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*European Standard (Telecommunications series)*

**Terrestrial Trunked Radio (TETRA);  
Voice plus Data (V+D);  
Part 10: Supplementary services stage 1;  
Sub-part 4: Call Forwarding (CF)**

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Reference

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# Contents

Intellectual Property Rights .....	5
Foreword.....	5
Introduction .....	7
1 Scope .....	8
2 References .....	8
3 Definitions, symbols and abbreviations .....	9
3.1 Definitions .....	9
3.2 Symbols.....	10
3.3 Abbreviations .....	10
4 SS-CF generic specification .....	11
4.1 Description .....	11
4.1.1 General description .....	11
4.1.2 SS-CFU specific features .....	12
4.1.3 SS-CFB specific features .....	12
4.1.4 SS-CFN <sub>Ry</sub> specific features .....	12
4.1.5 SS-CFN <sub>Rc</sub> specific features .....	13
4.1.6 Authorized users .....	13
4.2 Procedures .....	14
4.2.1 Provision/withdrawal.....	14
4.2.2 Normal procedures.....	14
4.2.2.1 SS-CF management.....	14
4.2.2.1.1 Activation/deactivation.....	14
4.2.2.1.2 Enable/disable .....	16
4.2.2.1.3 Registration .....	16
4.2.2.1.4 Interrogation .....	16
4.2.2.2 Invocation and operation.....	17
4.2.2.2.1 SS-CF invocation and operation.....	17
4.2.2.2.2 Forwarded-to user C notification.....	18
4.2.2.2.3 Calling user A notification .....	18
4.2.2.2.4 Served user notification.....	18
4.2.3 Exceptional procedures.....	18
4.2.3.1 Activation/deactivation .....	18
4.2.3.2 Interrogation.....	19
4.2.3.3 Invocation and operation.....	19
4.3 Interactions with other supplementary services and ANFs .....	19
4.3.1 Access priority .....	19
4.3.2 Ambiance listening .....	19
4.3.3 Area selection .....	19
4.3.4 Barring of incoming calls .....	19
4.3.5 Barring of outgoing calls .....	20
4.3.6 Call authorized by dispatcher.....	20
4.3.7 Call Completion on No Reply (SS-CCN <sub>Ry</sub> ).....	20
4.3.8 Call Completion to Busy Subscriber (SS-CCBS).....	20
4.3.9 Call hold .....	21
4.3.10 Calling/Connected Line Identification Restriction (SS-CLIR/SS-COLR).....	21
4.3.11 Calling Line Identification Presentation (SS-CLIP) .....	21
4.3.12 Call waiting.....	21
4.3.12.1 Common to SS-CF .....	21
4.3.12.2 Call Forwarding Unconditional (SS-CFU).....	21
4.3.12.3 Call Forwarding On Busy (SS-CFB) .....	21
4.3.12.4 Call Forwarding on No Reply (SS-CFN <sub>Ry</sub> ) .....	22
4.3.12.5 Call Forwarding on Not Reachable (SS-CFN <sub>Rc</sub> ) .....	22
4.3.13 Call report .....	22

4.3.14	Connected Line Identification Presentation (SS-COLP) .....	22
4.3.15	Discreet listening .....	22
4.3.16	Dynamic group number assignment .....	22
4.3.17	Include call.....	22
4.3.18	Late entry .....	22
4.3.19	List search call .....	22
4.3.20	Pre-emptive Priority Call .....	23
4.3.21	Priority call .....	23
4.3.22	Short number addressing .....	23
4.3.23	Talking party identification.....	23
4.3.24	Interaction with ANF mobility.....	23
4.4	Interworking considerations .....	23
5	SS-CF overall SDL.....	24
6	SS-CFU for SDS specification .....	28
6.1	General description.....	28
6.2	Procedures .....	29
6.3	Interactions with other supplementary services and ANFs .....	29
6.3.1	Interactions with other supplementary services .....	29
6.3.2	Interaction with ANF mobility.....	29
6.4	Interworking considerations .....	29
<b>Annex A (informative): Bibliography.....</b>		<b>30</b>
History .....		31

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## Foreword

This European Standard (Telecommunications series) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

The present document is part 10, sub-part 4 of a multi-part deliverable covering Voice plus Data (V+D), as identified below:

- EN 300 392-1: "General network design";
- EN 300 392-2: "Air Interface (AI)";
- EN 300 392-3: "Interworking at the Inter-System Interface (ISI)";
- ETS 300 392-4: "Gateways basic operation";
- EN 300 392-5: "Peripheral Equipment Interface (PEI)";
- EN 300 392-7: "Security";
- EN 300 392-9: "General requirements for supplementary services";
- EN 300 392-10: "Supplementary services stage 1";**
  - ETS 300 392-10-1: "Call identification";
  - ETS 300 392-10-2: "Call report";
  - ETS 300 392-10-3: "Talking Party Identification (TPI)";
  - EN 300 392-10-4: "Call Forwarding (CF)";**
  - ETS 300 392-10-5: "List Search Call (LSC)";
  - ETS 300 392-10-6: "Call Authorized by Dispatcher (CAD)";
  - ETS 300 392-10-7: "Short number addressing";
  - ETS 300 392-10-8: "Area selection";
  - ETS 300 392-10-9: "Access priority";
  - EN 300 392-10-10: "Priority Call (PC)";
  - ETS 300 392-10-11: "Call Waiting (CW)";
  - ETS 300 392-10-12: "Call Hold (CH)";
  - ETS 300 392-10-13: "Call completion to busy subscriber";
  - EN 300 392-10-14: "Late Entry (LE)";

- ETS 300 392-10-15: "Transfer of control";
- ETS 300 392-10-16: "Pre-emptive priority call";
- EN 300 392-10-17: "Include Call (IC)";
- EN 300 392-10-18: "Barring of Outgoing Calls (BOC)";
- EN 300 392-10-19: "Barring of Incoming Calls (BIC)";
- ETS 300 392-10-20: "Discreet Listening (DL)";
- EN 300 392-10-21: "Ambience Listening (AL)";
- EN 300 392-10-22: "Dynamic Group Number Assignment (DGNA)";
- ETS 300 392-10-23: "Call completion on no reply";
- ETS 300 392-10-24: "Call Retention (CRT)";
- EN 300 392-11: "Supplementary services stage 2";
- EN 300 392-12: "Supplementary services stage 3";
- ETS 300 392-13: "SDL model of the Air Interface (AI)";
- ETS 300 392-14: "Protocol Implementation Conformance Statement (PICS) proforma specification";
- TS 100 392-15: "TETRA frequency bands, duplex spacings and channel numbering";
- TS 100 392-16: "Network Performance Metrics";
- TS 100 392-17: "TETRA V+D and DMO Release 1.1 specifications".

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## Introduction

Supplementary services specifications are produced in three stages, according to the method described in ITU-T Recommendation I.210 [2]. The present document contains the stage 1 specifications of SS-CFU, SS-CFB, SS-CFNRY and SS-CFNRC. The stage 1 descriptions specify the supplementary services as seen by users of networks.

The first edition of the present document was presented as a delta document to the first edition of ECMA-173 [1]. The second edition was redrafted based on the latest published text of ECMA-173 [1] as a self contained document so as to be more readable. Additions compared to ECMA-173 [1] were made to take into account particular TETRA specifics such as group calls and to include user requirements and situations not addressed in ECMA-173 [1].

NOTE 1: Contrary to ECMA-173 [1], the present document does not specify SS-CD (Call Deflection) which is not presently supported by TETRA.

NOTE 2: Contrary to ECMA-173 [1], distinction is needed in the TETRA environment between "no reply" and "not reachable" because of the radio nature of the TETRA links. The distinction between the two services is that in the case of SS-CFNRY, the calling user obtains an ALERT signal while in the case of SS-CFNRC, the calling user does not obtain any signal.

The present document is updated to take into account improvements to the protocol in stage 3.

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# 1 Scope

The present document specifies the supplementary services Call Forwarding Unconditional (CFU), Call Forwarding Busy (CFB), Call Forwarding on No Reply (CFNRy) and Call Forwarding on Not Reachable (CFNRc) which are applicable to various basic services supported by TETRA SwMIs. Basic services are specified in EN 300 392-2 [4].

SS-CFU, SS-CFB, SS-CFNRy and SS-CFNRc are supplementary services which apply during call establishment providing a forwarding of an incoming call to an other destination than the original destination defined by the calling user under different conditions (busy, no reply or not reachable) or under no condition (unconditional).

The present document is applicable to circuit mode TETRA V+D tele-services and bearer services. The present document is also applicable to TETRA Short Data Service (SDS), but limited to the supplementary service Call Forwarding Unconditional (CFU).

Man machine interfaces and charging principles are outside the scope of the present document.

The present document specifies also the SS-CF invocation counter, which is applicable to various basic services supported by TETRA networks.

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

- [1] ECMA-173: "Private Integrated Services Network (PISN) - Specification, Functional Model and Information Flows - Call Diversion Supplementary Services (CFSD)".
- [2] ITU-T Recommendation I.210: "Principles of telecommunication services supported by an ISDN and the means to describe them".
- [3] ITU-T Recommendation Z.100: "Specification and description language (SDL)".
- [4] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".
- [5] ITU-T Recommendation Q.9: "Vocabulary of switching and signalling terms".
- [6] ETSI EN 300 392-12-4: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 12: Supplementary services stage 3; Sub-part 4: Call Forwarding (CF)".
- [7] ETSI EN 300 392-3-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 2: Additional Network Feature Individual Call (ANF-ISIIC)".
- [8] ETSI EN 300 392-7: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 7: Security".

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**Additional Network Feature (ANF):** capability, over and above that of a basic service, provided by a SwMI, but not directly to a SwMI user

**authorized user:** user who is responsible for the definition, activation and deactivation of the service

NOTE: The authorized user may also interrogate the service.

**busy:** TETRA destination is considered to be busy if either a "network determined user busy" or a "user determined user busy" condition exists

**call, basic call:** instance of the use of a basic service

**connected number:** number of the user that answers (user C)

**forwarded-to number:** number to which a call is forwarded

**forwarded-to user:** user to which a call is forwarded

**forwarding:** redirection of a call, on behalf of a called user and prior to connect, to a number different from the number of that called user

**forwarding cause:** contains the reason for the forwarding: CFU, CFB, CFNRy, CFNRc

**forwarding number:** number of the served user

**forwarding user:** user for which the call forwarding is invoked; it may be the called user first and then any of the successive forwarded-to users (see also last forwarding user)

**forward switching:** network routing algorithm which performs the forwarding by joining together the first connection from user A's node to user B's node and a second, new connection from user B's node to user C's node

**last forwarding user:** served user from the point of view of the forwarded-to user for a particular stage of call forwarding

NOTE: In the case of a call subject to a single stage of call forwarding, user B is the last forwarding user from the point of view of user C. In the case of a call subject to multiple stages of call forwarding, user B1 is the last forwarding user from the point of view of user B2, user B2 is the last forwarding user from the point of view of user B3, etc. The served user for the final stage of call forwarding is the last forwarding user from the point of view of user C.

**Mobile Station (MS):** physical grouping that contains all of the mobile equipment that is used to obtain TETRA services. By definition, a mobile station contains at least one Mobile Radio Stack (MRS)

**original called number:** number of user B (in case of multiple call forwarding user B1)

**original called user:** first served user of a call which is subject to one or more stages of call forwarding, i.e. user B or B1

**partial re-routing:** network routing algorithm which performs the call forwarding by replacing a particular part of the connection from user A's node to user B's node by another connection from user A's node to user C's node

**SDS message:** status or any type of SDS message

NOTE: This definition is used in the present document to combine all TETRA STATUS and SDS messages as defined in clause 13.3 of EN 300 392-2 [4].

**signalling connection:** connection used to exchange information between peer supplementary service protocol control entities independently of a basic call

**SS-CF invocation counter:** counter for the number of forwarding involved in a call or signalling connection during the establishment phase

**supplementary service:** any service provided by a network in addition to its basic service or services (defined in ITU-T Recommendation Q.9)

NOTE: A supplementary service modifies or supplements a basic telecommunication service. Consequently, it cannot be offered to a customer as a stand alone service. It must be offered together with or in association with a basic telecommunication service (extract from ITU-T Recommendation I.210 [2])

**Switching and Management Infrastructure (SwMI):** all of the TETRA equipment for a Voice plus Data (V+D) network except for subscriber terminals

NOTE: The SwMI enables subscriber terminals to communicate with each other via the SwMI.

**SwMI number:** number belonging to a SwMI numbering plan

**re-routeing:** network routeing algorithm which performs the call forwarding by replacing the connection from user A's node to user B's node by another connection from user A's node to user C's node

**served user:** user of a particular SwMI number who is requesting that calls to his number be forwarded

NOTE: This user may also be referred to as the forwarding user or the called user.

**tele-service:** type of telecommunications service that provides the complete capability, including terminal equipment functions, for communication between users according to agreed protocols

**served user:** user for whom the supplementary service is invoked

**user:** entity using the services of a telecommunications network via an externally accessible service access point

NOTE 1: Unless otherwise noted, the word user is to be understood as individual or group.

NOTE 2: A user may be a person or an application process.

**user application:** application process which acts as a user (see definition of user)

**user A:** calling user of a call which is subject to call forwarding

**user B:** served (forwarding) user of a call which is subject to call forwarding.

NOTE: User B is also known as the (original) called user.

**user B1, user B2, user B3, etc.:** these are the served (forwarding) users of a call which are subject to multiple stages of forwarding

NOTE 1: B1 is the first served user, B2 is the second served user, B3 is the third served user, etc.

NOTE 2: B2 is also the forwarded-to user with respect to the first stage of call forwarding, B3 is also the forwarded-to user with respect to the second stage of call forwarding, etc.

**user C:** forwarded-to user with respect to the final stage of call forwarding

## 3.2 Symbols

For the purposes of the present document, the symbols defined in ITU-T Recommendation Z.100 [3] apply.

## 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ANF	Additional Network Feature
GTSI	Group TETRA Subscriber Identity
ISDN	Integrated Services Digital Network
ISI	Inter System Interface

ITSI	Individual TETRA Subscriber Identity
MS	Mobile Station
NDUB	Network Determined User Busy
SDL	Specification and Description Language
SDS	Short Data Service
SS	Supplementary Service

NOTE: The abbreviation SS is only used when referring to a specific supplementary service.

SwMI	Switching and Management Infrastructure
TE	Terminal Equipment
TETRA	Terrestrial European Trunked Radio
UDUB	User Defined User Busy
V+D	Voice Plus Data

Supplementary service abbreviations:

AL	Ambience Listening
BIC	Barring of Incoming Calls
BOC	Barring of Outgoing Calls
CAD	Call Authorized by Dispatcher
CCBS	Call Completion to Busy Subscriber (TETRA)
CCNR	Call Completion on No Reply (TETRA)
CF	Call Forwarding
CFB	Call Forwarding on Busy
CFNRc	Call Forwarding on Not Reachable
CFNRy	Call Forwarding on No Reply
CFU	Call Forwarding Unconditional
CLIP	Calling Line Identification Presentation
CLIR	Calling/Connected Line Identification Restriction
COLP	COnnected Line Identification Presentation
COLR	COnnected Line Identification Restriction
CR	Call Report
CW	Call Waiting
DL	Discreet Listening
IC	Include Call
PC	Priority Call
PPC	Pre-emptive Priority Call
SNA	Short Number Addressing

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## 4 SS-CF generic specification

### 4.1 Description

#### 4.1.1 General description

This generic specification groups together all elements common to the four Call Forwarding procedures (CFU, CFB, CFNRy and CFNRc).

SS-CF enables a served user to have the network redirect, to either an ITSI, to a GTSI or to an external subscriber number, calls which are addressed to the served user's ITSI/GTSI/external subscriber number. SS-CF may operate on all calls or just those associated with specified basic services. The served user's ability to originate calls is unaffected by SS-CF.

SS-CF is provided on a per ITSI/GTSI basis.

NOTE 1: The external subscriber number has two distinct meaning in the relation to the SS-CF:

- number of an external subscriber not belonging to TETRA network(s); and
- number given to a TETRA subscriber in addition to the ITSI of that user; known also as MS-ISDN number.

Only the ITSI/GTSI is supported in the management of the SS-CF. For the operation of the SS-CF the MS-ISDN number is first converted into the equivalent ITSI.

SS-CF invocation counting shall be invoked in conjunction with a call forward request when it is desired to limit the number of forwarding that the call can encounter. The number of maximum call forwarding invocations for a single call is a network implementation option. When counting the number of forwarding, all types of forwarding shall be included.

NOTE 2: EN 300 392-3-2 [7] uses also transit counter information element in the ISI-SETUP PDU. That information element is intended for the same purpose over Inter-System Interface as the SS-CF invocation counter, which is also applicable inside a single SwMI. The transit counter and the SS-CF invocation counter are independent of each other.

Call forwarding of an individual call may be either to an ITSI, to a GTSI or to an external subscriber number. Group calls may be forwarded to either an ITSI or a GTSI (i.e. the communication type as defined in EN 300 392-2 [4], clause 14.8.2 may change due to forwarding) or optionally to an external number. In the case of the set-up of a group call, the activation of SS-CF by an individual member of the group (on his individual number) does not invoke SS-CF for the group call. Generally a non-member of the group shall not be accepted to activate SS-CF on the group.

In the case that multiple call forwarding types are activated at the same time for the served user the SS-CFU takes precedence over all other types.

Forwarding counter counts the number of forwarding that a call has been forwarded and allows to limit the number of forwarding that a call request may encounter during call establishment, e.g. to protect the network against indefinite looping. There is no user involved in the provision or operation of forwarding counter.

#### 4.1.2 SS-CFU specific features

SS-CFU enables served user to have the network redirect calls to him unconditionally to the forwarded-to user.

NOTE: In TETRA the call is not offered to the served user at all.

SS-CFU is applicable to voice, circuit mode data and SDS messages for both individual and group calls/messages.

#### 4.1.3 SS-CFB specific features

SS-CFB enables a served user to have the network redirect incoming calls to another ITSI/GTSI/external subscriber number, if they meet a busy condition at the served user. The network detects busy condition (NDUB) or the called user may invoke busy condition (UDUB).

NOTE 1: The UDUB condition is detected, when the user disconnects the call with a suitable disconnection reason without answering to it.

SS-CFB is applicable to voice and circuit mode data for both individual and group calls.

NOTE 2: The conditions that lead to the declaration of a group as being busy are outside the scope of the present document.

#### 4.1.4 SS-CFNRY specific features

SS-CFNRY enables a served user to have the network redirect incoming calls to another ITSI/GTSI/external subscriber number, if the connection is not established within a predefined time of alerting. The predefined alerting time should be set to be less than maximum call set-up time. The predefined time value is outside the scope of the present document.

SS-CFNRY is applicable to voice and circuit mode data for individual calls.

SS-CFN<sub>Ry</sub> may not be applicable to calls established with direct signalling. SS-CFN<sub>Ry</sub> is not applicable to group calls.

NOTE: If the called user disconnects the call without answering, then the SS-CFN<sub>Ry</sub> will not be invoked.

#### 4.1.5 SS-CFN<sub>Rc</sub> specific features

SS-CFN<sub>Rc</sub> permits a called user to have the network redirect incoming calls, when the served user is not reachable, to forwarded-to user ITSI/GTSI/external subscriber number.

SS-CFN<sub>Rc</sub> is applicable to voice and circuit mode data for individual calls. The resulting call may be a group call.

NOTE 1: Not reachable condition may be detected in the network e.g. user is not registered or at the call set-up signalling, when that fails e.g. due to a bad propagation condition.

NOTE 2: For the purposed of the present document a group may never be found "not reachable".

#### 4.1.6 Authorized users

For the purposes of the present document a generic term authorized user has been used. At least following roles of authorized users are identified:

- served user himself;
- authorized user created by the served user using enable process;
- forwarded-to user;
- authorized user defined upon subscription; and
- authorized user defined by network operator.

Table 1 outlines the roles of authorized users. A generic authorized user is used for the authorized user defined upon subscription and authorized user defined by network operator. The capabilities identified in the table 1 are optional and TETRA network may support any set of the capabilities. The present document does not set any restrictions nor rules, who may be an authorized user, e.g. dispatcher may be an authorized user for the group members. The same user may also have multiple authorized user's roles e.g. the forwarded-to user may be also a created authorized user.

**Table 1: Authorized users' roles**

Authorized user type	Activation/deactivation capability	Enabling/disabling capability	Interrogation capability	Remarks
Served user	Himself, unless a permanent activation is applied	Created or predefined authorized users, see note	Himself	Limits of activation and enabling are defined upon subscription
Created authorized user	On behalf of the served user	N/A	On behalf of the served user	Upon disabling looses all capabilities
Forwarded-to user	Only deactivation of the SS-CF he is the forwarded-to user	N/A	Only activation of the SS-CF he is the forwarded-to user	Upon deactivation looses all capabilities
Authorized user	On behalf of the served user	Created and predefined authorized users and potentially other authorized users	On behalf of the served user	Limits of activation and enabling are defined upon subscription

NOTE: Optionally enabling may be used both to create and enable authorized users.

## 4.2 Procedures

### 4.2.1 Provision/withdrawal

Provision and withdrawal of SS-CF shall be by pre-arrangement with the service provider. SS-CF subscription shall be on ITSI/GTSI basis. For each ITSI/GTSI the supplementary service may be subscribed to any combination of the basic services subscribed to at that ITSI/GTSI.

NOTE: Subscription related actions are outside the scope of the present document.

The subscription options and values offered by a SwMI are an implementation matter. The stage 3 standard [6] supports the options and values specified in table 2. A SwMI may offer more or less options and values than those specified in table 2.

Subscription options may apply separately to each basic service subscribed to on each ITSI/GTSI. Different subscription options may be applied to different services for the same ITSI/GTSI, e.g. SS-CF for voice may have different subscription option than SS-CF for circuit mode data or SDS for the same ITSI/GTSI. Subscription options for one call forwarding supplementary service may be different from corresponding subscription options for another call forwarding supplementary services for the same ITSI/GTSI.

Contrary to ECMA-173 [1], the served user/forwarding user does not receive notification that a call has been forwarded; this applies also to all the intermediate served users/forwarding users.

Contrary to ECMA-173 [1], the calling user receives notification that call has been forwarded has only one possible value "Yes without forwarded-to ITSI/GTSI/external number". The calling use may independently invoke SS-CI (COLP) in order to get information about the connected user ITSI/GTSI/external subscriber number.

**Table 2: Subscription options**

Subscription options	Value
Permanent activation	- Yes - No
Served user releases his ITSI/GTSI to forwarded-to user	- No - Yes

SS-CF invocation counter shall be generally applied for all calls/messages that involve call forwarding.

### 4.2.2 Normal procedures

#### 4.2.2.1 SS-CF management

##### 4.2.2.1.1 Activation/deactivation

SS-CF may be either permanently activated upon subscription or by other means or activated/deactivated under user control.

The activation/deactivation upon subscription and by other means are outside the scope of the present document.

If activation/deactivation is supported under user control, the SwMI may provide for activation/deactivation by authorized users (served user or not), refer to table 1. Any combination of the SS-CF types may be activated/deactivated at any time for each basic service and for any TSI subscribed to the service. Each SS-CF type and basic service combination may be defined for different forwarded-to users. The forwarded to user may be an ITSI, GTSI or external subscriber number.

NOTE 1: The served user of the forwarding cannot be the forwarded-to user (forwarding back to the same number).

The present document places no restriction on which authorized users (defined upon subscription or by the network operator) may activate or deactivate forwarding on behalf of any served user, refer to table 1. Authorized users may have different capability limitations than described in the table 1. The restrictions may be defined by the network operator or by implementation. One authorized user (including the served user) may activate a forwarding and another authorized user (again including the served user) may deactivate the same forwarding at the served user.

Any authorized user may activate SS-CF on behalf of the served user such that the activating (e.g. authorized user) user becomes the forwarded-to user.

In the case of SS-CF involving a served user being a served group, SS-CF may be permanently activated upon subscription for that group GTSI or may be activated/deactivated by an authorized user. A member of a group shall not be able to activate/deactivate SS-CF for the group he is a member of unless he is an authorized user.

NOTE 2: On the SS-CF activation capability point of view the members of the group are not the served users in the same sense as for ITSI. The features applicable to the served user on the GTSI may be allocated to an authorized user. The management and allocation of that is outside the scope of the present document.

Any forwarded-to user may be able to become an authorized user for the deactivation of SS-CF for the basic services and the forwarding procedures for which this user is defined as a forwarded-to user for the duration he is the forwarded-to user, refer to table 1. The forwarded-to user is considered to be a temporary authorized user; the forwarded-to user shall lose this authorized user capability as soon as SS-CF is deactivated in this way, and shall not regain the deactivation capability if SS-CF is activated again to a different forwarded-to user.

When an activation/deactivation procedure is performed successfully by an authorized user, the served user may be notified. The use of the notification is dependent of served user network options. The notification to the served user may include the ITSI/GTSI/external number of the forwarded-to user, forwarding types and the basic services. If the notification is not possible at the activation/deactivation time e.g. the served user is not reachable, then the SwMI may later, at a suitable time, send the notification to the served user.

NOTE 3: The authorized user gets the same information as part of the activation procedure.

NOTE 4: The use of a password facility for authorized user activation as an implementation option is not excluded.

To activate SS-CF, the authorized user shall:

- 1) define the forwarded-to user ITSI/GTSI/external subscriber number;
- 2) indicate the basic service or services for which it applies.

NOTE 5: A verification that the forwarded-to user ITSI/GTSI/external subscriber number exists and that the specified basic service is subscribed to at that ITSI/GTSI/external number may be carried out before accepting the SS-CF activation request. This verification is outside the scope of the present document.

The service provider shall return notification of acceptance of the request. Notification of acceptance shall include the ITSI/GTSI/external subscriber number of the forwarded-to user to whom the SS-CF is active.

It shall be possible to deactivate SS-CF by means of an explicit request for deactivation. An explicit request for deactivation shall be treated as follows:

- if deactivation of SS-CF for an individual basic service is requested, it shall be accepted only if SS-CF is already activated for that basic service;
- if deactivation of SS-CF collectively for all basic services is requested, it shall result in the discarding of any forwarded-to ITSI/GTSI/External Numbers for individual basic services and any forwarded-to ITSI/GTSI/External Number collectively for all basic services.

It shall be possible to deactivate SS-CF by activating SS-CF to a different forwarded-to ITSI/GTSI/External Number. A request for activation of SS-CF when SS-CF is already activated shall be treated as follows:

- if activation of SS-CF for an individual basic service is requested, it shall be accepted only if SS-CF is not already activated collectively for all basic services and, if SS-CF is already activated for that individual basic service, shall result in the overwriting of the existing forwarded-to ITSI/GTSI/External Number;
- if activation of SS-CF collectively for all basic services is requested, it shall result in the discarding of any existing forwarded-to ITSI/GTSI/External Numbers for each basic service and the overwriting of any existing forwarded-to ITSI/GTSI/External Number collectively for all basic services.

The nominated forward-to party is not informed when SS-CF is activated/deactivated at a served party.

The served/authorized user performed activation/deactivation process is optional.

#### 4.2.2.1.2 Enable/disable

The served user should be able to enable/disable any authorized user' activation/deactivation capability on behalf of himself as defined upon subscription. Optionally the served user may create authorized users by the enable process and he shall be able to disable the created authorized users he has been created using the enable process. The served user should not be capable to enable/disable himself.

The served user (or any other authorized user) shall not be able to disable the forwarded-to user deactivation capability.

The optionally authorized users (other than the served user) may be able to enable/disable other authorized users' activation/deactivation capability.

The created and forwarded-to authorized users shall not be able to use enable/disable processes especially to create new authorized users, refer to table 1.

The other authorized users may have the same, less or more capabilities than the served user.

If the served user is disabled to get TETRA services as defined in EN 300 392-7 [8], then an authorized user disabling of SS-CF activation shall be removed. It is outside the scope of the present document whether all or only some of the authorized users re-gain activation/deactivation capability.

The enabling/disabling process is optional.

#### 4.2.2.1.3 Registration

Registration of information is performed by subscription and/or on activation of SS-CF. There are no separate registration procedures.

NOTE: Registration means in this context that the information about the SS-CF activation is "registered" (stored) into the SwMI for a later invocation.

#### 4.2.2.1.4 Interrogation

The SwMI may provide interrogation to the served user and to any authorized user; the forwarded-to user may be defined as a temporary authorized user, refer to table 1.

In the case of SS-CF involving a served user being a group, SS-CF interrogation may be operated by an authorized user whether he is a member or not of the group, refer to table 1. A member of a served group shall not be able to interrogate SS-CF for the group unless he is an authorized user. Whether the members of a group are authorized users or not is outside the scope of the present document.

If interrogation is provided, a SwMI shall support interrogation on a per ITSI/GTSI basis for all basic services and/or for a user specified basic service. The SwMI response to an interrogation request shall provide the following information to the user:

- activated or deactivated state of the supplementary service;
- if activated:
  - forwarded-to ITSI/GTSI/external subscriber number;
  - which call forwarding types and basic service combinations are activated.

As additional information, the interrogation may provide information to the served user, whether activation by an authorized user has been enabled.

If interrogation by a user different from the served user is provided, it shall be possible from the following users, refer to table 1:

- any authorized user may interrogate SS-CF conditions on the served user. Authorization shall be implementation dependent (e.g. dispatchers may be authorized);
- the forwarded-to user may interrogate SS-CF at the served user (but only for those options for which he is the forwarded-to user).

The forwarded-to user may interrogate also who are the served users for activated call forwarding towards him.

NOTE: This optional service may be potential within a single system as the information collection otherwise may not be practical. The activation is not informed to the activated forwarded-to user SwMI.

The authorized user interrogation request and response shall include the information as specified for the served user interrogation and additionally the ITSI/GTSI of the served user.

The interrogation processes are optional.

## 4.2.2.2 Invocation and operation

### 4.2.2.2.1 SS-CF invocation and operation

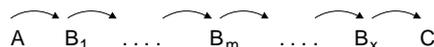
If more than one SS-CF is activated for the same basic service, then:

- the SS-CFU shall take precedence over and shall be invoked independently of other SS-CFU types;
- the SS-CFB has no interaction with SS-CFN<sub>Ry</sub> as if a served/forwarding user is busy, he cannot be in a "no reply" condition;
- the SS-CFB has no interaction with SS-CFN<sub>Rc</sub> as if a served user is in a "not reachable" condition, he cannot be in a busy condition; and
- the SS-CFN<sub>Ry</sub> has no interaction with SS-CFN<sub>Rc</sub> as if a served user is in a not reachable condition, he cannot be in a "no reply" condition.

All incoming calls indicating a basic service for which SS-CF is active shall be forwarded without being presented to the served user (excepted for SS-CFN<sub>Ry</sub> and SS-CFBS on UDUB case).

Once the call forwarding has been initiated, the original called user B shall not be able to participate in that forwarded call regardless of the fact that the original condition, which lead to the initiation of forwarding, disappeared (e.g. user B busy becomes non busy for SS-CFB, user B Not Reachable becomes Reachable for SS-CFN<sub>Rc</sub>). If the served user MS has been involved in the call set-up as in SS-CFB UDUB case and in SS-CFN<sub>Ry</sub>, then upon SS-CF invocation the network shall clear the call attempt to the served user.

- The following figure 1 clarifies the SS-CF procedures. Assume that A calls B<sub>1</sub>, who forwards the call to B<sub>2</sub>, ..., B<sub>m</sub>, ..., B<sub>x</sub>. The final destination of the call is C.



**Figure 1: SS-CF operation**

Contrary to ECMA-173 [1], in the case where a first call forwarding request to a first functional entity fails, it shall not be possible to request a second call forwarding against a second functional entity.

SS-CF invocations counting shall be invoked in conjunction with a call forwarding request. When the first call forwarding is invoked, the forwarding counter shall be set to an initial value and then incremented each time another call forwarding is invoked for the same call.

SS-CF invocation counting shall terminate when the call request reaches its destination, is released, or leaves the TETRA Network.

The maximum number of forwarding for a single call is a network implementation option in the range 1 to 29. When counting the number of forwarding, all types of forwarding shall be included.

- NOTE: The mechanism of the transit counter used in the ISI protocol is separate but similar to the forwarding counter mechanism that both are used to prevent infinite loops.

#### 4.2.2.2.2 Forwarded-to user C notification

The forwarded-to user shall receive an indication that the call has been forwarded with the appropriate forwarding cause. According to the served user's subscription option, the forwarded-to user may receive:

- the original served user's ITSI/GTSI;
- the cause for the original forwarding;
- the last forwarding number Bx; or
- the cause for the last forwarding.

The forwarding cause shall indicate which call forwarding supplementary invocation lead to the forwarding (CFU, CFB, CFNRy, CFNRc).

#### 4.2.2.2.3 Calling user A notification

The calling user may receive a notification that the call has been forwarded.

For single forwarding, a notification should be sent to the calling user indicating that call has been forwarded.

For multiple forwarding, notifications may be sent in addition to the calling user for each addition call forwarding invocation.

NOTE 1: The presentation of the ITSI/GTSI/external subscriber number of user C to the user A is managed by SS-CI and it shall not be affected by the SS-CF operation.

NOTE 2: Due to the invocation of SS-CF user A MS may receive an ALERT with one origin (user B alerting) followed by a CONNECT from a different source (user C).

#### 4.2.2.2.4 Served user notification

The served user may receive a reminder that the call forwarding is activated at a suitable signalling instance such as registration or call set-up using e.g. the same basic service.

### 4.2.3 Exceptional procedures

#### 4.2.3.1 Activation/deactivation

If the SwMI cannot accept an activation or deactivation request, the activating/deactivating user shall receive a notification that SS-CF activation/deactivation was unsuccessful. Possible causes for rejection are e.g.:

- SS-CF service or option not subscribed to the specified basic service;
- user not authorized;
- forwarded-to ITSI/GTSI/external subscriber number is a special service code;
- invalid forwarded-to ITSI/GTSI/external subscriber number;
- incorrect served user's ITSI/GTSI;
- invalid authorized user number;
- part of the deactivation request failed;
- temporarily unavailable; and
- rejected for undefined reason.

If the network deactivates SS-CF without the served user having requested deactivation, the served user may receive notification along with the cause.

The response to an unsuccessful activation/deactivation request shall be sent only to the activating/deactivating user.

### 4.2.3.2 Interrogation

If the SwMI cannot accept an interrogation request, the interrogating user shall receive a notification that SS-CF interrogation was unsuccessful. Possible causes for rejection are e.g.:

- SS-CF service or option not subscribed to the specified basic service;
- user not authorized;
- incorrect served user's ITSI/GTSI;
- temporarily unavailable; and
- rejected for undefined reason.

### 4.2.3.3 Invocation and operation

Within a SwMI the total number of all forwarding invocations for each call shall be limited. The maximum number of such forwarding invocations for each call shall be an implementation option. When counting the number of forwarding, all types of forwarding shall be included. If the limit is reached and an attempt is made to forward the call an additional time, the calling user shall receive call clearing with an appropriate disconnect cause.

NOTE: While ECMA forwarding counter mechanism allows for values from 1 to 31, for TETRA limit of 5 seems to be reasonable for proper performance.

If the forwarded call cannot be completed to the forwarded-to destination, then the SwMI shall clear the call and to the calling user shall be sent an indication that the call cannot be completed as defined for basic call.

The forwarding may be overridden for specific calls, e.g. calls from the forwarded-to user to the forwarding user. The conditions for this shall be implementation specific.

## 4.3 Interactions with other supplementary services and ANFs

### 4.3.1 Access priority

There cannot be any interaction between SS-CF and access priority.

### 4.3.2 Ambiance listening

An SS-AL call shall not be forwarded and so no SS-CF shall be invoked at an SS-AL call set-up.

### 4.3.3 Area selection

The call may be forwarded as long as the forwarded-to party is within the selected area.

### 4.3.4 Barring of incoming calls

The SS-BIC shall take precedence over SS-CF.

If an SS-BIC condition is encountered during the setup procedure, the call shall be cleared.

When SS-BIC is active on the called user (the served/forwarding user) and the calling user identity is part of the SS-BIC active list, the call and the call forwarding shall fail.

When SS-BIC is active on the forwarded-to user and the served user (forwarding user) identity is part of the SS-BIC active list, the call forwarding shall fail.

If SS-BIC is activated for user B (the SS-CF served user) with all incoming calls barred, the activation of SS-CF for the same basic service for that served user B should be rejected with reject cause provided to the activating SS-CF user (incompatible supplementary services).

NOTE: If SS-BIC activation is only barring certain calling users, then it is impossible to identify possible conflicts at the SS-CF activation time.

If SS-CF is activated for a served user B, activation of SS-BIC with all incoming calls barred, then the network should deactivate the SS-CF and inform the served user.

### 4.3.5 Barring of outgoing calls

SS-BOC shall take precedence over SS-CF.

When SS-CF has been activated against user B prior to the activation of Barring of Outgoing Calls (BOC) and the forwarding activation conflicts with the SS-BOC activation, then network should deactivate the SS-CF and inform the served user.

### 4.3.6 Call authorized by dispatcher

The SS-CAD should be invoked and completed for the call from the calling user to the served user before invocation of SS-CF, refer to table 3. Whether the SS-CAD is also or instead invoked for the call from the calling user to the forwarded-to user is outside the scope of the present document.

**Table 3: SS-CF and SS-CAD interactions**

CF type	SS-CAD invocation reason	Remarks
SS-CFU	Calling user and SS-CFU served user or forwarded-to user	
SS-CFB	Calling user and SS-CFB served user or forwarded-to user	The SS-CAD may be invoked after SS-CFB condition is met.
SS-CFNry	Calling user and SS-CFNry served user or forwarded-to user	The SS-CAD may be invoked after SS-CFNry condition is met.
SS-CFNrc	Calling user and SS-CFNrc served user or forwarded-to user	The SS-CAD may be invoked after SS-CFNry condition is met.

In the case of multiple call forwarding invocations any additional SS-CAD invocation is outside the scope of the present document.

### 4.3.7 Call Completion on No Reply (SS-CCNRy)

If the call to user B is forwarded to user C by SS-CFNry and user C does not answer, then a SS-CCNR request from user A shall be applied to user C.

If user B activates SS-CFNry and whilst the SS-CCNR recall (corresponding to a user A SS-CCNR request) has not yet been accepted by user A, then the SS-CCNR request shall continue to be applied to user B or cancelled.

Otherwise the same as for SS-CCBS.

### 4.3.8 Call Completion to Busy Subscriber (SS-CCBS)

If the call to user B is forwarded to user C by SS-CF and user C is busy, then a SS-CCBS request from user A shall be applied to the forwarded-to user C and not to the originally called user B.

If user B activates SS-CF whilst the SS-CCBS recall (corresponding to user A SS-CCBS request) has not yet been accepted by user A, then the SS-CCBS request shall either continue to be applied to user B or be cancelled.

If a user invokes SS-CCBS whilst SS-CF is activated, or a user invokes SS-CCBS and subsequently activates SS-CF, SS-CCBS recall shall still be given to that user.

NOTE: SS-CCBS recall is not an actual call and is not subject to call forwarding.

A call resulting from successful completion of SS-CCBS can be subject to SS-CFNry if not answered.

### 4.3.9 Call hold

SS-CF is completed before invocation of the SS-HOLD and so there can not be any interaction with call hold.

### 4.3.10 Calling/Connected Line Identification Restriction (SS-CLIR/SS-COLR)

No interaction.

When forwarding occurs, the number of a calling user which has invoked SS-CLIR, shall not be presented to the forwarded-to user, unless forwarded-to user has invoked override of this restriction as defined in SS-CI.

A forwarded-to user which has invoked SS-COLR shall not have its number presented to the calling user, unless the calling user has invoked override of this restriction as defined in SS-CI.

### 4.3.11 Calling Line Identification Presentation (SS-CLIP)

No interaction.

### 4.3.12 Call waiting

#### 4.3.12.1 Common to SS-CF

The diverted-to user may invoke SS-CW for the diverted call if he is busy and SS-CW is activated for him.

#### 4.3.12.2 Call Forwarding Unconditional (SS-CFU)

SS-CFU shall take precedence over SS-CW and SS-CW shall not have any interaction with SS-CFU, i.e.:

- if SS-CFU has been activated for the called user, then SS-CFU shall take precedence over SS-CW, even if the called user is busy (which normally is the reason to offer a call to the SS-CW served user);
- SS-CFU may be activated for the SS-CW served user while a call is waiting but the waiting call shall then not be forwarded.

#### 4.3.12.3 Call Forwarding On Busy (SS-CFB)

Optionally SS-CFB shall take precedence over SS-CW and SS-CW shall not have any interaction with SS-CFB, i.e.:

- if an individual new call is addressed to the served user while SS-CFB has been activated for that user and if the network knows that that user is busy the network will invoke SS-CFB for that new call (and not offer it to the served user);

Optionally SS-CFB and SS-CW may interact if an individual new call is addressed to the served user while SS-CFB has been activated for that user:

- if the network can offer that call to that user because of the limit in the number of calls waiting is not exceeded, such user will then be able to invoke SS-CW or e.g. to clear the call in indicating that he is busy;
- if the network knows that that user is busy and cannot offer that new call to him because of the limit in the number of calls waiting is exceeded, the network will invoke SS-CFB for that new call (and not offer it to the served user);
- the network will also invoke SS-CFB for that call after the served user has invoked SS-CW for it when that user clears it later in indicating that he is busy.

Otherwise SS-CW shall not have interaction with SS-CFB, i.e.:

- SS-CFB may be activated for the SS-CW served user while a call is waiting but the waiting call shall then not be forwarded unless the served user clears that waiting call in indicating that he is busy.

#### 4.3.12.4 Call Forwarding on No Reply (SS-CFNRY)

SS-CW shall interact with SS-CFNRY as follows:

- if SS-CFNRY has been activated for the SS-CW served user and that user has invoked SS-CW for an individual call, SS-CFNRY shall be invoked when the first of the following timers expires while the call is still waiting (e.g. before the SS-CW served user has accepted or cleared the waiting call):
  - call forwarding no reply; or
  - timer T2.

NOTE 1: Whichever timer among the two mentioned above expires while the call is still waiting, the call to the SS-CW served user will then be cleared due to the SS-CFNRY operation, therefore SS-CW operation will stop.

- the network will not invoke SS-CFNRY for a call after the served user has invoked SS-CW for it when that user clears it later for any reason.

NOTE 2: SS-CFB may be invoked in that case.

#### 4.3.12.5 Call Forwarding on Not Reachable (SS-CFNRC)

SS-CW shall not have any interaction with SS-CFNRC, i.e. when the SS-CW served user is not reachable the call cannot be offered to him, therefore, SS-CFNRC will be invoked if activated for that user.

#### 4.3.13 Call report

If the call to user B is forwarded to user C, then a SS-CR invocation from user A shall be applied to the forwarded-to user C.

#### 4.3.14 Connected Line Identification Presentation (SS-COLP)

No interaction.

#### 4.3.15 Discreet listening

If the SS-CF served user has activated SS-CF and the monitoring user has invoked the SS-DL on that served user, then SS-DL shall take precedence over SS-CF and the SS-DL call shall not be forwarded.

- NOTE: The SS-DL call is operated based on the call participants and so e.g. a forwarded call between a calling user and a forwarded-to user may be subject for a SS-DL call due to the forwarded-to user.

#### 4.3.16 Dynamic group number assignment

SS-CF shall not have any interaction with dynamic group number assignment.

#### 4.3.17 Include call

SS-CF operation is completed before SS-IC can be invoked and so there can not be any interaction with include call.

#### 4.3.18 Late entry

SS-CF is completed before invocation of SS-LE and so there can not be any interaction with late entry.

#### 4.3.19 List search call

SS-CF shall not have any interaction with list search call.

### 4.3.20 Pre-emptive Priority Call

There is no interaction between SS-PPC and either SS-CFU, the call shall be forwarded; or SS-CFNRY, the call shall be forwarded, if there is no reply from the called user; or SS-CFNRC, the call shall be forwarded, if the called MS is not reachable.

SS-PPC shall take precedence over SS-CFB and the served user shall be connected to the called user as defined in SS-PPC. If the SS-PPC operation does not result in pre-emption of the called user then the call shall be forwarded.

The priority level of the call is preserved during the forwarding process, and the forwarded-to user may be pre-empted.

NOTE: In the TETRA network environment, no alternate party defined by ECMA-173 [1] is used.

### 4.3.21 Priority call

SS-CF shall not have any interaction with priority call. The priority of the original call set-up may be used at the call set-up to the forwarded-to user.

### 4.3.22 Short number addressing

SS-SNA shall not have any interaction with SS-CF.

NOTE: SS-SNA short numbers are not used in SS-CF management procedures.

### 4.3.23 Talking party identification

SS-CF shall not have any interaction with talking party identification.

### 4.3.24 Interaction with ANF mobility

Within a SwMI or between different SwMIs, the number of call forwarding connections should be limited. The maximum number of call forwarding invocations should be limited to a value defined by each network independently to prevent infinite looping.

SS-CF uses the same procedures as use in the basic call, when either calling or called or both users are migrated. The SS-CF should be supported for those cases of calls from the calling user to the forwarding (served) user and from the forwarding user to the forwarded-to user as supported for basic calls.

In the case where the served user has activated SS-CF and that SS-CF is invoked when the served user is outside served user home SwMI, any invocation of SS-CF may be reported to served user home SwMI. The actual timing of the reporting (immediate, periodic, by batch) is outside the scope of the present document.

## 4.4 Interworking considerations

Interworking with other networks is optional. When interworking with another network, the implementation specific limit of the total number of known call forwarding invocations for each call shall still apply. The call forwarding invocation counting should apply to calls entering the TETRA network from another network or to calls going to another network.

NOTE 1: Some networks may not report the number of call forwarding.

Where a remote user is on a different network, notifications to the remote user, if applicable, shall be sent to the remote user's network for delivery to the remote user. Numbers included in this information shall be provided as required for the other network.

In the case of a call from another network to TETRA network, if the TETRA network detects forwarding back to a destination in the other network, the TETRA network may request that the other networks performs the call forwarding. Support details of that are outside the scope of the present document.

The gateway SwMI may activate, deactivate and interrogate SS-CFU in the public ISDN on behalf of a TETRA SwMI user. Support details are outside the scope of the present document.

If a forwarded call meets an interworking situation, then an interworking indication should be sent to the calling party.

NOTE 2: The "not reachable" condition may not be understood by all networks, e.g. ISDN; the "not reachable" condition may in that case of interworking be translated into a "no reply" condition.

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## 5 SS-CF overall SDL

Figure 2 contains the dynamic description of SS-CF using the Specification and Description Language (SDL) defined in ITU-T Recommendation Z.100 [3]. The SDL process represents the behaviour of the network in providing SS-CF only in the case of individual call.

Output signals to the left represent primitives to the calling user. Output signals to the right represent primitives to the served user or to the forwarded-to user. Input signals from the right represent internal stimuli.

In the original ECMA-173 [1] diagram, the diversion has been replaced by forwarding; the main ECMA options which are not kept in TETRA are shown with a comment "Not\_a\_TETRA\_option". These options are kept for the case of possible interworking.

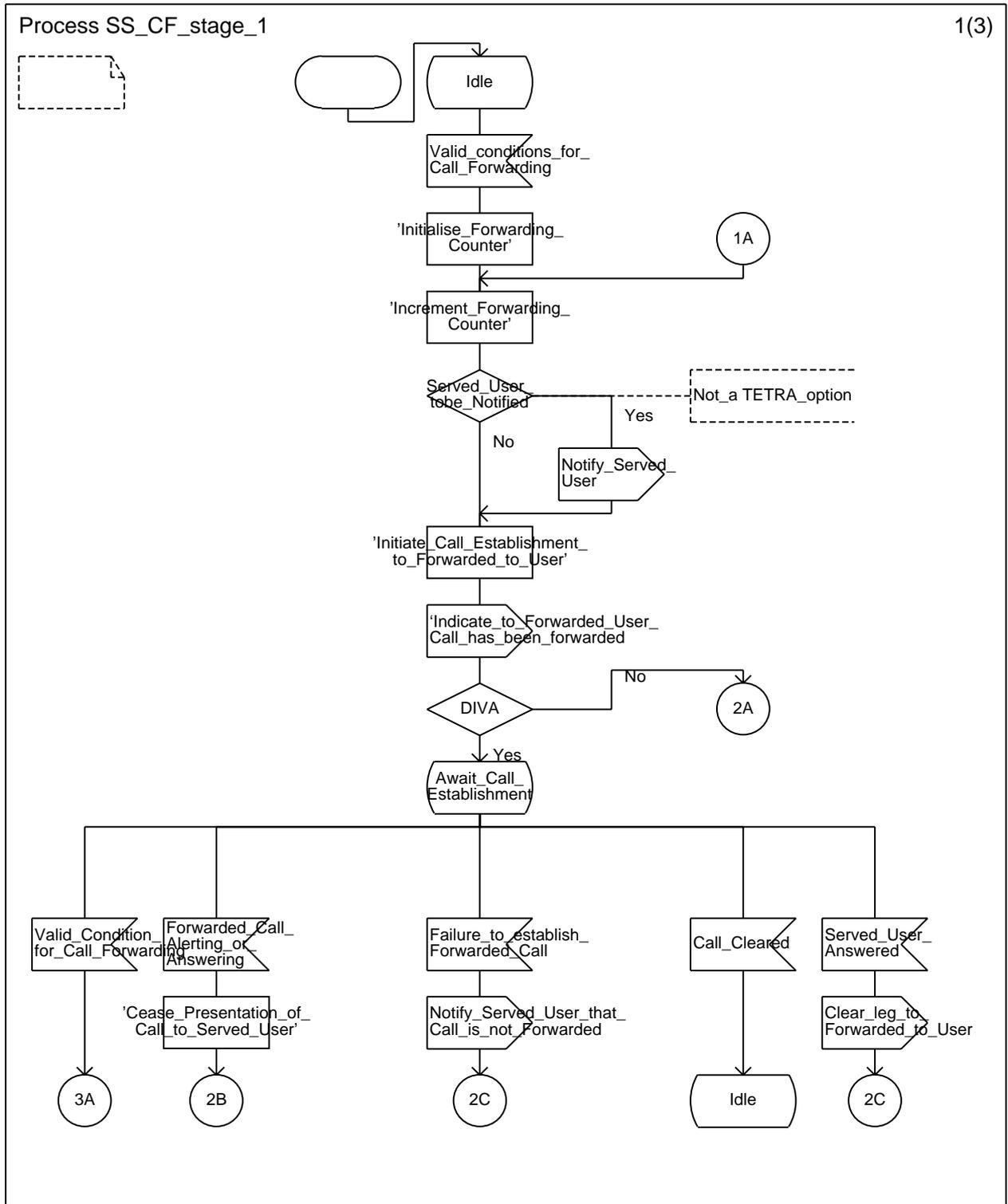


Figure 2 (sheet 1 of 3): SS-CF, Overall SDL

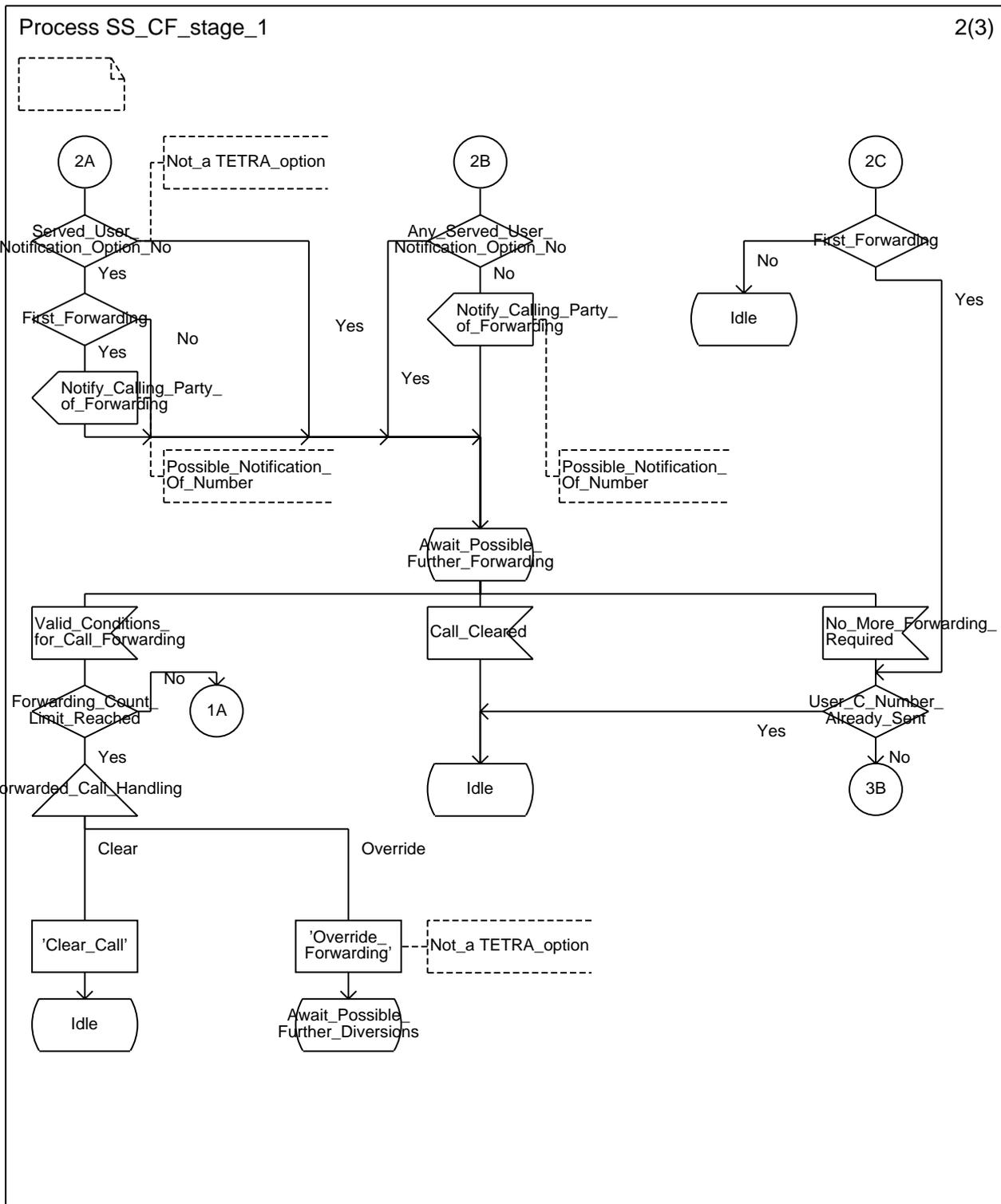


Figure 2 (sheet 2 of 3): SS-CF, Overall SDL

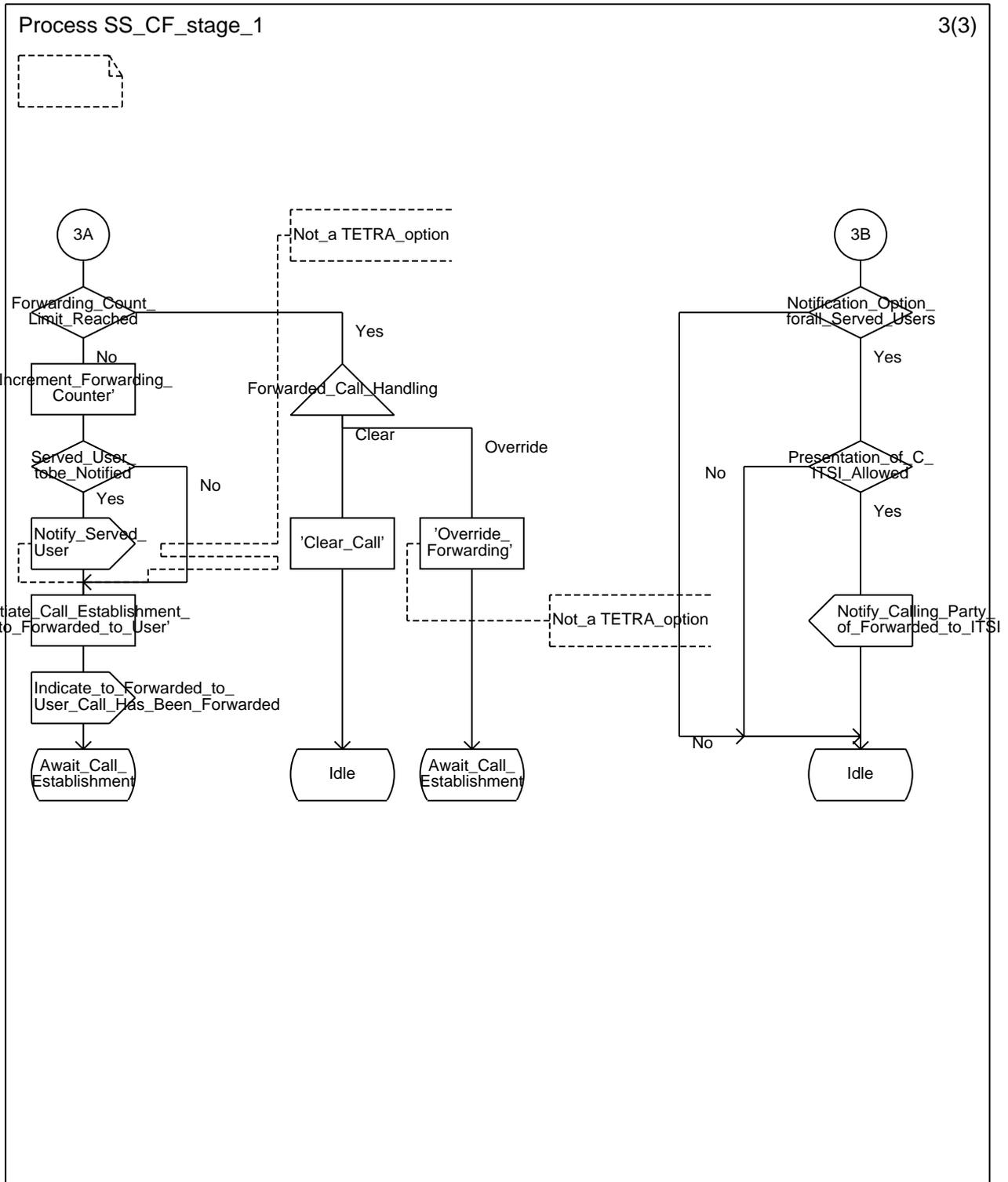


Figure 2 (sheet 3 of 3): SS-CF, Overall SDL

Figure 3 contains the dynamic description of call forwarding invocation counting using the Specification and Description Language (SDL) defined in ITU-T Recommendation Z.100 [3]. The SDL process represents the behaviour of the TETRA Network in providing FC. Input symbols from the left and output symbols to the left represent internal stimuli.

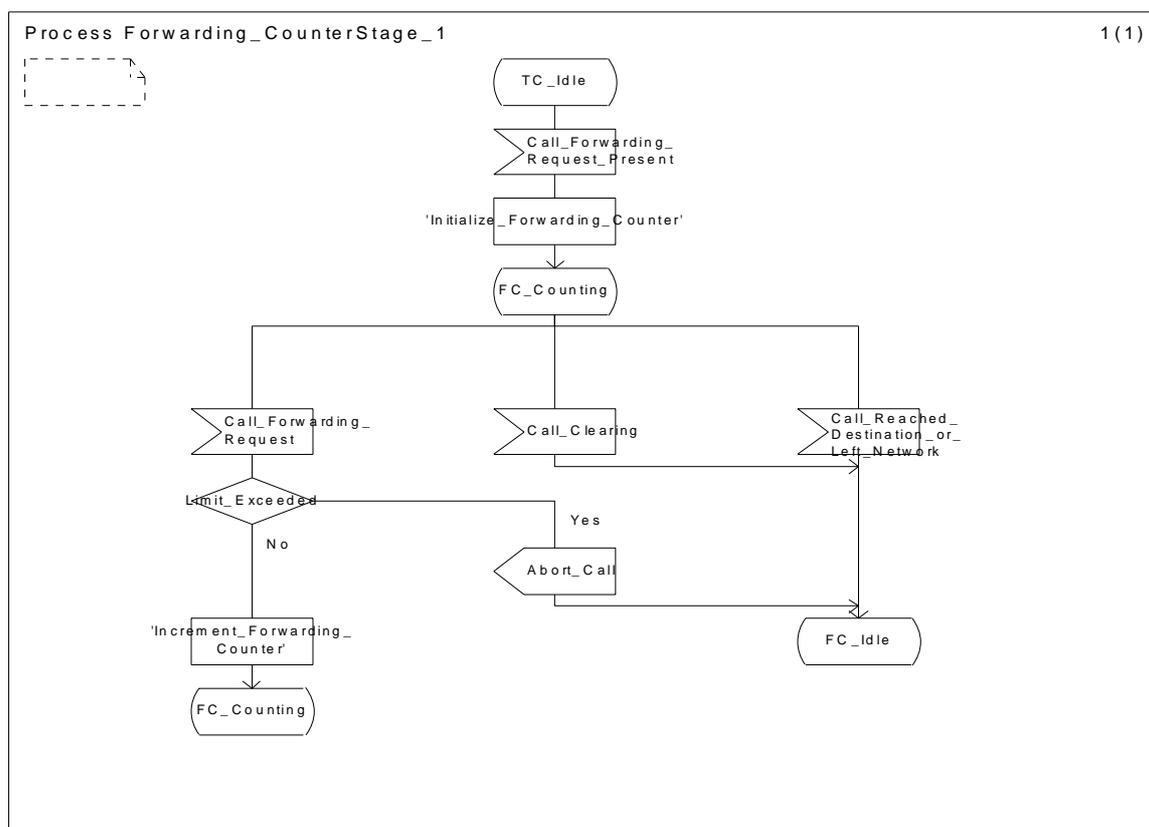


Figure 3: FC, overall SDL

## 6 SS-CFU for SDS specification

### 6.1 General description

SS-CFU for SDS permits a called user to have the network send unconditionally all incoming SDS user-data messages (regardless of their length), addressed to the called user ITSI to another forwarded-to user ITSI/GTSI/external subscriber number.

NOTE 1: The terminology CFU is not totally adequate since in the case of SDS, there is no call per se; SS-CFU for SDS will mean in what follows SDS user-data forwarding unconditional.

The served user may send SDS messages independently of the activation of SS-CFU for SDS.

SS-CFU for SDS is provided on a per TETRA ITSI/GTSI basis.

The maximum number of forwarding for a single user-data message is a network implementation option.

NOTE 2: Not seen to the user, the mechanism of the call forwarding invocation counting allows to count the number of forwarding of the SDS messages using the same mechanism as for voice and circuit mode data calls.

NOTE 3: SS-CFU for SDS is not specified in ECMA-173 [1].

## 6.2 Procedures

A limited set of SS-CFU functions may be available for SDS. Activation, deactivation, interrogation and operation by forward switching processes are optionally valid for SDS.

During operation there is no indication to the sending user or receiving user that the SDS is forwarded. In the SDS message the destination address is replaced by the forwarded-to address and the source address is retained. That should ensure that possible delivery reports reach the original sending user.

**NOTE:** On the sending user point of view SDS-TL reports are now received from a different address (not from the served user but from forwarded-to address) and the only linkage between the sent message and the received report is the message reference, refer to EN 300 392-2 [4], clause 29.

No reminder may be sent to the served user that the forwarding is activated, when the served user sends SDS messages.

The served user may send SDS messages independently of the activation of SS-CFU for SDS. The SDS-TL protocol reports sent to the served user should not be forwarded.

Otherwise provision, withdrawal, normal and exceptional procedures for SS-CFU defined in clause 4 shall apply.

If the served user is disabled as defined in EN 300 392-7 [8], then an authorized user disabling of SS-CF activation capability shall be removed. It is outside the scope of the present document whether all or only some of the authorized users re-gain activation/deactivation capability.

## 6.3 Interactions with other supplementary services and ANFs

### 6.3.1 Interactions with other supplementary services

There are no additional SDS messaging specific interactions with other supplementary services applicable to SDS messages than defined in clause 4.3.

### 6.3.2 Interaction with ANF mobility

The considerations specified for SS-CFU shall apply except that only the signalling connection shall be concerned and not the call forwarding part.

## 6.4 Interworking considerations

Interworking of SS-CFU for SDS with non TETRA networks does not add any new requirements for interworking.

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## Annex A (informative): Bibliography

- ITU-T Recommendation I.252.2 (1992): "Call Forwarding Busy".
- ITU-T Recommendation I.252.3 (1992): "Call Forwarding No Reply".
- ITU-T Recommendation I.252.4 (1992): "Call Forwarding Unconditional".

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## History

<b>Document history</b>		
Edition 1	April 1996	Publication as ETS 300 392-10-4
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