REFERENCE F 10 T 6002 4	
Company / organisation	**UIC ERTMS/GSM-R Operators Group** **GSM-R Industry Group**

FFFS FOR

CONFIRMATION OF HIGH PRIORITY CALLS

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EVOLUTION SHEET

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B	20/08/1996	AMC	Editorial changes and SMS usage added
C	09/09/1996	AMC	Editorial changes
1	25/09/1996	AMC	First approved version
1 A	14/04/1997	KAPSCH	Stage 3 incorporated: SMS removed, more detailed SDL charts
1 B	17/06/1997	KAPSCH	Comments of review incorporated
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3.02	31/03/2006	Siemens TS	Update after internal review
3.1	04/04/2006	Siemens TS	Submission to UIC
3.11	09/10/2006	Siemens TS	Update after UIC (OG) comments
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1. Scope

This Form Fit Functional Specification (FFFS) specifies the functions required from the GSM-R network for the confirmation of high priority calls. Defined in this FFFS are :

- The mobile application process including the data to be sent to Acknowledgement Centre
- The fixed application process

Not defined in this FFFS

- The interface to the Acknowledgement Centre

The confirmations are recorded by an Acknowledgement Centre to ensure the ability of **post-incident analysis**. The Acknowledgement Centre itself is external to the GSM-R network and therefore not within the scope of this specification. Only functional requirements for such a device are mentioned in order to describe the total functionality of the realised service.

The confirmation of high priority calls ensures an automatic confirmation of high priority voice broadcast and voice group calls, particularly of emergency calls, to an Acknowledgement Centre.

The location dependent addressing according to [1] serves for the addressing of the confirmation message to the correct Acknowledgement Centre.

2. Normative References

[1] MORANE FFFS for Location Dependent Addressing F 10 T 6001
[2] MORANE FIS for Confirmation of high priority calls F 12 T 6002 4
[3] MORANE FFFS for Presentation of Functional Numbers, Ref.: F 10 T 6003 4
[4] MORANE FFFIS for GSM-R SIM cards, Ref.: P 38 T 9001 4
[5] ETSI ETS 300 403-1, Integrated Services Digital Network (ISDN);Digital Subscriber Signalling System No. one (DSS1) protocol; Signalling network layer for circuit-mode basic call control; Part 1: Protocol specification
[6] ETSI EN 301 515 Requirements for GSM operation on Railways, version 2.3.0
[7] ETSI TR 102 281 Detailed requirements for GSM operation on Railways, version 2.0.0

3. Definitions and Abbreviations

3.1. Definitions

Application	Logical and/or physical entity that controls the confirmation process. It will have access to services of the GSM-R network at interfaces provided by the mobile termination (mobile application) and/or a fixed network user terminal (fixed network application). The fixed network application is realised by the Acknowledgement Centre(AC).
Ready to Receive State	State of the mobile termination after the voice broadcast or voice group call traffic channel has been set up and the mobile is ready to receive the broadcast or group call speech-information.
Post-Incident Analysis	Analysis that will **not** be done on-line, but triggered by some special events (e.g. post investigation of accidents). Not a time critical feature.
active FNR	active Functional number, in the case of a mobile registered to more than one FNR the active one is the one which would also be presented by the service 'Presentation of Functional Numbers'
Clear-Down	The mobile termination disconnects from the call this clear down can be caused by normal call termination, leaving the service area or radio link failure.

3.2. Abbreviations

AC	Acknowledgement Centre
BSS	Base Station System
CLI	Calling Line Identity
EF	Elementary File (on SIM)
ETSI	European Telecommunications Standard Institute
FFFS	Form Fit Functional Specification
FIS	Functional Interface Specification
FNR	Functional Number
GC_REF	Group Call reference (parameter in confirmation message)
GMSC	Gateway MSC
GSM	Global System for Mobile Communications
GSM-R	GSM Railways
ISDN	Integrated Service Digital Network
MA	Mobile Application
MORANE	Mobile Radio for Railway Networks in Europe
MSC	Mobile Switching Centre
MSISDN	Mobile Station International ISDN Number
MT	Mobile Termination
PABX	Private Automatic Branch eXchange
SAPI	Service Access Point Identifier
SIM	Subscriber Identity Module

UUIE	User-User Information Element
UUS1	User-to-user Signalling Service #1
VLR	Visitor Location Register

4. Main Concepts

The necessity to acknowledge a voice broadcast or voice group call can be indicated to the mobile application in two different ways:

- *Explicit indication*: The confirmation flag is set in the notification message of an incoming broadcast/group call.
- *Implicit indication*: By the incoming call priority level, evaluated by the mobile application, when no flag is available.

Which outgoing VBS and VGCS calls have to be confirmed is dependent on the priority level evaluated by the mobile application.

In order to avoid the necessity to implement synchronised clocks on all trains, no absolute time stamps but only relative values are used in the confirmation message.

All together the following parameters are recorded by the confirmation message:

- Identity of the sender
- Whether the sender was the initiator or the recipient of the VGCS/VBS call
- Duration of the call
- Time since *Clear-Down* of the call
- Group call reference according to [6] & [7]
- Priority level of the broadcast/group call
- Cause of termination

The parameter *Duration of the call* defines the time in-between *Ready to Receive State* and *Clear down* of the voice broadcast or voice group call.

After *Clear down* the mobile application starts the confirmation process by automatically originating a call.

In order to avoid network congestion, due to simultaneous calls of mobile terminals, the call set-up of each mobile is delayed by a random time offset between 0 and a maximum value. Therefore immediately after each individual subscriber has disconnected from the broadcast/group call (*Clear-Down*), a random timer is started. After the expiry of this timer, the associated mobile application sends the confirmation message to an Acknowledgement Centre (AC) using the telecommunication service of the GSM-R network UUS1.

The priority of the confirmation message has to be lower than the priority of a broadcast/group call to ensure that the confirmation message can always be interrupted by a new broadcast/group call.

For routing the confirmation message to the appropriate Acknowledgement Centre (AC) the mechanism of 'location dependent addressing' is used (see Ref [1]). The short code of the AC is stored on the SIM in $EF_{CallConfC}$ (Ref. to [4]). One Acknowledgement Centre will be situated per MSC zone . That means the address of the Acknowledgement Centre to be called always depends on the MSC area where the mobile subscriber is located. In the case that a subscriber changes from one MSC area to another during a priority call, the decision for the call routing

of the confirmation message always depends on the location of the mobile subscriber when sending the confirmation message and **not** that when taking part in the call.

The Acknowledgement Centre has to calculate the absolute call establishment time and *Clear-Down* time of the call itself by using the parameters included in the confirmation message.

5. General Architecture

For group or broadcast incoming calls, which are identified by a confirmation flag in the notification message, the mobile terminations are informed that they have to confirm the message. The confirmation flag is included within the NOTIFICATION messages according to [6] & [7]. If no confirmation flag is available the priority level of the incoming broadcast/group call shall be used to determine the necessity of confirming the call.

For outgoing broadcast/group call, only the priority level (the one assigned by the MSC) shall be used to determine whether the call has to be confirmed or not.

For the transfer of the confirmation message the standard GSM Supplementary Service UUS1 (refer to [6] & [7]) shall be used. The entities involved in the realisation of the confirmation service are shown in the following figure.

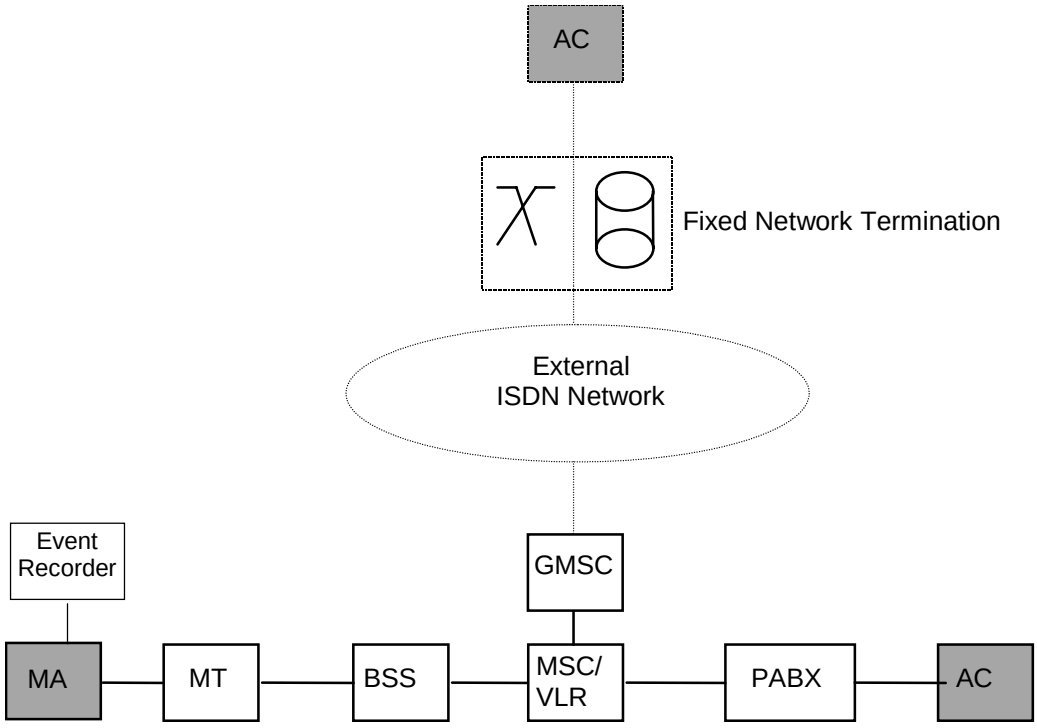


Figure 1 Functional Architecture

NOTE: The functional architecture is only indicative. Normally the Acknowledgement Centre is an application resident in a fixed network Terminal Equipment that uses a PABX as fixed Network Termination directly connected to the MSC However, it may also be logically co-located to the fixed Network Termination or co-located with the MSC. The MSC and GMSC may also be co-located.

Considering this functional architecture an end-to-end protocol between the MT and the fixed network Terminal Equipment based on the standard GSM supplementary service UUS1 is defined in this FFFS. The external network must support the transfer of user-to-user information.

6. Supplementary Service UUS1

The Supplementary Service UUS1 (Ref. to [6] & [7]) enables the transfer of user-to-user information during set-up and clearing phases of a call, with user-to-user information embedded within call control messages. This service allows the transmission of 32 octets per message (although more octets are possible in GSM networks only 32 octets are guaranteed to be transmitted via ISDN networks).

6.1. Functional Message Definition

The SETUP message may contain a user-user information element (optional) according [6] & [7]. This user-user information element shall be used for the transfer of the confirmation message to the Acknowledgement Centre. The usage of the user-user information element implicitly invokes the UUS1 supplementary service. The supplementary service UUS1 shall be activated in the HLR by default for all SIMs used on cab radios.

Beside the SETUP message the ALERTING, CONNECT, DISCONNECT, RELEASE and RELEASE_COMPLETE messages may also contain a user-user information element according (Ref. to [6] & [7]). These messages could be used to acknowledge the reception of a confirmation message towards the mobile application. This service shall use for acknowledgement of the confirmation message either RELEASE_COMPLETE or DISCONNECT message. The pair SETUP-RELEASE COMPLETE is the fastest way to use the layer 3 protocol, without assigning any traffic-channels, but in practice this sequence is impossible to guarantee because the ISDN between the AC and the GMSC may insert additional signalling messages such DISCONNECT.

6.2. Interaction with Other GSM Supplementary Services

The supplementary service *Calling Line Identification Presentation* (CLIP) is used in addition to UUS1 to provide the MSISDN of the calling subscriber to the Acknowledgement Centre beside the functional address that is already contained in the confirmation message. The usage of CLIP is necessary to store all the relevant data in one entity, without having the need to examine additional records in case of post-incident analysis.

6.3. Signalling Flow

Confirmation of the acknowledgement message (UUS1-acknowledge) can be sent either in RELEASE_COMPLETE or in DISCONNECT message towards the MS, which shall accept either message. It is preferable for the AC to use the RELEASE_COMPLETE message for the UUS1 acknowledgement, but the remote fixed network might insert additional signalling (such as CALL PROCEEDING) on its connection to the GMSC that requires the return of a DISCONNECT before the call can be released.

The message flow is indicated below:

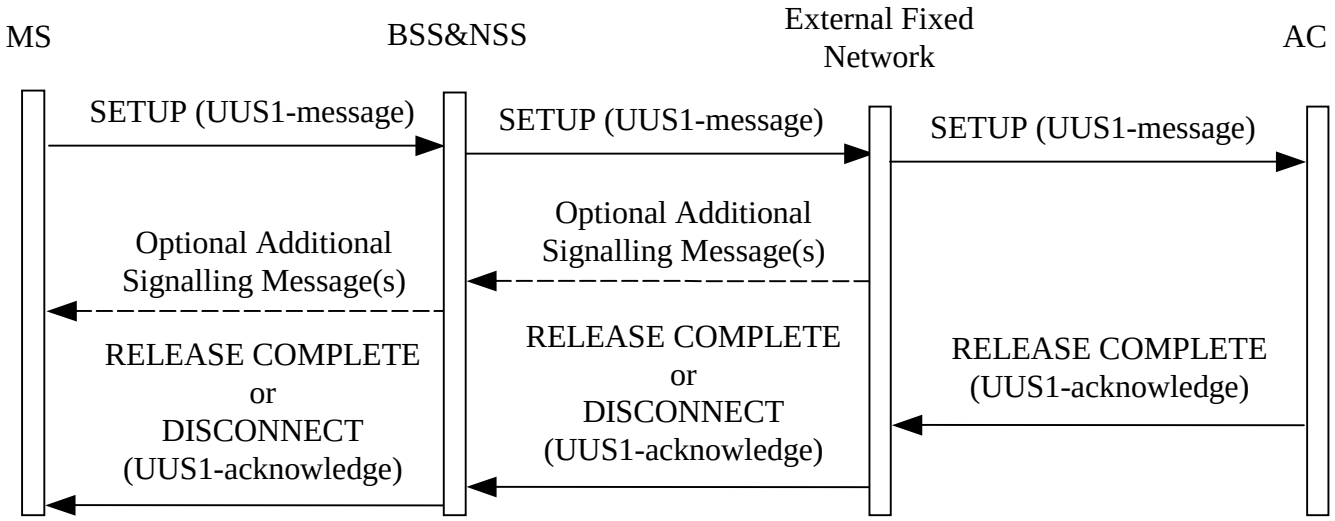


Figure 2 Overview of Message flow with User-to-User information

6.4. Normal Operation with Successful Outcome

The user-to-user information is transferred transparently embedded in signalling messages towards the fixed network Terminal Equipment. If an external network is used, it shall support the transfer of user-to-user information.

The Acknowledgement Centre fixed network application resident in the fixed network Terminal Equipment shall clear the call and shall acknowledge the received user-to-user information using the user-user information element of the RELEASE COMPLETE message.

The procedure is under control of the mobile application, even though the call is always cleared by the Acknowledgement Centre fixed network application. On receipt of the positive acknowledgement in either the RELEASE COMPLETE or DISCONNECT message the mobile application considers the confirmation procedure as successful.

6.5. Exceptional Procedures or Unsuccessful Outcome

If no acknowledgement message has been received by the mobile application, despite the call having been cleared (e.g. due to network congestion or radio link failure), the mobile application shall repeat the procedure by setting up an other call using an updated confirmation message (see section 7.1.2).

If a negative acknowledgement message is received by the mobile application, there are two cases to distinguish (see TASK MS-2 part3):

- negative acknowledgement #1 (NACK1) indicates a repairable error , the mobile shall repeat the confirmation (as long as the maximum repetition value is not reached) using an updated confirmation message,

- negative acknowledgement #2 (NACK2) indicates a fatal error, the mobile shall not repeat but instead shall store an error locally on an event recorder.

If the signalling of the confirmation call cannot be completed (e.g. interruption of the call by a call with higher priority) the mobile application shall repeat the procedure by setting up a call using an updated confirmation message after termination of the preceding signalling relationship. When more than one confirmation is pending the earliest call shall be confirmed first.

7. Applications

The applications are associated with the mobile termination (mobile application) or with the fixed network user terminal (fixed network application). Refer to section 3.1.

The functions required from the applications are specified below:

Mobile application:

- Provision of functional called party number when initiating the call
- Provision of the confirmation message
- Acceptance of the confirmation acknowledgement
- Procedure control (normal and exceptional procedures)
- Repetition of the AC response

Fixed network application:

- Clearing of incoming confirmation call with acknowledgement in the UUIE
- Recording of the confirmation message
- Calculation of absolute time stamps
- Recording of the corresponding CLIP
- Recording the reception time of the confirmation message

7.1. Mobile Application

The mobile application uses service point SAP_M for access to the Call Control sublayer (see figure 4) of the mobile termination to set-up a mobile originated call for the transfer of the confirmation message. This service access point may be provided by an AT command interface according to [6] & [7].

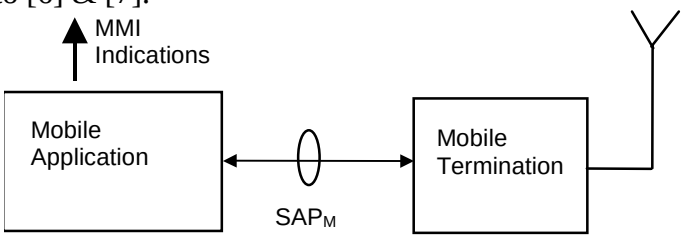


Figure 3 Mobile Application connected with MT

7.1.1. Storage of Configuration Data

The mobile application has to be initialised with configuration data:

- Priority level, which triggers confirmation procedure in the absence of the acknowledgement flag in call notification (PL_ACK)
- Time-out for call clearing (T_ACK)
- Number of repeated attempts in case of unsuccessful outcome (N_ACK)
- Priority level of the confirmation call itself (PL_CONF)
- Number of the AC using location depending addressing (CONF_NR)

7.1.2. Confirmation Procedure

Group or broadcast calls, which are identified by an acknowledgement flag in the notification message or have a priority level greater than certain threshold PL_ACK, shall be confirmed. Triggered by the *Ready to Receive Event* the mobile application starts a timer T_DUR to record the duration of the group or broadcast call. Additionally the mobile's own Functional Number is stored. In case of a registration of more than one Functional Number the same selection-algorithm as used by the service 'Presentation of Functional Numbers' applies (refer to [3]).

After disconnecting from (or terminating) the broadcast/group call (*Clear Down*), the associated mobile application stops timer T_DUR. Immediately a timer T_REL shall be started, that records the time since call clearing. Also a timer T_RAN shall be started that causes a random delay to avoid congestion. The initial value of T_RAN shall be generated each time the timer is started and shall lie in the range 0 to MAX_RAND with an equal probability distribution.. After expiration of T_RAN the mobile application shall determine a functional number according the location dependent addressing scheme and provide the confirmation message to the mobile termination with the contents according to the value T_DUR and the actual value T_REL. The call to the Acknowledgement Centre shall be set-up and the timer T_ACK is started, during which an answer to the confirmation message is expected.

If a positive acknowledgement of the confirmation message (UUS1) is received, all running timers shall be stopped and the procedure is recorded as successfully finished.

In all other cases except the reception of NACK2 (in case of reception of NACK1, time-out of T_ACK or radio resource failure) the call shall be cleared and the procedure repeated after re-initialisation of the appropriate parameters (T_REL is continually running and its actual value can be used in an updated confirmation message).

If another call which has to be confirmed arrives before the confirmation of the previous call has been finished all the relevant data for the confirmation shall be stored and an updated message shall be sent after the new call is ended (after expiry of the random timer which shall be started again). In any case the order of the transmission of the confirmations shall be same as the order of the calls being confirmed.

If the mobile has no network connection for any reason the repetition mechanism shall be frozen and restarted when the mobile is able to reach the network again. This is to prevent useless attempts in case of failure of a single BTS or in regions with no overall GSM coverage. A similar mechanism applies for powered off mobile stations: after power on the mobile shall restart to confirm remaining entries if there are any. For this reason non volatile memory for the pending confirmation table plus the provision of timers which do not stop counting in case of power failure are necessary.

If the procedure cannot be finished successfully after N_ACK_MAX attempts the unsuccessful outcome is recorded locally on the event recorder by the mobile application as an exceptional incident.

For cab radios every unsuccessful outcome of a confirmation message shall be recorded in an event recorder for post-incident analysis.

For handheld mobile radios an indication shall be given on the MMI to inform the user about an unsuccessful outcome.

7.1.3. Functional Description Using SDL Charts

The following SDL-charts show only the principal functions of the service. The separation into tasks is only to clarify the logical functionality and is not meant to imply a particular method of implementation.

Remark: Only signals relating to the acknowledgement process are shown; normal call control signalling is not included. The functionality is described for one call only, but must be implemented such that overlapping of new calls and outstanding confirmations is handled. The buffering of up to N_NESTED_MAX un-transmitted confirmations is included.

7.1.3.1. TASK MS-1:

7.1.3.1.1. Function

Triggering Confirmation:

- Deciding whether confirmation service routine has to be invoked or not
- Informing about beginning of call
- Informing about end of call

This is very likely not a standalone task, but rather a part of the layer 3 call control for group- and broadcast-calls. The basic intention of the SDL-charts is to show which information is necessary to trigger a confirmation, but not in which SW or HW entity the function is done. In this sense the definition of input-signals is problematic because it is very dependent on the task-border what is seen as an internal-signal or really as an input-signal.

7.1.3.1.2. Signals

Input-signals (from TASK MS-2):
none

Input-signals (from other sources e.g. Layer3 Call Control, refer to [6] & [7]):
Information concerning notification

(internal signals are not mentioned here)

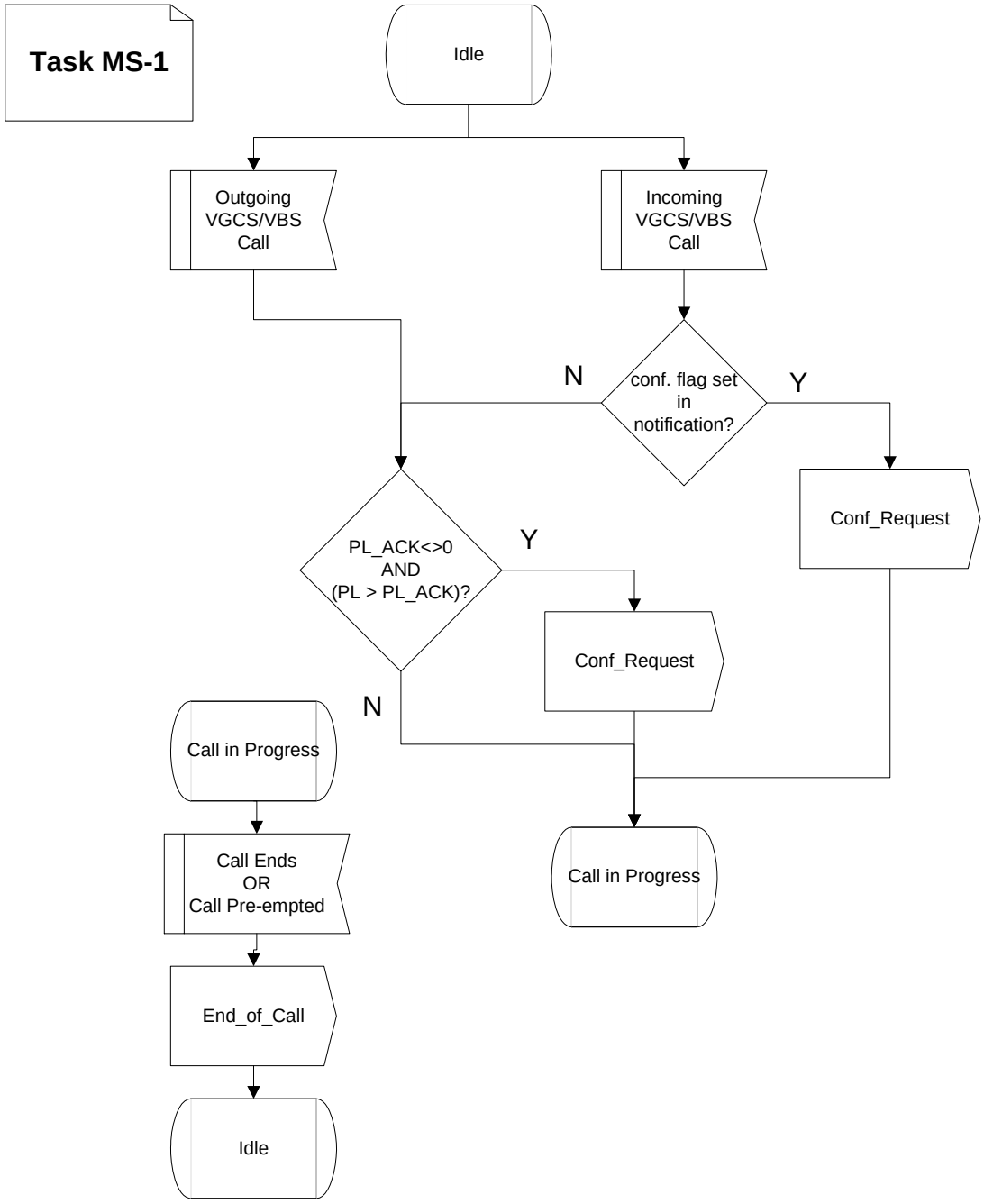
Output-signals (to TASK MS-2):
Conf._Request = Confirmation request
End_of_call

7.1.3.1.3. Global Storage

Storage of TASK MS-1 (only additional parameters mentioned):
Parameters necessary for deciding:
PL_ACK threshold value (switch for Confirmation Service enable/disable)

Information to be passed to TASK MS-2:
GC_REF
CAUSE
PL_CALL
FNR (active Functional Number)

7.1.3.1.4. SDL Chart



7.1.3.2. TASK MS-2:

7.1.3.2.1. Function

Confirmation Service Routine:

- Getting confirmation-parameters
- sending confirmation-message
- workout problems
- store confirmation data
- maintain timers
- send data to external event recorder

The signals with the prefix MNCC and their names are indicative only. Whether they are external or internal signals depends on how this function (TASK MS-2) is implemented. Their appearance in the SDL-charts indicates the triggering of the layer 3 messages SETUP, DISCONNECT and RELEASE_COMPLETE. As mentioned before the SDL-charts only show the principal functions in addition to the text description, but not implementation details.

7.1.3.2.2. Signals

Input-signals:
Conf._Request (from TASK MS-1)
End_of_call (from TASK MS-1)
MNCC_RELEASE_COMPLETE_IND (from layer 3 - Call Control refer to [6] & [7])

Internal-signals:
T_RAN_expired
T_ACK_expired

Output-signals:
MNCC_SETUP_REQ (to layer 3 - Call Control refer to [6] & [7])
MNCC_RELEASE_COMPLETE_REQ (to layer 3 - Call Control refer to [6] & [7])

7.1.3.2.3. Global Storage

For the format and values of the following parameters refer to the FIS [2]
Storage of Task MS-2:
Parameters for setting up the confirmation call (read from SIM in $EF_{CallConfC)}$:
N_ACK_MAX
MAX_RAND
PL_ACK
PL_CONF
CONF_NR

Buffer with N_NESTED_MAX - times the following:

T_DUR_s
T_REL_s
PL_CALL
CAUSE
GC_REF
FNR

7.1.3.2.4. Event Recording

In order not to overload the SDL-charts event recording is shown only in case of an error. The detailed process of event-recording is described here:
For every call to be confirmed three groups of entries are to be sent from the MA to the on board event-recorder:

(Entry #1) Immediately after reception of the signal 'Confirmation Request'
the parameters of the incoming call PL_CALL and GC_REF
plus the active value of the functional number of the mobile station (FNR)

(Entry #2) Immediately after reception of the signal 'End of call'
the measured duration of the call (value of T_DUR)
and the cause of call termination (value of CAUSE)

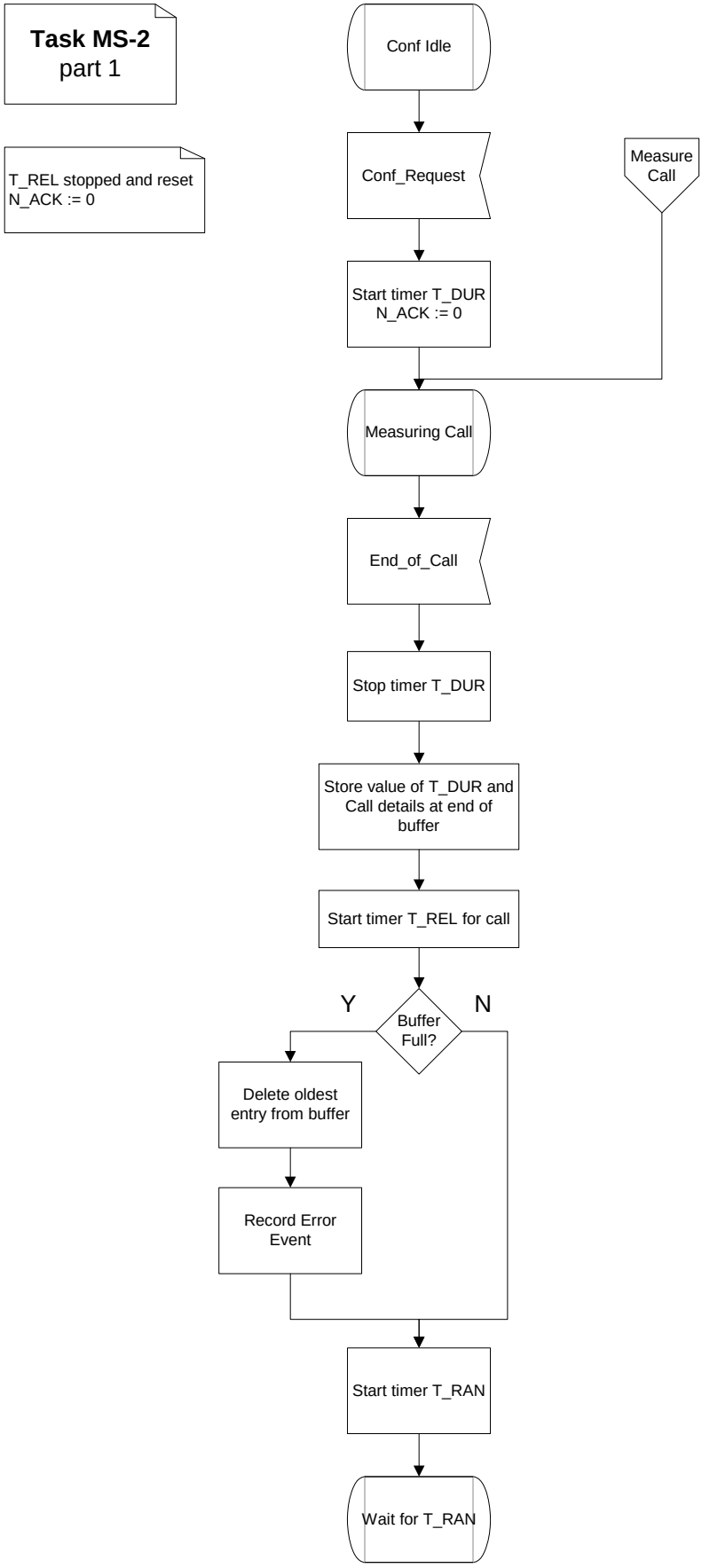
(Entry #3) Finally after reception of the acknowledgement from the AC, or in case of errors where mentioned in the SDL-chart the résumé is stored

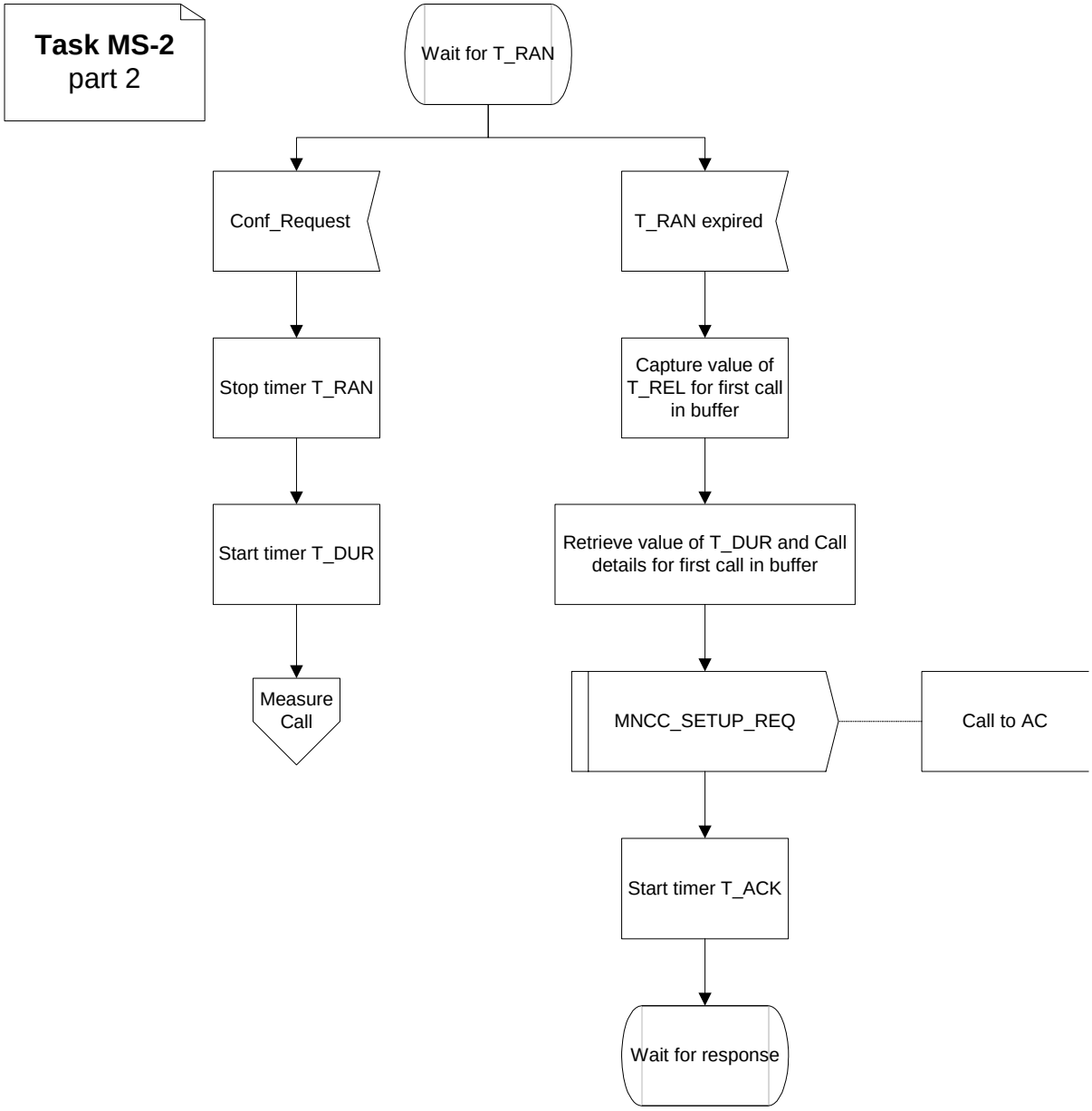
Provisions to link the three entries unambiguously have to taken.

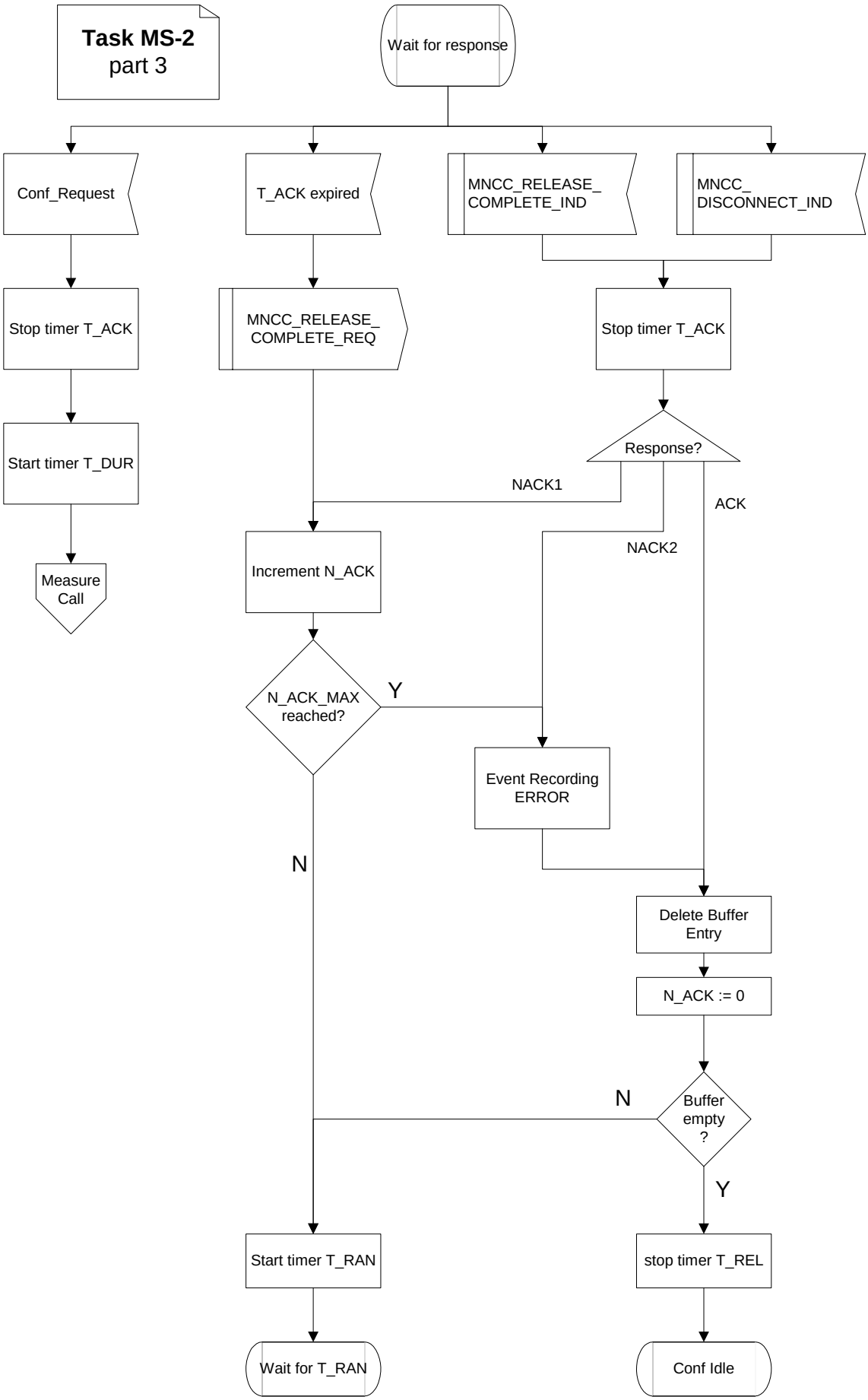
For the **format of entries #1-3** refer to the related FIS [2].

The **active functional number** is that functional number which is selected for 'presentation of functional numbers' (refer also to FFFS for Presentation of Functional Numbers [3]).

7.1.3.2.5. SDL Charts




Task MS-2
part 2
Wait for T_RAN
Conf_Request
T_RAN expired
Stop timer T_RAN
Capture value of T_REL for first call in buffer
Start timer T_DUR
Retrieve value of T_DUR and Call details for first call in buffer
Measure Call
MNCC_SETUP_REQ
Call to AC
Start timer T_ACK
Wait for response


Task MS-2
part 3
Wait for response
Conf_Request
T_ACK expired
MNCC_RELEASE_
COMPLETE_IND
MNCC_
DISCONNECT_IND
Stop timer T_ACK
MNCC_RELEASE_
COMPLETE_REQ
Stop timer T_ACK
Start timer T_DUR
Response?
NACK1
ACK
NACK2
Measure
Call
Increment N_ACK
N_ACK_MAX
reached?
Y
Event Recording
ERROR
N
Delete Buffer
Entry
N_ACK := 0
N
Buffer
empty
?
Y
Start timer T_RAN
stop timer T_REL
Wait for T_RAN
Conf Idle

7.2. Acknowledgement Centre Application

7.2.1. ISDN Access

For example a simple PABX can serve as fixed network termination (type NT2).

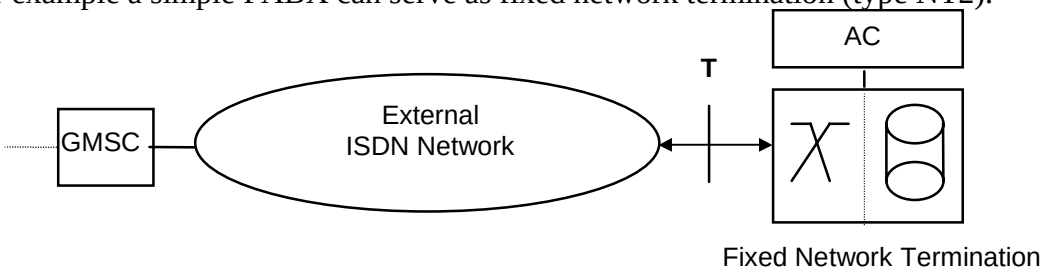


Figure 4 Acknowledgement Centre connected with Fixed Network User Termination

7.2.2. Procedures

The application has to handle the incoming confirmation calls. It shall be designed to clear the calls at the earliest possible time (e.g. answer the call with a RELEASE_COMPLETE Message according to ETS 300 403-1 [5]).

The user information for acknowledgement is inserted into the call clearing message by the application.

The user-to-user information of any incoming confirmation call shall be examined to determine if it is a confirmation message. If it is not then it shall be ignored and terminated. Absolute time stamps are determined and recorded afterwards by the Acknowledgement Centre. The variation in call set-up times leads to an inaccuracy in the calculation of absolute time stamps.

7.2.3. Functional Description Using SDL Charts

7.2.3.1. TASK AC-1

7.2.3.1.1. Function

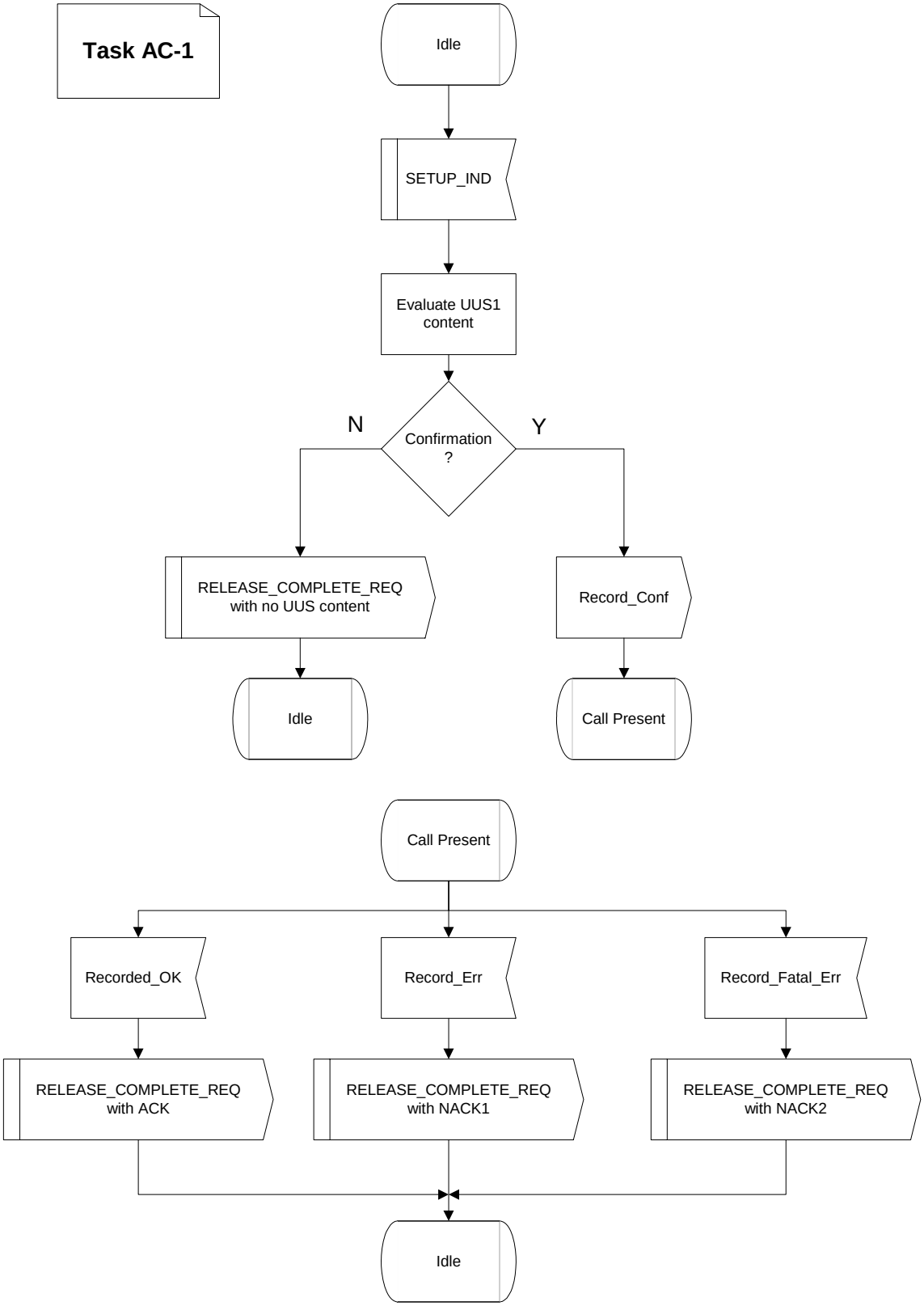
Accepting and answering confirmation calls, triggering the recording of the received data.

In case of successful storage "ACK" is sent back to the confirming mobile, in case of unsuccessful outcome either "NACK1" or "NACK2" is sent back. The latter to indicate that no repetition is allowed. Means for indication of error-states are not described here but shall be foreseen according to the respective network maintenance concept.

7.2.3.1.2. Signals

Output signal: Record_Conf. (to TASK AC-2)
Input signals:. Recorded_OK, Record_ERR, Record_Fatal_Err (from task AC-2)
All other signals as in ISDN protocol-stack, not mentioned here.

7.2.3.1.3. SDL Chart

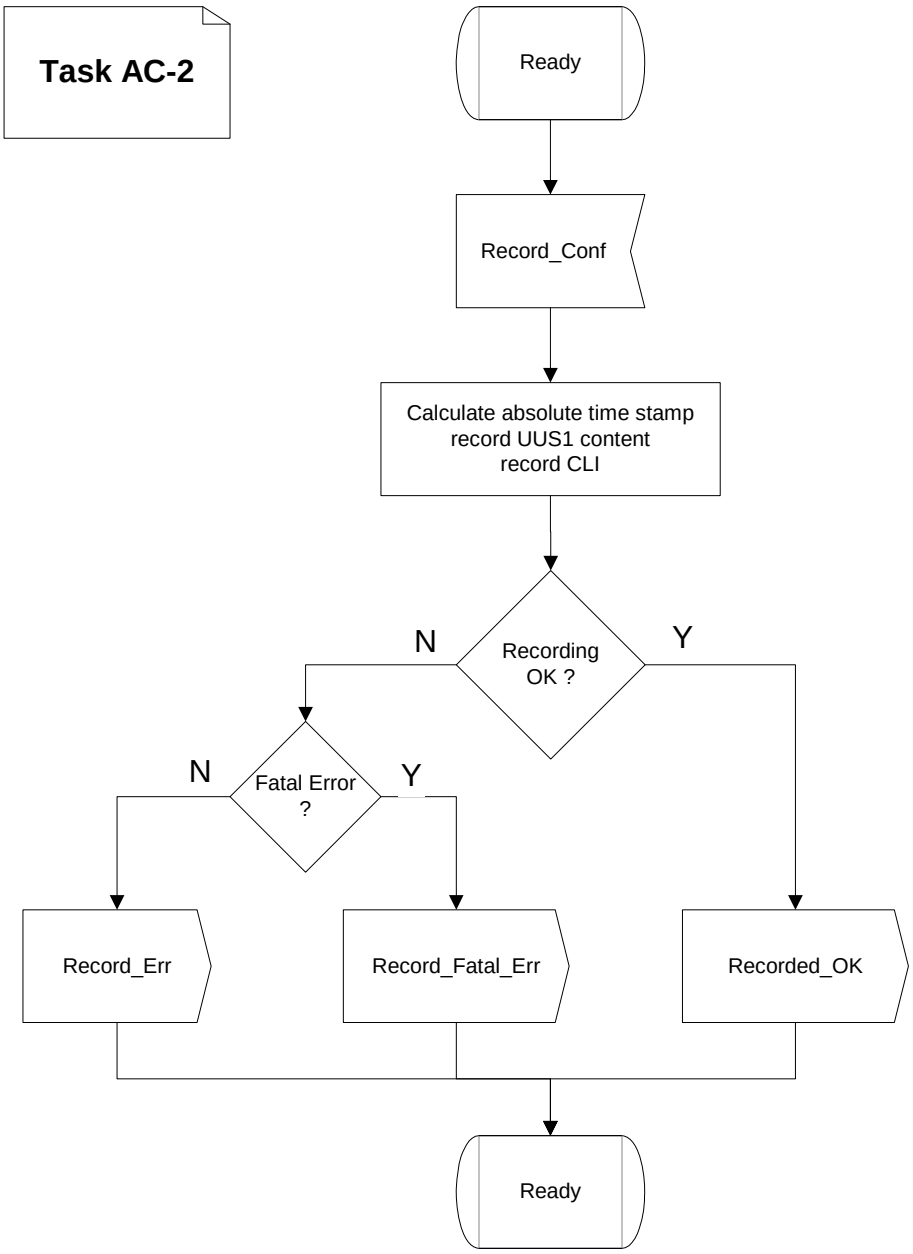


7.2.3.2. TASK AC-2

7.2.3.2.1. Function

Recording the received confirmation data and adding a time-stamp to remove the relativity of the time-information. The retrieval of the data is not described here but it should be mentioned that recording must have the higher priority over reading.

7.2.3.2.2. Signals

Input signal: Record_Conf. (from TASK AC-1)
Output signals: Recorded_OK, Record_Err and Record_Fatal_Err (to task AC-1)

7.2.3.2.3. SDL Chart