AbsentSubscriber                ERROR  
PARAMETERS                      Empty

::= 7

#### 4.3.8 *RoamingNotAllowed*

This error is returned by a location register when it is requested to update the location of a subscriber, roaming out of the area covered by its subscription.

RoamingNotAllowed		Code = 00001000
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

RoamingNotAllowed              ERROR  
PARAMETERS                      Empty

::= 8

#### 4.3.9 *IllegalMS*

This error is returned by a VLR when the procedure cannot be achieved because the mobile subscriber has not been authenticated.

IllegalMS		Code = 00001001
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

IllegalMS                      ERROR  
PARAMETERS                  Empty

::= 9

#### 4.3.10 *BearerServiceNotProvisioned*

This error is returned by a location register when it is requestion for call set-up information related to a non-provisioned bearer service.

BearerServiceNotProvisioned		Code = 00001010
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

BearerServiceNotProvisioned    ERROR  
PARAMETERS                      Empty

::= 10

#### 4.3.11 *TeleserviceNotProvisioned*

This error is returned by a location register when it is requested for all set-up information related to a non-provisioned teleservice.

TeleserviceNotProvisioned		Code = 00001011
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

TeleserviceNotProvisioned      ERROR  
PARAMETERS                      Empty

::= 11

#### 4.3.12 *InsufficientBearerCapabilities*

This error is returned by a visitor location register, when it is requested for call set-up information while the bearer capabilities of the mobile station are not sufficient to establish the associated call.

InsufficientBearerCapabilities		Code = 00001100
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

InsufficientBearerCapabilities      ERROR  
PARAMETERS                          Empty

::= 12

#### 4.3.13 *CallBarred*

This error is returned by a location register when a switching centre wants to set up a call transgressing the barring conditions.

CallBarred		Code = 00001101
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

CallBarred                              ERROR  
PARAMETERS                              Empty

::= 13

#### 4.3.14 *ForwardingViolation*

This error is returned by a location register when it is requested for routing information while the maximum number of forwarding is reached.

ForwardingViolation		Code = 00001110
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

ForwardingViolation                      ERROR  
PARAMETERS                              Empty

::= 14

#### 4.3.15 CUG-Reject

This error is reported by a location register to indicate that the call does not pass the CUG check or that the CUG barring conditions are transgressed.

CUG-Reject		Code = 00001111
<i>Parameters with Return Error</i>	Opt/Man	Reference
CUG-RejectCause	0	§ 5.3.3.26

#### ASN.1 FORMAL DESCRIPTION

CUG-Reject                      ERROR  
PARAMETERS                    CUG-RejectCause OPTIONAL

::= 15

#### 4.3.16 IllegalSS-Operation

This error is returned by a location register when it is requested to perform an illegal operation on a supplementary service (e.g., registration request for a service which must be registered by the administration).

IllegalSS-Operation		Code = 00010000
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

IllegalSS-Operation            ERROR  
PARAMETERS                   Empty

::= 16

#### 4.3.17 SS-ErrorStatus

This error is returned by a location register when it is requested to perform an operation which is not compatible with the current status of the relevant supplementary service. The current status is given as parameter.

SS-ErrorStatus		Code = 00010001
<i>Parameters with Return Error</i>	Opt/Man	Reference
SS-RegistrationStatus	0	§ 5.3.3.5
SS-ActivationStatus	0	§ 5.3.3.4

#### ASN.1 FORMAL DESCRIPTION

SS-ErrorStatus                ERROR  
PARAMETERS                   SEQUENCE {SS-RegistrationStatus OPTIONAL,  
                                 SS-ActivationStatus OPTIONAL} OPTIONAL

::= 17

#### 4.3.18 SS-NotAvailable

This error is returned by a visitor location register when it is requested to activate a supplementary service which is not available in the visited area.

SS-NotAvailable		Code = 00010010
Parameters with Return Error	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

SS-NotAvailable                      ERROR  
PARAMETERS                          Empty

::= 18

#### 4.3.19 SS-SubscriptionViolation

This error is returned by a location register when it is requested to activate a supplementary service, transgressing the subscription restrictions. The nature of the restriction or the transgressed option may be sent as parameters.

SS-SubscriptionViolation		Code = 00010011
Parameters with Return Error	Opt/Man	Reference
SS-Rest	0	§ 5.3.3.6
SubscriptionOption	0	§ 5.3.3.8 to § 5.3.3.19

#### ASN.1 FORMAL DESCRIPTION

SS-SubscriptionViolation              ERROR  
PARAMETERS                          SEQUENCE {SS-Rest OPTIONAL,  
   SubscriptionOption OPTIONAL} OPTIONAL

::= 19

#### 4.3.20 SS-Incompatibility

This error is returned by a location register when it is requested for a supplementary service operation incompatible with the status of an other supplementary service or with the teleservice or bearer service for which the operation is requested. The code and the status of the relevant service are possibly sent as parameters.

SS-Incompatibility		Code = 00010100
Parameters with Return Error	Opt/Man	Reference
SS-Code	0	§ 5.3.3.3
SS-ActivationStatus	0	§ 5.3.3.4
SS-RegistrationStatus	0	§ 5.3.3.5
BasicService	0	§ 5.3.2.8

#### ASN.1 FORMAL DESCRIPTION

SS-Incompatibility                      ERROR  
PARAMETERS                          SEQUENCE {SS-Code OPTIONAL,  
   SS-ActivationStatus OPTIONAL,  
   SS-RegistrationStatus OPTIONAL,  
   BasicService OPTIONAL} OPTIONAL

::= 20



#### 4.3.21 *FacilityNotSupported*

This error is returned by a location register receiving a request about a facility which is not supported in the PLMN.

FacilityNotSupported		Code = 00010101
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

FacilityNotSupported      ERROR  
PARAMETERS               Empty

::= 21

#### 4.3.22 *InvalidTargetBaseStation*

This error is returned by a MSC, when it is requested to perform a handover on an invalid base station.

InvalidTargetBaseStation		Code = 00010110
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

InvalidTargetBaseStation      ERROR  
PARAMETERS               Empty

::= 22

#### 4.3.23 *NoRadioResourceAvailable*

This error is returned by a MSC, when the radio path cannot be established because of congestion.

NoRadioResourceAvailable		Code = 00010111
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

NoRadioResourceAvailable      ERROR  
PARAMETERS               Empty

::= 23

#### 4.3.24 *NoHandoverNumberAvailable*

This error is returned by a VLR or a MSC, when no handover number can be allocated.

NoHandoverNumberAvailable		Code = 00011000
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

NoHandoverNumberAvailable    ERROR  
PARAMETERS                      Empty

::= 24

#### 4.3.25 *HandoverStateUndetermined*

This error is returned by a MSC when it received a call control request concerning a mobile subscriber while the handover state is undetermined.

HandoverStateUndetermined		Code = 00011001
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

HandoverStateUndetermined    ERROR  
PARAMETERS                      Empty

::= 25

#### 4.3.26 *NetworkConnectionFailure*

This error is returned by a MSC, when the connection to another MSC cannot be established.

NetworkConnectionFailure		Code = 00011010
<i>Parameters with Return Error</i>	Opt/Man	Reference
Empty		

#### ASN.1 FORMAL DESCRIPTION

NetworkConnectionFailure    ERROR  
PARAMETERS                      Empty

::= 26

#### 4.3.27 *SubsequentHandoverFailure*

This error is returned by a call control MSC to indicate to MSC-B that the handover procedure with MSC-B' failed.

SubsequentHandoverFailure		Code = 00011011
Parameters with Return Error	Opt/Man	Reference
Empty		

## ASN.1 FORMAL DESCRIPTION

SubsequentHandoverFailure	ERROR
PARAMETERS	Empty

$$::= 27$$

### 4.3.28 *NoResult*

This error is returned by a MSC when it cannot get any measurement results about a mobile subscriber.

NoResult		Code = 00011100
Parameters with Return Error	Opt/Man	Reference
Empty		

## ASN.1 FORMAL DESCRIPTION

NoResult	ERROR
PARAMETERS	Empty

**::= 28**

### 4.3.29 *SystemFailure*

This error is returned by any system entity, when it cannot perform an operation because of the failure of another entity.

SystemFailure		Code = 00011101
Parameters with Return Error	Opt/Man	Reference
NetworkResource	0	§ 5.3.7.3

## ASN.1 FORMAL DESCRIPTION

```
SystemFailure      ERROR  
PARAMETERS        {NetworkResource OPTIONAL
```

∴= 29

4.3.30 DataMissing

This error is returned by any entity when an optional parameter is missing in an invoke component, while it is required by the context of the request.

DataMissing		Code = 00011110
Parameters with Return Error	Opt/Man	Reference
SEQUENCE OF ASParameter_Id	0	§ 5.3.7.2

ASN.1 FORMAL DESCRIPTION

DataMissing                      ERROR  
PARAMETERS                      SEQUENCE OF ASParameter\_Id OPTIONAL

::= 30

4.3.31 UnexpectedDataValue

This error is returned by any entity when it receives a parameter with an unexpected value, without type violation. The relevant parameters are returned with the faulty value.

UnexpectedDataValue		Code = 00011111
Parameters with Return Error	Opt/Man	Reference
The parameters with the unexpected value	M	

ASN.1 FORMAL DESCRIPTION

UnexpectedDataValue              ERROR  
PARAMETERS                      CHOICE {NULL,  
                                    ANY,  
                                    SEQUENCE OF ANY  
                                    --- Any Application  
                                    --- Specific Parameter Type}

::= 31

4.3.32 InvalidPasswordFormat

This error is returned when a subscriber tries to register a password whose format is invalid.

InvalidPasswordFormat		Code = 00100000
Parameters with Return Error	Opt/Man	Reference
Empty		

ASN.1 FORMAL DESCRIPTION

InvalidPasswordFormat            ERROR  
PARAMETERS                      Empty

::= 32

#### 4.3.33 *BadPasswordSupplied*

This error is returned when the password supplied with a request is not the registered one.

BadPasswordSupplied		Code = 00100001
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

BadPasswordSupplied      ERROR  
PARAMETERS               Empty

::= 33

#### 4.3.34 *UnknownEquipment*

This error is returned by an EIR when it is requested for the status of a non-registered equipment.

UnknownEquipment		Code = 00100010
Parameters with Return Error	Opt/Man	Reference
Empty		

##### ASN.1 FORMAL DESCRIPTION

UnknownEquipment      ERROR  
PARAMETERS               Empty

::= 34

#### 4.4 *Mapping of operation onto TC primitives*

In the following, according to the layered model principles, all the MAP messages are described by the associated component sub-layer primitives.

To simplify the notation, Dialogue IDs, list value, addresses, are not indicated in the primitives descriptions.

As invoke and linked IDs receive their value when the operation is invoked, these last cannot be specified in this Recommendation; symbolic variables i, j, k are used to indicate the correlations.

##### 4.4.1 *TC interface for location area updating procedure*

###### Update location area message (MSC → VLR)

Component Handling Primitive: TC-Invoke

Invoke-Id: i

Operation: "Update location area"

Dialogue Handling Primitive: TC-Begin

**Location area updating accepted message (VLR → MSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**4.4.2 TC interface for location updating procedure between VLR and HLR**

**Update location message (VLR → HLR)**

Component Handling Primitive: TC-Invoke

Operation: "Update location"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**Allocate additional roaming numbers messages (HLR → VLR) <sup>2)</sup>**

Component Handling Primitive: TC-Invoke

Operation: "AllocateAdditionalRoamingNumbers"

Invoke-Id: j

Dialogue Handling Primitive: TC-Continue

**Additional roaming numbers acknowledge message (VLR → HLR) <sup>2)</sup>**

Component Handling Primitive: TC-Result-L

Invoke-Id: j

Dialogue Handling Primitive: TC-Continue

**Location updating accepted message (HLR → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**4.4.3 TC interface for IMSI enquiring procedure**

**IMSI enquiry message (VLR → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "Send parameters"

Invoke-Id: i

--- requested parameters:

--- IMSI

--- AuthenticationSet OPTIONAL

--- Ki OPTIONAL

Dialogue Handling Primitive: TC-Begin

**IMSI response message (VLR → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**4.4.4 TC interface for location cancellation procedure**

**Cancel location message (HLR → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "Cancel location"

Invoke-Id: i

---

<sup>2)</sup> These messages are included in the transaction only when analogue data services are provisioned to the mobile subscriber.

Dialogue Handling Primitive: TC-Begin

**Location cancellation accepted message (VLR → HLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**4.4.5 TC interface for IMSI-Attach/Detach procedures**

**Detach IMSI message (MSC → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "DetachIMSI"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

(Pre-arranged release)

**Attach IMSI message (MSC → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "AttachIMSI"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**IMSI attach acknowledgment message (VLR → MSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**4.4.6 TC interface for deregistration procedure**

**Deregister mobile subscriber message (VLR → HLR)**

Component Handling Primitive: TC-Invoke

Operation: "Deregister mobile subscriber"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**Deregistration accepted message (HLR → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**4.4.7 TC interface for handling of supplementary services procedure to VLR**

When the message regards several supplementary services the originating part sends as many component handling primitives as supplementary services it wants to handle.

**Operate supplementary services to VLR messages (MSC → VLR)**

Component Handling Primitive: TC-Invoke

Operation: Choice {Register SS to VLR,  
Erase SS to VLR,  
Activate SS to VLR,  
Deactivate SS to VLR,  
Interrogate SS to VLR,  
Invoke SS to VLR}

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

#### **Supplementary services acknowledge message (VLR → MSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### **4.4.8 TC interface for handling of supplementary services procedure to HLR**

When the message regards several supplementary services the originating part sends as many component handling primitives as supplementary services it wants to handle.

#### **Operate supplementary service to HLR message (VLR → HLR)**

Component Handling Primitive: TC-Invoke

Operation: Choice {Register SS to HLR,  
Erase SS to HLR,  
Activate SS to HLR,  
Deactivate SS to HLR,  
Interrogate SS to HLR}

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

#### **Supplementary services acknowledge message (HLR → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### **4.4.9 TC interface for category and suppl. services updating procedure**

#### **Update category/supplementary services message (HLR → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "Update Category and Supplementary Services"  
Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

#### **Category/SS updating acknowledge message (VLR → HLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### **4.4.10 TC interface for updating analogue data service provision procedure**

#### **Allocate additional roaming numbers messages (HLR → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "AllocateAdditionalRoamingNumbers"  
Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

#### **Additional roaming numbers acknowledgment message (VLR → HLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End



#### 4.4.11 *TC interface for MS originating call information retrieval procedure*

##### **Send information for O/G call set-up message (MSC → VLR)**

Component Handling Primitive: TC-Invoke

Operation: Send information for outgoing call set-up

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

##### **Information acknowledge for O/G call set-up message (VLR → MSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.12 *TC interface for MS terminating call information retrieval procedure*

##### **Send Information for I/C call set-up message (MSC → VLR)**

Component Handling Primitive: TC-Invoke

Operation: Send information for incoming call set-up

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

##### **Information acknowledge for I/C call set-up message (VLR → MSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.13 *TC interface for indirect information retrieval during call set-up*

##### **Call data request message (VLR → HLR)**

Component Handling Primitive: TC-Invoke

Operation: "Send Parameters from HLR"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

##### **Call data acknowledge message (HLR → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.14 *TC interface for obtaining routing data*

##### **Send routing information message (GMSC → HLR)**

Component Handling Primitive: TC-Invoke

Operation: "Send Routing Information"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

##### **Routing information acknowledge message (HLR → GMSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.15 *TC interface for handover initiation procedure*

##### **Perform measurement message (MSC → adjacent MSCs)**

Component Handling Primitive: TC-Invoke

Operation: "Perform measurement"

Invoke-Id: i

Dialogue Handling Primitive: TC-Result-L

##### **Measurement result message (in response to the previous message)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.16 *TC interface for handover procedures between MSCs*

When the messages within a transaction are not correlated at the component layer, the order shown in this section is not significant.

##### **Perform handover message (MSC-A → MSC-B)**

Component Handling Primitive: TC-Invoke

Operation: "Perform Handover"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

##### **Radio channel acknowledgment message (MSC-B → MSC-A)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-Continue

##### **Send end signal message (MSC-B → MSC-A)**

Component Handling Primitive: TC-Invoke

Operation: "Send end signal"

Invoke-Id: k

Dialogue Handling Primitive: TC-Continue

##### **Perform call control message (MSC-B → MSC-A) <sup>3)</sup>**

Component Handling Primitive: TC-Invoke

Operation: "Perform Call Control"

Invoke-Id: t

Dialogue Handling Primitive: TC-Continue

##### **Process call control information message (MSC-A → MSC-B)**

Component Handling Primitive: TC-invoke

Operation: "Process Call Control Information"

Invoke-Id: l

Dialogue Handling Primitive: TC-Continue

##### **Call control information acknowledge message (MSC-B → MSC-A) <sup>3)</sup>**

Component Handling Primitive: TC-Result-L

---

<sup>3)</sup> These messages (and acknowledgments) do not exist in all the handover transactions and are used to transfer information between the call control MSC and the MS. MSC-B is transparent to the parameter sequence which is passed on the BS/MSC interface as Application protocol data unit. MSC-B is also transparent to the possible parameter sequence included in a return result component.

Invoke-Id: l

Dialogue Handling Primitive: TC-Continue

**Perform subsequent handover message (MSC-B → MSC-A) <sup>4)</sup>**

Component Handling Primitive: TC-Invoke

Operation: "Perform subsequent handover"

Invoke-Id: m

Dialogue Handling Primitive: TC-Continue

**Subsequent handover acknowledge message (MSC-A → MSC-B) <sup>4)</sup>**

Component Handling Primitive: TC-Result-L

Invoke-Id: m

Dialogue Handling Primitive: TC-Continue

**Note internal handover message (MSC-B → MSC-A) <sup>5)</sup>**

Component Handling Primitive: TC-Invoke

Operation: "Note internal handover"

Invoke-Id: n

Dialogue Handling Primitive: TC-Continue

**End signal message (MSC-A → MSC-B)**

Component Handling Primitive: TC-Result-L

Invoke-Id: k

Dialogue Handling Primitive: TC-End

**Handover cancellation message (MSC-A → MSC-B) <sup>6)</sup>**

Dialogue Handling Primitive: TC-U-Abort

Reason: According to CCITT Recommendation Q.773

4.4.17 *TC interface for handover number allocation procedure*

**Allocate handover number message (MSC-B → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "Allocate Handover Number"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**Send handover report message (VLR → MSC-B)**

Component Handling Primitive: TC-Invoke

Operation: "Send handover report"

Invoke-Id: j

Linked-Id: i

Dialogue Handling Primitive: TC-Continue

---

<sup>4)</sup> These messages exist only if an extra handover is needed during the communication; the request may be sent at any moment between the successful handover message and the end signal, then another transaction is opened between MSC-A and MSC-B'.

<sup>5)</sup> This message exists only if an internal handover takes place in MSC-B.

<sup>6)</sup> This message abort the transaction and may be sent at any time before the successful handover message.

**Handover report message (MSC-B → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: j

Dialogue Handling Primitive: TC-End

**4.4.18 TC interface verify location procedure**

**4.4.18.1 The subscriber has to be kept in the VLR**

**Verify location message (VLR → HLR)**

Component Handling Primitive: TC-Invoke

Operation: "Verify location"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**Location verified message (HLR → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**4.4.18.2 The mobile subscriber has not to be kept in the VLR**

**Verify location message (VLR → HLR)**

Component Handling Primitive: TC-Invoke

Operation: "Verify location"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**Cancel location message (HLR → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "Cancel location"

Invoke-Id: j

Dialogue Handling Primitive: TC-Continue

**Location cancellation accepted message (VLR → HLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: j

Dialogue Handling Primitive: TC-End

**4.4.19 TC interface for location information retrieval procedure**

**Location information retrieval message (HLR → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "Send parameters from VLR"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**Location information retrieval acknowledge message (VLR → HLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.20 *TC interface for charging information transfer procedure*

##### **Register charging information message (MSC → HLR)**

Component Handling Primitive: TC-Invoke

Operation: "Register charging information"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

##### **Charging information accepted message (HLR → MSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.21 *TC interface for equipment identity check procedure*

##### **Check IMEI message (MSC → EIR)**

Component Handling Primitive: TC-Invoke

Operation: "Check IMEI"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

##### **Result check IMEI message (EIR → MSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.22 *TC interface for mobile subscriber search procedure*

##### **Search for mobile station message (VLR → MSC)**

Component Handling Primitive: TC-Invoke

Operation: "Search mobile subscriber"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

##### **Search acknowledge message (MSC → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.23 *TC interface for reset procedure*

##### **Reset message (HLR → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "Reset"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

(Pre-arranged release)

#### 4.4.24 *TC interface for authentication during MAP procedure*

##### **Request message (e.g. update location area) (MSC → VLR)**

Component Handling Primitive: TC-Invoke

Operation: (e.g., "update location area")

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**Authentication request message (VLR → MSC)**

Component Handling Primitive: TC-Invoke

Operation: "Authenticate"

Invoke-Id: j

Dialogue Handling Primitive: TC-Continue

**Authentication response message (MSC → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: j

Dialogue Handling Primitive: TC-Continue

**The acknowledgment message of the procedure (VLR → MSC)**

Component Handling Primitive: TC-Result-L

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**Acknowledgment message for authentication failure (MSC → VLR)**

Component Handling Primitive: TC-U-Error

Error: "Authentication Failure"

INvoke-Id: i

Dialogue Handling Primitive: TC-End

**4.4.25 TC interface for authentication initiation procedure**

**Initiate authentication procedure message (MSC → VLR)**

Component Handling Primitive: TC-Invoke

Operation: "Initiate Authentication"

Invoke-Id: i

Dialogue Handling Primitive: TC-Begin

**Authenticate request message (VLR → MSC)**

Component Handling Primitive: TC-Invoke

Operation: "Authenticate"

Invoke-Id: j

Dialogue Handling Primitive: TC-Continue

**Authentication response message (MSC → VLR)**

Component Handling Primitive: TC-Result-L

Invoke-Id: j

Dialogue Handling Primitive: TC-Continue

**Authentication initiation acknowledgment (VLR → MSC)**

Component Handling Primitive: TC-Result

Invoke-Id: i

Dialogue Handling Primitive: TC-End

**Acknowledgment message for authentication failure (MSC → VLR)**

Component Handling Primitive: TC-U-Error

Error: "Authentication Failure"

Invoke-Id: i

Dialogue Handling Primitive: TC-End

#### 4.4.26 TC interface for retrieval of authentication parameters

##### Authentication information request message (VLR → HLR)

Component Handling Primitive: TC-Invoke

Operation: "SendParameters

--- RequestedParameters

--- = AuthenticationSet  
and/or Ki

Id-Lancement: 1

Dialogue Handling Primitive: TC-Begin

##### Authentication information acknowledgment (HLR → VLR)

Component Handling Primitive: TC-Result

Invoke-Id: 1

Dialogue Handling Primitive: TC-End

#### 4.4.27 TC interface for abnormal situation in any MAP procedure

##### Any Error or refused message

Component Handling Primitive: TC-U-Error

Error: ERROR MACRO according to the situation

Invoke-Id: Invoke-Id of the correlated operation

Dialogue Handling Primitive: TC-End or TC-Continue <sup>7)</sup>

##### Any Reject message

Component Handling Primitive: TC-U-Reject or TC-Reject

Invoke-Id: Invoke-Id of the relevant component

Problem Code: According to the situation  
(See Recommendation Q.773)

Dialogue Handling Primitive: TC-End

##### Any Cancellation procedure message

Dialogue Handling Primitive: TC-U-Abort

Reason: According to Recommendation Q.773

#### 4.5 Operations to be implemented in the various system components

The following sections identify which operations have to be implemented in each system component and to which type of functional interface(s) they apply.

The functional interfaces are referred to as in § 3 of this Recommendation.

S indicates that the operation is invoked by the entity.

R indicates that the operation has to be performed by the entity.

Both indicates that the operation can be invoked or performed by the entity.

##### 4.5.1 Operations for MSC

OPERATION	Code	Interface	S/R
Update location area	1	B	S
Detach IMSI	4	B	S
Attach IMSI	5	B	S
Register supplementary service to VLR	12	B	S

<sup>7)</sup> TC-Continue can be used when the success of the associated invoke is not required to continue the transaction.

<i>OPERATION</i>	<i>Code</i>	<i>Interface</i>	<i>S/R</i>
Erase supplementary service to VLR	13	B	S
Activate supplementary service to VLR	14	B	S
Deactivate supplementary service to VLR	15	B	S
Interrogate supplementary service to VLR	16	B	S
Invoke supplementary service	17	B	S
Send information for incoming call set-up	19	B	S
Send information for outgoing call set-up	20	B	S
Send routing information	21	C	S
Perform measurement	22	E	Both
Perform handover	23	E	Both
Send end signal	24	E	Both
Perform subsequent handover	25	E	Both
Allocate handover number	26	B	S
Send handover report	27	B	R
Perform call control	28	E	Both
Process call control information	29	E	Both
Note internal handover	30	E	Both
Register charging information	31	C	S
Search for mobile subscriber	32	B	R
Initiate authentication	34	B	S
Authenticate	35	B	R
Check IMEI	36	F	S
Send parameters from VLR	37	B	S
Send parameters from HLR	38	C	S

#### 4.5.2 Operations for VLR

<i>OPERATION</i>	<i>Code</i>	<i>Interface</i>	<i>S/R</i>
Update location area	1	B	R
Update location	2	D	S
Cancel location	3	D	R
Detach IMSI	4	B	R
Attach IMSI	5	B	R
Deregister mobile subscriber	6	D	S
Allocate additional roaming numbers	39	D	R
Register supplementary service to HLR	7	D	S
Erase supplementary service to HLR	8	D	S
Activate supplementary service to HLR	9	D	S
Deactivate supplementary service to HLR	10	D	S
Interrogate supplementary service to HLR	11	D	S
Register supplementary service to VLR	12	B	R
Erase supplementary service to VLR	13	B	R
Activate supplementary service to VLR	14	B	R
Deactivate supplementary service to VLR	15	B	R
Interrogate supplementary service to VLR	16	B	R
Invoke supplementary service	17	B	R
Update category and supplementary services	18	D	R
Send information for incoming call set-up	19	B	R
Send information for outgoing call set-up	20	B	R
Allocate handover number	26	B	R
Send handover report	27	B	S
Search for mobile subscriber	32	B	S
Reset	33	D	R
Initiate authentication	34	B	R
Authenticate	35	B	S
Send parameters from VLR	37	B, D, G	Both
Send parameters from HLR	38	D	S
Verify location	40	D	S



### 4.5.3 Operations for HLR

<i>OPERATION</i>	<i>Code</i>	<i>Interface</i>	<i>S/R</i>
Update location	2	D	R
Cancel location	3	D	S
Deregister mobile subscriber	6	D	R
Allocation additional roaming numbers	39	D	S
Register supplementary service to HLR	7	D	R
Erase supplementary service to HLR	8	D	R
Activate supplementary service to HLR	9	D	R
Deactivate supplementary service to HLR	10	D	R
Interrogate supplementary service to HLR	11	D	R
Update category and supplementary services	12	D	S
Send routing information	21	C	R
Register charging information	31	C	R
Reset	33	D	S
Send parameters from VLR	37	D	S
Send parameters from HLR	38	C, D	R
Verify location	40	D	R

### 4.5.4 Operations for EIR

<i>OPERATION</i>	<i>Code</i>	<i>Interface</i>	<i>S/R</i>
Check IMEI	36	F	R

### 4.6 Timers in MAP Procedures

The following timers are used in the Mobile Application Part ASEs specifications:

<i>OPERATION</i>	<i>Timer</i>	<i>Location</i>	<i>Value</i>
Update location area	T-lau	MSC	m
Update location	T-lu	VLR	m
Cancel location	T-lc	HLR	m
Detach IMSI	T-id	MSC	s
Attach IMSI	T-iar	MSC	s
Deregister mobile subscriber	T-dr	VLR	m
Allocate additional roaming numbers	T-arn	HLR	m
Register supplementary service to HLR	T-ssi	VLR	m
Erase supplementary service to HLR	T-ssi	VLR	m
Activate supplementary service to HLR	T-ssi	VLR	m
Deactivate supplementary service to HLR	T-ssi	VLR	m
Interrogate supplementary service to HLR	T-ssi	VLR	m
Register supplementary service to VLR	T-ss	MSC	m
Erase supplementary service to VLR	T-ss	MSC	m
Activate supplementary service to VLR	T-ss	MSC	m
Deactivate supplementary service to VLR	T-ss	MSC	m
Interrogate supplementary service to VLR	T-ss	MSC	m
Invoke supplementary service	T-ss	MSC	m
Update category and supplementary services	T-csu	HLR	m
Send information for incoming call set-up	T-ir	VLR	m
Send information for outgoing call set-up	T-ir	VLR	m
Send routing information	T-rd	GMSC	m
Perform measurement	T-mr	MSC-A	m
Perform handover	T-ho	MSC-A	s
Send end signal	T-es	MSC-B	l
Perform subsequent handover	T-sho	MSC-B	m
Allocate handover number	T-ahn	MSC-B	s
Send handover report	T-hr	VLR-B	l
Perform call control	T-ccr	MSC-B	s

<i>OPERATION</i>	<i>Timer</i>	<i>Location</i>	<i>Value</i>
Process call control information	T-cci	MSC-A	s
Note internal handover	T-nho	MSC-B	s
Register charging information	T-ci	MSC	m
Search for mobile subscriber	T-sms	VLR	m
Reset	T-res	HLR	m
Initiate authentication	T-aur	MSC	m
Authenticate	T-aut	VLR	s
Check IMEI	T-cim	MSC	m
Send parameters from VLR	T-pv	any	m
Send parameters from HLR	T-ph	any	m
Verify location	T-vl	VLR	m

Value:

s: from 5 seconds to 10 seconds  
m: from 15 seconds to 30 seconds  
l: from 28 hours to 38 hours.

## 5 Format and coding of information elements

### 5.1 TCAP parameters

TCAP parameters are encoded according to Recommendation Q.773.

### 5.2 Common encoding representation rules

#### 5.2.1 General

*Note* - Each octet shown as a sequence of 8 bits, is represented with the most significant bit on the left.

MAP parameters are coded according to Recommendation X.209.

Individual MAP parameters are tagged in CONTEXT-SPECIFIC or UNIVERSAL class, the reference context is the mobile application context.

The UNIVERSAL class is used when the individual parameter is always included in a tagged constructor parameter.

In this section, the parameters length are represented using one of the following forms:

- a decimal number representing the number of octets, when the length is constant;
- symbol "V" when the length depends on the situation, but will be specified when the parameter value will be assigned;
- symbol "I" when the length is indefinite. When this form is used, the length is encoded 80<sub>16</sub> and a special element EOC terminates the parameter contents.

#### 5.2.2 Coding of address numbers

The parameters explicitly or implicitly typed as AddressNumber are encoded according to the following scheme:

8	7	6	5	4	3	2	1
Nature of address							
Numbering Plan							
2nd Digit				1st Digit			
4th Digit				3rd Digit			
Filler (or last)				nth Digit			

The nature of address field is encoded as following:

NatureOfAddress	
Contents	Meaning
00000000	Spare
00000001	National use
00000010	National use
00000011	National significant number
00000100	International number

The Number plan is encoded as following:

NumberingPlan	
Contents	Meaning
00000000	Spare
00000001	ISDN (Rec. E.164)
00000010	Data numbering plan (Rec. X.121)
00000011	Telex numbering plan (Rec. F.69)
00000100	Maritime mobile numbering plan
00000101	Land mobile identification plan (Rec. E.212)

Each digit encoded as following:

0000 Digit 0  
0001 Digit 1  
0010 Digit 2  
0011 Digit 3  
0100 Digit 4  
0101 Digit 5  
0110 Digit 6  
0111 Digit 7  
1000 Digit 8  
1001 Digit 9

.... Spare

1111 Filler

ASN.1 FORMAL DESCRIPTION

AddressNumber ::= OCTET-STRING  
--- Internal structure does not follow X.409  
--- Octet 1 coded according to table "Nature of address"  
--- Octet 2 coded according to table "Numbering plan"  
--- Following octets coded as TBCD-STRING

TBCD-STRING::= OCTET-STRING  
-- The digits 0 through 9, two digits per octet  
-- Each digit encoded 0000<sub>2</sub> to 1001<sub>2</sub>  
-- 1111<sub>2</sub> used as filler

5.3 Application parameters

5.3.1 Numbering and identification parameters

5.3.1.1 SubscriberId

The SubscriberId is the number used to identify the subscriber, it can be the IMSI or the TMSI.

SubscriberId ::= CHOICE {IMSI,  
TMSI}

5.3.1.2 IMSI

The IMSI is the International Mobile subscriber Identity.

IMSI	Length $\leq 8$	Tag = 81 <sub>16</sub>
Contents	Meaning	
Internal structure: Mobile Country Code: 3 digits Mobile Network Code: 1 or 2 digits Mobile Subscriber Identification Number: n digits Coded as TBCD-STRING		

IMSI ::= [1] IMPLICIT TBCD-STRING

5.3.1.3 TMSI

The TMSI is the Temporary Mobile Subscriber Identity.

TMSI		Length $\leq 4$	Tag = 82 <sub>16</sub>
Contents	Meaning		
Unspecified			

TMSI ::= [2] IMPLICIT OCTET-STRING

5.3.1.4 IMEI

The IMEI is the International Mobile Station Equipment Identity.

IMEI		Length = 8	Tag = 83 <sub>16</sub>
Contents	Meaning		
Internal structure: Type Approval Code: 6 digits Manufacturer place: 2 digits Individual serial number: 6 digits Unassigned: 1 digit			

IMEI ::= [3] IMPLICIT TBCD-STRING

#### 5.3.1.5 *LocAreaId*

The LocAreaId is the identification number of a location area, the country code and the network code are included.

LocAreaId	Length = V	Tag = 84 <sub>16</sub>
Contents	Meaning	
Internal structure: Mobile Country Code: 3 digits according to Rec. E.212 Mobile Network Code: 1 or 2 digits according to Rec. E.212 Location Area Code: an integer number		

LocAreaId ::= [4] IMPLICIT OCTET-STRING

--- Octets 1 to 3 coded as TBCD-STRING  
 --- Following octets coded as INTEGER

#### 5.3.1.6 *TargetLocAreaId*

The TargetLocAreaId identifies the location area in which a mobile subscriber wants to roam.

TargetLocAreaId		Length = V	Tag = 85 <sub>16</sub>
Contents	Meaning		
Like LocAreaId:			

TargetLocAreaId ::= [5] IMPLICIT LocAreaId

#### 5.3.1.7 *BaseStationId*

The BaseStationId is the identity of the base station controlling the MS.

BaseStationId	Length = V	Tag = A6 <sub>16</sub>
<i>Contents</i>	Opt/Man	Reference
LocAreaId	O	§ 5.3.1.5
BaseStationCode	M	§ 5.3.1.8

BaseStationId ::= [6] IMPLICIT SEQUENCE (LocAreaId OPTIONAL,  
 BaseStationCode)

### 5.3.1.8 *BaseStationCode*

A serial number identifying a base station within a location area.

BaseStationCode		Length = 1	Tag = 02 <sub>16</sub>
Contents	Meaning		
An integer number fully encoded using one octet			

BaseStationCode ::= INTEGER

### 5.3.1.9 *TargetBaseStationId*

The TargetBaseStationId is the identity of the base station on which a call has to be handed over.

TargetBaseStationId		Length = V	Tag = A7 <sub>16</sub>
Contents	Meaning		
Like BaseStationId			

TargetBaseStationId ::= [7] IMPLICIT BaseStationId

### 5.3.1.10 *TargetMscId*

The TargetMscId is the identity of the MSC in which a call has to be handed over.

TargetMscId		Length = V	Tag = 88 <sub>16</sub>
Contents	Meaning		
ISDN Number of the MSC			

TargetMscId ::= [8] IMPLICIT AddressNumber

### 5.3.1.11 *CallControlMscId*

The CallControlMscId is the identity of the MSC which controls the call.

CallControlMscId		Length = V	Tag = 89 <sub>16</sub>
Contents	Meaning		
ISDN Number of the MSC			

CallControlMscId ::= [9] IMPLICIT AddressNumber

### 5.3.1.12 *HlrId*

The HlrId is the identity of the home location register.

HlrId		Length = V	Tag = 8A <sub>16</sub>
Contents	Meaning		
ISDN Number of the HLR			

HlrId ::= [10] IMPLICIT AddressNumber

### 5.3.1.13 *MSIsdn (Mobile Subscriber ISDN Number)*

This parameter is the ISDN number of the mobile subscriber and is defined in Recommendation E.213.

MSIsdn		Length = V	Tag = 8B <sub>16</sub>
Contents	Meaning		
ISDN number of the subscriber, coded as address number			

MSIsdn ::= [11] IMPLICIT AddressNumber

### 5.3.1.14 *RoutingNumber*

The routing address is the address given by a HLR, in reply to an interrogation for a given subscriber. It may be the roaming number of the subscriber or a forwarded to number.

RoutingNumber ::= CHOICE { RoutingNumber,  
ForwardedToNumber }

### 5.3.1.15 *RoamingNumber*

The roaming number is defined in Recommendation E.213, it is an ISDN number.

RoamingNumber		Length = V	Tag = 8C <sub>16</sub>
Contents	Meaning		
ISDN number coded as AddressNumber			

RoamingNumber ::= [12] IMPLICIT AddressNumber

### 5.3.1.16 *HandoverNumber*

The HandoverNumber is used to route a call between MSC during handover.

HandoverNumber		Length = V	Tag = 8D <sub>16</sub>
Contents	Meaning		
ISDN number coded as AddressNumber			

HandoverNumber ::= [13] IMPLICIT AddressNumber

### 5.3.1.17 ForwardedToNumber

The ForwardedToNumber is an address where the calls are forwarded to.

ForwardedToNumber		Length = V	Tag = 8E <sub>16</sub>
Contents	Meaning		
Coded as AddressNumber			

ForwardedToNumber ::= [14] IMPLICIT AddressNumber

### 5.3.1.18 CalledNumber

The CalledNumber is the number called by the mobile subscriber.

CalledNumber		Length = V	Tag = 8F <sub>16</sub>
Contents	Meaning		
ISDN Number coded as AddressNumber			

CalledNumber ::= [15] IMPLICIT AddressNumber

### 5.3.1.19 CallingNumber

The CallingNumber is the address of the calling party.

CallingNumber		Length = V	Tag = 90 <sub>16</sub>
Contents	Meaning		
ISDN Number coded as AddressNumber			

CallingNumber ::= [16] IMPLICIT AddressNumber

### 5.3.1.20 AdditionalRoamingInfo

The AdditionalRoamingInfo includes specifics roaming numbers requested for routing analogue data calls from PSTN to mobile subscribers.

AdditionalRoamingInfo		Length = I	Tag = 30 <sub>16</sub>
Contents	Opt/Man		Reference
AnalogueDataService RoamingNumber	M		§ 5.3.2.10
	M		§ 5.3.1.15

AdditionalRoamingInfo ::= SEQUENCE {  
     AnalogueDataService,  
     associatedRoamingNumber CHOICE {RoamingNumber,  
   Null }  
     }

--- Null if the service is not supported



### 5.3.2 Subscriber management parameters

#### 5.3.2.1 Category

This parameter type is used to indicate the mobile subscriber category.

Category		Length = 1	Tag = 94 <sub>16</sub>
Contents	Meaning		
00000000	Removable Subscriber Identity Module (SIM)		
00000001	Subscriber card		
00000010	Fixed Subscriber Identity Module		

Category ::= [20] IMPLICIT INTEGER { removableSIM (0),  
subscriberCard (1),  
fixedSIM (2)}

#### 5.3.2.2 EquipStatus

The EquipStatus is the status of a mobile equipment

EquipStatus		Length = 1	Tag = 95 <sub>16</sub>
Contents	Meaning		
00000000	White listed		
00000001	Black listed		
00000010	Grey listed		

EquipStatus ::= [21] IMPLICIT INTEGER {white-listed (0),  
black-listed (1),  
grey-listed (2)}

#### 5.3.2.3 SleepMode

The SleepMode parameter indicates if the sleep mode is in use.

SleepMode		Length = 1	Tag = 96 <sub>16</sub>
Contents	Meaning		
00000000	Not in use		
Any other	In use		

SleepMode ::= [22] IMPLICIT BOOLEAN

#### 5.3.2.4 DetachFlag

The DetachFlag is a flag indicating if a subscriber is set as deregistered in the VLR.

DetachFlag		Length = 1	Tag = 97 <sub>16</sub>
Contents	Meaning		
00000000	IMSI Not Detached		
Any other	IMSI Detached		

DetachFlag ::= [23] IMPLICIT BOOLEAN

### 5.3.2.5 *SpeechCodec*

The SpeechCodec parameter indicates the type of codec used by the subscriber.

SpeechCodec		Length = 1	Tag = 98 <sub>16</sub>
Contents	Meaning		
00000000	Full rate		
00000001	Half rate		
00000010	Dual rate		

SpeechCodec ::= [24] IMPLICIT INTEGER { Full rate (0),  
Half rate (1),  
Dual rate (2)}

### 5.3.2.6 *BearerService*

This parameter identifies a bearer service or a group of bearer services.

BearerService		Length = 1	Tag = 99 <sub>16</sub>
Contents	Meaning		
00010001	Audio restricted		
00100000	Data c.d.a		
00100001	Data c.d.a 300 bit/s		
00100010	Data c.d.a 1200 bit/s		
00100011	Data c.d.a 1200 - 75 bit/s		
00100100	Data c.d.a 2400 bit/s		
00100101	Data c.d.a 4800 bit/s		
00100110	Data c.d.a 9600 bit/s		
00110000	Data c.d.s		
00110010	Data c.d.s 1200 bit/s		
00110100	Data c.d.s 2400 bit/s		
00110101	Data c.d.s 4800 bit/s		
00110110	Data c.d.s 9600 bit/s		
01000000	PAD access c.d.a		
01000001	PAD access c.d.a 300 bit/s		
01000010	PAD access c.d.a 1200 bit/s		
01000011	PAD access c.d.a 1200 - 75 bit/s		
01000100	PAD access c.d.a 2400 bit/s		
01000101	PAD access c.d.a 4800 bit/s		
01000110	PAD access c.d.a 9600 bit/s		
01010000	Data p.d.s		
01010100	Data p.d.s 2400 bit/s		
01010101	Data p.d.s 4800 bit/s		
01010110	Data p.d.s 9600 bit/s		
01100001	Alternate speech/unrestricted digital		
01110001	12.6 kbit/s unrestricted digital		
10000001	ISDN terminal support		

BearerService ::= [25] IMPLICIT OCTET-STRING  
 --- Internal structure does not follow X.409  
 --- Encoding rules  
 --- Internal coding BCD

#### BIT 8765 Bearer service group

0001 Audio restricted  
 0010 Circuit data asynchronous  
 0011 Circuit data synchronous  
 0100 PAD access c.d.a  
 0101 Packet data synchronous  
 0110 Alternate speech/unrestricted digital  
 0111 12.6 kbit/s unrestricted digital  
 1000 ISDN terminal support

#### BIT 4321 Rate (for bearer service group 2,3,4,5)

0000 Any  
 0001 300 - 300 bit/s  
 0010 1200 - 1200 bit/s  
 0011 1200 - 75 bit/s  
 0100 2400 - 2400 bit/s  
 0101 4800 - 4800 bit/s  
 0110 9600 - 9600 bit/s

Bits 4321 = 0000 can be used to refer to all the bearer services of the corresponding group.

#### 5.3.2.7 TeleService

This parameter identifies a teleservice or a group of teleservices.

TeleService		Length = 1	Tag = 9A <sub>16</sub>
Contents	Meaning		
10000000	Speech transmission		
10000001	Telephony		
10000010	Emergency calls		
00100000	Short messages services		
00100001	Short message MT/PP		
00100010	Short message MO/PP		
00100011	Short message cell broadcast		
00110000	Data MHS		
00110001	Data MHS access 300-1200		
00110010	Data MHS access 300-9600		
00110011	Advanced MHS access		
01000000	Videotex access services		
01000001	Videotex access profile 1		
01000010	Videotex access profile 2		
01000011	Videotex access profile 3		
01010000	Teletex service		
01010001	Teletex CS		
01010010	Teletex PS		
01100000	Facsimile		
01100001	Facsimile Group 3 and alternate speech		

TeleService ::= [26] IMPLICIT OCTET-STRING  
 --- Internal structure does not follow  
 --- X.409 encoding rules  
 --- Internal structure BCD

Bit 8-5 encode the teleservice group

Bit 4-1 = 0000 can be used to refer to all the teleservice of the corresponding group.

#### 5.3.2.8 BasicService

This parameter identifies a basic service (teleservice or bearer service) involved in call or supplementary service handling.

BasicService ::= CHOICE {BearerService,  
 Teleservice}

#### 5.3.2.9 AnalogueDataInfo

This parameter contains the information related to an analogue data service.

AnalogueDataInfo	Length = I	Tag = BB <sub>16</sub>
<i>Contents</i>	Opt/Man	Reference
AnalogueDataService	M	§ 5.3.2.10
MSIsdn (To access the associated service)	M	§ 5.3.1.13

AnalogueDataInfo ::= [27] IMPLICIT SEQUENCE {AnalogueDataService,  
 MSIsdn}

#### 5.3.2.10 AnalogueDataService

This parameter type is used to identify an analogue data service.

AnalogueDataService	Length = 1	Tag = 9C <sub>16</sub>
<i>Contents</i>	<i>Meaning</i>	
00000001	V21	
00000010	V22	
00000011	V23	
FFS		

AnalogueDataService ::= [28] IMPLICIT INTEGER {V21 (1),  
 V22 (2),  
 V23 (3),  
 FFS}

#### 5.3.2.11 BearerCapability

The BearerCapability parameters indicate the bearer service which can be supported by a mobile station.

BearerCapability ::= [28] IMPLICIT BearerService

### 5.3.3 *Supplementary services parameters*

#### 5.3.3.1 *SS-Information*

The SS-Information type contains a sequence of all information concerning a supplementary service. When the supplementary service does not depend on the basic service used, only one SS-Data parameter is provided. One SS-information parameter is provided for each CUG.

SS-Information	Length = I	Tag = BE <sub>16</sub>
<i>Contents</i>	Opt/Man	Reference
SS-Code	M	§ 5.3.3.3
CUG-Interlock	O	§ 5.3.3.22
CUG-Index	O	§ 5.3.3.23
CallBarringPassword	O	§ 5.3.3.21
SEQUENCE OF SS-Data	O	§ 5.3.3.2

SS-Information ::= [30] IMPLICIT SEQUENCE {  
    SS-Code,  
    CUG-Interlock OPTIONAL,  
    CUG-Index OPTIONAL,  
    CallBarringPassword OPTIONAL,  
    SEQUENCE OF SS-Data OPTIONAL}

#### 5.3.3.2 *SS-Data*

The SS-Data parameter type includes all the information attached to a supplementary service for the specified basic service. If BasicService is missing, SS-Data applies to all the basic services.

SS-Data	Length = I	Tag = 30 <sub>16</sub>
<i>Contents</i>	Opt/Man	Reference
BasicService	O	§ 5.3.2.8
SS-RegistrationStatus	O	§ 5.3.3.5
SS-ActivationStatus	O	§ 5.3.3.4
SEQUENCE OF SubscriptionOption	O	§ 5.3.3.8
ForwardedToNumber	O	§ 5.3.1.17
NoReplyConditionTime	O	§ 5.3.3.20

SS-Data ::= SEQUENCE {BasicService OPTIONAL,  
    SS-RegistrationStatus OPTIONAL,  
    SS-ActivationStatus OPTIONAL,  
    SEQUENCE OF SubscriptionOption OPTIONAL,  
    ForwardedToNumber OPTIONAL,  
    NoReplyConditionTime OPTIONAL}

#### 5.3.3.3 *SS-Code*

The SS-Code type is used to identify a supplementary service.

SS-Code		Length = 1	Tag = 9F <sub>16</sub> , 1F <sub>16</sub>
Contents	Meaning		
00000000	Calling number identification presentation		
00000001	Calling number identification restriction		
00000010	Called number identification presentation		
00000011	Called number identification restriction		
00000100	Malicious call identification		
00000101	Call forwarding unconditional		
00000110	Call forwarding on mobile subscriber busy		
00000111	Call forwarding on no reply		
00001000	Call forwarding on radio congestion		
00001001	Call forwarding on no paging response		
00001010	Call forwarding on deregistration		
00001011	Call waiting		
00001100	Completion of calls to busy subscribers		
00001101	Closed user group		
00001110	Advice of charge		
00001111	Freephone service		
00010000	Reverse charging		
00010001	Call hold		
00010010	Call transfer		
01010011	Three party service		
00010100	Conference calling		
00010101	Barring of all outgoing calls		
00010110	Barring of all outgoing international calls		
00010111	Barring of all OG international non-CEPT directed calls		
00011000	Barring of all OG international non-HPLMN directed calls		
00011001	Barring of all OG calls when outside HPLMN		
00011010	Barring of all incoming calls		
00011011	Barring of all IC calls when outside HPLMN		
00011100	Mobile access hunting		
00011101	User-to-user signalling		

SS-Code ::= [31] IMPLICIT INTEGER {  
 Calling number identification presentation (0),  
 Calling number identification restriction (1),  
 Called number identification presentation (2),  
 Called number identification restriction (3),  
 Malicious call identification (4),  
 Call forwarding unconditional (5),  
 Call forwarding on mobile subscriber busy (6),  
 Call forwarding on no reply (7),  
 Call forwarding on radio congestion (8),  
 Call forwarding on no paging response (9),  
 Call forwarding on deregistration (10),  
 Call waiting (11),  
 Completion of calls to busy subscribers (12),  
 Closed user group (13),  
 Advice of charge (14),  
 Freephone service (15),  
 Reverse charging (16),  
 Call hold (17),  
 Call transfer (18),  
 Three party service (19),  
 Conference calling (20),

Barring of all outgoing calls (21),  
 Barring of all outgoing international calls (22),  
 Barring of all OG international non-CEPT directed calls (23),  
 Barring of all OG international non-HPLMN directed calls (24),  
 Barring of all OG calls when outside HPLMN (25),  
 Barring of all incoming calls (26),  
 Barring of all IC calls when outside HPLMN (27),  
 Mobile access hunting (28),  
 User-to-user signalling (29)

#### 5.3.3.4 SS-ActivationStatus

The SS-ActivationStatus is the activation status of a supplementary service.

SS-ActivationStatus		Length = 1	Tag = 9F <sub>16</sub> , 20 <sub>16</sub>
Contents	Meaning		
00000000	Not active		
Any Other	Active		

SS-ActivationStatus ::= [32] IMPLICIT BOOLEAN

#### 5.3.3.5 SS-RegistrationStatus

The SS-RegistrationStatus indicates if the required data are registered for a supplementary service.

SS-RegistrationStatus		Length = 1	Tag = 9F <sub>16</sub> , 21 <sub>16</sub>
Contents	Meaning		
00000000	Not Registered		
Any Other	Registered		

SS-RegistrationStatus ::= [33] IMPLICIT BOOLEAN

#### 5.3.3.6 SS-Rest

This parameter type is used to indicate whether or not certain restriction applies to the subscription for a supplementary service.

SS-Rest		Length = 1	Tag = 9F <sub>16</sub> , 22 <sub>16</sub>
Contents	Meaning		
00000000	All PLMNs		
00000001	One or more PLMNs		
00000010	Regional		
00000011	Regional + all other PLMNs		

SS-Rest ::= [34] IMPLICIT INTEGER {All PLMNs(0),  
 One or more PLMNs (1),  
 Regional (2),  
 Regional plus other PLMNs (3)}

### 5.3.3.7 SS-Request

The SS-Request indicates the nature of a supplementary service request.

SS-Request		Length = 1	Tag = 9F <sub>16</sub> , 23 <sub>16</sub>
<i>Contents</i>	Meaning		
00000000	Registration		
00000001	Erasure		
00000010	Activation		
00000011	Deactivation		
00000100	Interrogation		
00000101	Invoke		

SS-Request ::= [35] IMPLICIT INTEGER {Registration (0),  
Erasure (1),  
Activation (2),  
Deactivation (3),  
Interrogation (4),  
Invoke (5)}

### 5.3.3.8 SubscriptionOption

This parameter type identifies an option attached to a supplementary service. All the possible options are not applicable to all the supplementary services.

SubscriptionOption ::= CHOICE{  
AllowableForwardedToNumber,  
CallWhichMayBeForwarded,  
NotificationToForwardingParty,  
NotificationToCallingParty,  
ForwardingSubscriberIdentification,  
Schedule,  
UserToUserService Indicator,  
CUG-options,  
MaximumConferenceesNumber,  
UseOfPassword,  
HuntGroupAccessSelectionOrder}

### 5.3.3.9 AllowableForwardedToNumbers

This subscription option is defined in CCITT Recommendation I.252.

AllowableForwardedToNumbers		Length = 1	Tag = 9F <sub>16</sub> , 24 <sub>16</sub>
<i>Contents</i>	Meaning		
00000000	All		
00000001	Intra-CUG-only		

AllowableForwardedToNumbers ::= [36] IMPLICIT INTEGER {all (0),  
intra-CUG only (1)}

### 5.3.3.10 CallWhichMayBeForwarded

This subscription option is defined in CCITT Recommendation I.252.



CallWhichMayBeForwarded		Length = 1	Tag = 9F <sub>16</sub> , 25 <sub>16</sub>
Contents	Meaning		
00000000	All		
00000001	Intra-CUG-Only		
00000010	From outside CUG Only		

CallWhichMayBeForwarded ::= [37] IMPLICIT INTEGER {All (0),  
Intra-CUG-Only (1),  
From-Outside-CUG-Only (2)}

#### 5.3.3.11 NotificationToForwardingParty

This subscription option is defined in CCITT Recommendation I.252.

NotificationToForwardingParty		Length = 1	Tag = 9F <sub>16</sub> , 26 <sub>16</sub>
Contents	Meaning		
00000000	No notification		
00000001	Notification with calling number identity		
00000010	Notification without calling number identity		

NotificationToForwardingParty ::= [38] IMPLICIT INTEGER {  
No notification (0),  
with calling number identity (1),  
without calling number identity (2)}

#### 5.3.3.12 NotificationToCallingParty

This subscription option is defined in CCITT Recommendation I.252.

NotificationToCallingParty		Length = 1	Tag = 9F <sub>16</sub> , 27 <sub>16</sub>
Contents	Meaning		
00000000	No notification		
00000001	Notification with forwarded-to number		
00000010	Notification without forwarded-to number		

NotificationToCallingParty ::= [39] IMPLICIT INTEGER {  
No notification (0),  
with forwarded-to number (1),  
without forwarded-to number (2)}

#### 5.3.3.13 ForwardingSubscriberIdentification

This subscription option is defined in CCITT Recommendation I.252.

ForwardingSubscriberIdentification		Length = 1	Tag = 9F <sub>16</sub> , 28 <sub>16</sub>
Contents	Meaning		
00000000	No identification		
Any Other	Identification		

ForwardingSubscriberIdentification ::= [40] IMPLICIT BOOLEAN

#### 5.3.3.14 Schedule

This subscription option is defined in CCITT Recommendation I.252.

Schedule	Length = 1	Tag = 9F <sub>16</sub> , 29 <sub>16</sub>
Contents	Meaning	
FFS		

Schedule ::= [41] FFS

#### 5.3.3.15 UserToUserServiceIndicator

This subscription option is defined in CCITT Recommendation I.257.

UserToUserServiceIndicator	Length = 1	Tag = 9F <sub>16</sub> , 2A <sub>16</sub>
Contents	Meaning	
00000001	Service 1	
00000010	Service 2	
00000011	Service 3	

UserToUserServiceIndicator ::= [42] IMPLICIT INTEGER {Service1 (1),  
Service2 (2),  
Service3 (3)}

#### 5.3.3.16 CUG-Options

This parameter indicates the subscription options related to a CUG. (See Recommendation I.255.)

CUG-Options		Length = 1	Tag = 9F <sub>16</sub> , 2B <sub>16</sub>
Contents	Meaning		
Internal structure does not follow X.409 encoding rules			

CUG-Options ::= [43] IMPLICIT OCTET-STRING

```
-- BIT 8-7 00
-- BIT 6-5 CUG-Facilities
    00 CUG only facilities
    01 GUG with outgoing access
    10 CUG with incoming access
    11 CUG with both incoming and outgoing access
-- BIT 4 preferential CUG indicator
    0 no preferential
    1 preferential CUG
-- BIT 3 barring of incoming calls within the CUG
    0 no barring
    1 barring
-- BIT 2 barring of outgoing calls within the CUG
    0 no barring
    1 barring
-- BIT 1 0
```

### 5.3.3.17 *MaximumConferencesNumber*

This subscription option is defined in CCITT Recommendation I.254.

MaximumConferencesNumber		Length = 1	Tag = 9F <sub>16</sub> , 2C <sub>16</sub>
Contents	Meaning		
An integer number not exceeding 10			

MaximumConferencesNumber ::= [44] IMPLICIT INTEGER

### 5.3.3.18 *UseOfPassword*

This subscription option is being defined in CCITT.

UseOfPassword		Length = 1	Tag = 9F <sub>16</sub> , 2D <sub>16</sub>
Contents	Meaning		
00000000	Not Allowed		
Any other	Allowed		

UseOfPassword ::= [45] IMPLICIT BOOLEAN

### 5.3.3.19 *HuntGroupAccessSelectionOrder*

This subscription option is defined in CCITT Recommendation I.252.

HuntGroupAccessSelectionOrder		Length =	Tag = 9F <sub>16</sub> , 2E <sub>16</sub>
Contents	Meaning		
FFS			

HuntGroupAccessSelectionOrder ::= [46] FFS

### 5.3.3.20 *NoReplyConditionTime*

This parameter specifies the no reply condition for call forwarding on no reply service.

NoReplyConditionTime		Length = 1	Tag = 9F <sub>16</sub> , 2F <sub>16</sub>
Contents	Meaning		
An integer number from 5 to 30			

NoReplyConditionTime ::= [47] IMPLICIT INTEGER {first(5), last(30)}

### 5.3.3.21 *CallBarringPassword*

The CallBarringPassword is a password used for call barring services when the subscription option UseOfPassword value is true.

CallBarringPassword		Length = 1	Tag = 9F <sub>16</sub> , 30 <sub>16</sub>
Contents	Meaning		
A printable string			

CallBarringPassword ::= [48] IMPLICIT PRINTABLE-STRING

#### 5.3.3.22 CUG-Interlock

A CUG-Interlock parameter is used to indicate the interlock code of a CUG, and as defined for ISDN.

CUG-Interlock		Length = 4	Tag = 9F <sub>16</sub> , 31 <sub>16</sub>
Contents	Meaning		
Defined in ISDN specification			

CUG-Interlock ::= [49] IMPLICIT OCTET-STRING

#### 5.3.3.23 CUG-Index

A CUG-Index parameter is used to indicate the index of a CUG, as defined for ISDN.

CUG-Index		Length = 1	Tag = 9F <sub>16</sub> , 32 <sub>16</sub>
Contents	Meaning		
Defined in ISDN specification			

CUG-Index ::= [50] IMPLICIT OCTET-STRING

#### 5.3.3.24 NumberOfConferenees

This parameter indicates the number of conferenees requested by the mobile subscriber.

NumberOfConferenees		Length = 1	Tag = 9F <sub>16</sub> , 33 <sub>16</sub>
Contents	Meaning		
An integer number from 1 to 10			

NumberOfConferenees ::= [51] IMPLICIT INTEGER {first (1), last (10)}

#### 5.3.3.25 InterrogationType

This parameter indicates the type of supplementary service interrogation requested by the mobile subscriber.

InterrogationType		Length = 1	Tag = 9F <sub>16</sub> , 34 <sub>16</sub>
Contents	Meaning		
00000000	Status check		
00000001	General data request		
00000010	Specific data request		
00000011	Data check		

InterrogationType ::= [52] IMPLICIT INTEGER {StatusCheck (0),  
GeneralDataRequest (1),  
SpecificDataRequest (2),  
DataCheck (3)}

#### 5.3.3.26 CUG-RejectCause

This parameter indicates a specific cause for a CUG-Reject ERROR.

CUG-RejectCause		Length = 1	Tag = 9F <sub>16</sub> , 35 <sub>16</sub>
Contents	Meaning		
00000000	IncomingCallBarred		
00000001	Non CUG Member		

CUG-RejectCause ::= [53] IMPLICIT INTEGER {Incoming call barred (0),  
Non CUG Member (1)}

#### 5.3.4 Call parameters

##### 5.3.4.1 CallReference

The CallReference is the reference allocated by the call control MSC.

CallReference		Length = 1	Tag = 9F <sub>16</sub> , 3C <sub>16</sub>
Contents	Meaning		
Unspecified queue number			

CallReference ::= [60] IMPLICIT INTEGER

##### 5.3.4.2 ChargeType

This parameter indicates the reason of the charging message.

ChargeType		Length = 1	Tag = 9F <sub>16</sub> , 3D <sub>16</sub>
Contents	Meaning		
00000000	Incoming call		
00000001	Incoming forwarded call		
00000010	Outgoing call		
00001000	Handling of supplementary service		

ChargeType ::= [61] IMPLICIT INTEGER {Incoming call (0),  
Incoming forwarded call (1),  
Outgoing call (2),  
SS-request (8)}

5.3.4.3 SS-ChargingInfo

This sequence contains all the parameters requested to charge a subscriber for supplementary service using.

SS-ChargingInfo	Length = 1	Tag = 30 <sub>16</sub>
Contents	Opt/Man	Reference
SS-Request	M	§ 5.3.3.7
SS-Code	M	§ 5.3.3.3
SS-Charge	M	§ 5.3.4.9

SS-ChargingInfo ::= SEQUENCE {  
                          SS-Request,  
                          SS-Code,  
                          SS-Charge}

5.3.4.4 CallDuration

The CallDuration is the duration of the call (in seconds).

CallDuration		Length = 3	Tag = 9F <sub>16</sub> , 3E <sub>16</sub>
Contents	Meaning		
Integer number			

CallDuration ::= [62] IMPLICIT INTEGER

5.3.4.5 CallDateTime

The CallDateTime indicates the date and time of the call termination, even when the call is only a supplementary service request.

Format FFS

CallDateTime tagged CONTEXT - SPECIFIC 63

5.3.4.6 ChargeUnit

This parameters indicates the unit attached to the charges.

ChargeUnit		Length = 1	Tag = 9F <sub>16</sub> , 40 <sub>16</sub>
Contents	Meaning		
FFS			

ChargeUnit ::= [64] IMPLICIT INTEGER

#### 5.3.4.7 *RadioCharge*

The *RadioCharge* is the charge for radio path using, expressed in the unit indicated by the *ChargingUnit* parameter.

RadioCharge		Length = 1	Tag = 9F <sub>16</sub> , 41 <sub>16</sub>
Contents	Meaning		
An integer number			

*RadioCharge* ::= [65] IMPLICIT INTEGER

#### 5.3.4.8 *NetworkCharge*

The *NetworkCharge* is the charge for network using, expressed in the unit indicated by the *ChargingUnit* parameter.

NetworkCharge		Length = 2	Tag = 9F <sub>16</sub> , 42 <sub>16</sub>
Contents	Meaning		
An integer number			

*NetworkCharge* ::= [66] IMPLICIT INTEGER

#### 5.3.4.9 *SS-Charge*

The *SS-Charge* is the charge for supplementary services using, expressed in the unit indicated by the *ChargingUnit* parameter.

SS-Charge		Length = 2	Tag = 02 <sub>16</sub>
Contents	Meaning		
An integer number			

*SS-Charge* ::= INTEGER

#### 5.3.4.10 *NumberOfForwarding*

This parameter indicates the number of times that a call has been forwarded.

NumberOfForwarding		Length = 1	Tag = 9F <sub>16</sub> , 43 <sub>16</sub>
Contents	Meaning		
An integer number from 1 to 5			

*NumberOfForwarding* ::= [67] IMPLICIT INTEGER {first(1), last(5)}

5.3.5 Radio parameters

5.3.5.1 ChannelId

This parameter type identifies a radio channel allocated to the mobile subscriber. It can refer to a DCCH or a TCH.

ChannelId	Length = V	Tag = BF <sub>16</sub> , 46 <sub>16</sub>
Contents	Opt/Man	Reference
BaseStationId	O	§ 5.3.1.7
ChannelType	M	§ 5.3.5.7
ChannelNumber	M	§ 5.3.5.5

ChannelId ::= [70] IMPLICIT SEQUENCE{BaseStationId OPTIONAL,  
ChannelType,  
ChannelNumber}

5.3.5.2 TargetChannelId

This parameter type identifies a radio channel on which a mobile station has to be handed over. It can refer to a TCH or a DCCH.

TargetChannelId		Length = V	Tag = 9F <sub>16</sub> , 47 <sub>16</sub>
Contents	Meaning		
Like ChannelId			

TargetChannelId ::= [71] IMPLICIT ChannelId

5.3.5.3 FrequencyHoppingParameters

FFS

Tagged CONTEXT-SPECIFIC 72

5.3.5.4 HandoverReference

This parameter is used to identify a Mobile subscriber when it turns on new channel during handover.

HandoverReference	Length = 1	Tag = 9F <sub>16</sub> , 49 <sub>16</sub>
Contents	Meaning	
Bit 8-6 encoded 000 Bit 5-1 encoded the handover reference		

HandoverReference ::= [73] IMPLICIT BIT-STRING



5.3.5.5 ChannelNumber

This parameter identifies a radio channel within a base station.

ChannelNumber		Length = 2	Tag = 02 <sub>16</sub>
Contents	Meaning		
An integer number fully encoded using two octets			

ChannelNumber ::= INTEGER

5.3.5.6 MeasurementValues

For further study.

5.3.5.7 ChannelType

A ChannelType parameter is used to discriminate dedicated control channels (DCCH) from traffic channels (TCH).

ChannelType	Length = 1	Tag = 02 <sub>16</sub>
Contents	Meaning	
00000000 00000001	TCH DCCH	

ChannelType ::= INTEGER {TCH(0),  
DCCH (1)}

5.3.6 Authentication Parameters

5.3.6.1 AuthenticationSet

This parameter contains a set of authentication parameters related to a subscriber. Generally several sets are transmitted.

AuthenticationSet	Length = I	Tag = BF <sub>16</sub> , 50 <sub>16</sub>
Contents	Opt/Man	Reference
Rand	M	§ 5.3.6.2
Sres	M	§ 5.3.6.3
K1	M	§ 5.3.6.4

AuthenticationSet ::= [80] IMPLICIT SEQUENCE {Rand,  
Sres,  
K1}

5.3.6.2 Rand

This is a random number used for authentication procedures.

Rand		Length = 16	Tag = 9F <sub>16</sub> , 51 <sub>16</sub>
Contents		Meaning	
A 128 bit string			

Rand ::= [81] IMPLICIT OCTET - STRING

#### 5.3.6.3 Sres

This parameter is a response to an authentication request.

Sres		Length = 4	Tag = 9F <sub>16</sub> , 52 <sub>16</sub>
Contents	Meaning		
A 32 bit string			

Sres ::= [82] IMPLICIT OCTET - STRING

#### 5.3.6.4 K1

A K1 parameter is a key used for signalling encryption.

K1		Length = 16	Tag = 9F <sub>16</sub> , 53 <sub>16</sub>
Contents		Meaning	
A 128 bit string			

K1 ::= [83] IMPLICIT OCTET - STRING

#### 5.3.6.5 Ki

The Ki parameter is the authentication key for a mobile subscriber.

Ki		Length = 16	Tag = 9F <sub>16</sub> , 54 <sub>16</sub>
Contents		Meaning	
A 128 bit string			

Ki ::= [84] IMPLICIT OCTET - STRING

#### 5.3.6.6 Ks

The Ks parameter is the session key used for user data encryption.

Ks		Length = 16	Tag = 9F <sub>16</sub> , 55 <sub>16</sub>
Contents		Meaning	
A 128 bit string			

Ks ::= [85] IMPLICIT OCTET - STRING

### 5.3.7 Others

#### 5.3.7.1 BSPDU

This parameter contains the information exchanged between a call control MSC and a mobile subscriber which has been handed over MSC-B. It fits into the user data field of the Network Service Data Units (NSDUs) of the BS/MSC interface.

BSPDU		Length = I	Tag = 9F <sub>16</sub> , 5A <sub>16</sub>
Contents	Meaning		
Information from/to BS encoded according to the BS/MSC protocol			

BSPDU ::= [90] IMPLICIT OCTET-STRING

- Internal structure does not follow
- X.409 encoding rules

#### 5.3.7.2 ASParameter\_Id

This parameter contains the number of tags related to any other MAP parameter. It is used to request a network entity for the relevant parameter value.

ASParameter_Id		Length = V	Tag = 9F <sub>16</sub> , 5B <sub>16</sub>
Contents	Meaning		
The tag value of a MAP parameter using full hexadecimal coding			

ASParameter\_Id ::= [91] IMPLICIT INTEGER {IMSI (1),  
TMSI (2),  
IMEI (3),  
  
AuthenticationSet (80),  
Ki (84)}

#### 5.3.7.3 NetworkResource

A NetworkResource parameter indicates a class of network entities.

NetworkResource		Length = 1	Tag = 9F <sub>16</sub> , 5C <sub>16</sub>
<i>Contents</i>	<i>Meaning</i>		
00000001	HLR		
00000010	VLR		
00000011	Previous VLR		
00000100	Controlling MSC		
00000101	VMSC		
00000110	EIR		
00100111	Radio SubSystem		
...	Spare		

NetworkResource ::= [92] IMPLICIT INTEGER {HLR (1),  
VLR (2),  
PREVIOUS-VLR (3),  
Controlling-MSC (4),  
VMSC(5),  
EIR (6),  
RadioSubSystem (7)}

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## **SECTION 2**

### **DIGITAL PLMN USER-NETWORK INTERFACES**

#### **Recommendation Q.1061**

#### **GENERAL ASPECTS AND PRINCIPLES RELATING TO DIGITAL PLMN ACCESS SIGNALLING REFERENCE POINTS**

##### **1 General**

1.1 Recommendation I.120 provides the conceptual principles on which an ISDN is based. The main feature of an ISDN is the support of a wide range of service capabilities, including voice and non-voice applications, in the same network by offering end-to-end digital connectivity.

1.2 The ISDN concept supports a wide range of service capabilities within the same network such as: packet-switched and circuit-switched connections up to and including 64 kbits/sec on a bearer (B) channel. A digital PLMN network supports the same wide range of service capabilities, including reliable end-to-end digital connectivity and contains specialized supporting functions, e.g. speech bit rate reduction processing. However, due to the limited resources associated with radio channels nominal circuit-switched connections may have to be limited to rates lower than 64 kbit/s (e.g. connections up to and including 16 kbits/sec).

1.3 The key element of service integration for a digital PLMN is the provision of a set of standard, multipurpose user network interfaces. These interfaces present a focal point for the development of digital PLMN components and configurations that result in PLMN ISDN-like terminal equipment and applications.

1.4 A digital PLMN is recognized by the service characteristics available through the user-network interfaces, rather than by its internal architecture, configuration and technology. This concept plays a key role in permitting user and network technologies and configurations to evolve separately.

The service definitions are provided in separate Recommendations.

1.5 The digital PLMN user-network interface point should provide:

- a) flexibility of user terminals with respect to digital PLMN network interconnection;
- b) flexibility of separate user terminal evolution and PLMN technology evolution;

- c) flexibility of definition and provisioning for PLMN basic bearer services, teleservices and supplementary services; and
- d) operation and maintenance capabilities.

## 1.6 *Interface applications*

Figure 1/Q.1061 shows some examples of digital PLMN interfaces. The following cases are identified:

- 1) access of individual digital PLMN terminals (i.e., hand-portable or vehicle-mounted terminals);
- 2) access of multiple digital PLMN terminal installation;
- 3) access of a mobile PABX or LAN;
- 4) dedicated service networks; and
- 5) land-line ISDN networks.

1.7 A number of digital PLMN signalling reference points are specified and any one of these reference points may be used as the user to network interface point. Figure 2/Q.1061 illustrates the major signalling reference points in a digital PLMN.

- a) Xm - TEM to mobility management reference point;
- b) Sm - mobility management to RF transmission management reference point; and
- c) Um - mobile station (MS) to base station (BS) reference point.

The description of the functional entities is given in § 2.

1.8 The MS-BS interface for the digital PLMN mobile station includes both the logical part of the communication between the MS and the BS, and the control and physical requirements of the radio channel.

It should be noted that the Um reference point is the traditional radio-based network interface and is very much RF technology dependent.

The detailed Um reference point will be specified in separate Recommendations.

## 2 **Functional entities between signalling reference points**

2.1 PLMN call control adaptation functions are those functions necessary to convert standard CCITT call control signalling into call control signalling appropriate in the digital PLMN environment. For example, some parameters of standard CCITT call control signalling messages need to be translated or some new parameters need to be added, such as IMSI, mobile serial number.

2.2 Mobility management functions are those functions necessary to support the mobility of the user terminal, such as informing the network of its present location, and managing user terminals during handover. In addition, because of the "open" connection via radio, some functions such as user authentication are included in this functional entity.

2.3 RF transmission management includes those functions associated with providing a radio connection to the BS based on cellular technology, such as selecting the channel coding, controlling transmitter power, seizing a channel, changing a channel, etc.

2.4 The relationship of these four functional entities is envisaged as of a nested nature and can be illustrated in Figure 3.Q.1061.

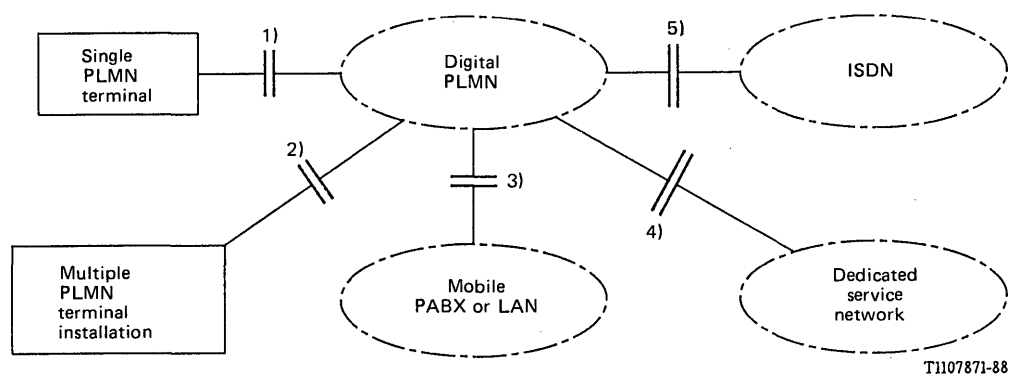


FIGURE 1/Q.1061

**Digital PLMN interfaces**

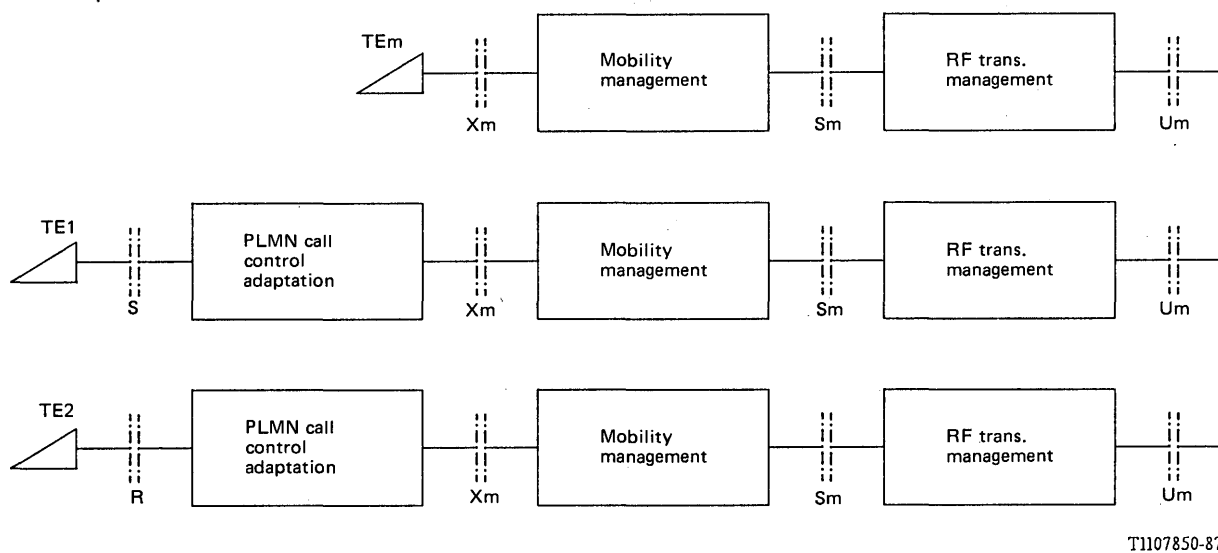


FIGURE 2/Q.1061

**Signalling reference points in a digital PLMN**



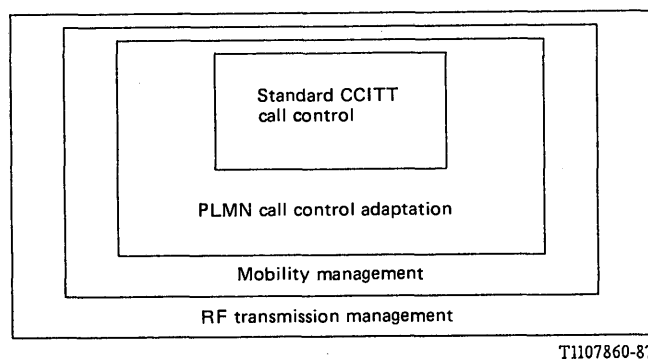


FIGURE 3/Q.1061

### Relationship between functional entities

#### 3 Signalling reference point characteristics

The PLMN signalling reference points are specified by a comprehensive set of characteristics, including:

- 1) channel structures and access capabilities;
- 2) signalling protocols; and
- 3) performance characteristics.

The definition of the digital PLMN interfaces at the signalling reference points follows the ISDN layered approach to the S and T interfaces according to the OSI reference model.

#### 4 Signalling reference point capabilities

In addition to the multi-service capability, a digital PLMN signalling reference point may allow for capabilities such as the following:

- 1) multidrop and other multiple terminal arrangements;
- 2) choice of information bit rate, switching mode, coding method, etc., on a call-by-call or other basis (e.g. semi-permanent or subscription time option); and
- 3) capability for compatibility checking in order to check whether calling or called terminals can communicate with each other.

#### 5 Relation of signalling reference points to the user network interface(s)

5.1 Signalling reference points are functional interfaces where the user-network interface(s) may be specified.

5.2 The choice of the user-network interface is based on service definitions in the relevant digital PLMN Recommendations.

## DIGITAL PLMN ACCESS SIGNALLING REFERENCE CONFIGURATION<sub>3</sub>

### 1 General

This Recommendation provides the access signalling reference configuration for the digital PLMN.

### 2 Definitions

#### 2.1 reference configurations

Reference configurations are conceptual configurations useful in identifying various possible physical access arrangements to the PLMN. Two concepts are useful in defining reference configurations: reference points and functional groups.

#### 2.2 functional groups

Functional groups are sets of functions which may be needed in PLMN access arrangements. In a particular access arrangement, a specific function in a functional group may or may not be present. Note that a specific function in a functional group may be performed in one or more pieces of equipment.

#### 2.3 reference points

Reference points are the conceptual points dividing functional groups. In a specific access arrangement a reference point may correspond to a physical interface (e.g., Um) between pieces of equipment or there may not be any physical interface corresponding to the reference point.

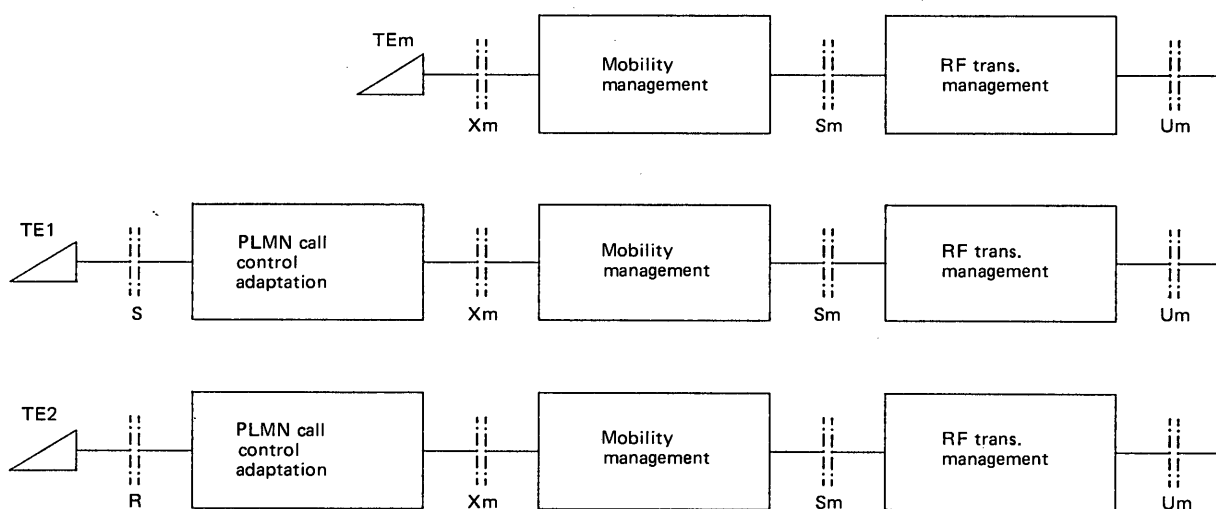
### 3 Signalling reference configurations

3.1 The reference configurations for the PLMN access define reference points and types of functions that can be provided. Figure 1/Q.1062 shows some of the signalling reference configurations.

3.2 The Sm signalling reference point is the demarcation between RF transmission management and the combined functions of call control and mobility management. Similarly, the Xm signalling reference point is the demarcation between call control and mobility management.

The mobile station - base station Recommendations apply to interfaces at reference point Um. These Recommendations are dependent on the pertaining RF transmission capabilities and will not be dealt with in this document.

At the reference point S, ISDN installations in accordance with I-Series Recommendations may be used. At reference point R, physical interfaces in accordance with other CCITT Recommendations (e.g. the X-Series interface Recommendations) may be used.



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FIGURE 1/Q.1062

### Signalling reference configurations

3.3 The list of functions for each functional group is given below.

3.3.1 The RF transmission management block may perform functions similar to those of NT1, or combined NT1 and NT2 of the CCITT I-Series Recommendations.

It may include functions for:

- radio transmission termination(s); and
- upper layer protocol capabilities for radio transmission channel management.

3.3.2 The mobility management block may perform functions associated with:

- location updating/registration;
- handover coordination; and
- upper layer protocol capabilities for coordination functions between terminal equipment and RF transmission management.

3.3.3 A TEm may perform functions similar to those of the TE of the I-Series Recommendations. It may include functions for:

- Layer 1 (physical) interface;
- Layer 2 (data link) protocol handling;
- Layer 3 protocol handling, and call control;
- maintenance functions; and
- switching and concentration (if applicable).

3.3.4 The PLMN call control adaptation block includes signalling related functions belonging to Layer 1 and higher layers of the Recommendation X.200 reference model that allows a TE1 or TE2 terminal to be served by the digital PLMN. It may also include rate adaptation and flow control.

#### 4 Physical realization of reference configurations

4.1 Mobile station implementations may require that the S, R, Xm and Sm reference points be combined into a single physical entity, as in the case of a fully integrated mobile equipment.

Figure 2/Q.1062 shows possible realizations and/or configurations of the reference points mentioned earlier. The examples shown are not exhaustive, but only serve to illustrate possible configurations of the respective functional blocks.

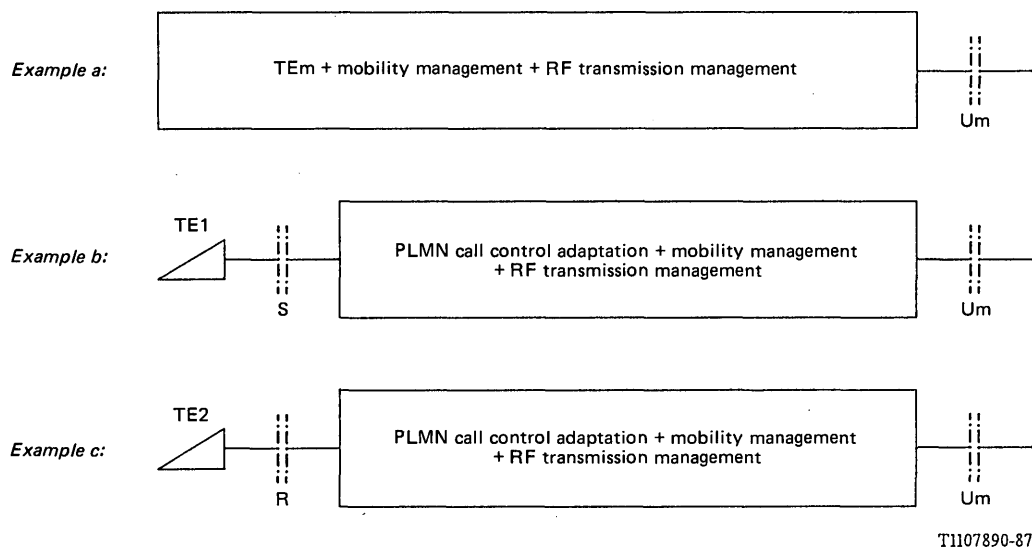


FIGURE 2/Q.1062

#### Examples of physical realizations

4.2 Example a) of Figure 2/Q.1062 illustrates a fully integrated equipment where the Xm and Sm reference points are logically identifiable, but physically do not exist.

4.3 Example b) of Figure 2/Q.1062 illustrates the S reference point with respect to a CCITT TE1. In this example the PLMN call control adaptation function is integrated with the remaining blocks as in a). As before the Xm and Sm reference points only bear logical significance.

4.4 Example c) of Figure 2/Q.1062 illustrates the same configuration as in b), but now a CCITT TE2 is provided at reference point R. The PLMN call control adaptation procedures are distinct with respect to the one identified in b), but nonetheless the functionality is the same as mentioned earlier.

## DIGITAL PLMN CHANNEL STRUCTURES AND ACCESS CAPABILITIES AT THE RADIO INTERFACE (U<sub>m</sub> REFERENCE POINT)

### 1 General

This Recommendation defines a limited set of channel types, access capabilities and channel configurations with respect to the U<sub>m</sub> reference point (i.e. the radio interface, see Recommendation Q.1062).

### 2 Definitions

A **channel** represents a specific portion of the information carrying capability of an interface.

2.1 Channels are classified by types according to common characteristics. Channel types appearing at the radio interface are identified in sections 3 and 4.

2.2 The **complete interface between a Base Station (BS) and its associated Mobile Stations (MS)** is defined by the interface structure at a given point in time. This interface may change over time.

2.3 An **MS channel configuration** is defined by the interface structure that the MS actually uses to transmit or receive information with respect to the BS at a given point in time. This interface structure may change over time.

2.4 An **access capability** defines possible access arrangements with respect to the number and type of channels that can be supported by an equipment. In this way an MS access capability is the set of possible channel configurations supported by the equipment. Similarly, the BS access capability may be considered to be a super-set with respect to the MS.

The access capability is thus a fixed attribute of an equipment.

### 3 Functional channel types

In this Recommendation the functional channel types are defined relative to the radio interface. These channels are used to carry information streams defined at the S<sub>m</sub> reference point, and which are to be specified in a separate Recommendation.

#### 3.1 *Traffic channel*

The Traffic Channel (TCH) is intended to carry a wide variety of user information streams. A distinguishing characteristic is that this channel does not carry signalling information for call control, MS management or RF transmission management. This signalling information is carried by other types of channels, e.g. control channels.

#### 3.2 *Control channel*

The Control Channel (CCH) consists of the Associated Control Channel (ACCH), Dedicated Control Channel (DCCH), Common Control Channel (CCCH), Broadcast Control Channel (BCCH) and User Packet Channel (UPCH). These channels carry signalling information for call control, MS management, RF transmission management, and other functions.

## **4 Channel usage for user information**

### **4.1 TCH**

Traffic channels are physical gross rate channels, accompanied with timing.

Traffic channels are intended to carry a wide variety of user information streams.

The provision of these information streams is to be defined in a separate Recommendation.

TCHSs may be used to provide access to a variety of communications modes within the PLMN and the networks it provides access to. Examples of these are:

- i) circuit switched communications; and
- ii) packet switched communications, supporting packet mode terminals.

In case i), the PLMN can provide either a transparent connection, or a connection specifically suited to a particular service, such as telephony.

In case ii), the traffic channel carries protocols at layers 2 and 3 according to Recommendation X.25, or other packet-mode standardized protocols.

## **5 Channel usage for control**

5.1 Control channels are used to provide active Mobile Stations and Base Stations a means of signalling communication across the radio interface.

5.2 A Mobile Station channel configuration contains one or more control channels. These control channels change depending on the required channel configuration. RF transmission management signalling functions ensure the continuity of communication when a change in the control channel type occurs.

Control channels are classified by control channel types, which have common characteristics.

Control channels are primarily intended to carry signalling information for call control, mobility management and RF transmission management.

5.3 In addition to signalling information, control channels may also carry user packet data (e.g. for Short Message Service).

### **5.4 Control channels**

#### **5.4.1 Broadcast control channel**

The BCCH provides the broadcast capability for a variety of information streams from Base Stations to Mobile Stations, including information necessary for the MS to register in the system (e.g. synchronization data or CCCH coordinates).

The notion of a BCCH is defined for applications where the CCCH is insufficient in capacity in light of signalling traffic, or where only unidirectional communication to an MS is required.

#### **5.4.2 Common control channel**

A CCCH is a point-to-multipoint, bidirectional control channel. A CCCH is primarily intended to support signalling information for call control, mobility management and RF transmission management.

A CCCH uses a layered protocol to be defined in a separate Recommendation. In particular the CCCH is a common resource available to more than one MS within a specific geographic area. In this way the CCCH is managed and allocated based on specific random access techniques.

#### 5.4.3 *User packet channel*

A UPCH is a point-to-multipoint, bidirectional control channel. A UPCH is primarily intended to support user packet data.

A UPCH uses a layered protocol to be defined in a separate Recommendation. In particular, the UPCH is a common resource available to more than one MS within a specific geographic area. In this way the UPCH is managed and allocated based on specific random access techniques.

#### 5.4.4 *Associated control channel*

An ACCH is a point-to-point, bidirectional control channel that supports both signalling and user packet data. The ACCH is always associated with the TCH, and provides for call control mobility management and RF transmission management signalling. The ACCH uses a layered protocol to be defined in a separate Recommendation.

#### 5.4.5 *Dedicated control channel*

A DCCH is a point-to-point, bidirectional control channel that supports both signalling and user packet data. The DCCH is not associated with an TCH. The DCCH uses a layered protocol to be defined in a separate Recommendation.

#### 5.4.6 *Sets of functional channels*

##### 5.4.6.1 *Common access channels*

The functional channels defined in §§ 5.4.1, 5.4.2 and 5.4.3 are classified as Common Access Channels (CAC).

##### 5.4.6.2 *User specific channels*

The functional channels described in §§ 5.4.4 and 5.4.5 are classified as user specific channels.

### 6 **Base station access capability**

The base station access capability provides the means to describe the actual BS access arrangement (i.e. the type and functional groups of channels supported by the BS).

6.1 The BS access capability is a combination of functional channels defined in § 5.4. Each group operates independently.

6.2 For example a BS access capability may consist of the following combination:

One BCCH; n1 (CCCH), n2 (UPCH), n3 (DCCH) and n4 (TCH + ACCH).

Specific access capabilities are an area for further study.

### 7 **Mobile station access capability**

The mobile station access capability provides the means to describe the actual MS access arrangement (i.e. the type and functional groups of channels supported by the MS).

7.1 The MS access capability is defined by a combination of functional channels defined in § 5.4.

7.2 The access capability defined for a mobile station at a minimum consists of a BCCH and/or a CCCH. In addition a MS access capability may include a UPCH and/or a DCCH and/or a TCH + ACCH.

### 8 **Channel configurations**

8.1 At any point in time an MS accesses a unique physical set of channels that are available on its radio interface. Examples of the channel configuration are identified below. The actual combination is dependent on the physical BS configuration.

8.2 Possible channel configurations accessible by an MS at any one point in time are as follows:

- i) BCCH
- ii) CCCH
- iii) UPCH
- iv) DCCH
- v) TCH + ACCH

Configuration i) is defined for the state in which a unique physical channel is not allocated to an MS and a unidirectional communication is provided (i.e., upon power-on or after extended interruption of the physical connection due to poor propagation conditions).

Configuration ii) is defined for the state in which a unique physical channel is not allocated to an MS, the MS is not idle and a bidirectional communication is required.

Configuration iii) is defined for the state in which a unique physical channel is not allocated to an MS but the MS may support user packet data on the common physical channels.

Configuration iv) is defined for the state in which a unique physical channel is allocated to an MS and a dedicated control channel is provided.

Configuration v) is defined for the state in which a unique physical channel is allocated to an MS and a traffic channel and an associated control channel are provided.

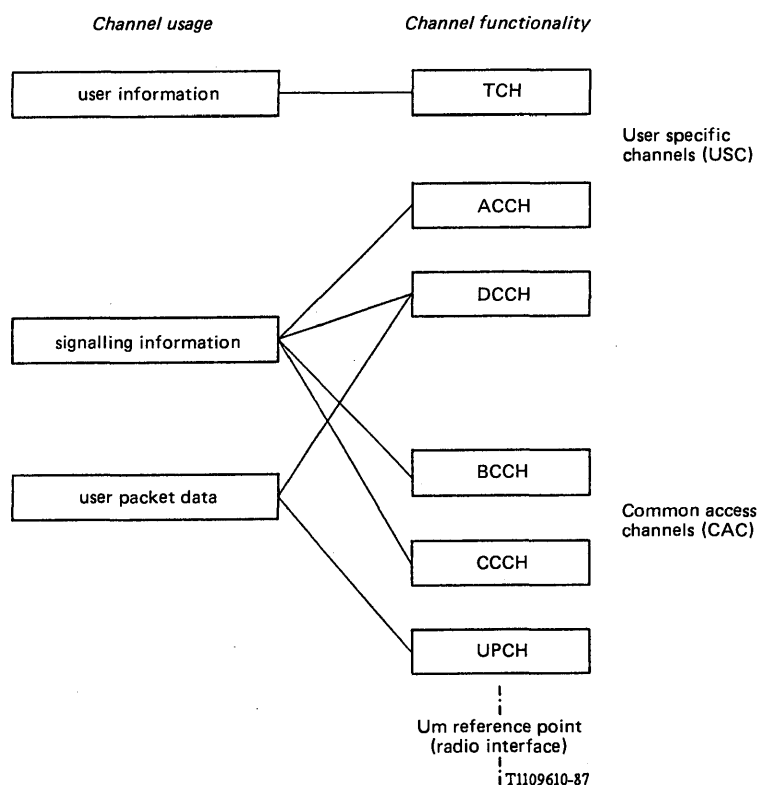


FIGURE 1/Q.1063

Channel types



