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## Digital cellular telecommunications system; Call Forwarding (CF) supplementary services - Stage 2 (GSM 03.82)

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## Contents

Foreword .....		5
0	Scope .....	7
	0.1 Normative references .....	7
	0.2 Abbreviations .....	7
	0.3 The forwarded-to number .....	7
	0.4 Cross phase compatibility .....	7
1	Call forwarding unconditional (CFU) .....	8
	1.1 Handling of call forwarding unconditional .....	8
	1.1.1 Registration .....	8
	1.1.2 Erasure .....	11
	1.1.3 Activation .....	13
	1.1.4 Deactivation .....	15
	1.1.5 Interrogation .....	17
	1.2 Functions and information flows .....	17
	1.3 Information stored in the HLR .....	20
	1.4 State transition model .....	21
	1.5 Transfer of information from HLR to VLR .....	21
	1.6 Information stored in the VLR .....	22
	1.7 Handover .....	22
	1.8 Cross phase compatibility .....	22
	1.8.1 MS, MSC, VLR or HLR only support Phase 1 control of SS by the subscriber .....	22
	1.8.2 HLR only supports Phase 1 updating of subscriber information .....	22
	1.8.3 VLR only supports Phase 1 updating of subscriber information .....	22
	1.8.4 GMSC only supports Phase 1 call handling .....	22
2	Call forwarding on mobile subscriber busy .....	23
	2.1 Handling of call forwarding on mobile subscriber busy .....	23
	2.1.1 Registration .....	23
	2.1.2 Erasure .....	25
	2.1.3 Activation .....	27
	2.1.4 Deactivation .....	29
	2.1.5 Interrogation .....	31
	2.2 Functions and information flows .....	31
	2.3 Information stored in the HLR .....	37
	2.4 State transition model .....	38
	2.5 Transfer of information from HLR to VLR .....	38
	2.6 Information stored in the VLR .....	39
	2.7 Handover .....	39
	2.8 Cross phase compatibility .....	39
	2.8.1 MS, MSC, VLR or HLR only support Phase 1 control of SS by the subscriber .....	39
	2.8.2 HLR only supports Phase 1 updating of subscriber information .....	39
	2.8.3 VLR only supports Phase 1 updating of subscriber information .....	39
	2.8.4 VLR only supports Phase 1 call handling .....	39
3	Call forwarding on no reply .....	40
	3.1 Handling of call forwarding on no reply .....	40
	3.1.1 Registration .....	40
	3.1.2 Erasure .....	42
	3.1.3 Activation .....	44
	3.1.4 Deactivation .....	46

3.1.5	Interrogation.....	48
3.2	Functions and information flows .....	48
3.3	Information stored in the HLR .....	52
3.4	State transition model .....	53
3.5	Transfer of information from HLR to VLR.....	53
3.6	Information stored in the VLR .....	54
3.7	Handover .....	54
3.8	Cross phase compatibility.....	54
3.8.1	MS, MSC, VLR or HLR only support Phase 1 control of SS by the subscriber .....	54
3.8.2	HLR only supports Phase 1 updating of subscriber information .....	54
3.8.3	VLR only supports Phase 1 updating of subscriber information .....	54
3.8.4	VLR only supports Phase 1 call handling.....	54
4	Call forwarding on mobile subscriber not reachable .....	55
4.1	Handling of call forwarding on mobile subscriber not reachable.....	55
4.1.1	Registration.....	55
4.1.2	Erasure.....	57
4.1.3	Activation .....	59
4.1.4	Deactivation .....	61
4.1.5	Interrogation.....	63
4.2	Functions and information flows .....	64
4.2.1	Call re-routed from VLR .....	64
4.2.2	Call re-routed from HLR .....	64
4.3	Information stored in the HLR .....	76
4.4	State transition model .....	77
4.5	Transfer of information from HLR to VLR.....	77
4.6	Information stored in the VLR .....	78
4.7	Handover .....	78
4.8	Cross phase compatibility.....	78
4.8.1	MS, MSC, VLR or HLR only support Phase 1 control of SS by the subscriber .....	78
4.8.2	HLR only supports Phase 1 updating of subscriber information .....	78
4.8.3	VLR only supports Phase 1 updating of subscriber information .....	78
4.8.4	GMSC only supports Phase 1 call handling .....	78
4.8.5	VLR only supports Phase 1 call handling.....	78
	History.....	79

## Foreword

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

This GTS defines the stage 2 of the Call Forwarding (CF) supplementary services for the Digital cellular telecommunications system.

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

Version 5.x.y

where:

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

The specification from which this GTS has been derived was originally based on CEPT documentation, hence the presentation of this GTS may not be entirely in accordance with the ETSI/PNE rules.

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## 0 Scope

This Global System for Mobile communications Technical Specification (GTS) gives the stage 2 description of the call forwarding supplementary services.

The group of supplementary services call offering supplementary services is divided into 4 different supplementary services:

- Call forwarding unconditional (CFU) (clause 1);
- Call forwarding on mobile subscriber busy (CFB) (clause 2);
- Call forwarding on no reply (CFNRy) (clause 3);
- Call forwarding on mobile subscriber not reachable (CFNRc) (clause 4).

### 0.1 Normative references

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

- [1] GSM 01.04 (ETR 350): "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".
- [2] GSM 02.04 (ETS 300 918): "Digital cellular telecommunications system (Phase 2+); General on supplementary services".
- [3] GSM 02.82: "Digital cellular telecommunications system; Call Forwarding (CF) Supplementary Services - Stage 1".
- [3] GSM 03.11 (ETS 300 928): "Digital cellular telecommunications system; Technical realization of supplementary services".
- [4] GSM 03.15: "Digital cellular telecommunications system (Phase 2+); Technical realization of operator determined barring".

### 0.2 Abbreviations

Abbreviations used in this GTS are listed in GSM 01.04.

### 0.3 The forwarded-to number

As indicated in GSM 02.82 the forwarded-to numbers are stored in the international format. The transfer from the HLR to other network entities and storage in the VLR shall also be in the international format.

### 0.4 Cross phase compatibility

For the following supplementary services, a number of changes exist between this GTS and the Phase 1 specification:

- Call forwarding unconditional;
- Call forwarding on mobile subscriber busy;
- Call forwarding on no reply;

- Call forwarding on mobile subscriber not reachable.

The main body of this GTS assumes that all network entities comply with this version of the service. In each case an additional subclause (subclause x.6) defines the additional requirements for when one or more network entities or the MS complies with the Phase 1 specifications for the supplementary service procedures.

## **1 Call forwarding unconditional (CFU)**

### **1.1 Handling of call forwarding unconditional**

#### **1.1.1 Registration**

At the beginning of registration subscription to the basic service, provision of the supplementary service and sufficiency of registration information has to be checked (see figure 1.2).

The following information has to be registered in the network:

- 1) the forwarded-to number (possibly including a sub-address);
- 2) information as to whether all calls or all calls of a specific basic service group should be forwarded.

#### **The basic service group code**

If the registration request received by the HLR does not contain any basic service group code, the registration shall be performed for all subscribed basic service groups for which CFU is provided (see figure 1.2).

#### **The forwarded-to number**

If the forwarded-to number is a number in the HPLMN country, it may be entered by the served mobile subscriber in three different formats, independent of his actual location, according to the schemes:

- 1) national (significant) number;
- 2) (trunk) prefix plus national (significant) number;
- 3) international prefix, country code, national (significant) number.

The received number may have to be converted to an international number before further processing (see figure 1.2).

The network may also validate the forwarded-to number before accepting the call forwarding registration request.

#### **Supplementary Service interaction**

Possible interaction situations between CFU and other call forwarding and barring supplementary services must then be checked. This is described in figure 1.2. Also see technical specifications GSM 02.04 and 02.82. For interaction between CFU and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

#### **Notifications to the subscriber**

When the mobile subscriber registers CFU, the network shall attempt to register and activate the service. The network will return notification of acceptance of the request. This notification will include the forwarded-to number and possibly the basic service group code to which CFU is registered.



If the system cannot accept a registration request, the network sends a notification that CFU registration was not successful to the served mobile subscriber.

The information flow for registration of CFU is shown in figure 1.1.

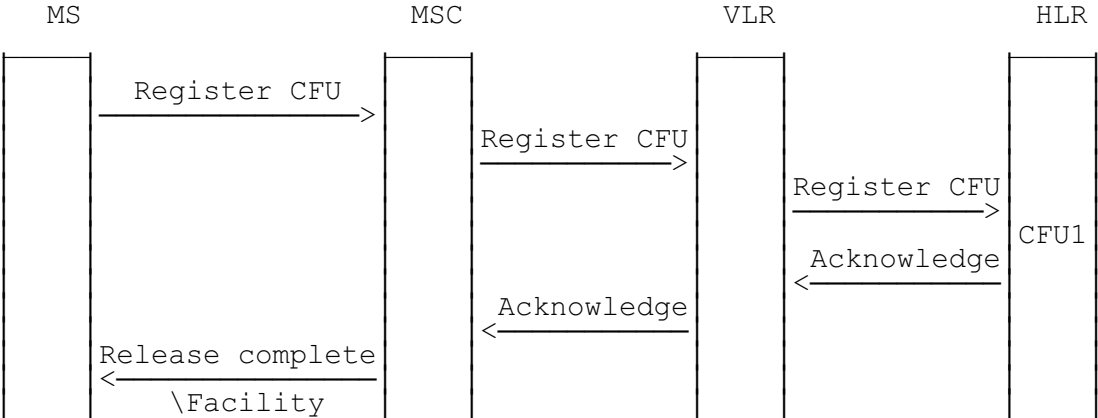


Figure 1.1: Registration of call forwarding unconditional

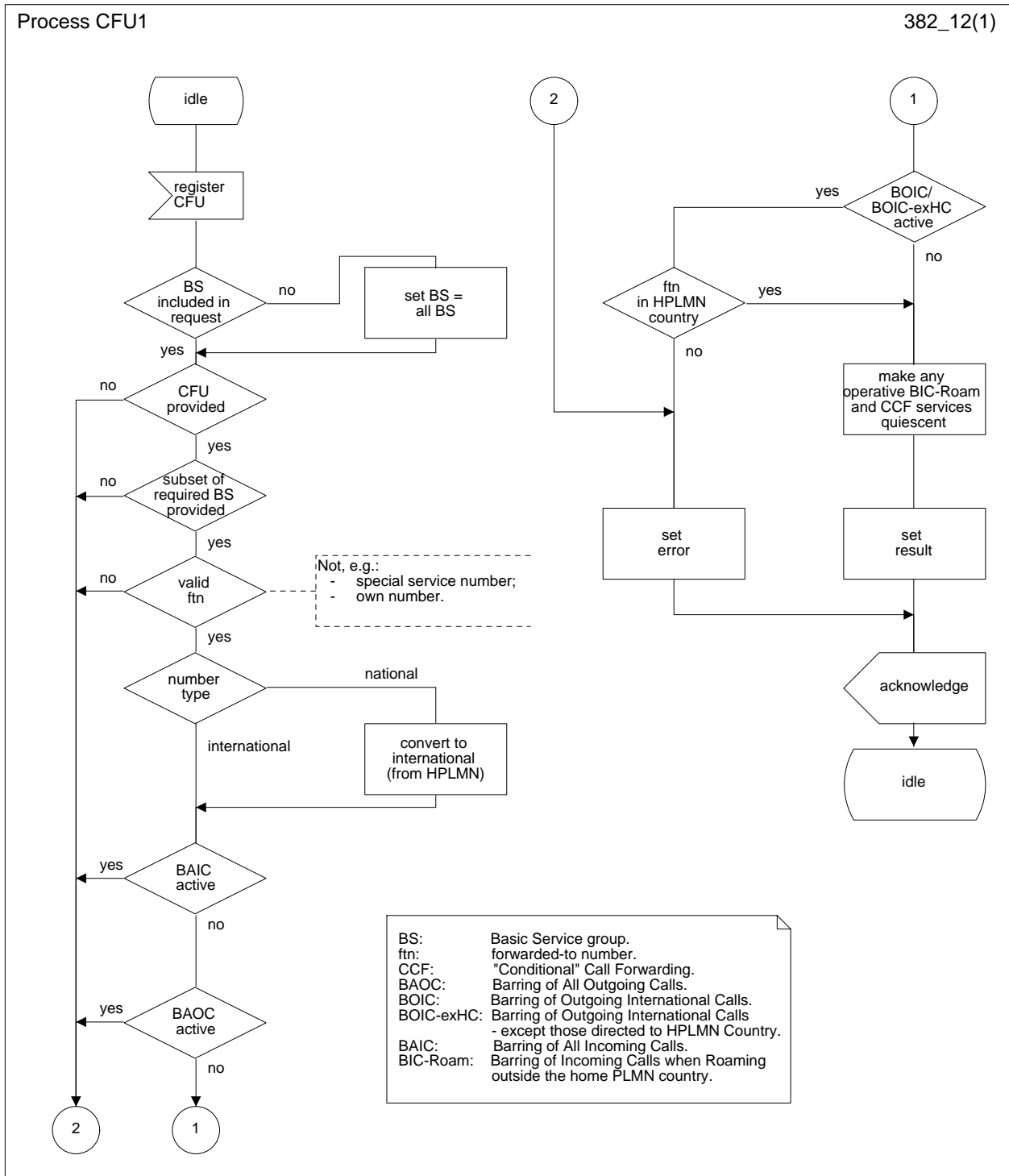


Figure 1.2: CFU1 Call forwarding unconditional registration process

**1.1.2 Erasure**

A previous registration can be erased in either of the following three ways:

- the subscriber can specifically erase a previous registration (to a basic service group) with an appropriate control procedure;
- the subscriber can register information for CFU (to a basic service group), thus causing previous registrations of CFU to be overridden (in the network this shall be handled as an erasure immediately followed by a registration);
- all information is erased as a result of withdrawal of the supplementary service (administrative handling).

**The basic service group code**

If the erasure request received by the HLR does not contain any basic service group code, the erasure request applies for all basic service groups for which CFU is registered (see figure 1.4).

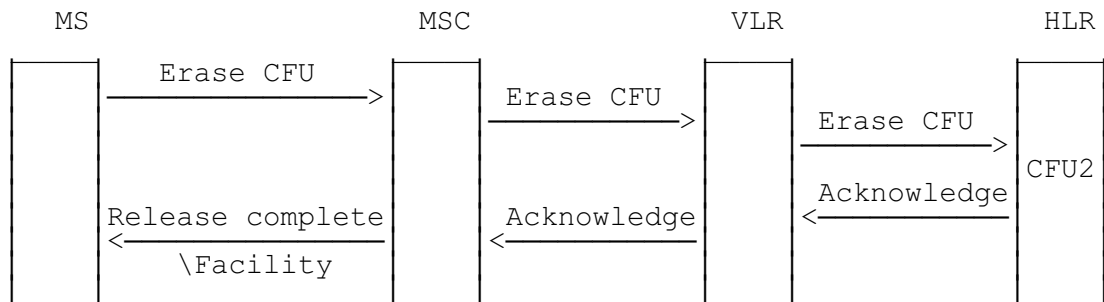
**Supplementary Service interaction**

Possible interaction situations between CFU and other supplementary services must then be checked. This is shown in figure 1.4. Also see technical specifications GSM 02.04 and 02.82. For interaction between CFU and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

**Notifications to the subscriber**

When the mobile subscriber erases CFU, the network shall attempt to erase (and thus deactivate) the service. The network shall send an indication of acceptance or rejection of the erasure request to the served mobile station.

The information flow for erasure of CFU is shown in figure 1.3.



**Figure 1.3: Erasure of call forwarding unconditional**

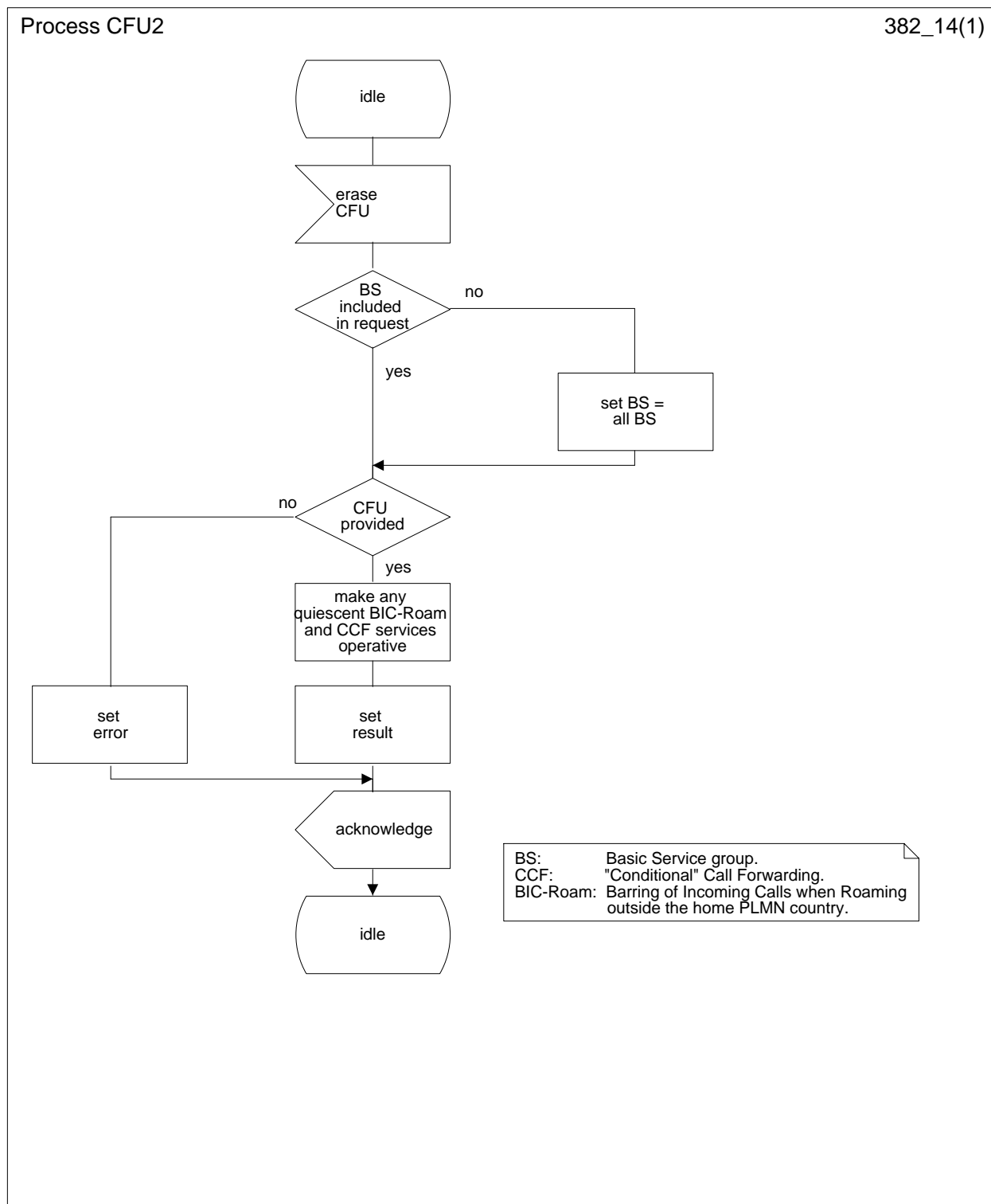


Figure 1.4: CFU2 Call forwarding unconditional erasure process

**1.1.3 Activation**

The network initially checks subscription to the basic service and registration status of the supplementary service (see figure 1.6).

Possible interaction situations between CFU and other supplementary services must then be checked. The SDL diagrams in figure 1.6 shows the function to be performed in the HLR in order to deal with the interactions between CFU and the call restriction and conditional call forwarding services. Also see GSM 02.04 and 02.82. For interaction between CFU and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

**The Basic Service Group Code**

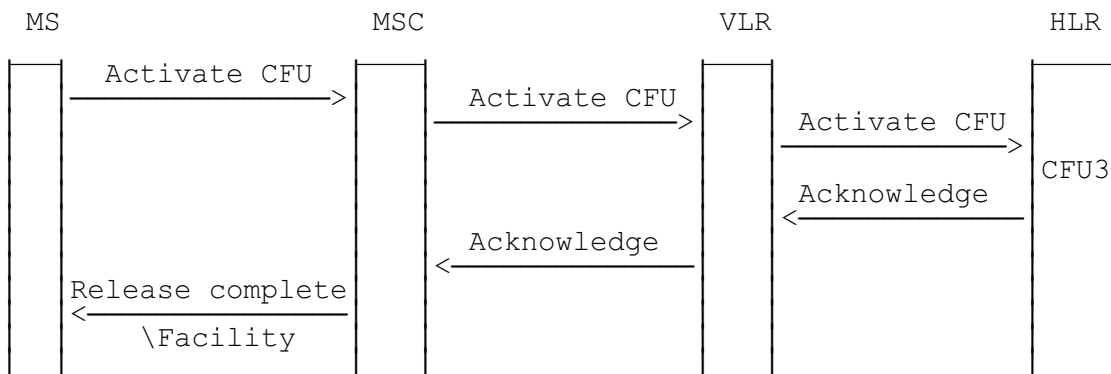
If the activation request received by the HLR does not contain any basic service group code, the activation request shall apply to all subscribed basic service groups against which a CFU forwarded-to number is registered. If a forwarded-to number is not registered against even a subset of the required basic service group, the request will be rejected.

Note that according to GSM 02.04, a request for activation shall still be accepted although the CFU supplementary service was already active for all basic service groups.

**Notification to the subscriber**

The network will return notification of acceptance, partial acceptance or rejection of the request to the mobile station.

The information flow for activation of CFU is shown in figure 1.5.



**Figure 1.5: Activation of call forwarding unconditional**

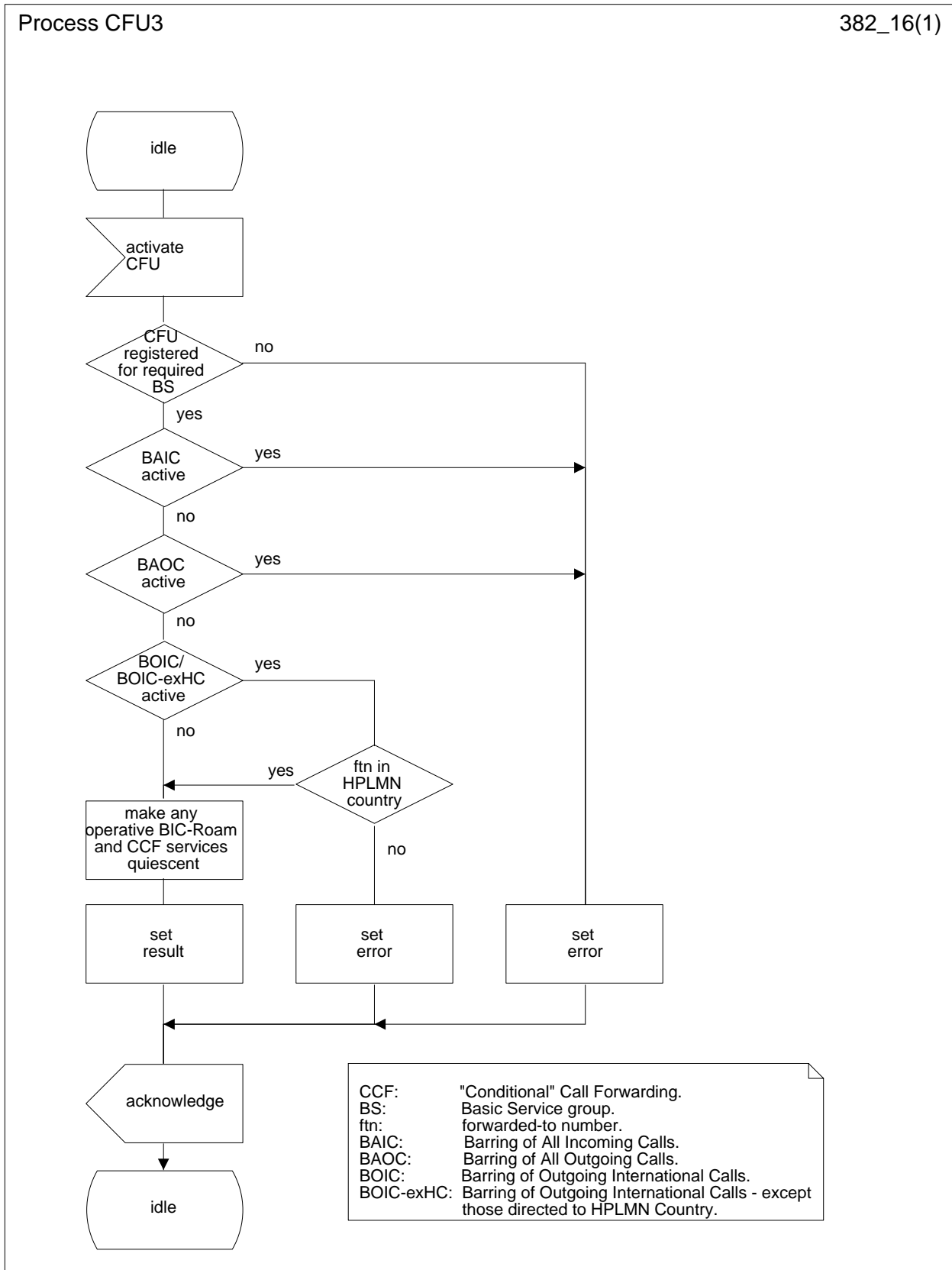


Figure 1.6: CFU3 Call forwarding unconditional activation process

### 1.1.4 Deactivation

The previous activation can be deactivated in either of the following three ways:

- the subscriber can specifically deactivate a previous activation (to a basic service group) with an appropriate control procedure;
- the subscriber can register information for CFU (to a basic service group), thus causing previous registrations and activations of CFU to be overridden (this shall be handled in the same way as an erasure (implying deactivation) immediately followed by a registration (implying activation));
- the service is deactivated as a result of withdrawal of the supplementary service (administrative handling).

Possible interaction situations between CFU and other supplementary services must be checked. The SDL diagram in figure 1.8 shows the function to be performed in the HLR in order to deal with the possible interactions between CFU and the conditional call forwarding services.

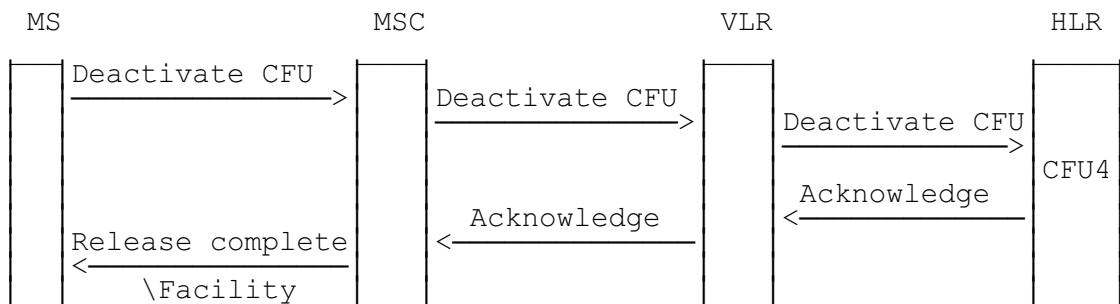
#### The Basic Service Group Code

The CFU deactivation request may specify a basic service group for which deactivation is required. If the deactivation request received by the HLR does not contain any basic service group code, the deactivation request shall apply to all basic services for which CFU is active (see figure 1.8).

If the deactivation request received by the HLR contains a basic service group code, only information related to the specified basic service group(s) is affected. Note that according to GSM 02.04, a request for deactivation shall still be accepted even if the CFU supplementary service was already deactive for all basic service groups.

The user shall receive a notification of acceptance or rejection of the CFU deactivation request.

The information flow for deactivation of call forwarding unconditional is shown in figure 1.7.



**Figure 1.7: Deactivation of call forwarding unconditional**

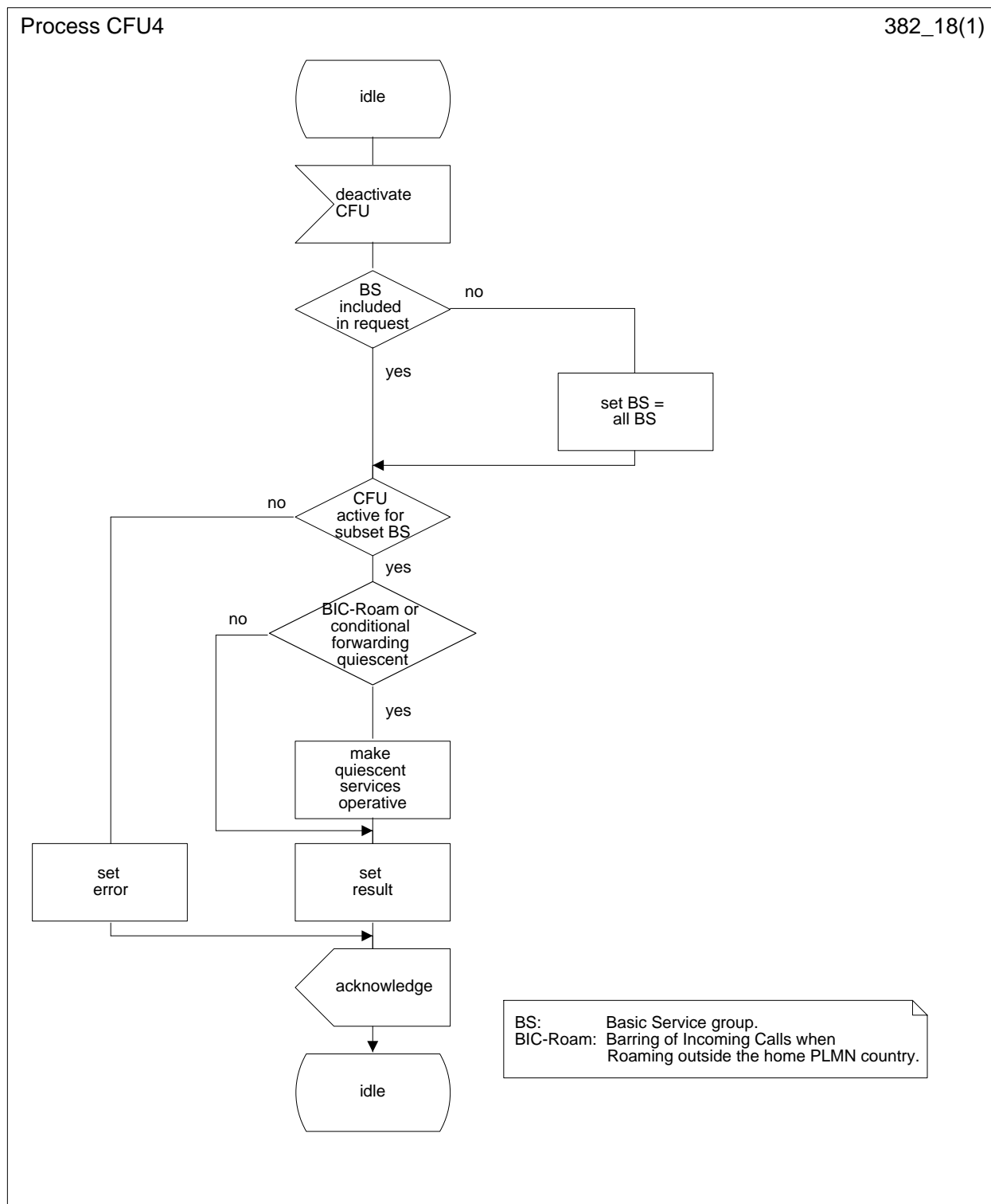


Figure 1.8: CFU4 Call forwarding unconditional deactivation process



1.1.5 Interrogation

Data request

The data request procedure enables the mobile subscriber to obtain information about the data stored in the PLMN. Interrogation of CFU is handled by the HLR which returns the required information or error to the MS (see figure 1.9).

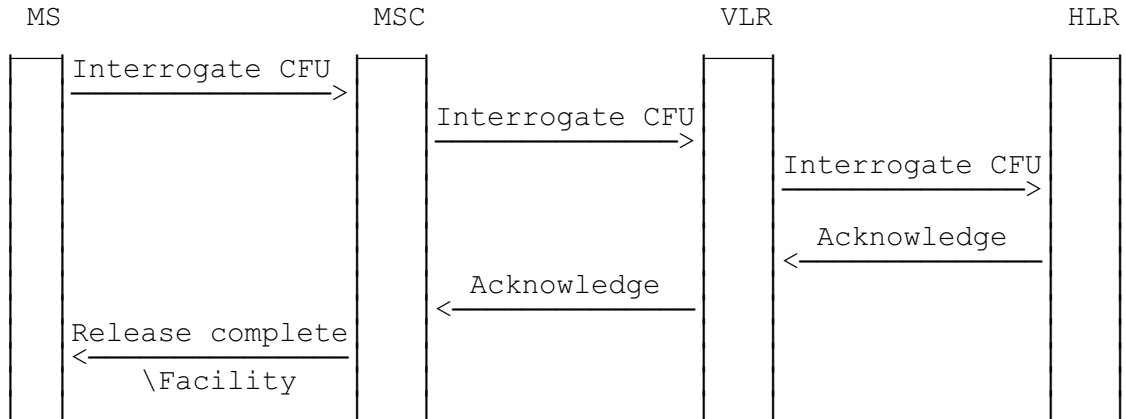


Figure 1.9: Interrogation of call forwarding unconditional

1.2 Functions and information flows

The following Mobile Additional Function has been identified for the PLMN:

MAF007

Call forwarding unconditional authorizations examination  
 The ability of a PLMN component to determine the authorizations relating to CFU.  
 See figure 1.10.  
 Location: HLR.

The information flow for call forwarding unconditional is shown in figure 1.11.

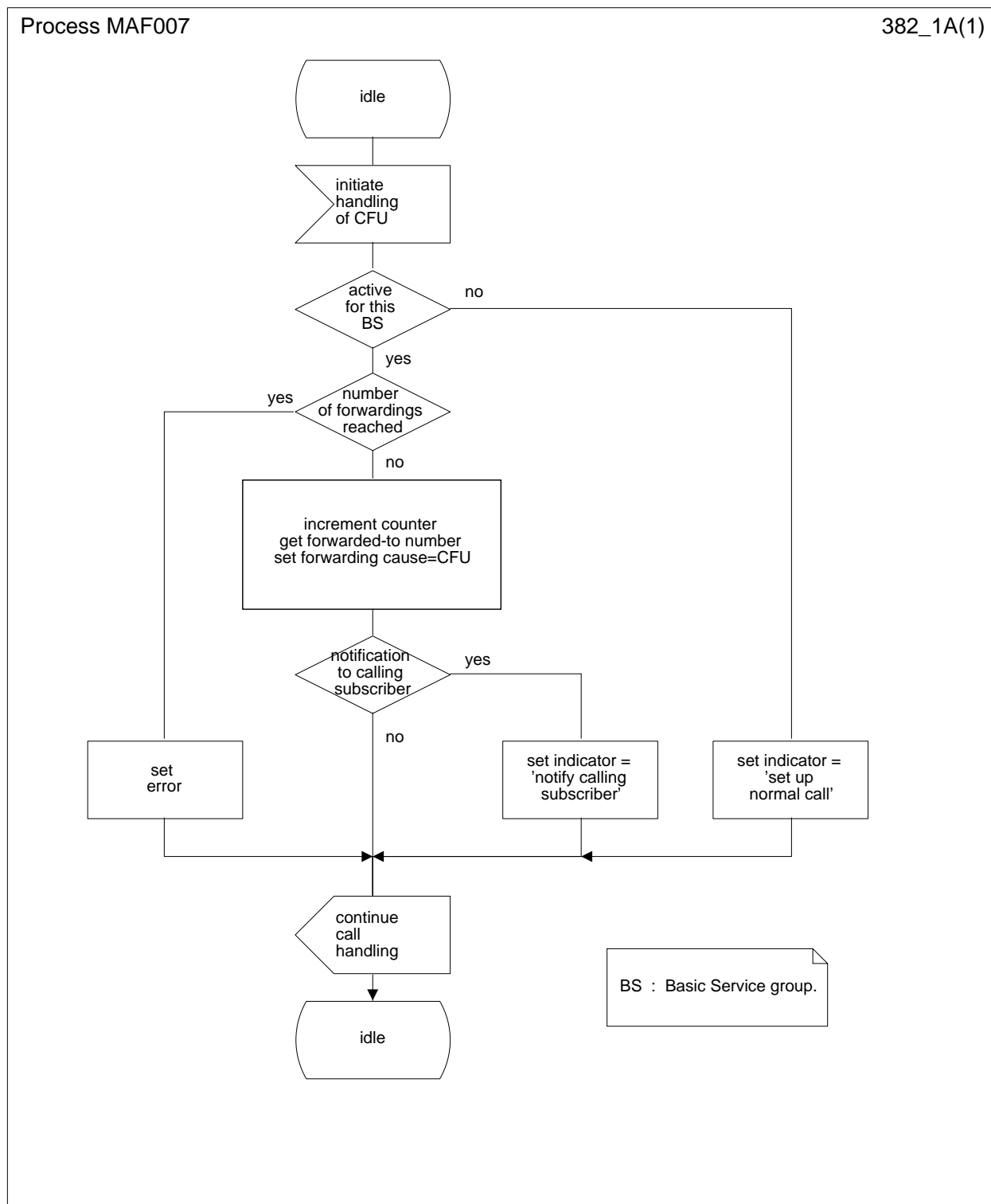
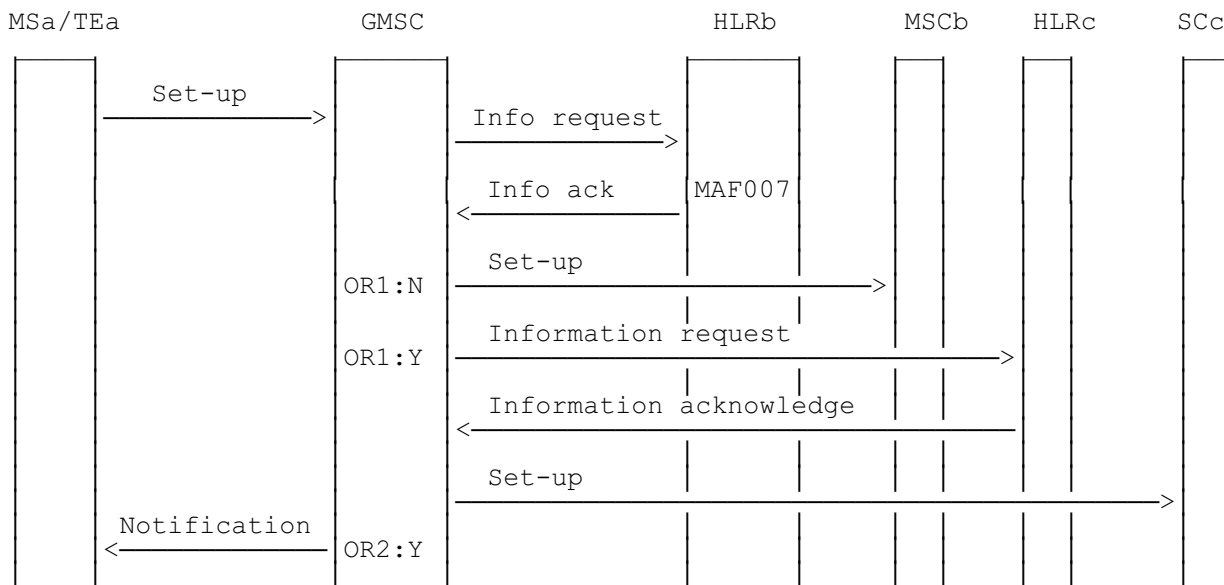
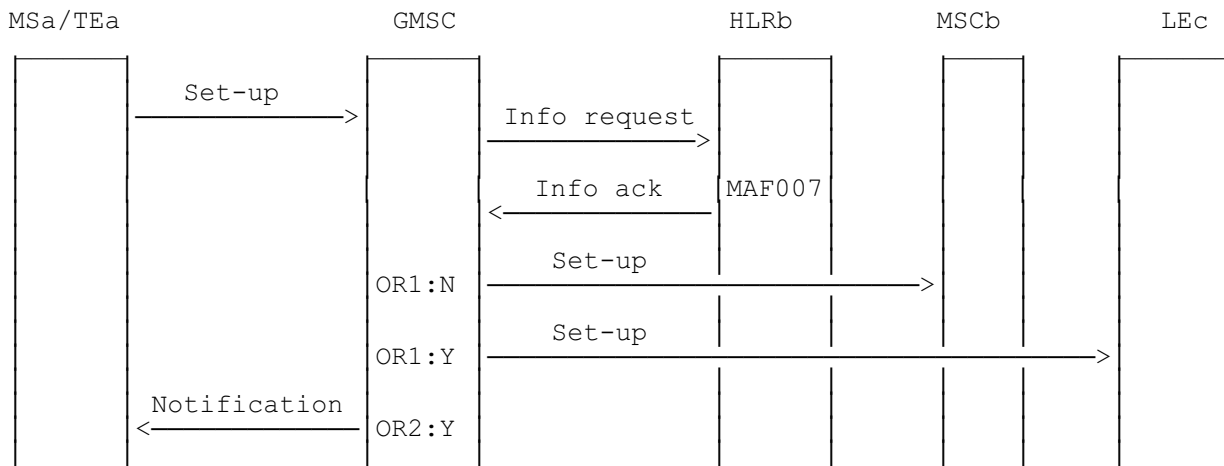


Figure 1.10: MAF007 Call forwarding unconditional authorizations examination (HLR)



NOTE: info: information Y: Yes  
 req: request N: No  
 ack: acknowledge  
 OR1: Forwarding requested  
 OR2: Notification to calling subscriber required

Figure 1.11: Information flow for call forwarding unconditional

### 1.3 Information stored in the HLR

The following logical states are applicable for CFU (refer to GSM 03.11 for an explanation of the notation):

<b>Provisioning State</b>	<b>Registration State</b>	<b>Activation State</b>	<b>HLR Induction State</b>
(Not Provisioned,	Not Registered,	Not Active,	Not Induced)
(Provisioned,	Not Registered,	Not Active,	Not Induced)
(Provisioned,	Registered,	Not Active,	Not Induced)
(Provisioned,	Registered,	Active and Quiescent,	Not Induced)
(Provisioned,	Registered,	Active and Operative,	Not Induced)

The registration and activation state may be different for each applicable elementary basic service group.

The provisioning state shall be on a per subscriber basis, and hence the same for all basic service groups.

The HLR shall store:

- the state of CFU (which shall be one of the valid states listed above) for each applicable elementary basic service group;
- the subscription option "notification to the calling party" on a per subscriber basis;  
This subscription option takes one of the following values:
  - no notification;
  - notification.
- the registration parameter "forwarded-to number" (possibly including a forwarded-to sub-address) for each applicable elementary basic service group.

Note that the value "Active and Quiescent" of the activation state is required in case of interaction with Operator Determined Barring (see GSM 03.15).

## 1.4 State transition model

The following figure shows the successful cases of transition between the applicable logical states of CFU. The state changes are either caused by actions of the service provider, the mobile user or the network.

Note that error cases are not shown in the diagram as they normally do not cause a state change. Additionally, some successful requests may not cause a state change. Hence, they are not shown in the diagram.

The diagram only shows operations on an elementary basic service group.

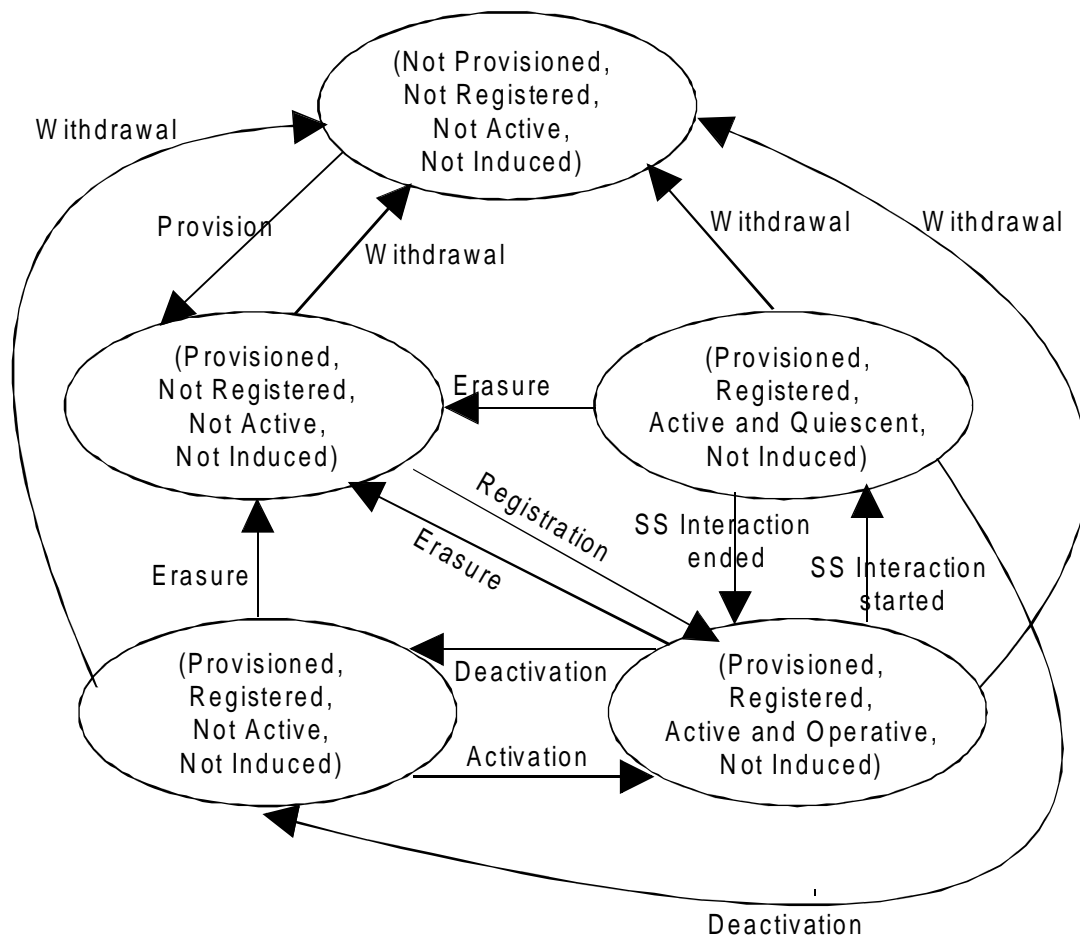


Figure 1.12: State transition model for CFU

## 1.5 Transfer of information from HLR to VLR

If the provisioning state for CFU is "Provisioned" then, when the subscriber registers on a VLR, the HLR shall send that VLR information about the logical state of CFU for all relevant elementary basic service groups.

If the logical state of CFU is changed while a subscriber is registered on a VLR then for the affected basic service groups, the HLR shall inform the VLR of the new logical state of CFU.

## 1.6 Information stored in the VLR

For CFU the VLR shall store the service state information received from the HLR for all relevant elementary basic service groups.

## 1.7 Handover

Handover will have no impact on the control procedure and the operation of the service.

## 1.8 Cross phase compatibility

### 1.8.1 MS, MSC, VLR or HLR only support Phase 1 control of SS by the subscriber

In response to a CFU interrogation request, if the MS or any network element involved is of Phase 1, only information concerning basic service groups for which the activation state has the value "Active and Operative" will be returned. This means, for example, that the subscriber will not be aware that the forwarded to number is registered if CFU is deactivated. A subaddress (if registered) will not be included in the response.

Note that if any network element involved is of Phase 1, CFU Registration requests which use a subaddress and all CFU Activation and Deactivation requests will be rejected, as these are not specified in Phase 1.

### 1.8.2 HLR only supports Phase 1 updating of subscriber information

The VLR shall ignore the subscription option "notification to the calling party" and the registration parameter "forwarded to number" when received from a Phase 1 HLR.

If the VLR receives the SS-Status parameter from a Phase 1 HLR it shall act if it has received the SS-Status parameter with the values shown in the following:

- 1) Activated               => A bit = 1, Q bit = 0;
- 2) Deactivated           => A bit = 0, Q bit = 0 or 1

### 1.8.3 VLR only supports Phase 1 updating of subscriber information

When passing CFU information to a Phase 1 VLR, the HLR shall send the service state information in a form which the VLR can accept, based on the logical state held in the HLR, as follows:

- 1) (Provisioned, Not Registered, Not Active, Not Induced)  
    => Erased, Deactivated;
- 2) (Provisioned, Registered, Not Active, Not Induced)  
    => Registered, Deactivated;
- 3) (Provisioned, Registered, Active and Operative, Not Induced)  
    => Registered, Activated;
- 4) (Provisioned, Registered, Active and Quiescent, Not Induced)  
    => Registered, Deactivated.

The HLR shall not pass a subaddress to a Phase 1 VLR.

### 1.8.4 GMSC only supports Phase 1 call handling

When a call is forwarded unconditionally, the HLR shall not pass the subaddress to a Phase 1 GMSC. Calls shall be forwarded without the subaddress.

## 2 Call forwarding on mobile subscriber busy

### 2.1 Handling of call forwarding on mobile subscriber busy

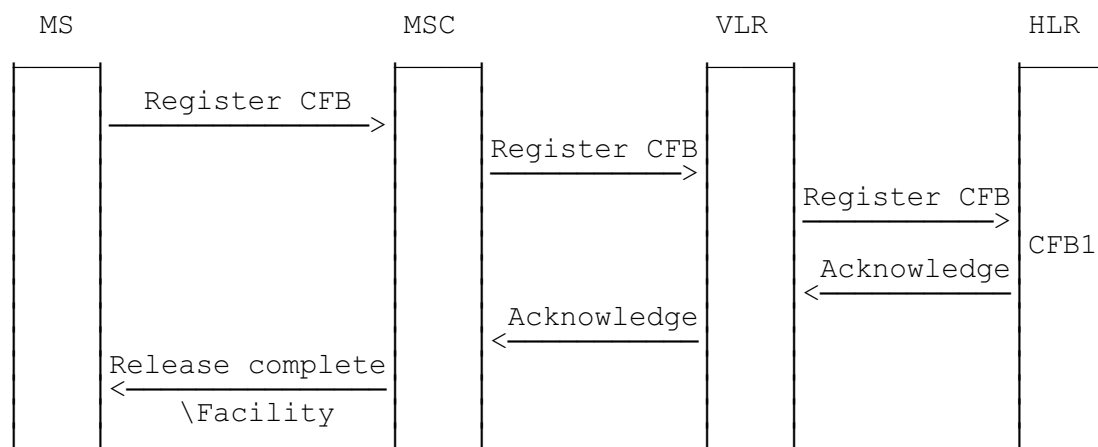
#### 2.1.1 Registration

The same rules apply for the registration of Call Forwarding on Mobile Subscriber Busy as were described for Call Forwarding Unconditional in subclause 1.1.1 above, with the exception of the checking of interaction with other supplementary services. Basic registration of information is illustrated in figure 2.2.

#### Supplementary Service Interaction

Possible interaction situations between CFB and other supplementary services must then be checked. This is described in figure 2.2 (also see GSM 02.04 and 02.82). For interaction between CFB and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

The information flow for registration of CFB is shown in figure 2.1.



**Figure 2.1: Registration of call forwarding on mobile subscriber busy**

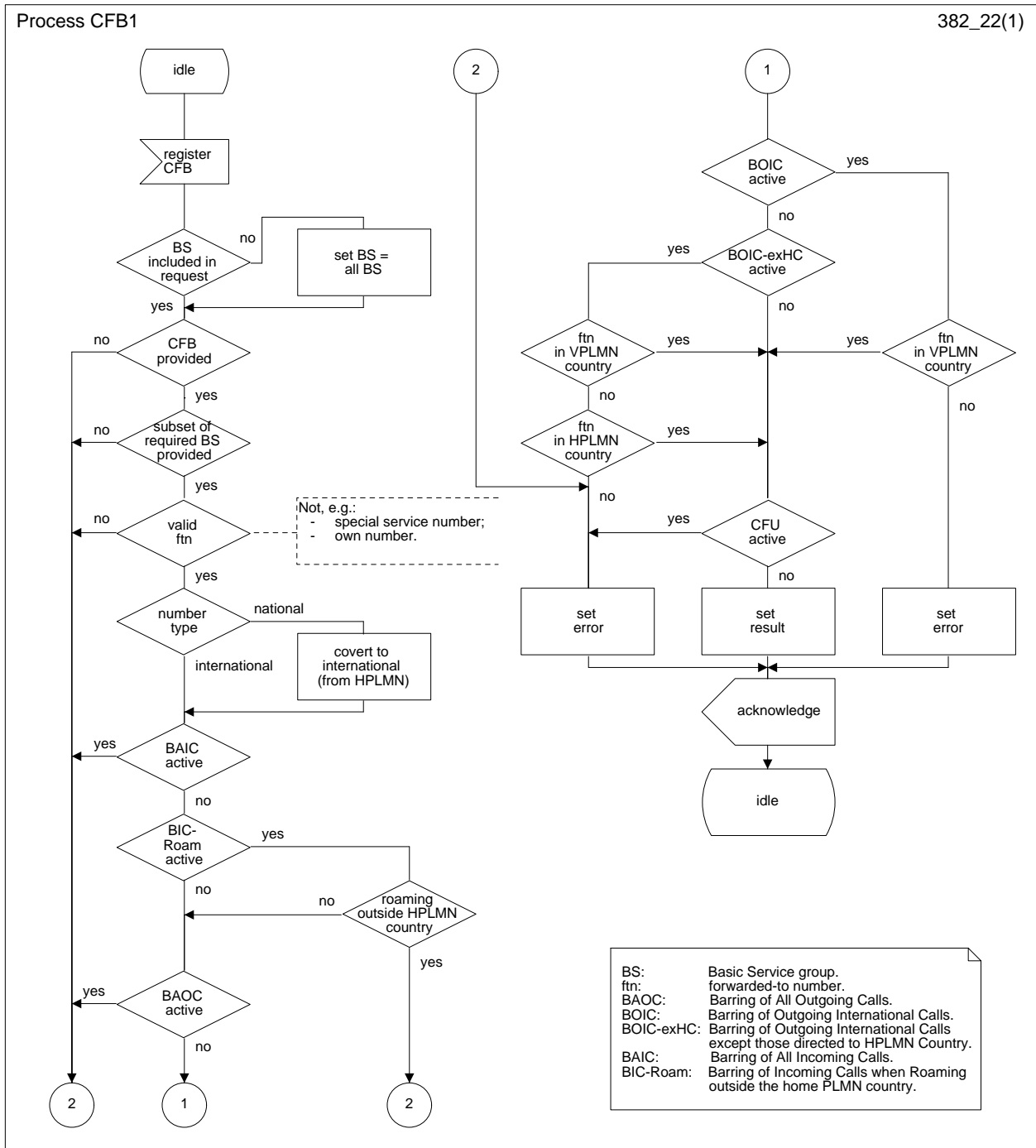


Figure 2.2: CFB1 Call forwarding on mobile subscriber busy registration process



### 2.1.2 Erasure

The same rules apply for the erasure of CFB as were described for CFU in subclause 1.1.2 above. However, no checks for interaction with other supplementary services are required for erasure of CFB (see figure 2.4).

The information flow for registration of CFB is shown in figure 2.3.

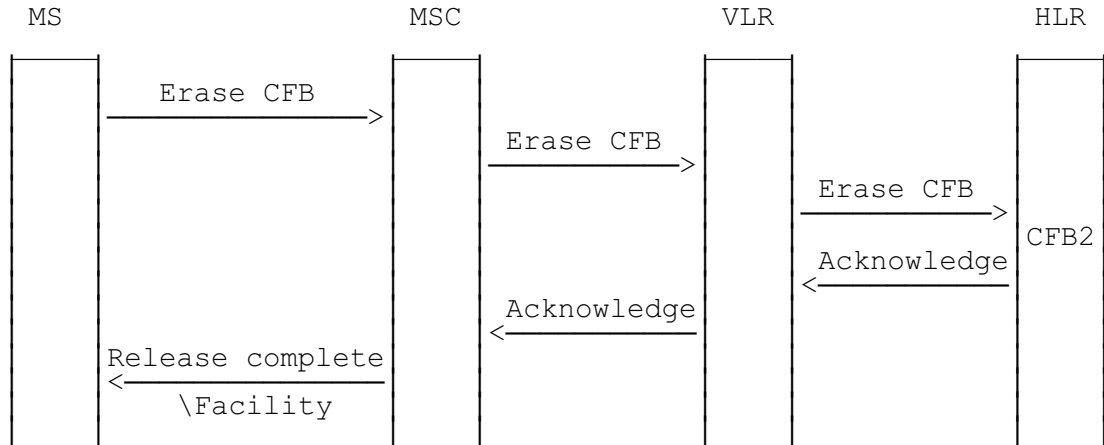


Figure 2.3: Erasure of call forwarding on mobile subscriber busy

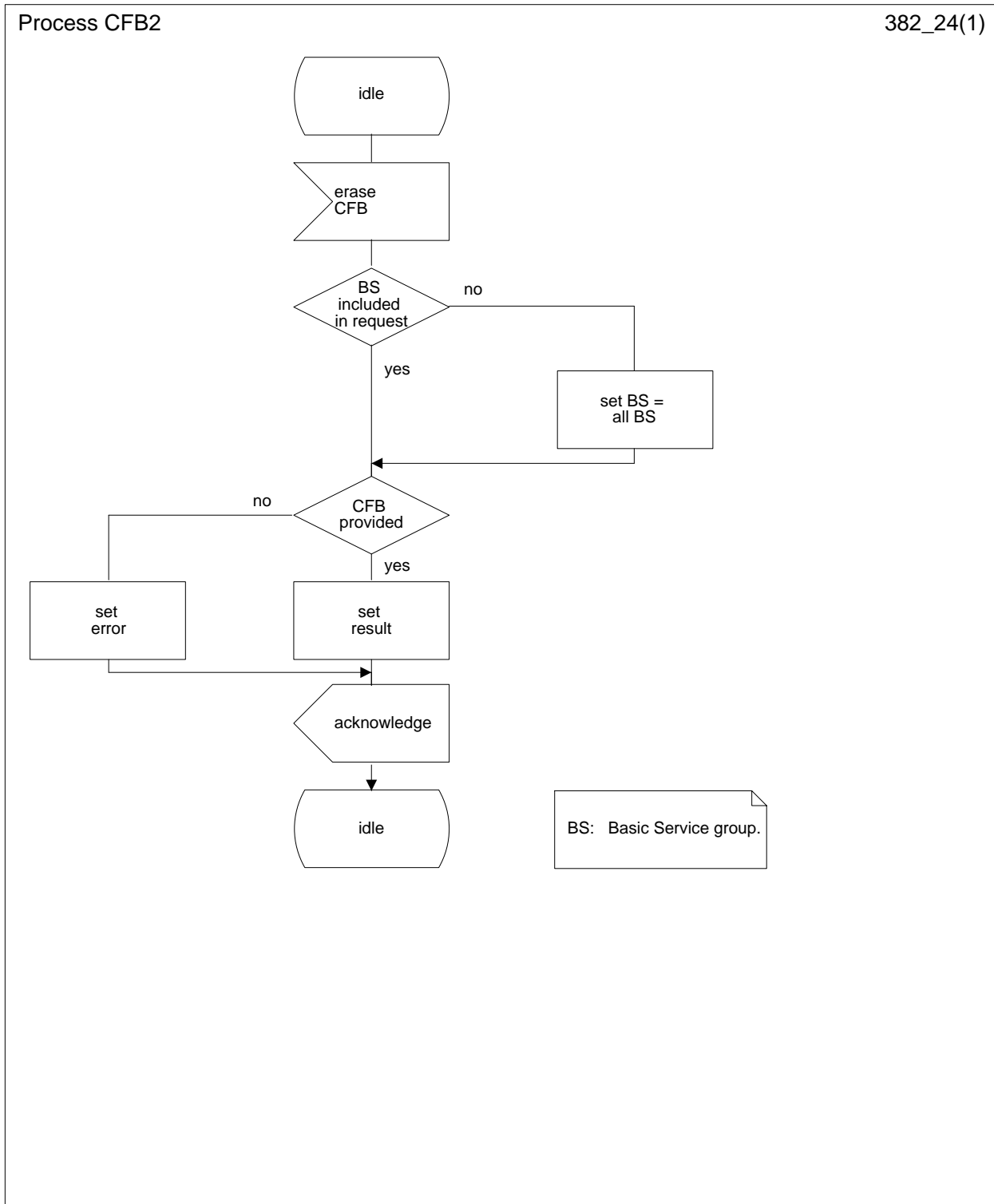


Figure 2.4: CFB2 Call forwarding on mobile subscriber busy erasure process

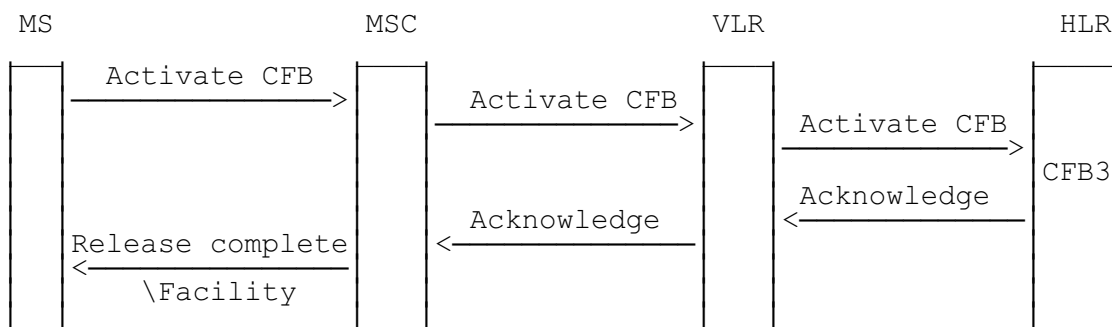
### 2.1.3 Activation

The same rules apply for the activation of CFB as were described for CFU in subclause 1.1.3 above, with the exception of the checking of interaction with other supplementary services. Basic activation of CFNRc is illustrated in figure 2.6.

#### Supplementary Service Interaction

Possible interaction situations between CFB and other supplementary services must then be checked. This is described in figure 2.6. Also see GSM 02.04 and 02.82. For interaction between CFB and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

The information flow for activation of call forwarding on MS busy is shown in figure 2.5.



**Figure 2.5: Activation of call forwarding on MS busy**

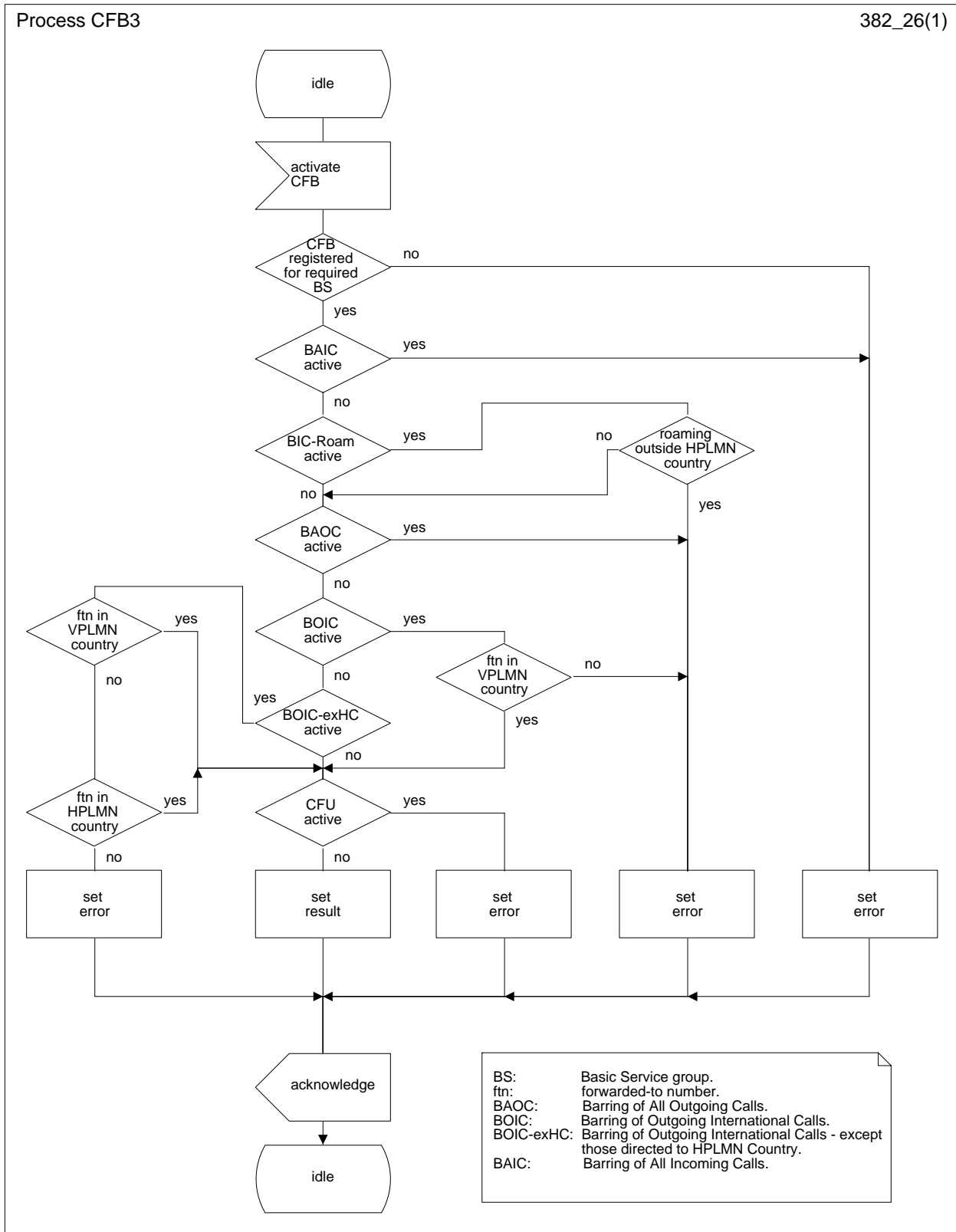
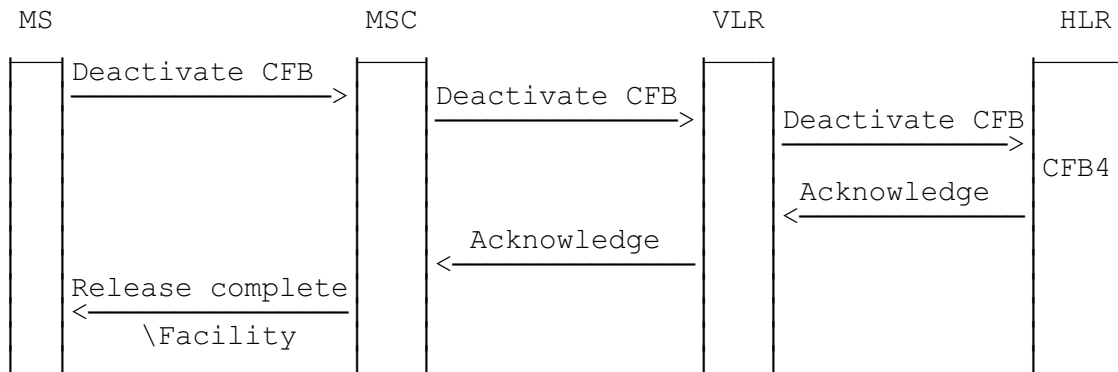


Figure 2.6: CFB3 Call forwarding on mobile subscriber busy activation process

### 2.1.4 Deactivation

The same rules apply for the deactivation of CFB as were described for CFU in subclause 1.1.4 above (see figure 2.8).

The information flow for deactivation of call forwarding on mobile subscriber busy is shown in figure 2.7.



**Figure 2.7: Deactivation of call forwarding on mobile subscriber busy**

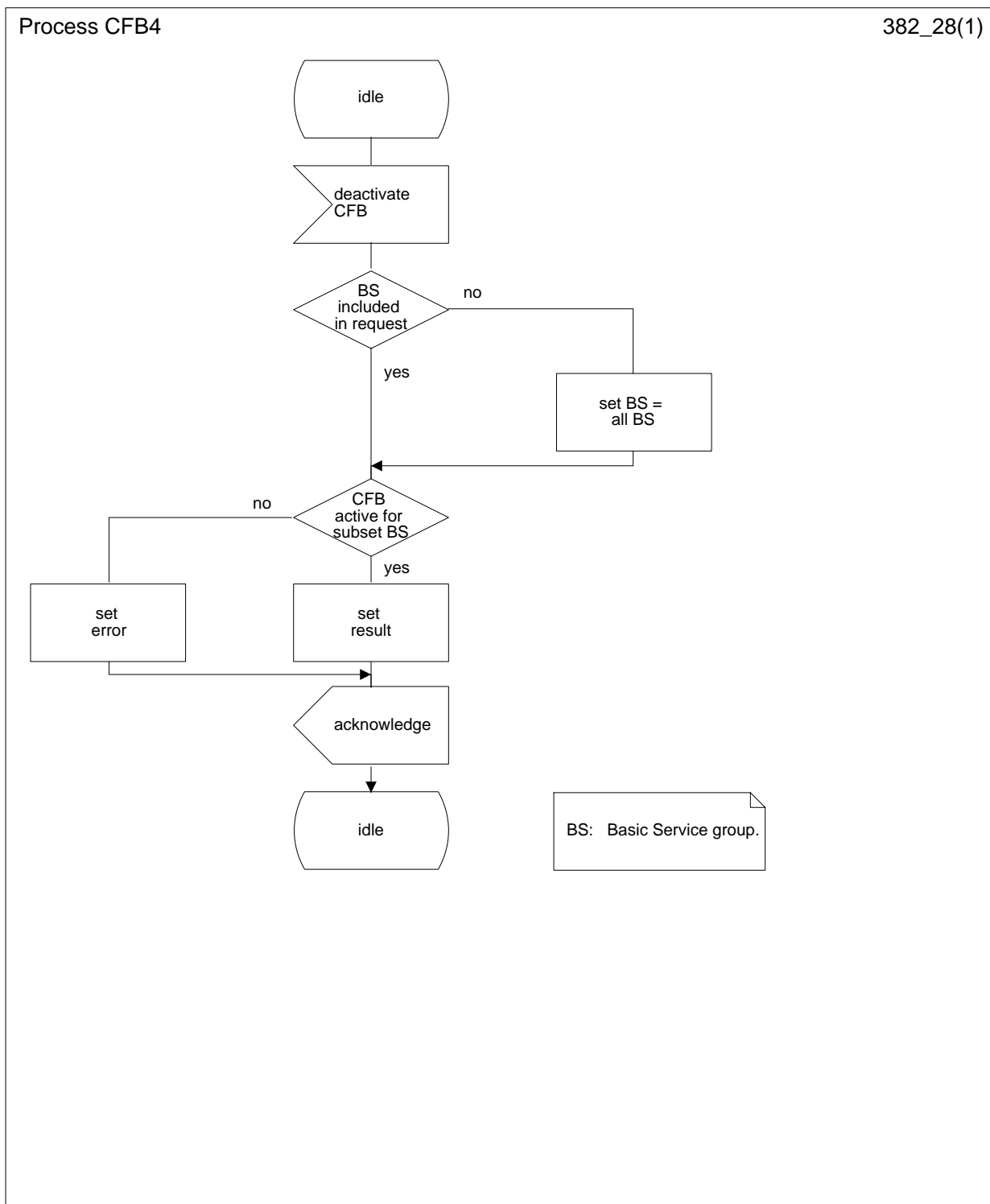


Figure 2.8: CFB4 Call forwarding on mobile subscriber busy deactivation process

## 2.1.5 Interrogation

### Data request

The data request procedure enables the mobile subscriber to obtain information about the data stored in the PLMN. Interrogation of CFB is handled by the VLR which returns the required information or error to the MS (see figure 2.9).

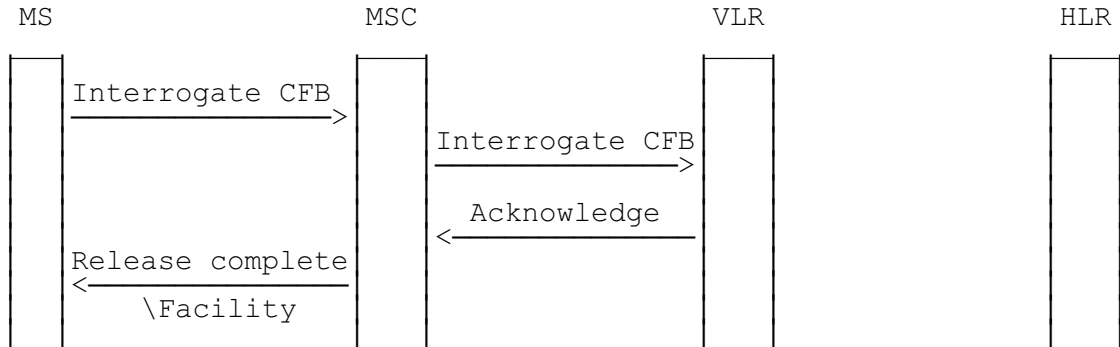


Figure 2.9: Interrogation of call forwarding on mobile subscriber busy

## 2.2 Functions and information flows

The following Mobile Additional Function has been identified for the PLMN:

### MAF008

Call forwarding on mobile subscriber busy authorizations examination

The ability of a PLMN component to determine the authorizations relating to call forwarding on mobile subscriber busy (SEE figure 2.10).

Location: VLR.

The information flows for forwarding to fixed terminal and to mobile station are shown in figures 2.11, 2.12, 2.13 and 2.14 respectively.

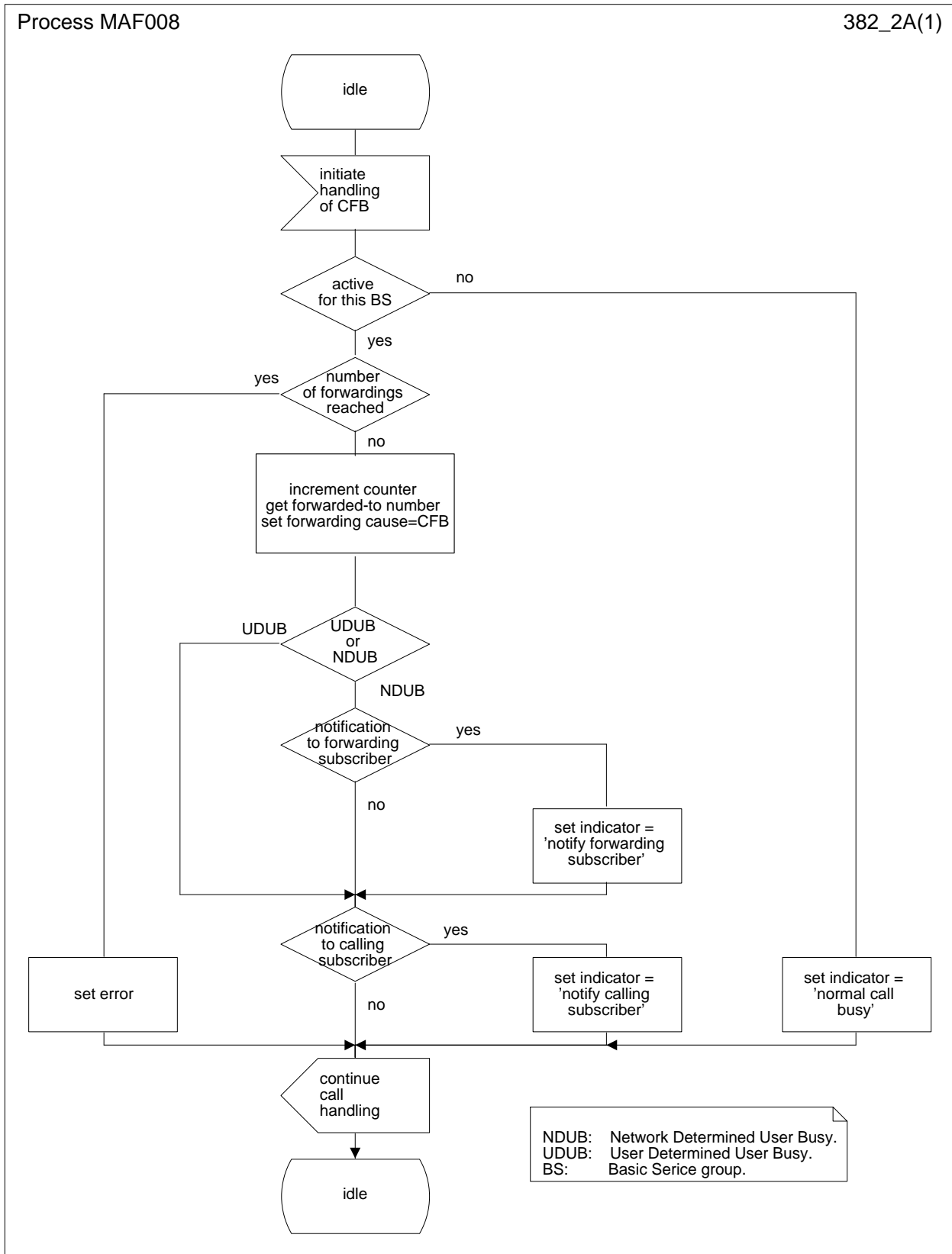
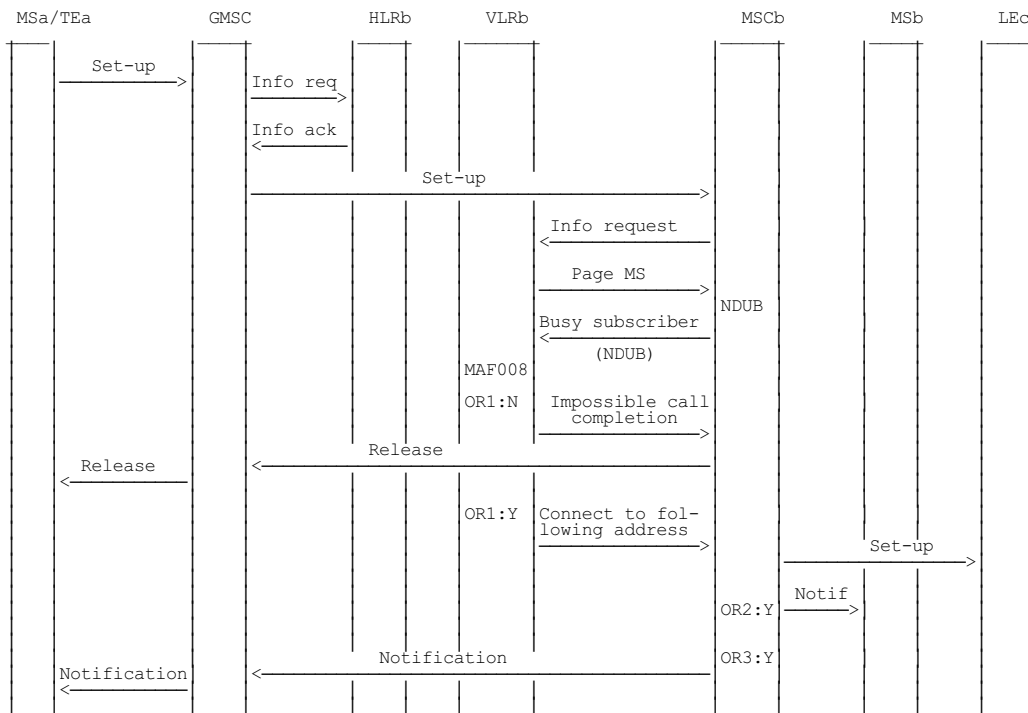


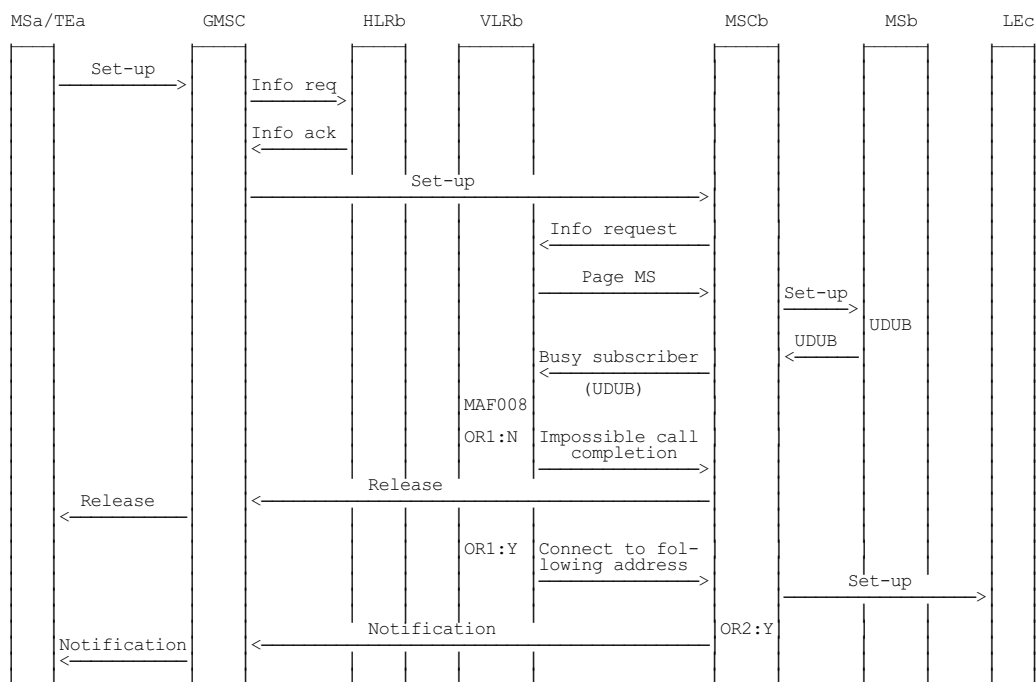
Figure 2.10: MAF008 Call forwarding on mobile subscriber busy authorizations examination (VLR)





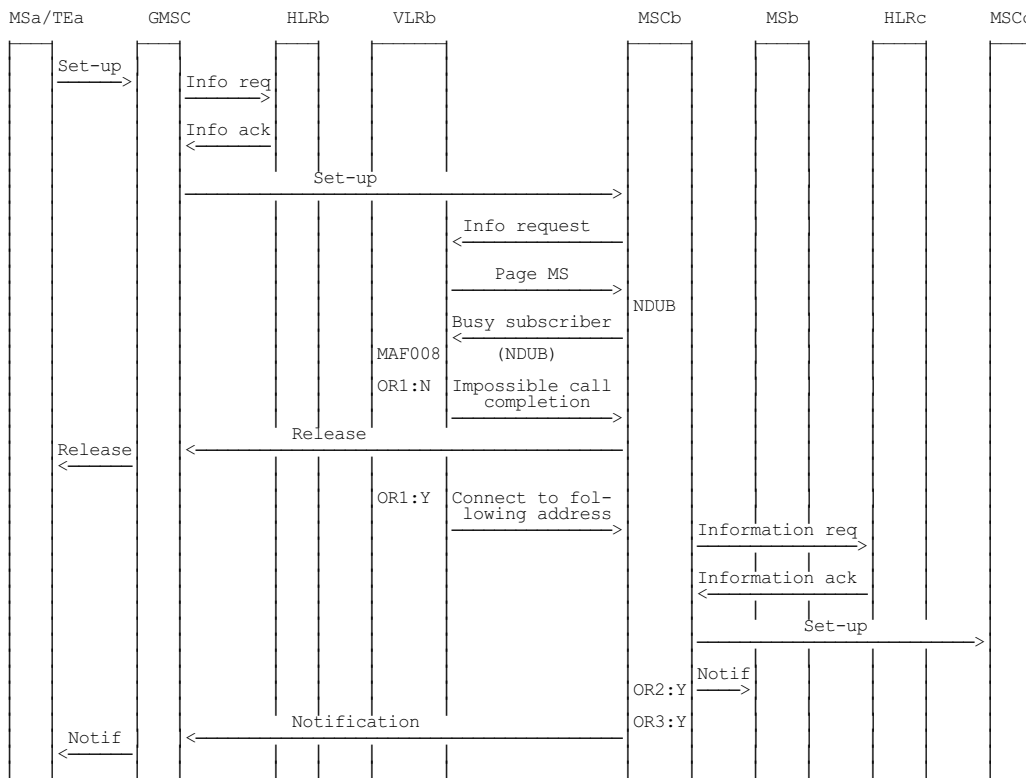
NOTE: NDUB: Network Determined User Busy  
 info: information Y: Yes  
 req: request N: No  
 ack: acknowledge  
 notif: notification  
 OR1: Call to be forwarded  
 OR2: Notification to forwarding subscriber required  
 OR3: Notification to calling subscriber required

Figure 2.11: Information flow for call forwarding on mobile subscriber busy (to fixed terminal) (NDUB)



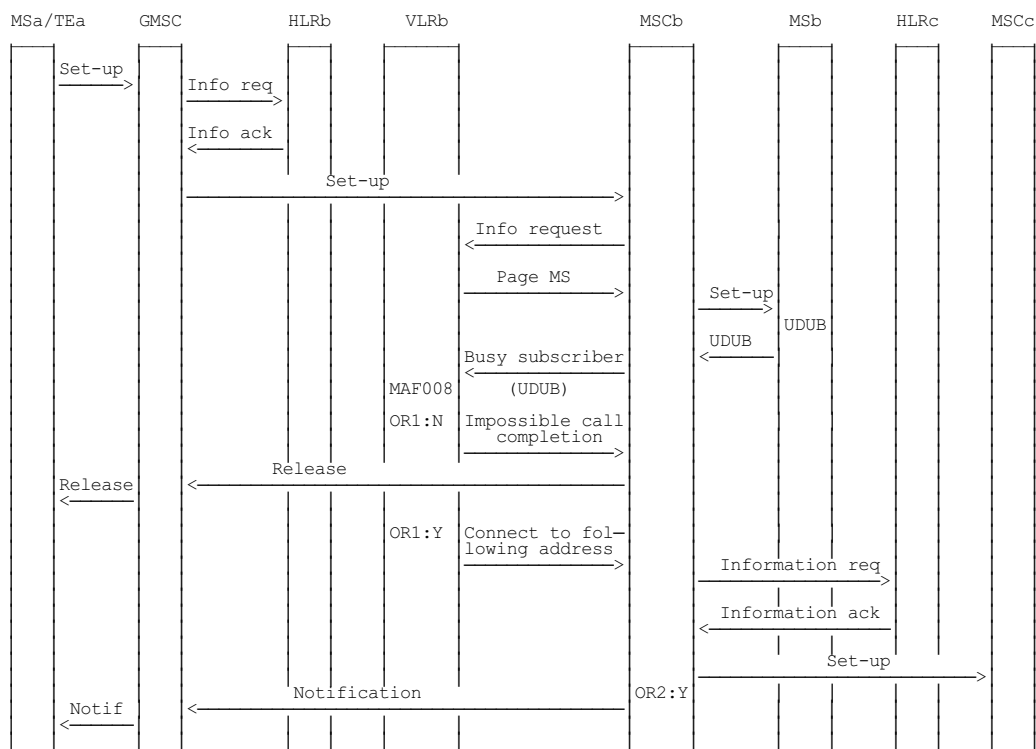
NOTE: UDUB: User Determined User Busy  
 info: information Y: Yes  
 req: request N: No  
 ack: acknowledge  
 notif: notification  
 OR1: Call to be forwarded  
 OR2: Notification to calling subscriber required

**Figure 2.12: Information flow for call forwarding on mobile subscriber busy (to fixed terminal) (UDUB)**



NOTE: NDUB: Network Determined User Busy  
 info: information Y: Yes  
 req: request N: No  
 ack: acknowledge  
 notif: notification  
 OR1: Call to be forwarded  
 OR2: Notification to forwarding subscriber required  
 OR3: Notification to calling subscriber required

**Figure 2.13: Information flow for call forwarding on mobile subscriber busy (to mobile station) (NDUB)**



NOTE: UDUB: User Determined User Busy  
 info: information Y: Yes  
 req: request N: No  
 ack: acknowledge  
 notif: notification  
 OR1: Call to be forwarded  
 OR2: Notification to calling subscriber required

Figure 2.14: Information flow for call forwarding on mobile subscriber busy (to mobile station) (UDUB)

### 2.3 Information stored in the HLR

The following logical states are applicable for CFB (refer to GSM 03.11 for an explanation of the notation):

<b>Provisioning State</b>	<b>Registration State</b>	<b>Activation State</b>	<b>HLR Induction State</b>
(Not Provisioned,	Not Registered,	Not Active,	Not Induced)
(Provisioned,	Not Registered,	Not Active,	Not Induced)
(Provisioned,	Registered,	Not Active,	Not Induced)
(Provisioned,	Registered,	Active and Quiescent,	Not Induced)
(Provisioned,	Registered,	Active and Operative,	Not Induced)

The registration and activation state may be different for each applicable elementary basic service group.

The provisioning state shall be on a per subscriber basis, and hence the same for all basic service groups.

The HLR shall store:

- the state of CFB (which shall be one of the valid states listed above) for each applicable elementary basic service group;
- the subscription option "notification to the calling party" on a per subscriber basis;  
This subscription option takes one of the following values:
  - no notification;
  - notification.
- the subscription option "notification to the forwarding party" on a per subscriber basis;  
This subscription option takes one of the following values:
  - no notification;
  - notification.
- the registration parameter "forwarded-to number" (possibly including a forwarded-to sub-address) for each applicable elementary basic service group.

2.4 State transition model

The following figure shows the successful cases of transition between the applicable logical states of CFB. The state changes are either caused by actions of the service provider, the mobile user or the network.

Note that error cases are not shown in the diagram as they normally do not cause a state change. Additionally, some successful requests may not cause a state change. Hence, they are not shown in the diagram. The diagram only shows operations on an elementary basic service group.

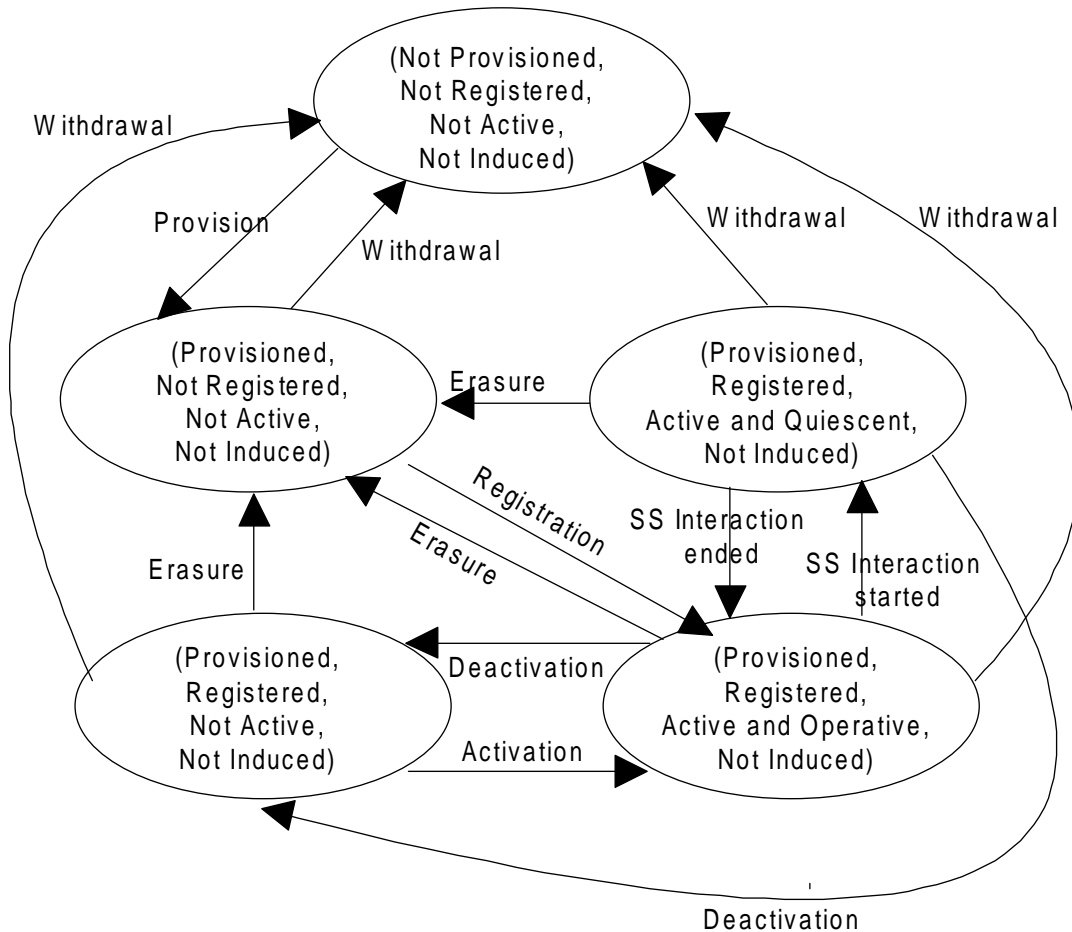


Figure 2.15: State transition model for CFB

2.5 Transfer of information from HLR to VLR

If the provisioning state for CFB is "Provisioned" then, when the subscriber registers on a VLR, the HLR shall send that VLR information about the logical state of CFB for all relevant elementary basic service groups.

If the registration state for CFB is "Registered" then, when the subscriber registers on a VLR, the HLR shall send that VLR the registration parameter "forwarded-to number" for all relevant elementary basic service groups and information about the subscription options "notification to the calling party" and "notification to the forwarding party".

If the logical state or the registration parameter "forwarded-to number" of CFB is changed while a subscriber is registered on a VLR then for the affected basic service groups, the HLR shall inform the VLR respectively of the new logical state or the new registration parameter of CFB.

If information about the subscription options "notification to the calling party" and "notification to the forwarding party" of CFB is changed while a subscriber is registered on a VLR and the registration state of CFB is "Registered" then the HLR shall inform the VLR of the new information about the subscription options of CFB.

## 2.6 Information stored in the VLR

For CFB the VLR shall store the service state information, the registration parameter "forward-to number" and the subscription options received from the HLR.

## 2.7 Handover

Handover will have no impact on the control procedure and the operation of the service.

## 2.8 Cross phase compatibility

### 2.8.1 MS, MSC, VLR or HLR only support Phase 1 control of SS by the subscriber

In response to a CFB interrogation request, if the MS or any network element involved is of Phase 1, only information concerning basic service groups for which the activation state has the value "Active and Operative" will be returned. This means that the subscriber will not be aware that the forwarded to number is registered if CFB is deactivated or active (quiescent). A subaddress (if registered) will not be included.

Note that if any network element involved is of Phase 1, CFB Registration requests which use a subaddress and all CFB Activation and Deactivation requests will be rejected, as these are not specified in Phase 1.

### 2.8.2 HLR only supports Phase 1 updating of subscriber information

If the VLR receives the SS-Status parameter from a Phase 1 HLR it shall act if it has received the SS-Status parameter with the values shown in the following:

- 1) Registered, Activated                   => P bit = 1, R bit = 1, A bit = 1, Q bit = 0;
- 2) Registered, Deactivated               => P bit = 1, R bit = 1, A bit = 0, Q bit = 0 or 1;
- 3) Erased                                   => P bit = 1, R bit = 0, A bit = 0, Q bit = 0 or 1.

### 2.8.3 VLR only supports Phase 1 updating of subscriber information

When passing CFB information to a Phase 1 VLR, the HLR shall send the service state information in a form which the VLR can accept, based on the logical state held in the HLR, as follows:

- 1) (Provisioned, Not Registered, Not Active, Not Induced)  
=> Erased, Deactivated;
- 2) (Provisioned, Registered, Not Active, Not Induced)  
=> Registered, Deactivated;
- 3) (Provisioned, Registered, Active and Operative, Not Induced)  
=> Registered, Activated;
- 4) (Provisioned, Registered, Active and Quiescent, Not Induced)  
=> Registered, Deactivated.

The HLR shall not pass a subaddress to a Phase 1 VLR.

### 2.8.4 VLR only supports Phase 1 call handling

When a call is forwarded on busy, as the HLR does not pass the subaddress to the VLR, calls shall be forwarded without the subaddress.

### 3 Call forwarding on no reply

#### 3.1 Handling of call forwarding on no reply

##### 3.1.1 Registration

The same rules apply for the registration of Call Forwarding on No Reply as were described for Call Forwarding Unconditional in subclause 1.1.1 above, with the exceptions described below. Basic registration of information is illustrated in figure 3.2.

##### The No Reply Condition Timer

If a value for the no reply condition timer is not included in the registration request received from the MS, then the previous value set by the mobile user or the network operator applies.

##### Supplementary Service Interaction

Possible interaction situations between CFNRy and other supplementary services must then be checked. This is described in figure 3.2. Also see GSM 02.04 and 02.82. For interaction between CFNRy and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

The information flow for registration of call forwarding on no reply is shown in figure 3.1.

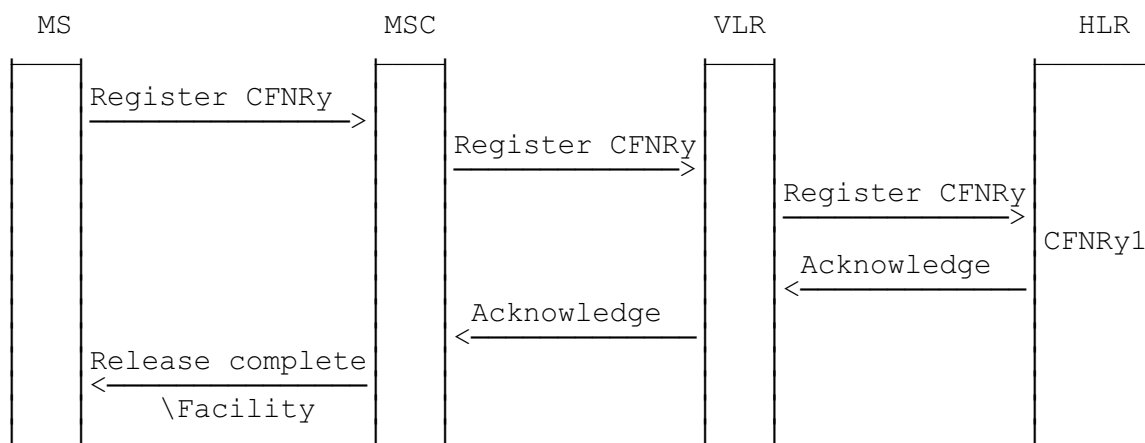


Figure 3.1: Registration of call forwarding on no reply



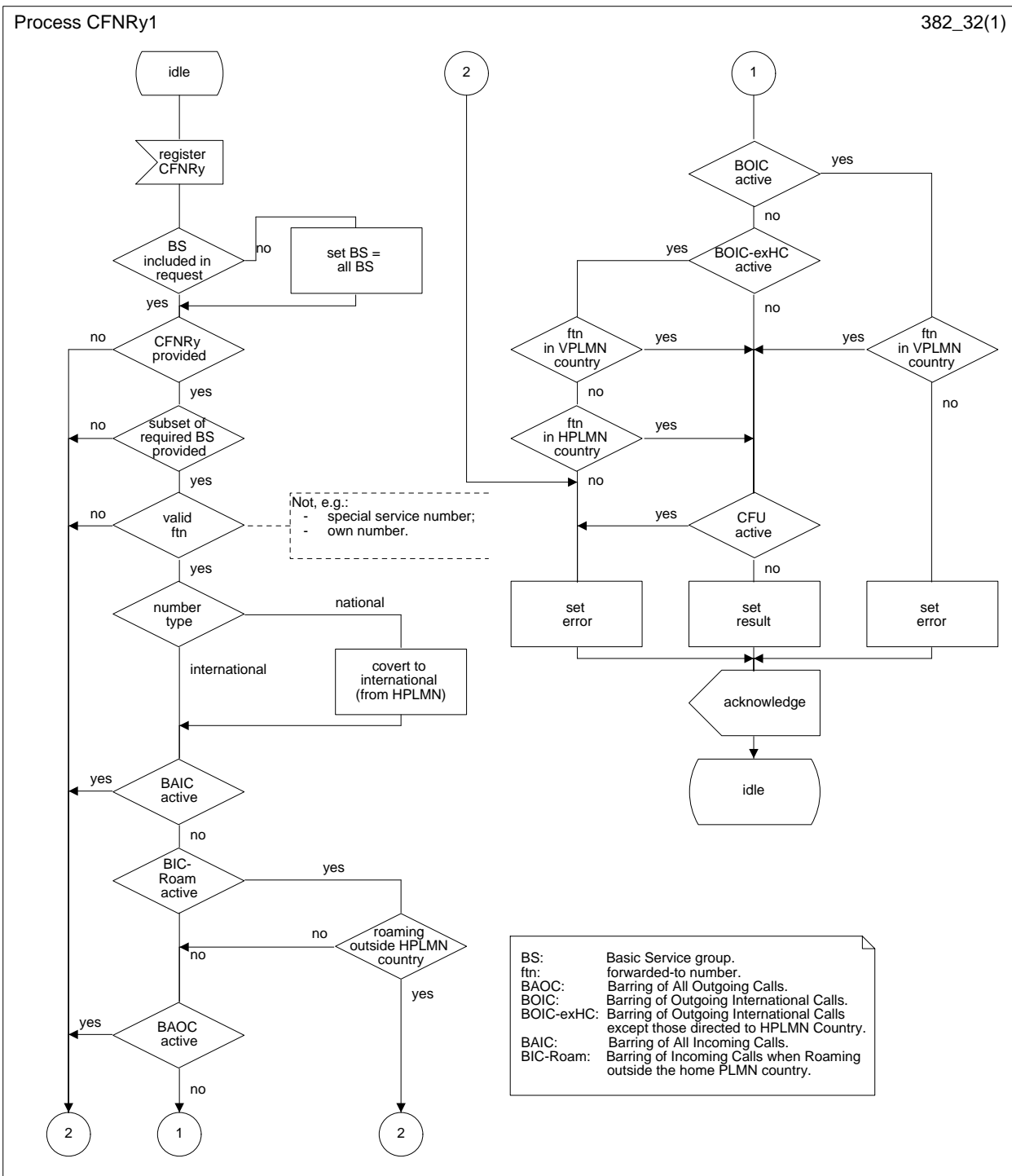


Figure 3.2: CFNRy1 Call forwarding on no reply registration process

### 3.1.2 Erasure

The same rules apply for the erasure of Call Forwarding on No Reply as were described for Call Forwarding Unconditional in subclause 1.1.2 above. However, no checks for interaction with other supplementary services are required for erasure of CFNRy (see figures 3.3 and 3.4).

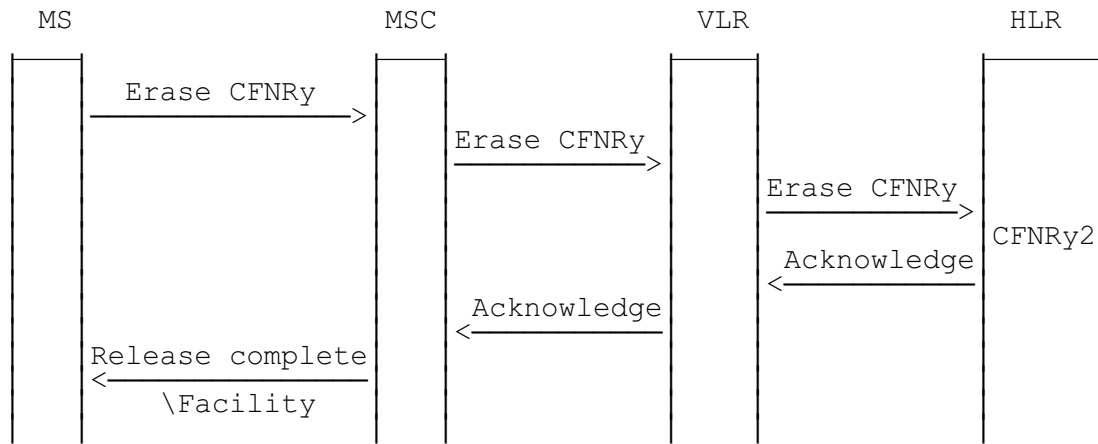


Figure 3.3: Erasure of call forwarding on no reply

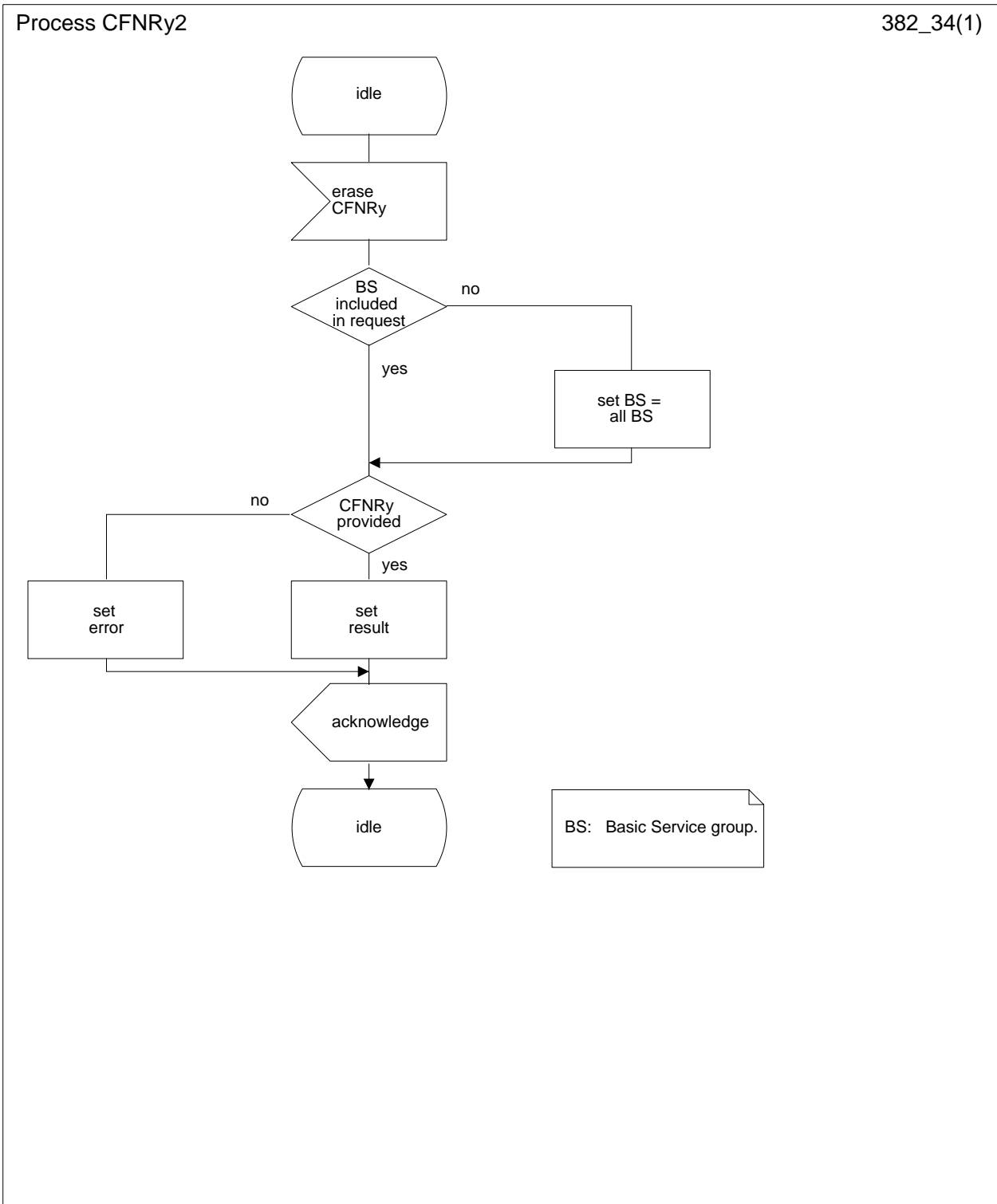


Figure 3.4: CFNRy2 Call forwarding on no reply erasure process

3.1.3 Activation

The same rules apply for the activation of Call Forwarding on No Reply as were described for Call Forwarding Unconditional in subclause 1.1.3 above, with the exception of the checking of interaction with other supplementary services. Basic activation of CFNRy is illustrated in figure 3.6.

Supplementary Service Interaction

Possible interaction situations between CFNRy and other supplementary services must then be checked. This is described in figure 3.6 (also see GSM 02.04 and 02.82). For interaction between CFNRy and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

The information flow for activation of CFNRy is shown in figure 3.5.

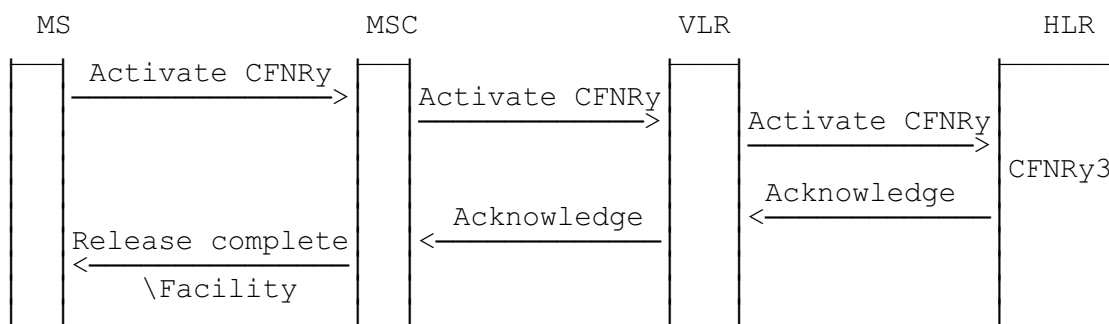


Figure 3.5: Activation of call forwarding on no reply

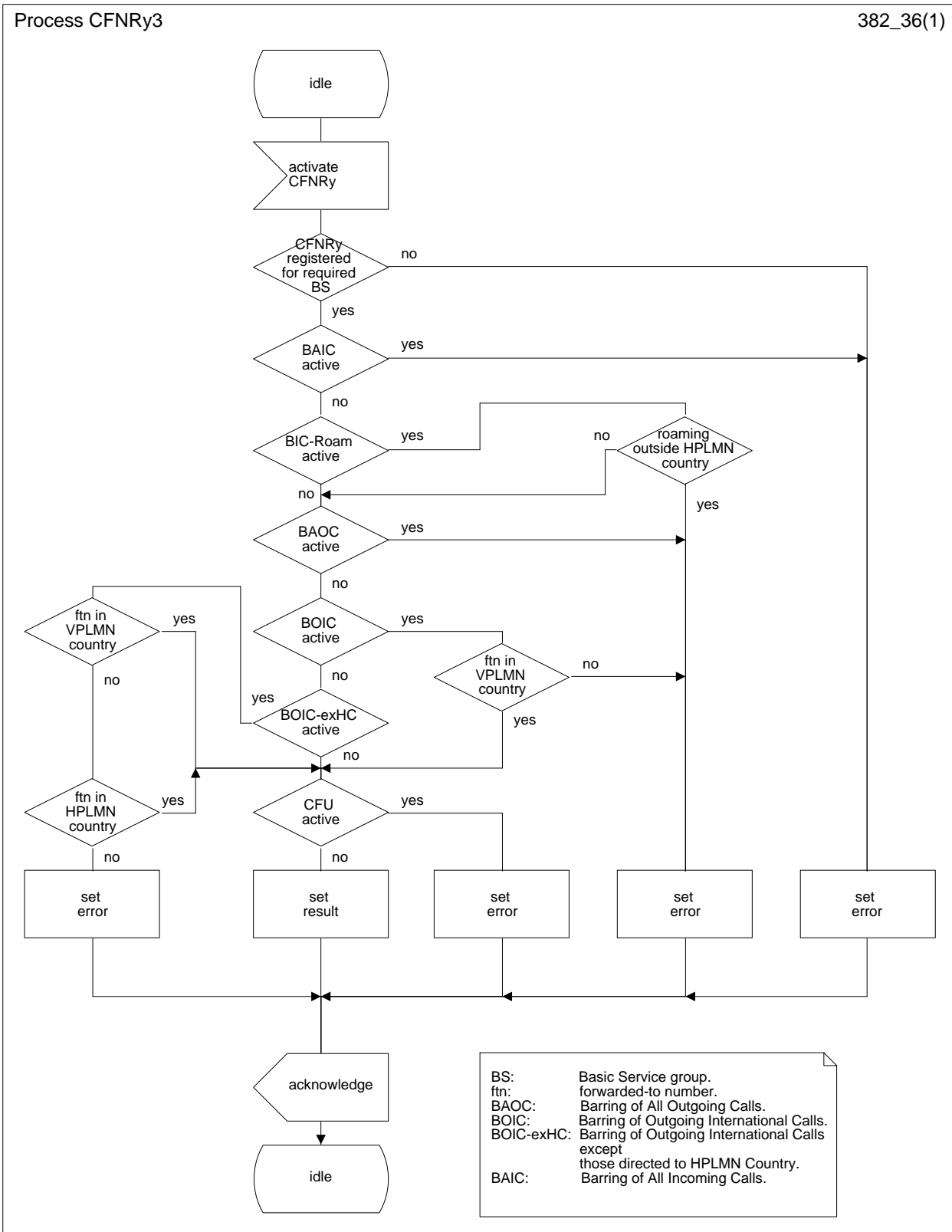


Figure 3.6: CFNRy3 Call forwarding on no reply activation process

3.1.4 Deactivation

The same rules apply for the deactivation of CFNRy as were described for CFU in subclause 1.1.4 above (see figures 3.7 and 3.8).

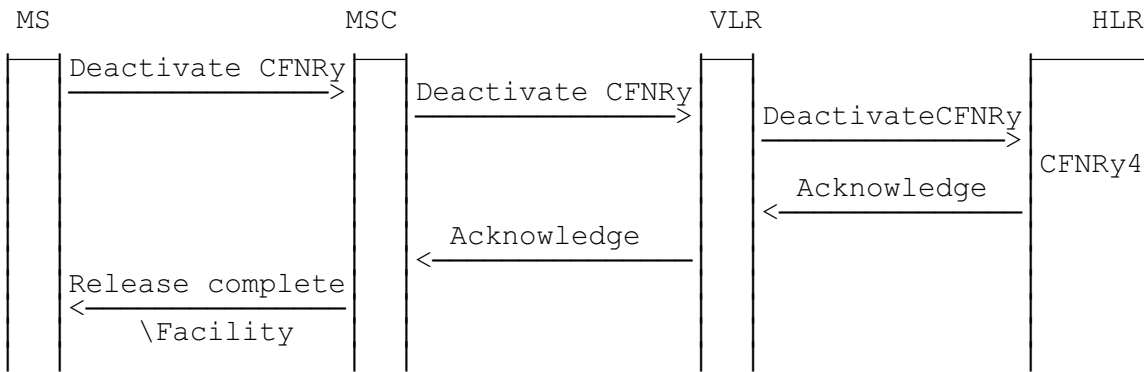


Figure 3.7: Deactivation of call forwarding on no reply

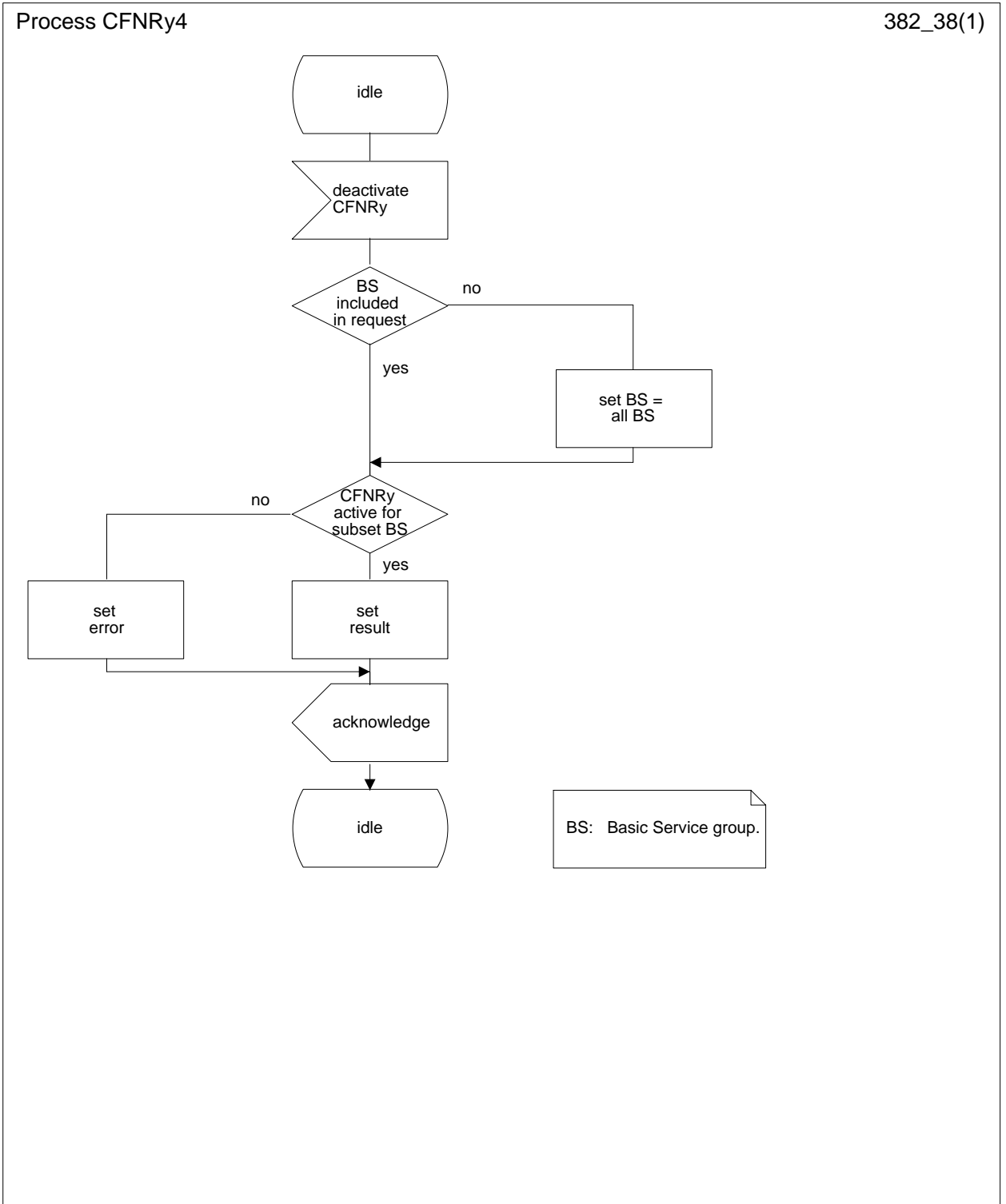
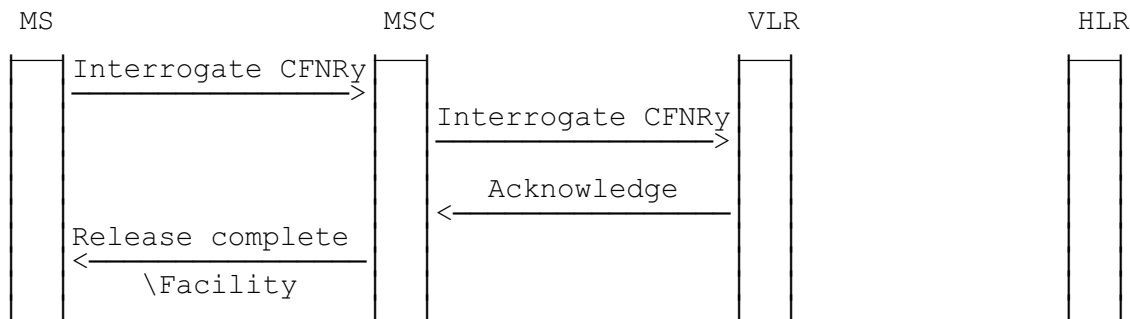


Figure 3.8: CFNRy4 Call forwarding on no reply deactivation process

### 3.1.5 Interrogation

#### Data request

The data request procedure enables the mobile subscriber to obtain information about the data stored in the PLMN. Interrogation of CFNRy is handled by the VLR which returns the required information or error to the MS (see figure 3.9).



**Figure 3.9: Interrogation of call forwarding on no reply**

### 3.2 Functions and information flows

The following Mobile Additional Function has been identified for the PLMN:

#### MAF009

Call forwarding on no reply authorizations examination

The ability of a PLMN component to determine the authorizations relating to call forwarding on no reply (see figure 3.10).

Location: VLR.

The information flows for forwarding to fixed terminal and to mobile station are shown in figures 3.11 and 3.12 respectively.



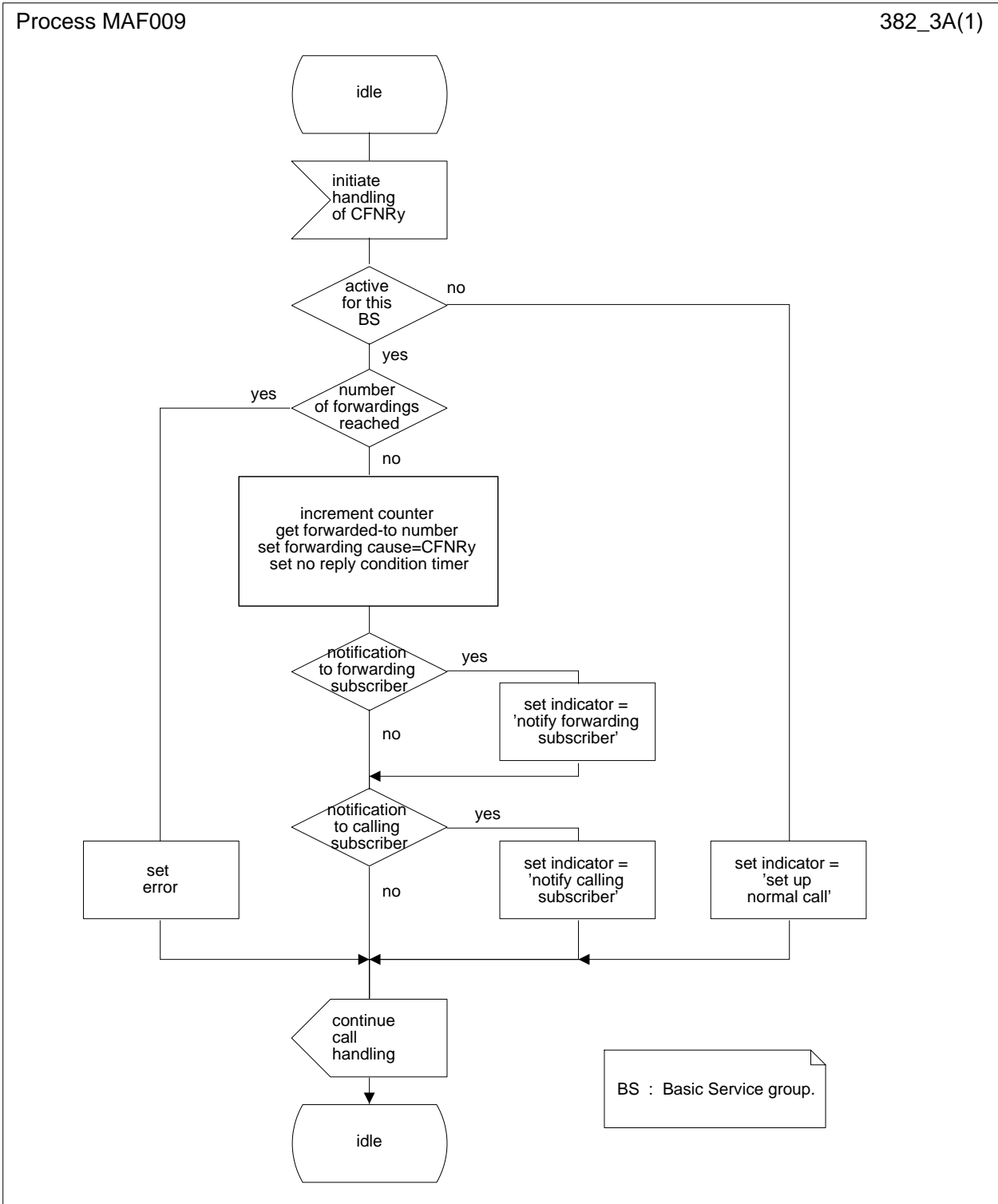
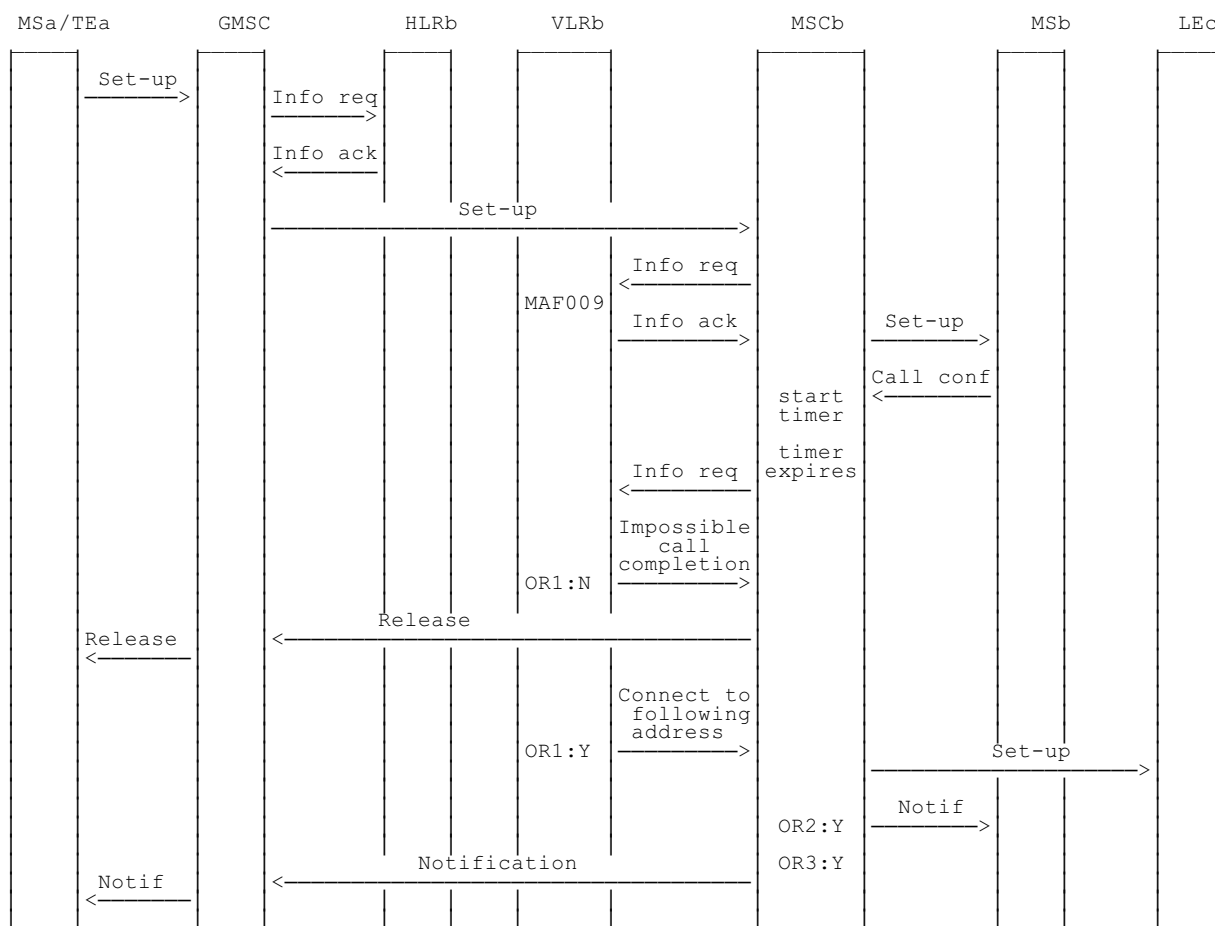
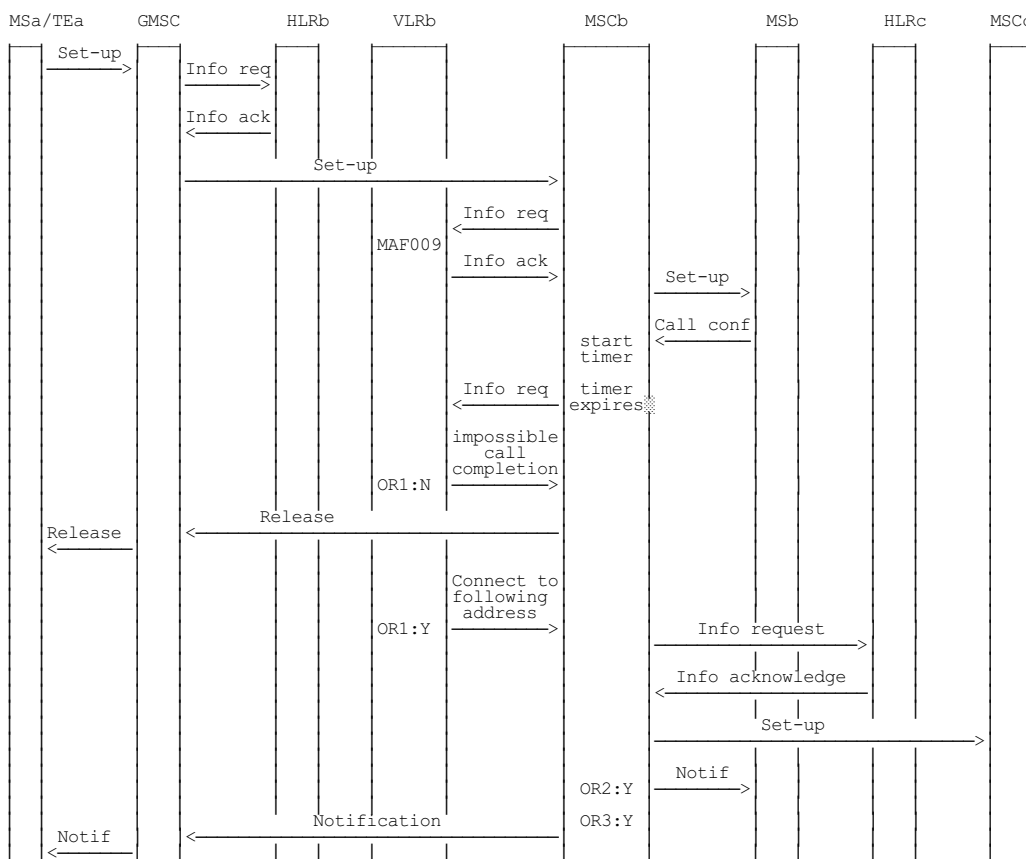


Figure 3.10: MAF008 Call forwarding on no reply authorizations examination (VLR)



NOTE: info: information Y: Yes  
 req: request N: No  
 ack: acknowledge  
 notif: notification  
 conf: confirmation  
 OR1: Call to be forwarded  
 OR2: Notification to forwarding subscriber required  
 OR3: Notification to calling subscriber required

Figure 3.11: Information flow for call forwarding on no reply  
 (to fixed terminal)



NOTE: info: information Y: Yes  
 req: request N: no  
 ack: acknowledge  
 notif: notification  
 conf: confirmation  
 OR1: Call to be forwarded  
 OR2: Notification to forwarding subscriber required  
 OR3: Notification to calling subscriber required

**Figure 3.12: Information flow for call forwarding on no reply (to mobile station)**

### 3.3 Information stored in the HLR

The following logical states are applicable for CFNRy (refer to GSM 03.11 for an explanation of the notation):

<b>Provisioning State</b>	<b>Registration State</b>	<b>Activation State</b>	<b>HLR Induction State</b>
(Not Provisioned,	Not Registered,	Not Active,	Not Induced)
(Provisioned,	Not Registered,	Not Active,	Not Induced)
(Provisioned,	Registered,	Not Active,	Not Induced)
(Provisioned,	Registered,	Active and Quiescent,	Not Induced)
(Provisioned,	Registered,	Active and Operative,	Not Induced)

The registration and activation state may be different for each applicable elementary basic service group.

The provisioning state shall be on a per subscriber basis, and hence the same for all basic service groups.

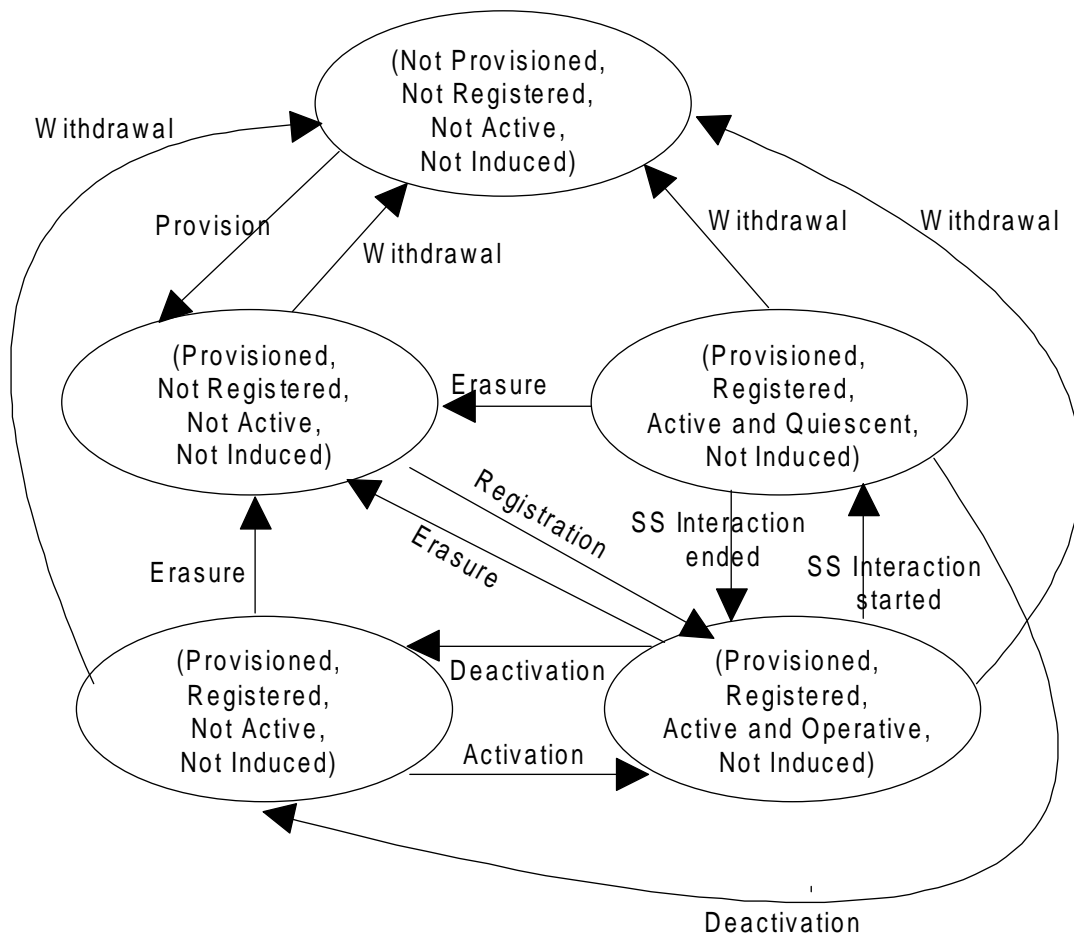
The HLR shall store:

- the state of CFNRy (which shall be one of the valid states listed above) for each applicable elementary basic service group;
- the subscription option "notification to the calling party" on a per subscriber basis;  
This subscription option takes one of the following values:
  - no notification;
  - notification.
- the subscription option "notification to the forwarding party" on a per subscriber basis;  
This subscription option takes one of the following values:
  - no notification;
  - notification.
- the registration parameter "forwarded-to number" (possibly including a forwarded-to sub-address) for each applicable elementary basic service group;
- the registration parameter "no reply condition timer" for each applicable elementary basic service group.  
This parameter may take values in the range 5 - 30 seconds in steps of 5 seconds.

**3.4 State transition model**

The following figure shows the successful cases of transition between the applicable logical states of CFNRy. The state changes are either caused by actions of the service provider, the mobile user or the network.

Note that error cases are not shown in the diagram as they normally do not cause a state change. Additionally, some successful requests may not cause a state change. Hence, they are not shown in the diagram. The diagram only shows operations on an elementary basic service group.



**Figure 3.13: State transition model for CFNRy**

**3.5 Transfer of information from HLR to VLR**

If the provisioning state for CFNRy is "Provisioned" then, when the subscriber registers on a VLR, the HLR shall send that VLR information about the logical state of CFNRy for all relevant elementary basic service groups.

If the registration state for CFNRy is "Registered" then, when the subscriber registers on a VLR, the HLR shall send that VLR the registration parameter "forwarded-to number" and "no reply condition timer" for all relevant elementary basic service groups and information about the subscription options "notification to the calling party" and "notification to the forwarding party".

If the logical state, the registration parameter "forwarded-to number" or the registration parameter "no reply condition timer" of CFNRy is changed while a subscriber is registered on a VLR then for the affected basic service groups, the HLR shall inform the VLR respectively of the new logical state or the new registration parameter of CFNRy.

If information about the subscription options "notification to the calling party" and "notification to the forwarding party" of CFNRy is changed while a subscriber is registered on a VLR and the registration state

of CFNRy is "Registered" then the HLR shall inform the VLR of the new information about the subscription options of CFNRy.

### 3.6 Information stored in the VLR

For CFNRy the VLR shall store the service state information, the registration parameter "forward-to-number", the registration parameter "no reply condition timer" and the subscription options received from the HLR.

### 3.7 Handover

Handover will have no impact on the control procedure and the operation of the service.

### 3.8 Cross phase compatibility

#### 3.8.1 MS, MSC, VLR or HLR only support Phase 1 control of SS by the subscriber

In response to a CFNRy interrogation request, if the MS or any network element involved is of Phase 1, only information concerning basic service groups for which the activation state has the value "Active and Operative" will be returned. This means that the subscriber will not be aware that the forwarded to number is registered if CFNRy is deactivated or active (quiescent). A subaddress (if registered) will not be included.

Note that if any network element involved is of Phase 1, CFNRy Registration requests which use a subaddress and all CFNRy Activation and Deactivation requests will be rejected, as these are not specified in Phase 1.

#### 3.8.2 HLR only supports Phase 1 updating of subscriber information

If the VLR receives the SS-Status parameter from a Phase 1 HLR it shall act if it has received the SS-Status parameter with the values shown in the following:

- 1) Registered, Activated => P bit = 1, R bit = 1, A bit = 1, Q bit = 0;
- 2) Registered, Deactivated => P bit = 1, R bit = 1, A bit = 0, Q bit = 0 or 1;
- 3) Erased => P bit = 1, R bit = 0, A bit = 0, Q bit = 0 or 1.

#### 3.8.3 VLR only supports Phase 1 updating of subscriber information

When passing CFNRy information to a Phase 1 VLR, the HLR shall send the service state information in a form which the VLR can accept, based on the logical state held in the HLR, as follows:

- 1) (Provisioned, Not Registered, Not Active, Not Induced)  
=> Erased, Deactivated;
- 2) (Provisioned, Registered, Not Active, Not Induced)  
=> Registered, Deactivated;
- 3) (Provisioned, Registered, Active and Operative, Not Induced)  
=> Registered, Activated;
- 4) (Provisioned, Registered, Active and Quiescent, Not Induced)  
=> Registered, Deactivated.

The HLR shall not pass a subaddress to a Phase 1 VLR.

#### 3.8.4 VLR only supports Phase 1 call handling

When a call is forwarded on no reply, as the HLR does not pass the subaddress to the VLR, calls shall be forwarded without the subaddress.

## 4 Call forwarding on mobile subscriber not reachable

### 4.1 Handling of call forwarding on mobile subscriber not reachable

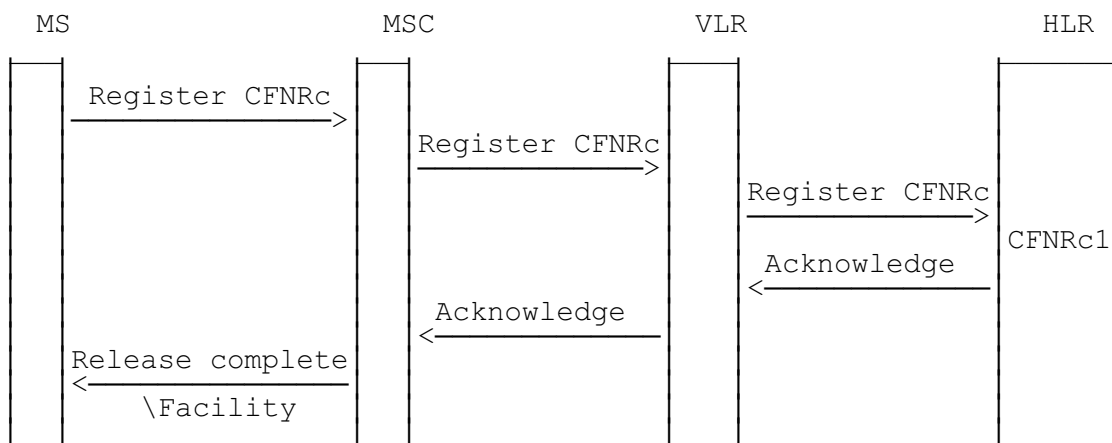
#### 4.1.1 Registration

The same rules apply for the registration of Call Forwarding on Mobile Subscriber Not Reachable as were described for Call Forwarding Unconditional in subclause 1.1.1 above, with the exception of the checking of interaction with other supplementary services. Basic registration of information is illustrated in figure 4.2.

#### Supplementary Service Interaction

Possible interaction situations between CFNRc and other supplementary services must then be checked. This is described in figure 4.2 (also see GSM 02.04 and 02.82). For interaction between CFNRc and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

The information flow for registration of call forwarding on mobile subscriber not reachable is shown in figure 4.1.



**Figure 4.1: Registration of call forwarding on mobile subscriber not reachable**

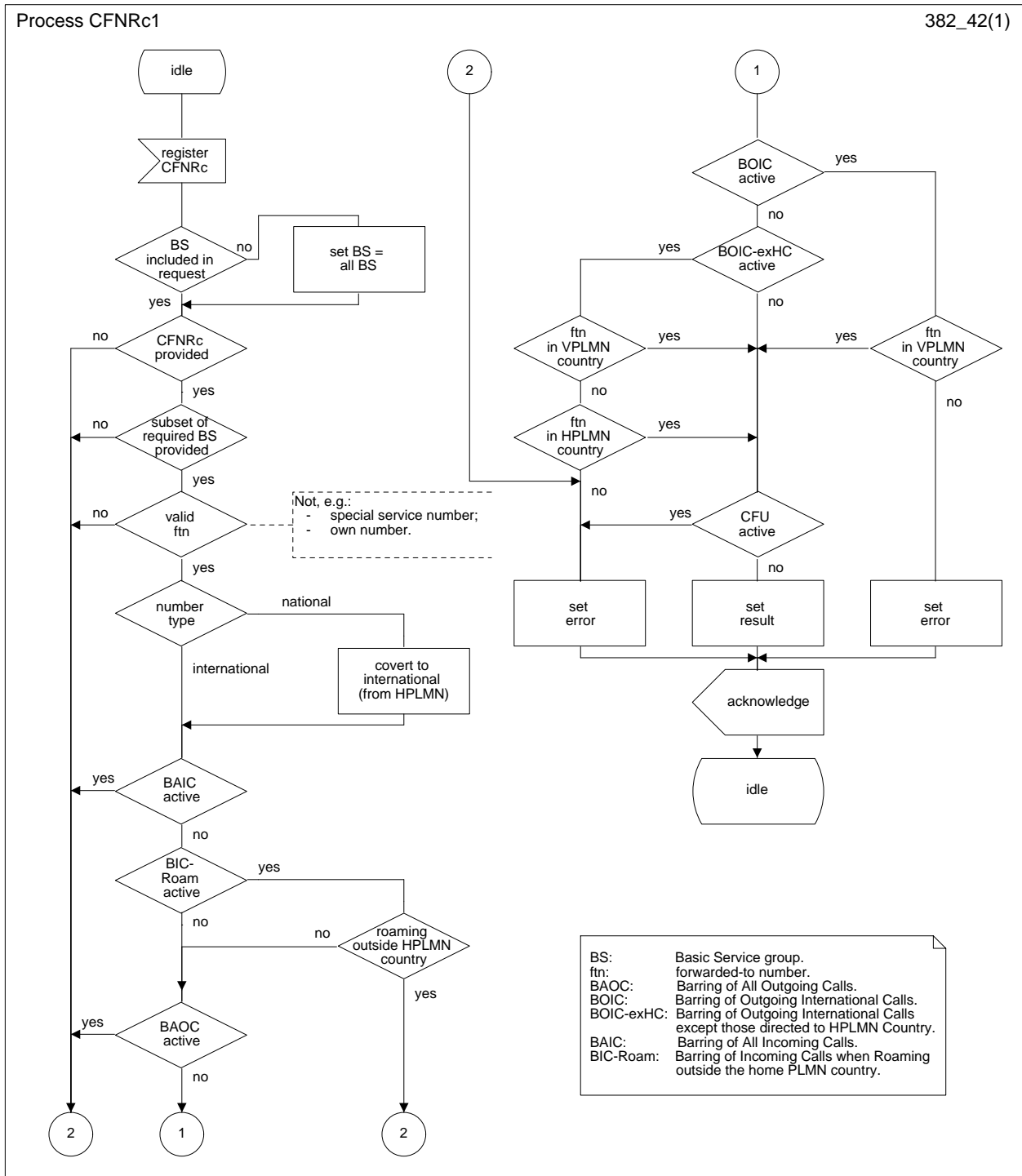


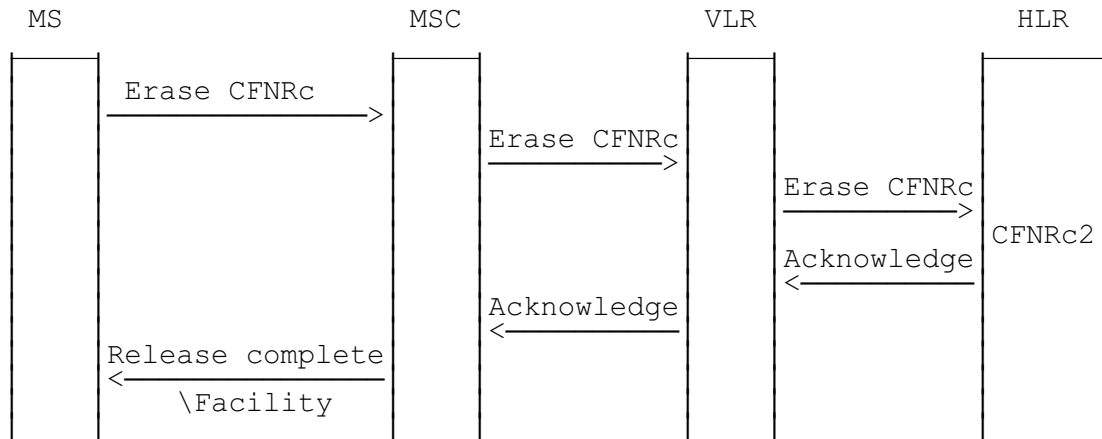
Figure 4.2: CFNRc1 Call forwarding on mobile subscriber not reachable registration process



#### 4.1.2 Erasure

The same rules apply for the erasure of CFNRc as were described for CFU in subclause 1.1.2 above. However, no checks for interaction with other supplementary services are required for erasure of CFNRc (see figure 4.4).

The information flow for registration of CFNRc is shown in figure 4.3.



**Figure 4.3: Erasure of call forwarding on mobile subscriber not reachable**

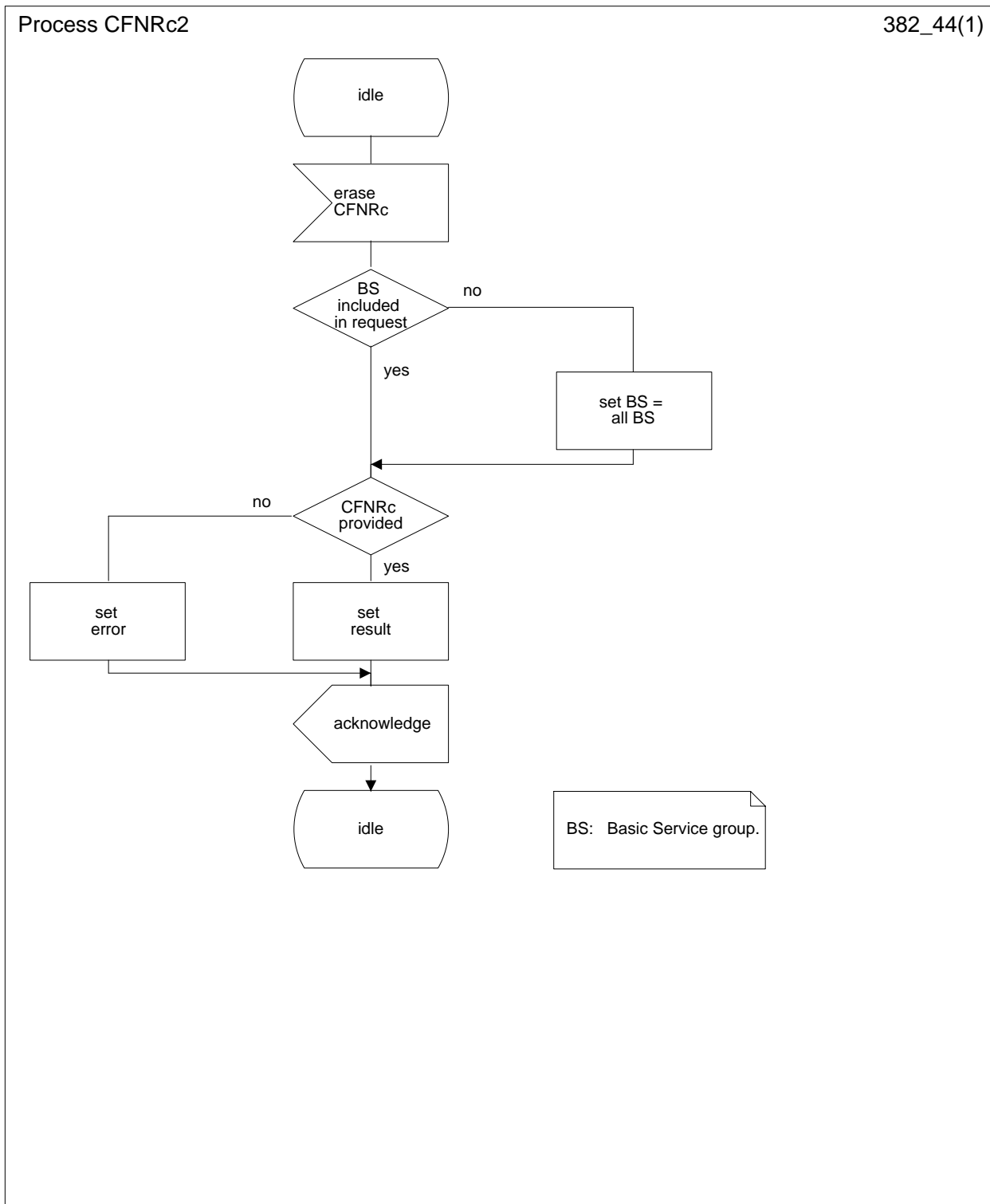


Figure 4.4: CFNRc2 Call forwarding on mobile subscriber not reachable erasure process

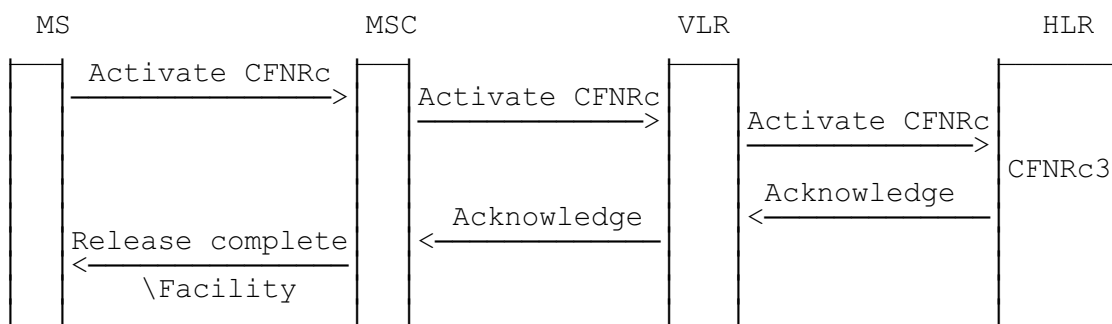
### 4.1.3 Activation

The same rules apply for the activation of CFNRc as were described for CFU in subclause 1.1.3 above, with the exception of the checking of interaction with other supplementary services. Basic activation of CFNRc is illustrated in figure 4.6.

#### Supplementary Service Interaction

Possible interaction situations between CFNRc and other supplementary services must then be checked. This is described in figure 4.6 (also see GSM 02.04 and 02.82). For interaction between CFNRc and other supplementary services (i.e. not call barring or call forwarding services), the reader is referred to the respective technical specification for those supplementary services.

The information flow for activation of call forwarding on MS not reachable is shown in figure 4.5.



**Figure 4.5: Activation of call forwarding on MS not reachable**

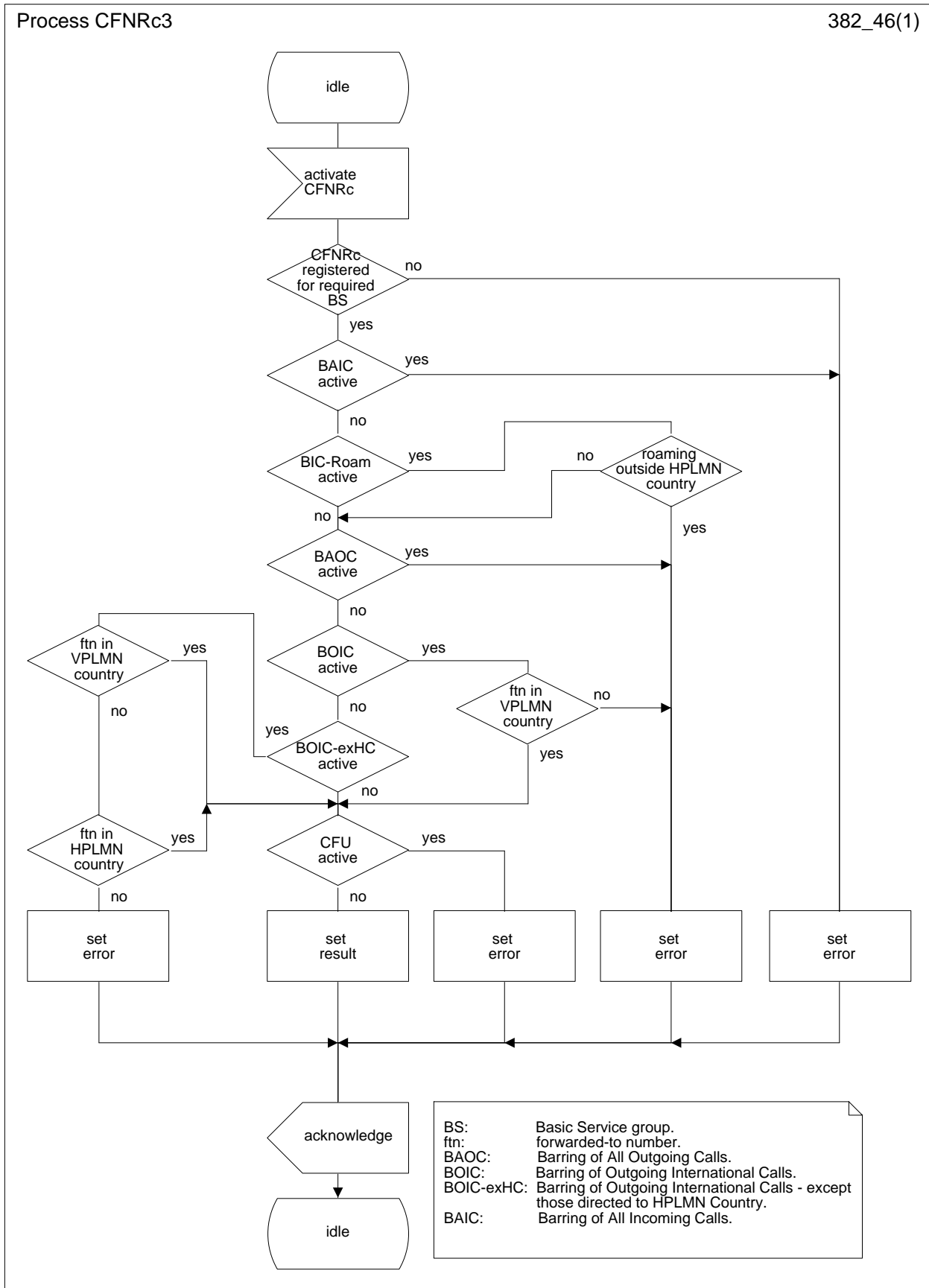


Figure 4.6: CFNRc3 Call forwarding on mobile subscriber not reachable activation process

#### 4.1.4 Deactivation

The same rules apply for the deactivation of CFNRc as were described for CFU in subclause 1.1.4 above (see figure 4.8).

The information flow for deactivation of call forwarding on mobile subscriber not reachable is shown in figure 4.7.

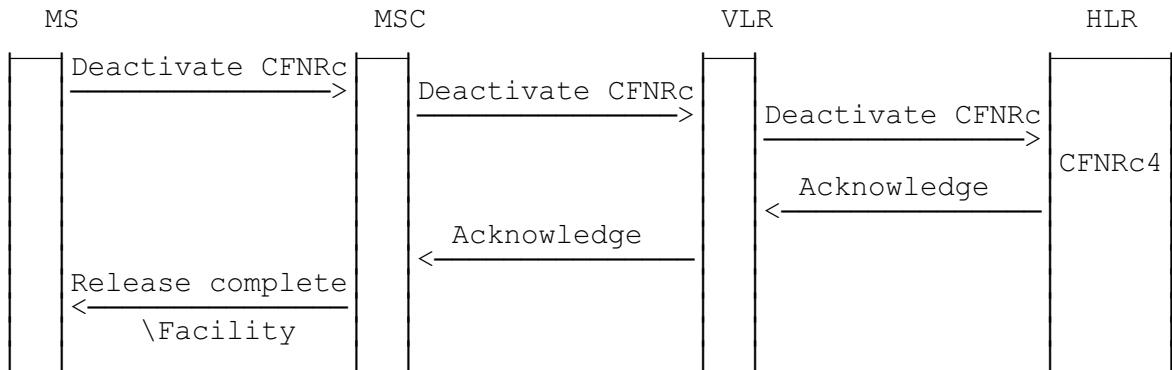


Figure 4.7: Deactivation of call forwarding on mobile subscriber not reachable

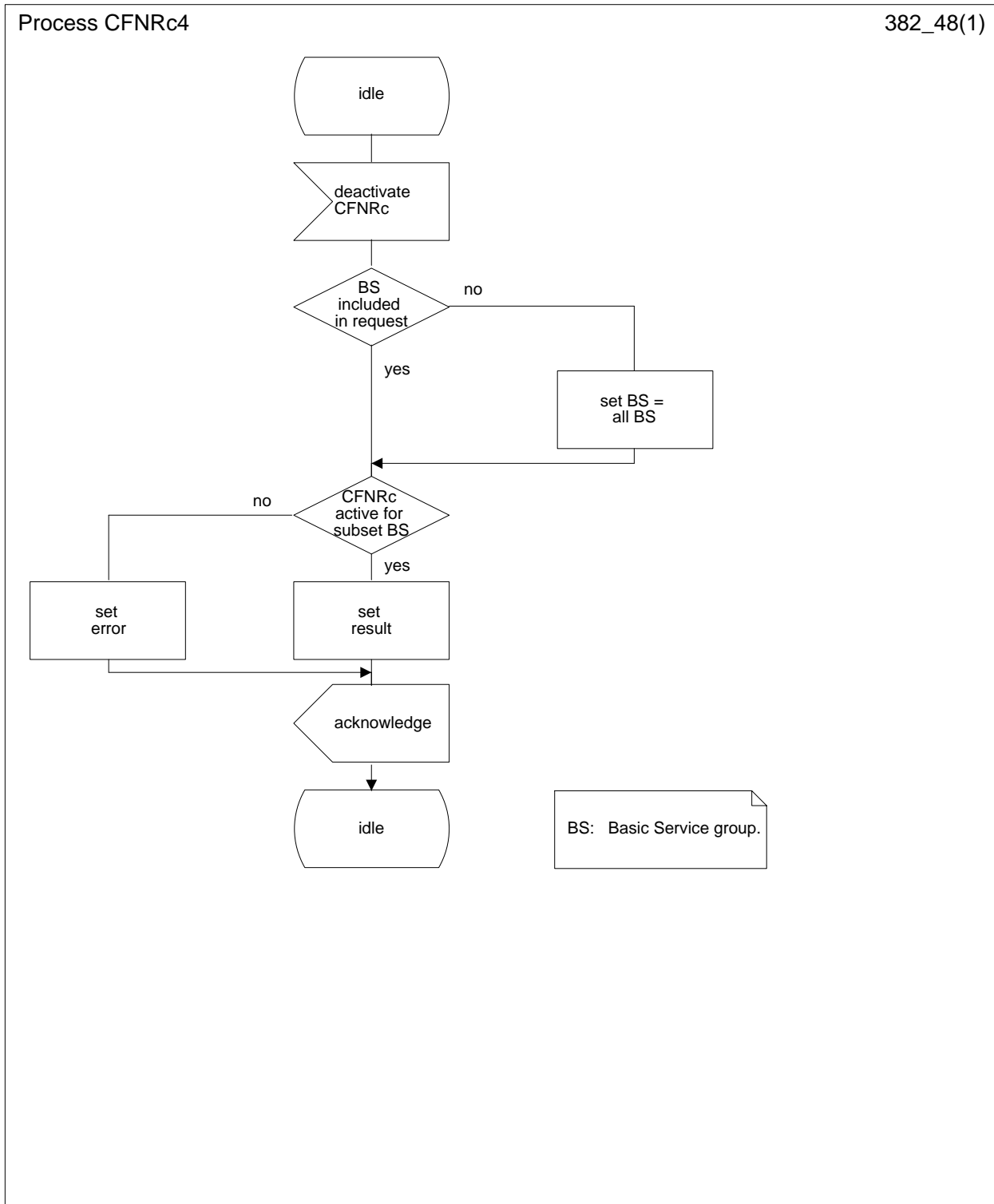
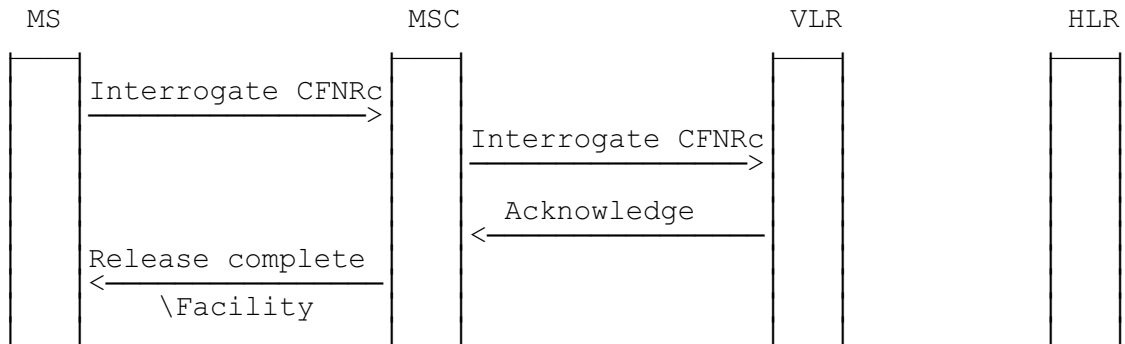


Figure 4.8: CFNRc4 Call forwarding on mobile subscriber not reachable deactivation process

#### 4.1.5 Interrogation

##### Data request

The data request procedure enables the mobile subscriber to obtain information about the data stored in the PLMN. Interrogation of CFNRc is handled by the VLR which returns the required information or error to the MS (see figure 4.9).



**Figure 4.9: Interrogation of call forwarding on mobile subscriber not reachable**

## 4.2 Functions and information flows

### 4.2.1 Call re-routed from VLR

The following Mobile Additional Function has been identified for the PLMN:

#### MAF010

Examination of call forwarding on mobile subscriber not reachable authorizations

The ability of a PLMN component to determine the authorizations relating to call forwarding on mobile subscriber not reachable in case the mobile subscriber is not reachable in the VLR, in case of no paging response or radio congestion (see figure 4.10).

Location: VLR.

The information flows for forwarding to fixed terminal and to mobile station are shown in figures 4.11 and 4.12 respectively. These flows represent the case where the mobile subscriber is not reachable in the VLR, and that this fact was not detected at interrogation from the HLR. This situation occurs if the MSC requests the VLR to provide information for a mobile terminating call towards a subscriber who is detached in the VLR.

Figures 4.13 and 4.14 show the information flows in case of no paging response.

Figures 4.15 and 4.16 show the information flows in case of radio congestion.

### 4.2.2 Call re-routed from HLR

The following Mobile Additional Function has been identified for the PLMN:

#### MAF010

Examination of call forwarding on mobile subscriber not reachable authorizations

The ability of a PLMN component to determine the authorizations relating to call forwarding on mobile subscriber not reachable in case the mobile subscriber is deregistered or purged in the HLR or not reachable in the VLR (see figure 4.10).

Location: HLR.

The information flows for forwarding to fixed terminal and to mobile station are shown in figures 4.17 and 4.18 respectively. These flows represent the case where the call is re-routed from the HLR because information from the VLR indicates that the subscriber cannot be reached in the VLR. This situation occurs if the VLR detects at roaming number request time that the subscriber concerned is detached or that there is no roaming number available.

Figures 4.19 and 4.20 show the information flows for forwarding to fixed terminal and to mobile station respectively in case where the call is re-routed by the HLR because the subscriber is deregistered or purged in the HLR.



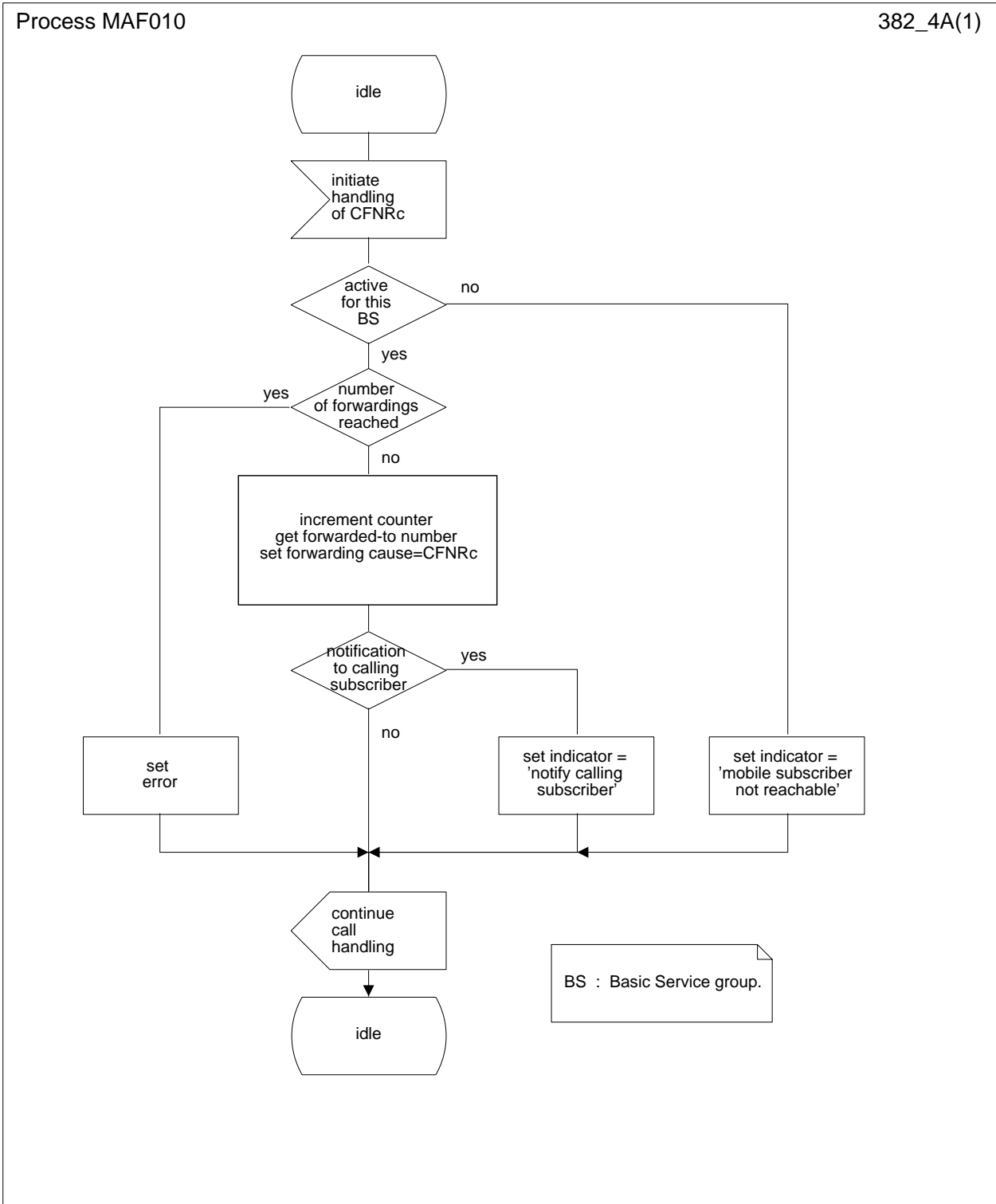


Figure 4.10: MAF010 Call forwarding on mobile subscriber not reachable authorizations examination (VLR and HLR)

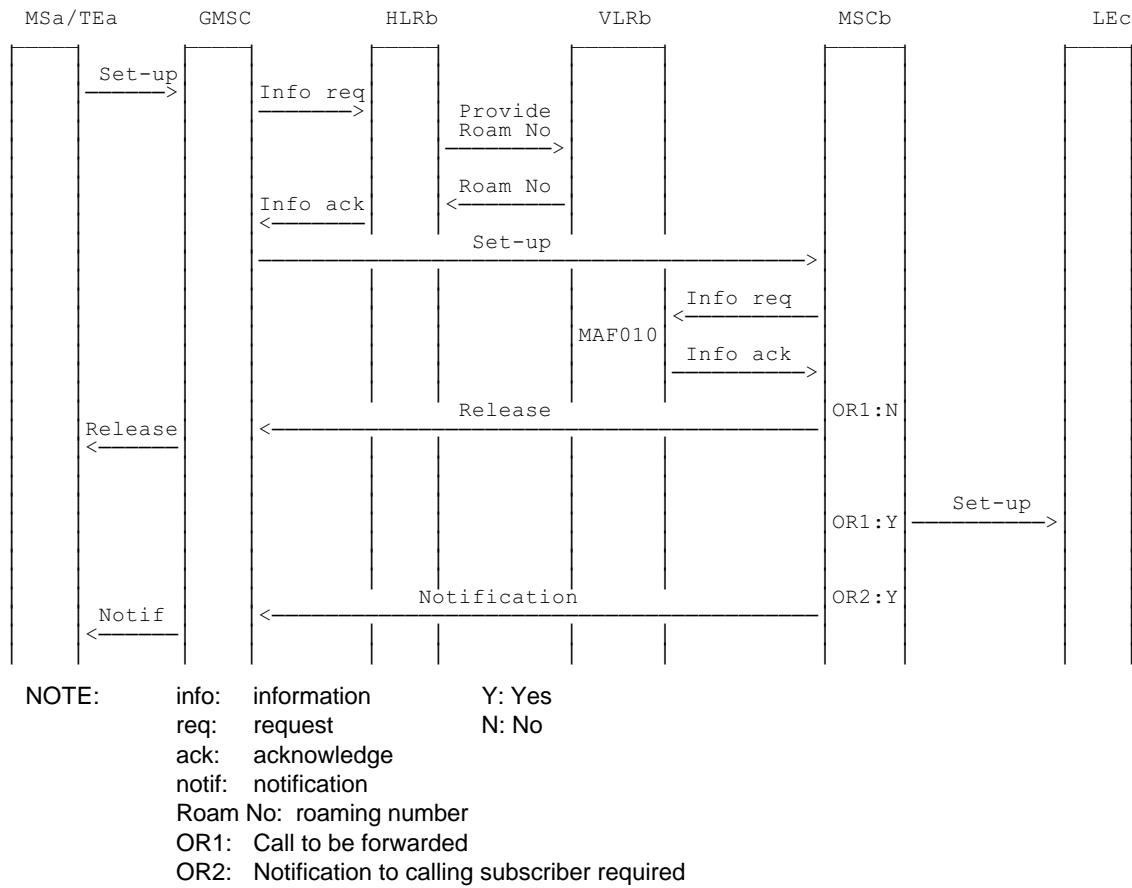
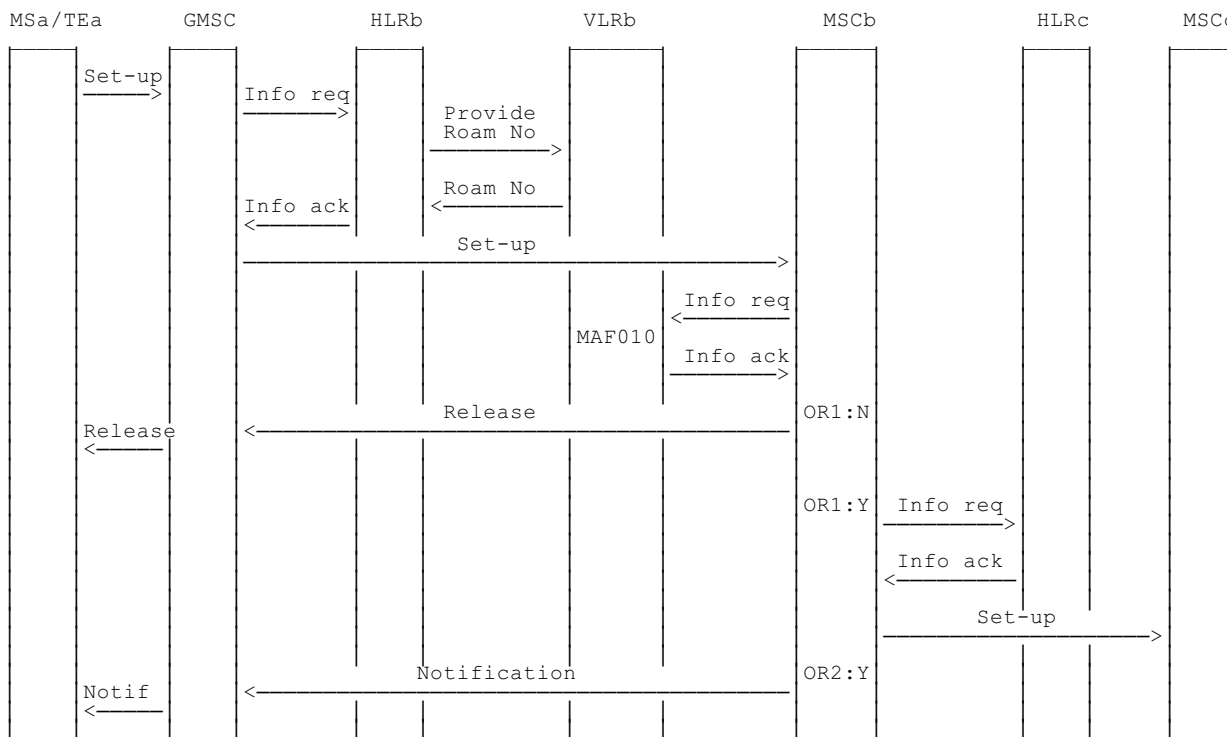


Figure 4.11: Information flow for call forwarding on mobile subscriber not reachable in case of mobile subscriber not reachable in the VLR (to fixed terminal) (re-routing by VLR)



NOTE: info: information Y: Yes  
 req: request N: No  
 ack: acknowledge  
 notif: notification  
 Roam No: roaming number  
 OR1: Call to be forwarded  
 OR2: Notification to calling subscriber required

Figure 4.12: Information flow for call forwarding on mobile subscriber not reachable in case of mobile subscriber not reachable in the VLR (to mobile station) (re-routing by VLR)

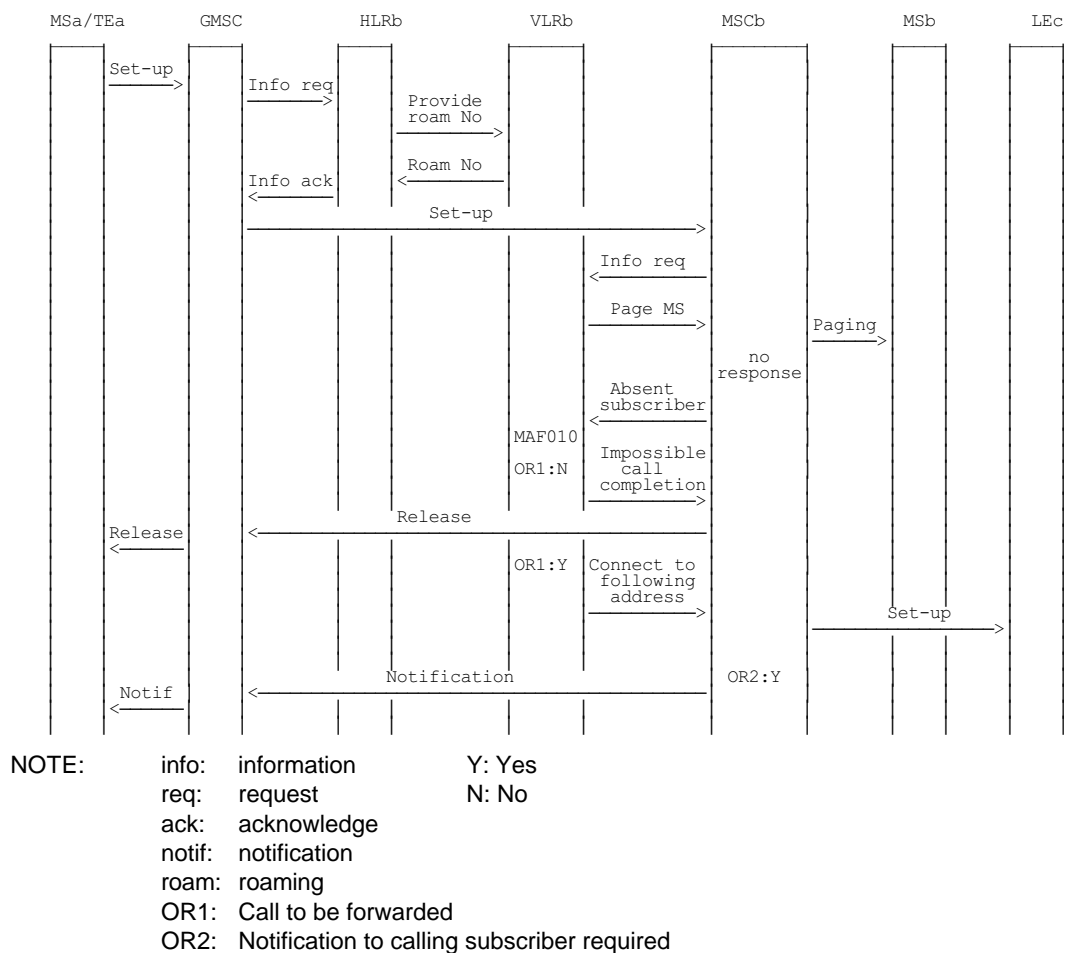


Figure 4.13: Information flow for call forwarding on mobile subscriber not reachable in case of no paging response (to fixed terminal) (re-routing by VLR)

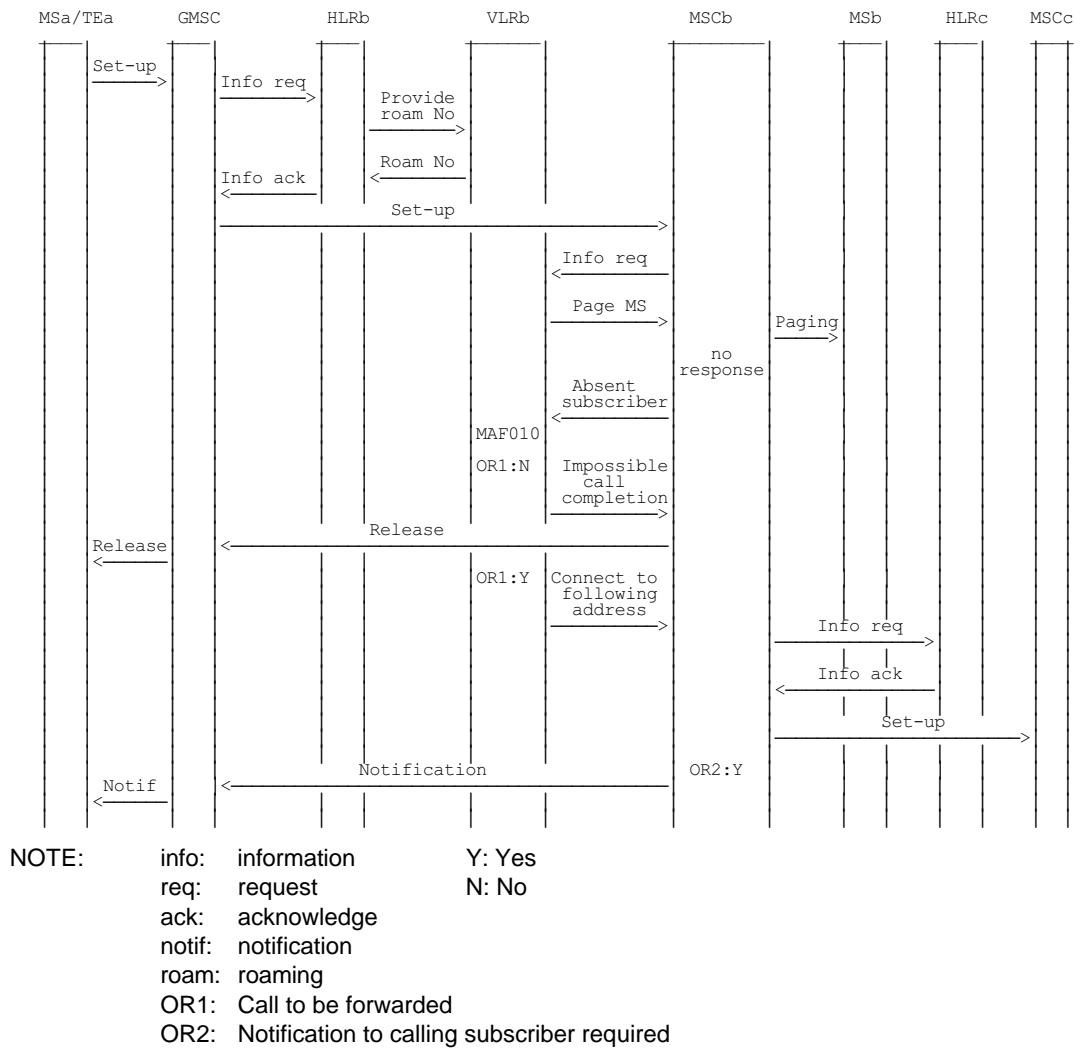


Figure 4.14: Information flow for call forwarding on mobile subscriber not reachable in case of no paging response (to mobile station) (re-routing by VLR)

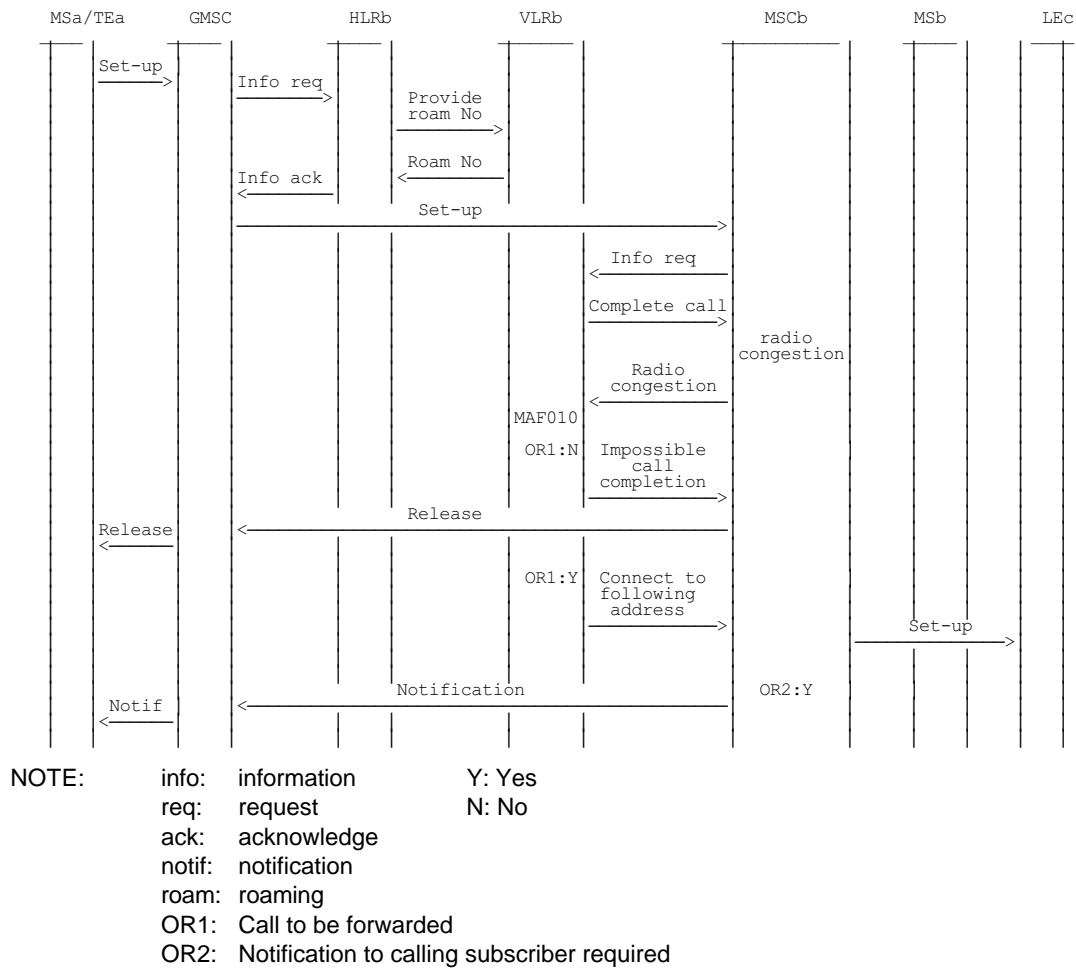
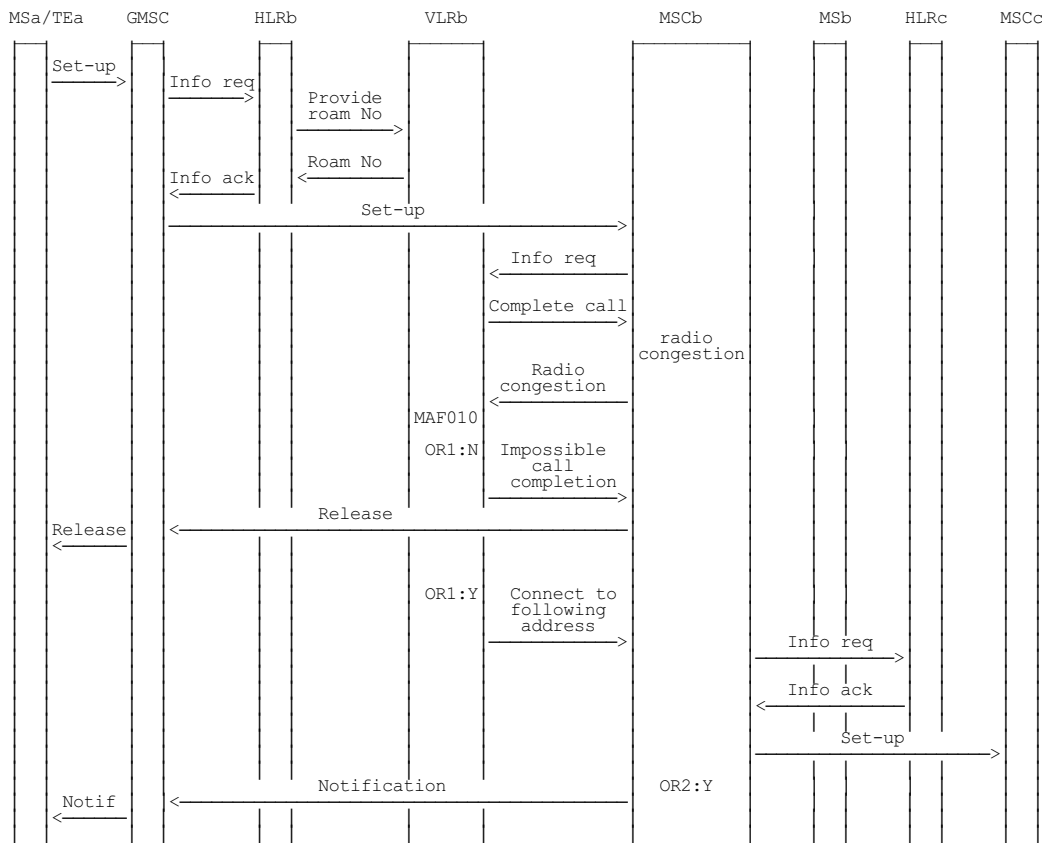
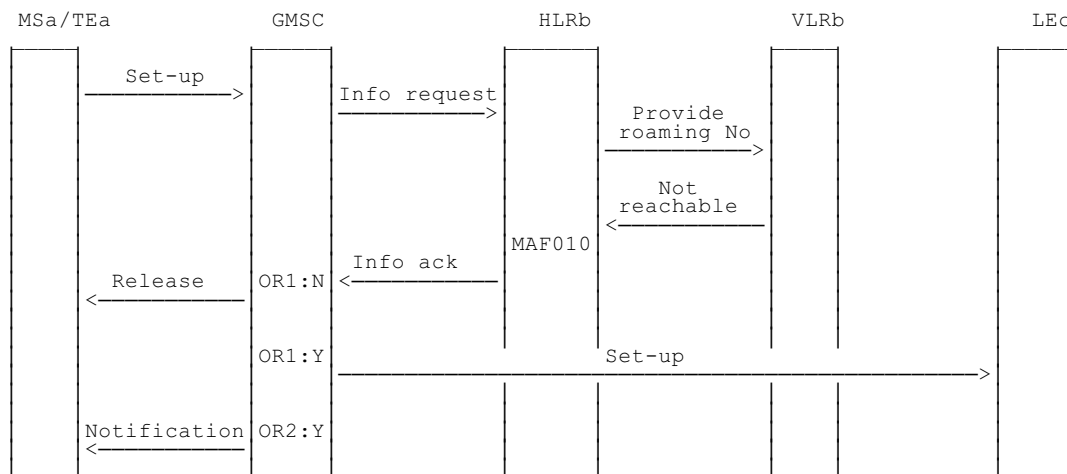


Figure 4.15: Information flow for call forwarding on mobile subscriber not reachable in case of radio congestion (to fixed terminal) (re-routing by VLR)



NOTE: info: information Y: Yes  
 req: request N: No  
 ack: acknowledge  
 notif: notification  
 roam: roaming  
 OR1: Call to be forwarded  
 OR2: Notification to calling subscriber required

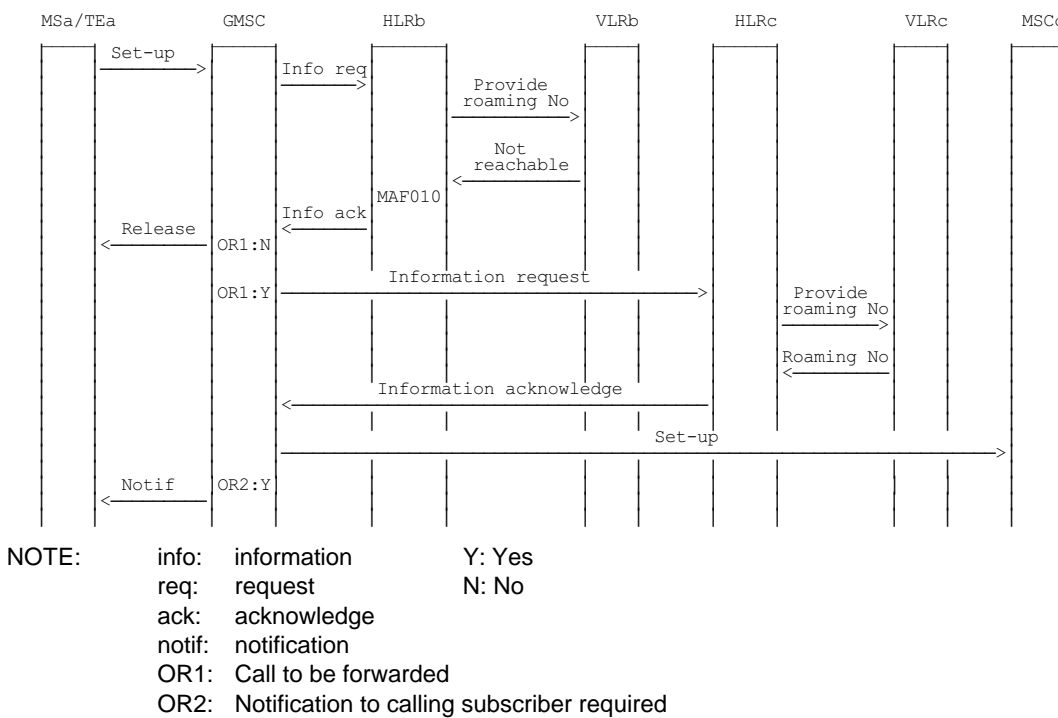
Figure 4.16: Information flow for call forwarding on mobile subscriber not reachable in case of radio congestion (to mobile station) (re-routing by VLR)



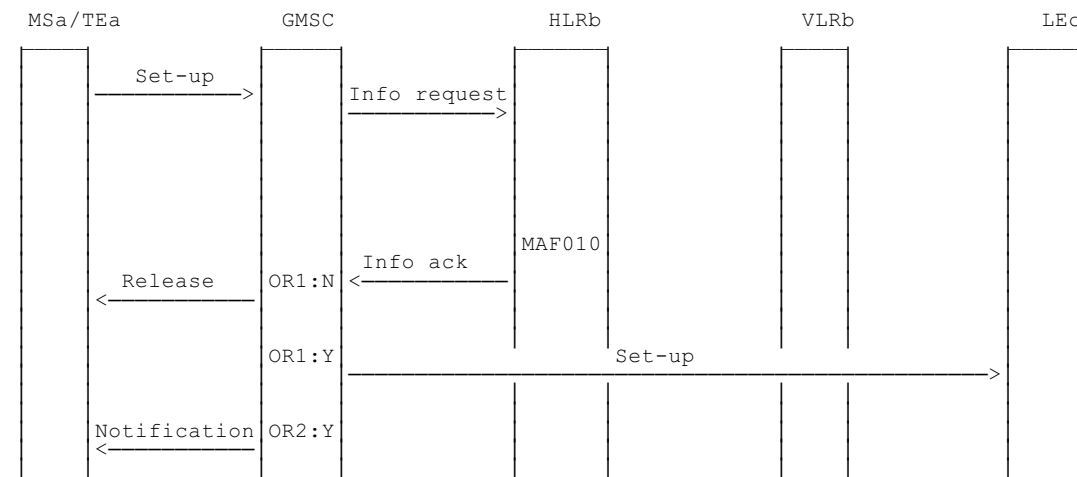
NOTE: info: information Y: Yes  
 ack: acknowledge N: No  
 OR1: Call to be forwarded  
 OR2: Notification to calling subscriber required

**Figure 4.17: Information flow for call forwarding on mobile subscriber not reachable in case of mobile subscriber not reachable in the VLR (to fixed terminal) (re-routing by HLR)**



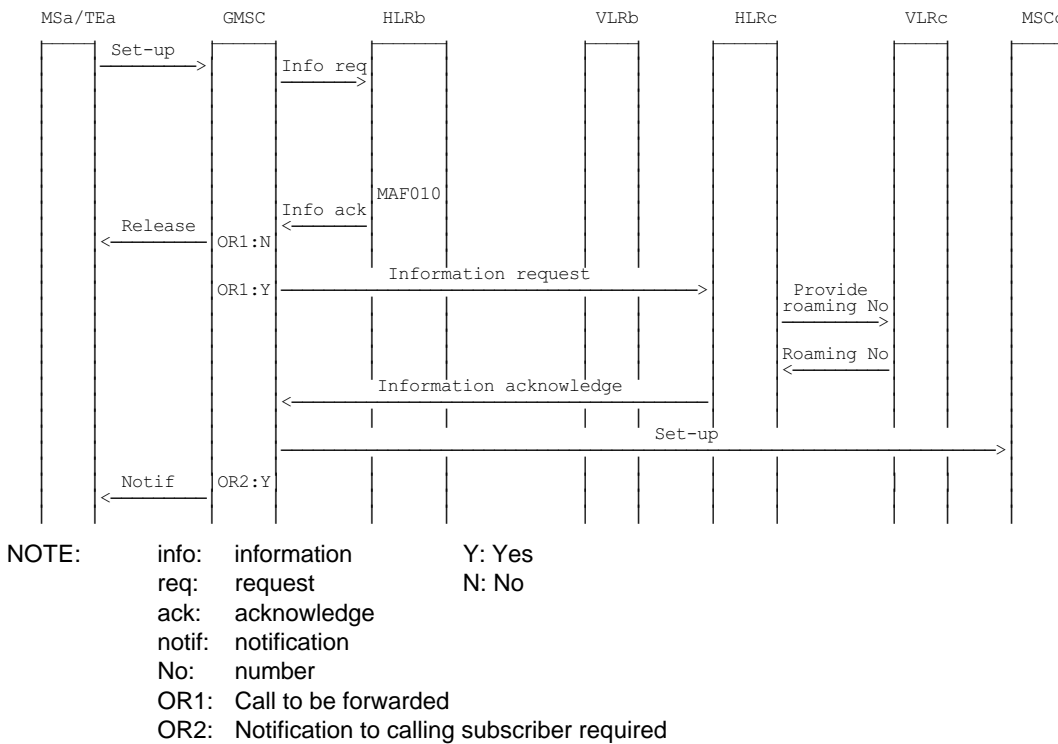


**Figure 4.18: Information flow for call forwarding on mobile subscriber not reachable in case of mobile subscriber not reachable in the VLR (to mobile station) (re-routing by HLR)**



NOTE: info: information Y: Yes  
 ack: acknowledge N: No  
 OR1: Call to be forwarded  
 OR2: Notification to calling subscriber required

**Figure 4.19: Information flow for call forwarding on mobile subscriber not reachable in case of mobile subscriber deregistered or purged (to fixed terminal) (re-routing by HLR)**



**Figure 4.20: Information flow for call forwarding on mobile subscriber not reachable in case of mobile subscriber deregistered or purged (to mobile station) (re-routing by HLR)**

### 4.3 Information stored in the HLR

The following logical states are applicable for CFNRc (refer to GSM 03.11 for an explanation of the notation):

<b>Provisioning State</b>	<b>Registration State</b>	<b>Activation State</b>	<b>HLR Induction State</b>
(Not Provisioned,	Not Registered,	Not Active,	Not Induced)
(Provisioned,	Not Registered,	Not Active,	Not Induced)
(Provisioned,	Registered,	Not Active,	Not Induced)
(Provisioned,	Registered,	Active and Quiescent,	Not Induced)
(Provisioned,	Registered,	Active and Operative,	Not Induced)

The registration and activation state may be different for each applicable elementary basic service group.

The provisioning state shall be on a per subscriber basis, and hence the same for all basic service groups.

The HLR shall store:

- the state of CFNRc (which shall be one of the valid states listed above) for each applicable elementary basic service group;
- the subscription option "notification to the calling party" on a per subscriber basis;  
This subscription option takes one of the following values:
  - no notification;
  - notification.
- the registration parameter "forwarded-to number" (possibly including a forwarded-to sub-address) for each applicable elementary basic service group;

#### 4.4 State transition model

The following figure shows the successful cases of transition between the applicable logical states of CFNRc. The state changes are either caused by actions of the service provider, the mobile user or the network.

Note that error cases are not shown in the diagram as they normally do not cause a state change. Additionally, some successful requests may not cause a state change. Hence, they are not shown in the diagram.

The diagram only shows operations on an elementary basic service group.

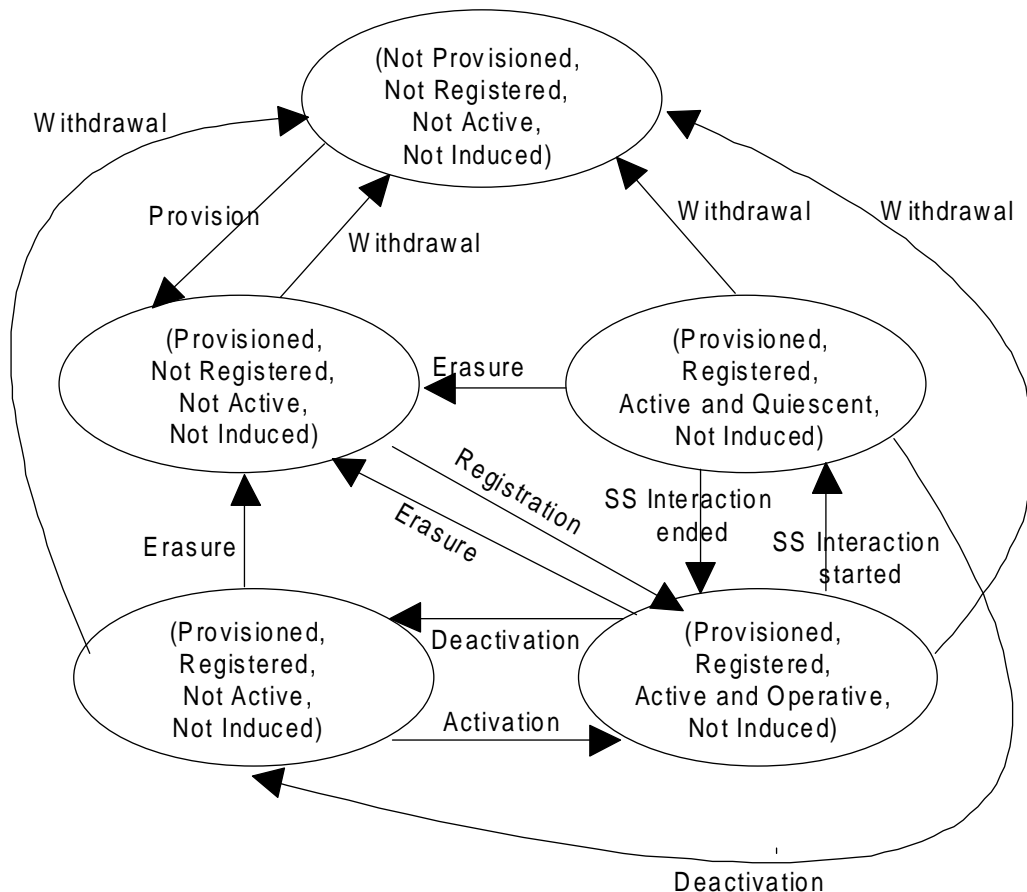


Figure 4.21: State transition model for CFNRc

#### 4.5 Transfer of information from HLR to VLR

If the provisioning state for CFNRc is "Provisioned" then, when the subscriber registers on a VLR, the HLR shall send that VLR information about the logical state of CFNRc for all relevant elementary basic service groups.

If the registration state for CFNRc is "Registered" then, when the subscriber registers on a VLR, the HLR shall send that VLR the registration parameter "forwarded-to number" for all relevant elementary basic service groups and information about the subscription option "notification to the calling party".

If the logical state or the registration parameter "forwarded-to number" of CFNRc is changed while a subscriber is registered on a VLR then for the affected basic service groups, the HLR shall inform the VLR respectively of the new logical state or the new registration parameter of CFNRc.

If information about the subscription option "notification to the calling party" of CFNRc is changed while a subscriber is registered on a VLR and the registration state of CFNRc is "Registered" then the HLR shall inform the VLR of the new information about the subscription option of CFNRc.

#### 4.6 Information stored in the VLR

For CFNRc the VLR shall store the service state information, the registration parameter "forward-to number" and the subscription options received from the HLR.

#### 4.7 Handover

Handover will have no impact on the control procedure and the operation of the service.

#### 4.8 Cross phase compatibility

##### 4.8.1 MS, MSC, VLR or HLR only support Phase 1 control of SS by the subscriber

In response to a CFNRc interrogation request, if the MS or any network element involved is of Phase 1, only information concerning basic service groups for which the activation state has the value "Active and Operative" will be returned. This means that the subscriber will not be aware that the forwarded to number is registered if CFNRc is deactivated or active (quiescent). A subaddress (if registered) will not be included.

Note that if any network element involved is of Phase 1, CFNRc Registration requests which use a subaddress and all CFNRc Activation and Deactivation requests will be rejected, as these are not specified in Phase 1.

##### 4.8.2 HLR only supports Phase 1 updating of subscriber information

If the VLR receives the SS-Status parameter from a Phase 1 HLR it shall act if it has received the SS-Status parameter with the values shown in the following:

- 1) Registered, Activated => P bit = 1, R bit = 1, A bit = 1, Q bit = 0;
- 2) Registered, Deactivated => P bit = 1, R bit = 1, A bit = 0, Q bit = 0 or 1;
- 3) Erased => P bit = 1, R bit = 0, A bit = 0, Q bit = 0 or 1.

##### 4.8.3 VLR only supports Phase 1 updating of subscriber information

When passing CFNRc information to a Phase 1 VLR, the HLR shall send the service state information in a form which the VLR can accept, based on the logical state held in the HLR, as follows:

- 1) (Provisioned, Not Registered, Not Active, Not Induced)  
=> Erased, Deactivated;
- 2) (Provisioned, Registered, Not Active, Not Induced)  
=> Registered, Deactivated;
- 3) (Provisioned, Registered, Active and Operative, Not Induced)  
=> Registered, Activated;
- 4) (Provisioned, Registered, Active and Quiescent, Not Induced)  
=> Registered, Deactivated.

The HLR shall not pass a subaddress to a Phase 1 VLR.

##### 4.8.4 GMSC only supports Phase 1 call handling

When a call is forwarded on not reachable at the GMSC, the HLR shall not pass the subaddress to a Phase 1 GMSC. Calls shall be forwarded without the subaddress.

##### 4.8.5 VLR only supports Phase 1 call handling

When a call is forwarded on not reachable at the VMSC, as the HLR does not pass the subaddress to the VLR, calls shall be forwarded without the subaddress.

**History**

<b>Document history</b>	
December 1996	Publication of GSM 03.82 version 5.0.0