



TECHNICAL SPECIFICATION

**Terrestrial Trunked Radio (TETRA);
Voice plus Data (V+D);
Part 3: Interworking at the Inter-System Interface (ISI);
Sub-part 12: Transport layer independent Additional Network
Feature Individual Call (ANF-ISIIC)**

Reference

DTS/TCCE-03243

Keywords

ANF, interworking, TETRA, V+D

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2018.

All rights reserved.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members.

3GPP™ and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

oneM2M logo is protected for the benefit of its Members.

GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

Contents

| | |
|---|----|
| Intellectual Property Rights | 8 |
| Foreword | 8 |
| Modal verbs terminology | 9 |
| 1 Scope | 10 |
| 2 References | 10 |
| 2.1 Normative references | 10 |
| 2.2 Informative references | 11 |
| 3 Definitions and abbreviations | 12 |
| 3.1 Definitions | 12 |
| 3.2 Abbreviations | 13 |
| 4 ANF-ISIIC stage 1 specification | 14 |
| 4.1 Description | 14 |
| 4.1.1 General description | 14 |
| 4.1.2 Qualifications on applicability to telecommunication services | 14 |
| 4.2 Procedures | 14 |
| 4.2.1 Provision/withdrawal | 14 |
| 4.2.2 Normal procedures | 15 |
| 4.2.2.1 Activation/deactivation/registration/interrogation | 15 |
| 4.2.2.2 Invocation and operation | 15 |
| 4.2.2.2.1 General | 15 |
| 4.2.2.2.2 Call routing | 15 |
| 4.2.2.2.3 Control of call time-out timers | 15 |
| 4.2.2.2.4 Transmission control | 16 |
| 4.2.2.2.5 Setup modification | 16 |
| 4.2.2.2.6 Call modification | 16 |
| 4.2.2.2.7 Call restoration after migration | 16 |
| 4.2.2.2.8 Call clearing | 17 |
| 4.2.2.2.9 Interaction between ANF-ISIICs | 17 |
| 4.2.2.2.10 Resource queuing and allocation policies | 17 |
| 4.2.3 Exceptional procedures | 17 |
| 4.2.3.1 Activation/deactivation/registration/interrogation | 17 |
| 4.2.3.2 Invocation and operation | 17 |
| 4.3 Interactions with other TETRA supplementary services and ANFs | 18 |
| 4.3.1 Introduction | 18 |
| 4.3.2 Calling Line Identification Presentation (SS-CLIP) | 18 |
| 4.3.3 Connected Line identification Presentation (SS-COLP) | 18 |
| 4.3.4 Calling/connected Line Identification Restriction (SS-CLIR) | 18 |
| 4.3.5 Call Report (SS-CR) | 18 |
| 4.3.6 Talking Party Identification (SS-TPI) | 18 |
| 4.3.7 Call Forwarding Unconditional (SS-CFU) | 19 |
| 4.3.8 Call Forwarding on Busy (SS-CFB) | 20 |
| 4.3.9 Call Forwarding on No Reply (SS-CFNRy) | 22 |
| 4.3.10 Call Forwarding on Not Reachable (SS-CFNRc) | 22 |
| 4.3.11 List Search Call (SS-LSC) | 22 |
| 4.3.12 Call Authorized by Dispatcher (SS-CAD) | 22 |
| 4.3.13 Short Number Addressing (SS-SNA) | 23 |
| 4.3.14 Area Selection (SS-AS) | 24 |
| 4.3.15 Access Priority (SS-AP) | 24 |
| 4.3.16 Priority Call (SS-PC) | 24 |
| 4.3.17 Call Waiting (SS-CW) | 24 |
| 4.3.18 Call Hold (SS-HOLD) | 24 |
| 4.3.19 Call Completion to Busy Subscriber (SS-CCBS) | 24 |
| 4.3.20 Late Entry (SS-LE) | 24 |
| 4.3.21 Pre-emptive Priority Call (SS-PPC) | 25 |

| | | |
|------------|---|----|
| 4.3.22 | Include Call (SS-IC) | 25 |
| 4.3.23 | Barring of Outgoing Calls (SS-BOC) | 25 |
| 4.3.24 | Barring of Incoming Calls (SS-BIC)..... | 25 |
| 4.3.25 | Discreet Listening (SS-DL) | 26 |
| 4.3.26 | Ambience Listening (SS-AL) | 26 |
| 4.3.27 | Dynamic Group Number Assignment (SS-DGNA)..... | 26 |
| 4.3.28 | Call Completion on No Reply (SS-CCNR)..... | 26 |
| 4.3.29 | Call Retention (SS-CRT) | 26 |
| 4.3.30 | Additional Network Feature - Inter System Interface Group Call (ANF-ISIGC)..... | 27 |
| 4.3.31 | Additional Network Feature - Inter System Interface Short Data Service (ANF-ISISDS)..... | 27 |
| 4.3.32 | Additional Network Feature - Inter System Interface Mobility Management (ANF-ISIMM)..... | 27 |
| 4.3.33 | Additional Network Feature - Inter System Interface Supplementary service (ANF-ISISS)..... | 27 |
| 4.4 | Interworking considerations | 27 |
| 5 | ANF-ISIIC stage 2 specification | 28 |
| 5.1 | Functional model | 28 |
| 5.1.1 | Functional model description | 28 |
| 5.1.2 | Description of functional entities | 32 |
| 5.1.2.1 | Originating/Controlling SwMI individual call control application functional entity, FE1 | 32 |
| 5.1.2.2 | Originating/Controlling SwMI ISI individual call originating functional entity, FE2 | 32 |
| 5.1.2.3 | Called/Forward Switching SwMI call control functional entity, FE3 | 33 |
| 5.1.2.4 | Called/Forward Switching SwMI ISI individual call functional entity, FE4 | 34 |
| 5.1.2.5 | Terminating SwMI individual call control functional entity, FE5 | 34 |
| 5.1.2.6 | ISI individual call terminating functional entity, FE6 | 34 |
| 5.1.2.7 | New terminating SwMI call restoring functional entity, FE7 | 35 |
| 5.1.2.8 | New terminating SwMI ISI call restoring functional entity (ANF-ISIIC), FE8 | 35 |
| 5.2 | Information flow | 35 |
| 5.2.1 | Examples of information flow sequences | 35 |
| 5.2.1.1 | Introduction | 35 |
| 5.2.1.2 | Successful call set-up when the called user is registered in SwMI B and uses on/off hook signalling | 36 |
| 5.2.1.3 | Successful call set up when the called user is registered in SwMI B and uses direct set-up signalling | 37 |
| 5.2.1.4 | ANF-ISIIC set-up to a called user having migrated from SwMI B, using forward switching | 38 |
| 5.2.1.5 | ANF-ISIIC set-up to a called user having migrated from SwMI B, using re-routeing..... | 38 |
| 5.2.1.6 | Loop avoidance in case of intra-TETRA call | 39 |
| 5.2.1.7 | Unsuccessful ANF-ISIIC call set-up | 40 |
| 5.2.1.8 | Transmission control | 41 |
| 5.2.1.9 | Call modify..... | 44 |
| 5.2.1.10 | Call restoration after migration | 44 |
| 5.2.1.11 | Call clearing | 47 |
| 5.2.1.12 | Resource queuing and allocation..... | 48 |
| 5.2.2 | Definition of information flows | 49 |
| 5.2.2.1 | General | 49 |
| 5.2.2.2 | CALL RESTORE | 49 |
| 5.2.2.3 | CALL RESTORE PREPARE | 50 |
| 5.2.2.4 | CHARACTERISTIC CHANGE | 50 |
| 5.2.2.5 | COMPLETE | 51 |
| 5.2.2.6 | MIGRATION | 51 |
| 5.2.2.7 | MODIFY | 52 |
| 5.2.2.8 | RELEASE | 52 |
| 5.2.2.9 | SETUP | 52 |
| 5.2.2.10 | SETUP PROLONGATION | 54 |
| 5.2.2.11 | TROMBONE | 54 |
| 5.2.2.12 | TX-CEASED | 54 |
| 5.2.2.12.1 | TX-CEASED 1 | 54 |
| 5.2.2.12.2 | TX-CEASED 2 | 54 |
| 5.2.2.13 | TX-CONTINUE 1 | 55 |
| 5.2.2.14 | TX-CONTINUE 2 | 55 |
| 5.2.2.15 | TX-DEMAND | 55 |
| 5.2.2.16 | TX-GRANTED | 56 |
| 5.2.2.17 | TX-INTERRUPT | 56 |

| | | |
|------------|---|----|
| 5.2.2.18 | TX-WAIT | 56 |
| 5.3 | Functional entity actions | 56 |
| 5.4 | Allocation of functional entities to physical equipment/SwMIs | 57 |
| 6 | ANF-ISIIC stage 3 specification | 59 |
| 6.1 | ANF-ISIIC coding requirements | 59 |
| 6.1.1 | General | 59 |
| 6.1.2 | TETRA PDUs | 59 |
| 6.1.2.1 | General encoding rule | 59 |
| 6.1.2.2 | ISI-SETUP PDU message sent by the originating or the forward switching SwMI | 60 |
| 6.1.2.3 | ISI-PROGRESS PDU used to give information about the call progress | 62 |
| 6.1.2.4 | ISI-REDIRECT PDU sent by the called SwMI when it is not the terminating SwMI because of migration or SS-CF invocation | 62 |
| 6.1.2.5 | ISI-FORWARD SWITCH PDU sent by the originating or the forward switching SwMI to request forward switching | 64 |
| 6.1.2.6 | ISI-ALERTING PDU sent by by the terminating or the forward switching SwMI to give information about the connected party alerted | 64 |
| 6.1.2.7 | ISI-CONNECT PDU sent by by the terminating or the forward switching SwMI to give information that the connected party has answered the call | 64 |
| 6.1.2.8 | ISI-CALL PROCEEDING sent by the terminating SwMI before the ISI-ALERTING or ISI-CONNECT message | 65 |
| 6.1.2.9 | ISI-SETUP PROLONGATION PDU sent to prolong the call setup time | 66 |
| 6.1.2.10 | ISI CONNECT ACKNOWLEDGE PDU sent by the originating SwMI | 66 |
| 6.1.2.11 | Transmission control PDUs sent by the controlling SwMI | 66 |
| 6.1.2.12 | ISI-TX WAIT PDU possibly sent by either the controlling or the terminating SwMI | 68 |
| 6.1.2.13 | ISI-INFO DEMAND and ISI-INFO REPLY PDU possibly sent by either the originating or the terminating SwMI | 68 |
| 6.1.2.14 | Transmission control PDUs sent by the terminating SwMI | 69 |
| 6.1.2.15 | TETRA PDUs to restore the call after the calling or the connected user has migrated in a new SwMI | 70 |
| 6.1.2.15.1 | Case where no connection between the old SwMI and the new SwMI already exists or has not been identified | 70 |
| 6.1.2.15.2 | Cases where no new connection is needed between the old SwMI and the new SwMI | 71 |
| 6.1.2.16 | ISI-DISCONNECT PDU sent by a SwMI in case of call clearing or call rejection | 73 |
| 6.1.2.17 | TETRA PDUs specific for interaction with supplementary service protocol sent to the originating SwMI | 73 |
| 6.1.2.18 | ISI-QUEUING PDUs sent towards the terminating SwMI | 74 |
| 6.1.2.19 | ISI-RESOURCE PDU sent towards the Terminating SwMI | 75 |
| 6.1.2.20 | ISI-RESOURCE RESPONSE PDUs sent towards the Called or Originating SwMI after the call has connected | 75 |
| 6.1.3 | TETRA PDU information element coding | 75 |
| 6.1.3.1 | Introduction | 75 |
| 6.1.3.2 | Specific ISI definition of some information elements already defined for air interface messages | 76 |
| 6.1.3.2.1 | Basic service information | 76 |
| 6.1.3.2.2 | Call status | 76 |
| 6.1.3.2.3 | Call time-out, set-up phase | 76 |
| 6.1.3.2.4 | Disconnect cause information element | 77 |
| 6.1.3.2.5 | PDU type | 78 |
| 6.1.3.3 | New information elements used at the ISI | 79 |
| 6.1.3.3.1 | Call diverted to a dispatcher | 79 |
| 6.1.3.3.2 | Call has been forward switched | 79 |
| 6.1.3.3.3 | Call identified as fleet call | 79 |
| 6.1.3.3.4 | Called/forwarded-to external subscriber number | 79 |
| 6.1.3.3.5 | Called/forwarded-to party extension | 79 |
| 6.1.3.3.6 | Called/forwarded-to party SSI | 79 |
| 6.1.3.3.7 | Called/forwarded-to party fleet number SSI | 79 |
| 6.1.3.3.8 | Called/forwarded-to user having migrated | 80 |
| 6.1.3.3.9 | Calling external subscriber number | 80 |
| 6.1.3.3.10 | Calling external subscriber number parameters | 80 |
| 6.1.3.3.11 | Calling party fleet number SSI | 80 |
| 6.1.3.3.12 | Calling party presentation indicator | 80 |
| 6.1.3.3.13 | Cause for PDU addressed to originating SwMI | 81 |

| | | |
|------------|---|----|
| 6.1.3.3.14 | Connected external subscriber number | 81 |
| 6.1.3.3.15 | Connected external subscriber number parameters | 81 |
| 6.1.3.3.16 | Connected party presentation indicator | 81 |
| 6.1.3.3.17 | Connected party extension..... | 81 |
| 6.1.3.3.18 | Connected party SSI | 81 |
| 6.1.3.3.19 | Connected party fleet number SSI | 82 |
| 6.1.3.3.20 | Controlling SwMI..... | 82 |
| 6.1.3.3.21 | Incoming call barring status..... | 82 |
| 6.1.3.3.22 | Forwarded-to external subscriber number | 82 |
| 6.1.3.3.23 | Forwarded-to user extension..... | 82 |
| 6.1.3.3.24 | Forwarded-to user SSI | 82 |
| 6.1.3.3.25 | Last Forwarding SwMI MNI | 82 |
| 6.1.3.3.26 | Modify accepted | 82 |
| 6.1.3.3.27 | Modify request..... | 83 |
| 6.1.3.3.28 | MSISDN present as external subscriber number | 83 |
| 6.1.3.3.29 | New SwMI MNI..... | 83 |
| 6.1.3.3.30 | Number of digits in called/forwarded-to external subscriber number | 83 |
| 6.1.3.3.31 | Number of digits in calling external subscriber number | 83 |
| 6.1.3.3.32 | Number of digits in connected external subscriber number..... | 83 |
| 6.1.3.3.33 | Number of digits in forwarded-to external subscriber number | 84 |
| 6.1.3.3.34 | Number of digits in visited/forwarded-to SwMI PISN number..... | 84 |
| 6.1.3.3.35 | Originating SwMI MNI..... | 84 |
| 6.1.3.3.36 | Other end SwMI MNI..... | 84 |
| 6.1.3.3.37 | Override SS-CAD invocation | 84 |
| 6.1.3.3.38 | PDU addressed to originating SwMI | 84 |
| 6.1.3.3.39 | Possible ISI trombone or loop connection detected..... | 84 |
| 6.1.3.3.40 | Restoring party extension | 85 |
| 6.1.3.3.41 | Restoring party SSI..... | 85 |
| 6.1.3.3.42 | Resource release permission..... | 85 |
| 6.1.3.3.43 | Resource release signalling support..... | 85 |
| 6.1.3.3.44 | Resource indicator | 85 |
| 6.1.3.3.45 | Routeing method choice | 86 |
| 6.1.3.3.46 | Routeing method response..... | 86 |
| 6.1.3.3.47 | Security level at air interface | 86 |
| 6.1.3.3.48 | Setup resource allocation | 86 |
| 6.1.3.3.49 | Speech service requested/chosen/used..... | 87 |
| 6.1.3.3.50 | Speech services supported | 87 |
| 6.1.3.3.51 | SS-CF invocation counter | 87 |
| 6.1.3.3.52 | SS-CF invoked..... | 87 |
| 6.1.3.3.53 | SS-CLIR invoked for other party..... | 87 |
| 6.1.3.3.54 | Terminating SwMI MNI..... | 87 |
| 6.1.3.3.55 | Visited/forwarded-to SwMI MNI | 88 |
| 6.1.3.3.56 | Visited/forwarded-to SwMI PISN number | 88 |
| 6.2 | ANF-ISIIC state definitions..... | 88 |
| 6.3 | ANF-ISIIC signalling procedures..... | 88 |
| 6.3.1 | General..... | 88 |
| 6.3.2 | Call establishment..... | 88 |
| 6.3.2.1 | Call request and call proceeding..... | 88 |
| 6.3.2.2 | Called user migration | 88 |
| 6.3.2.2.1 | Introduction | 88 |
| 6.3.2.2.2 | Called user having migrated in SwMI C different from SwMI A | 89 |
| 6.3.2.2.3 | Called user having migrated in SwMI C coinciding with SwMI A | 91 |
| 6.3.2.3 | Call characteristics and set-up time negotiation by the terminating SwMI | 92 |
| 6.3.2.4 | Call through connection | 92 |
| 6.3.2.4.1 | Call confirmation indication by the terminating SwMI | 92 |
| 6.3.2.4.2 | Resource queuing and different resource allocation policies when no forward switching SwMIs involved..... | 93 |
| 6.3.2.4.3 | Resource queuing and different resource allocation policies if forward switching SwMIs are involved | 95 |
| 6.3.2.5 | Failure of call establishment..... | 97 |
| 6.3.3 | Call maintenance procedures | 97 |
| 6.3.3.1 | Transmission control procedures..... | 97 |

| | | |
|---|---|------------|
| 6.3.3.2 | Call modification | 97 |
| 6.3.3.3 | Call restoration | 98 |
| 6.3.3.3.1 | General call restoration procedure | 98 |
| 6.3.3.3.2 | Specific call restoration procedure in a SwMI already on the path of the call | 99 |
| 6.3.4 | DTMF procedures | 100 |
| 6.3.5 | ANF-ISIIC clearing | 100 |
| 6.4 | ANF-ISIIC impact of interworking with ISDN/PISN/PSTN | 101 |
| 6.5 | Protocol interactions between ANF-ISIIC and supplementary services and other ANFs | 102 |
| 6.5.1 | Interaction with SS-CLIR | 102 |
| 6.5.2 | Interactions with SS-CF | 102 |
| 6.5.2.1 | Interaction with SS-CF at call establishment | 102 |
| 6.5.2.2 | Specific interaction with SS-CFNRY at call establishment | 103 |
| 6.5.2.3 | Interaction with SS-CF at call restoration | 103 |
| 6.5.3 | Interaction with SS-CAD | 104 |
| 6.5.3.1 | Invocation of a specific ANF-ISIIC | 104 |
| 6.5.3.2 | Interception of an already invoked ANF-ISIIC | 104 |
| 6.5.3.3 | Call authorization by a distant dispatcher | 104 |
| 6.5.3.4 | Completion of call establishment | 104 |
| 6.5.3.4.1 | Call not diverted to dispatcher | 104 |
| 6.5.3.4.2 | Call diverted to dispatcher | 104 |
| 6.5.4 | Interactions with SS-PC, SS-PPC and SS-CRT | 105 |
| 6.5.5 | Interaction with SS-CW | 105 |
| 6.5.6 | Interaction with SS-HOLD | 106 |
| 6.5.7 | Interaction with SS-CCBS and SS-CCNR | 106 |
| 6.5.8 | Interaction with SS-BIC | 106 |
| 6.5.9 | Area Selection (SS-AS) and selected area number | 106 |
| 6.5.10 | Interactions with other supplementary services | 106 |
| 6.6 | ANF-ISIIC parameter values (timers) | 106 |
| Annex A (informative): Interactions of SS-CFU with ANF-ISIIC | | 107 |
| A.1 | Possible SS-CFU activation | 107 |
| A.2 | Invocation and operation | 107 |
| A.2.1 | Invocation | 107 |
| A.2.2 | Called user home SwMI being SwMI A | 107 |
| A.2.3 | Called user home SwMI being SwMI B | 107 |
| A.2.3.1 | Introduction | 107 |
| A.2.3.2 | Forwarded-to user with home SwMI being SwMI B, being registered in its home SwMI | 108 |
| A.2.3.3 | Forwarded-to user with home SwMI being SwMI B, having migrated | 109 |
| A.2.3.4 | Forwarded-to user with home SwMI different from SwMI B, being registered in its home SwMI | 109 |
| A.2.3.5 | Forwarded-to user with home SwMI different from SwMI B, having migrated | 109 |
| Annex B (informative): Change Requests | | 112 |
| History | | 113 |

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee TETRA and Critical Communications Evolution (TCCE).

The present document is part 3, sub-part 12 of a multi-part deliverable covering the Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D), as identified below:

Part 1: "General network design";

Part 2: "Air Interface (AI)";

Part 3: "Interworking at the Inter-System Interface (ISI)":

Sub-part 1: "General design";

Sub-part 2: "Additional Network Feature Individual Call (ANF-ISIIC)";

Sub-part 3: "Additional Network Feature Group Call (ANF-ISIGC)";

Sub-part 4: "Additional Network Feature Short Data Service (ANF-ISISDS)";

Sub-part 5: "Additional Network Feature for Mobility Management (ANF-ISIMM)";

Sub-part 6: "Speech format implementation for circuit mode transmission";

Sub-part 7: "Speech Format Implementation for Packet Mode Transmission";

Sub-part 8: "Generic Speech Format Implementation";

Sub-part 9: "Transport layer independent, General design";

Sub-part 10: "General design, PSS1 over E.1";

Sub-part 11: "General design, SIP/IP";

Sub-part 12: "Transport layer independent Additional Network Feature Individual Call (ANF-ISIIC)";

Sub-part 13: "Transport layer independent Additional Network Feature Group Call (ANF-ISIGC)";

Sub-part 14: "Transport layer independent Additional Network Feature Short Data Service (ANF-ISISDS)";

Sub-part 15: Transport layer independent Additional Network Feature, Mobility Management (ANF-ISIMM)";

Part 4: "Gateways basic operation";

Part 5: "Peripheral Equipment Interface (PEI)";

Part 7: "Security";

Part 9: "General requirements for supplementary services";

Part 10: "Supplementary services stage 1";

Part 11: "Supplementary services stage 2";

Part 12: "Supplementary services stage 3";

Part 13: "SDL model of the Air Interface (AI)";

Part 14: "Protocol Implementation Conformance Statement (PICS) proforma specification";

Part 15: "TETRA frequency bands, duplex spacings and channel numbering";

Part 16: "Network Performance Metrics";

Part 17: "TETRA V+D and DMO specifications";

Part 18: "Air interface optimized applications";

NOTE 1: Part 3, sub-parts 6 and 7 (Speech format implementation), part 4, sub-part 3 (Data networks gateway), part 10, sub-part 15 (Transfer of control), part 13 (SDL) and part 14 (PICS) of this multi-part deliverable are in status "historical" and are not maintained.

NOTE 2: Some parts are also published as Technical Specifications such as ETSI TS 100 392-2 and those may be the latest version of the document.

The present document is based on ETSI EN 300 392-3-2 "Interworking at the Inter-System Interface, Sub-part 2 Additional Network Feature for Individual Call (ANF-ISIIC)". The main changes are:

- Removal of any reference to the bearer protocol
- Clean up of stage 2 descriptions

For all sub-parts in the TETRA specification ETSI EN 300 392-3, "Interworking at the Inter-System Interface (ISI)" the terms ISI and TETRA ISI are equivalent.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document defines the Terrestrial Trunked Radio (TETRA) system supporting Voice plus Data (V+D). It specifies:

- the interworking of individual calls between TETRA networks;
- the supplementary services interaction with individual calls between TETRA networks.

The TETRA V+D interworking - basic operation part defines the interworking between TETRA networks over the corresponding interface: the Inter-System Interface (ISI). It comprises the following sub-parts:

- Transport layer independent General design [2];
- General Design, PSS1 over E.1 [3];
- General Design, SIP/IP [4];
- Transport layer independent Additional Network Feature - ISI Individual Call (ANF-ISIIC) (the present document);
- Transport layer independent Additional Network Feature - ISI Group Call (ANF-ISIGC) [5];
- Transport layer independent Additional Network Feature - ISI Short Data service (ANF-ISISDS) [i.8];
- Transport layer independent Additional Network Feature - ISI Mobility Management (ANF-ISIMM) [6];
- Generic Speech Format Implementation [i.7].

The present document is the ANF-ISIIC sub-part.

Like all other Additional Network Feature (ANF) specifications, those of ANF-ISIIC are produced in three stages, according to the method described in Recommendation ITU-T I.130 [i.4]. The present document contains the stage 1 and 2 descriptions of ANF-ISIIC, and stage 3 description. The stage 1 description specifies the ANF as seen by its users, which are essentially the individual call control entities in both TETRA networks. The stage 2 description identifies the functional entities involved in the ANF and the information flows between them. And the stage 3 description of ANF-ISIIC specifies its protocol.

NOTE 1: According to Recommendation ITU-T I.130 [i.4], the stage 3 description of a bearer or tele-service addresses the network implementation aspects. Consequently, it comprises two steps: the specifications of all protocols at the various reference points involved in any of the service procedures (notably the service operation) are the first step of the stage 3 description, and the specifications of the functions of the corresponding network entities are its second step.

NOTE 2: The SDL diagrams have not been provided since they can be derived from the specification of the functional entity actions in the stage 2 description.

The present document applies to TETRA networks which support inter-TETRA individual calls. More specifically, it applies to their Circuit Mode Control Entities (CMCE), as defined in clause 14.2 of ETSI EN 300 392-2 [1], and to their ANF-ISIIC entities defined in the stage 2 description.

The relation between the ANF-ISIIC and the transport layer protocol is described in the General Design documents [2], [3] and [4].

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

- [1] ETSI EN 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".
- [2] ETSI TS 100 392-3-9: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 9: Transport layer independent, General design".
- [3] ETSI TS 100 392-3-10: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 10: General design, PSS1 over E.1".
- [4] ETSI TS 100 392-3-11: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 11: General design, SIP/IP".
- [5] ETSI TS 100 392-3-13: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 13: Transport layer independent Additional Network Feature Group Call (ANF-ISIGC)".
- [6] ETSI TS 100 392-3-15: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 15: Transport layer independent Additional Network Feature, Mobility Management (ANF-ISIMM)".
- [7] ETSI EN 300 392-9: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 9: General requirements for supplementary services".
- [8] 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)".
- [9] ISO/IEC 11572: "Information technology - Telecommunications and information exchange between systems - Private Integrated Services Network - Circuit mode bearer services - Inter-exchange signalling procedures and protocol".
- [10] ETSI EN 300 392-12-8: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 12: Supplementary services stage 3; Sub-part 8: Area Selection (AS)".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI EN 300 392-7: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 7: Security".
- [i.2] ETSI EN 300 392-10-19: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 10: Supplementary services stage 1; Sub-part 19: Barring of Incoming Calls (BIC)".
- [i.3] ETSI EN 300 395-2: "Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel; Part 2: TETRA codec".
- [i.4] Recommendation ITU-T I.130: "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".

- [i.5] ETSI TR 102 300-5: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Designers' guide; Part 5: Guidance on numbering and addressing".
- [i.6] ETSI EN 300 392-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 1: General network design".
- [i.7] ETSI TS 100 392-3-8: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 8: Generic Speech Format Implementation".
- [i.8] ETSI TS 100 392-3-14: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 14: Transport layer independent Additional Network Feature Short Data Service (ANF-ISISDS)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in ETSI TS 100 392-3-9 [2] and the following apply:

called SwMI: Switching and Management Infrastructure to which ANF-ISIIC routes the first call attempt

controlling SwMI: Switching and Management Infrastructure responsible of the speech item management in half duplex individual calls

NOTE: During the call setup the originating SwMI is also the controlling SwMI. When the calling party migrates during a call the control of the call is transferred to that SwMI.

fleet call: call to a closed user group using a Fleet Specific Short Number

NOTE: Refer to ETSI TR 102 300-5 [i.5], clause 5.4.3.

forward switching: network routing algorithm which performs the routing from SwMI A to SwMI C by joining together the first connection, from SwMI A to SwMI B, and a second connection from SwMI B to SwMI C

home SwMI: SwMI which is the home of the MS (or LS) ITSI, i.e. to which the Mobile Network Identity (MNI) which is part of the ITSI belongs

loop connection: ISI connection which has both its ends in the same SwMI

originating SwMI: Switching and Management Infrastructure in which the calling user has registered when the call is set up

re-routing: network routing algorithm which performs the routing from SwMI A to SwMI C by replacing the connection from SwMI A to SwMI B by another connection from SwMI A to SwMI C

SwMI A: Switching and Management Infrastructure in which the calling user has registered or in case of call forwarding SS where the call forwarding is performed

SwMI B: Switching and Management Infrastructure to which ANF-ISIIC of SwMI A routes the call attempt

SwMI C: Switching and Management Infrastructure in which the called user or the forwarded-to user has registered after having migrated from SwMI B, in the case where its home SwMI is SwMI B

terminating SwMI: Switching and Management Infrastructure in which the connected user is registered

NOTE: Unless an interaction with one or more supplementary services which modify the routing of the call (e.g. call forwarding) has occurred, the connected user will be the called user; and the terminating SwMI will be the SwMI where the called user is registered, i.e. SwMI B or SwMI C.

Transit SwMI: TETRA SwMI involved in a call but not being controlling or terminating SwMI

NOTE: A SwMI performing forward switching becomes a transit SwMI. Also in case of call restoration the old visited SwMI becomes a transit SwMI.

trombone connection: two inter-SwMI connections between two SwMIs for the same call

visited SwMI: TETRA network which MNI is not equal to the user's MNI

NOTE: In the present document the term visited SwMI follows the definition of the Air Interface standard ETSI EN 300 392-2 [1].

3.2 Abbreviations

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

| | |
|--------|--|
| AL | Ambience Listening |
| ANF | Additional Network Feature |
| AP | Access Priority |
| APDU | Application Packet Data Unit |
| AS | Area Selection |
| BIC | Barring of Incoming Calls |
| BOC | Barring of Outgoing Calls |
| CAD | Call Authorized by Dispatcher |
| CC | Call Control (PISN functional entity) |
| CCAp | Call Control Application (SwMI functional entity) |
| CCBS | Call Completion to Busy Subscriber |
| CCNR | Call Completion on No Reply |
| 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 |
| CMCE | Circuit Mode Control Entities |
| COLP | COnnected Line identification Presentation |
| CR | Call Report |
| CRT | Call ReTention |
| CRV | Call Retention Value |
| CW | Call Waiting |
| DGNA | Dynamic Group Number Assignment |
| DL | Discreet Listening |
| DTMF | Dual Tone Multi Frequency |
| FE | Functional Entity |
| GTSI | Group TETRA Subscriber Identity |
| HOLD | Call Hold |
| IC | Include Call |
| ISDN | Integrated Services Digital Network |
| ISI | Inter System Interface |
| ISIGC | Inter System Interface Group Call |
| ISIIC | Inter System Interface Individual Call |
| ISIMM | Inter System Interface Mobility Management |
| ISISDS | Inter System Interface Short Data Service |
| ISISS | Inter System Interface Supplementary Service |
| ITSI | Individual TETRA Subscriber Identity |
| LE | Late Entry |
| LS | Line Station |
| LSC | List Search Call |
| MLE | Mobile Link Entity |
| MNI | Mobile Network Identity |
| MS | Mobile Station |
| MSISDN | Mobile Station Integrated Services Digital Network |
| PC | Priority Call |

| | |
|------|---|
| PDU | Protocol Data Unit |
| PEI | Peripheral Equipment Interface |
| PISN | Private Integrated Services Network |
| PPC | Pre-emptive Priority Call |
| PSS1 | Private integrated Signalling System number 1 |
| PSTN | Public Switched Telephone Network |
| RSI | Removal of Subscriber Information |
| SDL | Specification and Description Language |
| SNA | Short Number Addressing |
| SS | Supplementary Service |
| SSI | Short Subscriber Identity |
| SwMI | Switching and Management Infrastructure |
| TNCC | TETRA Network layer Call Control |
| TPI | Talking Party Identification |

4 ANF-ISIIC stage 1 specification

4.1 Description

4.1.1 General description

ANF-ISIIC enables individual calls to be set-up from a TETRA user registered in one Switching and Management Infrastructure (SwMI) to another TETRA user registered in another SwMI. ANF-ISIIC operates at the Inter System Interface (ISI) of the SwMI Call Control Applications (CCAs), in such a manner that these calls can be routed between and through transit SwMIs. Additionally, for the duration of each call, ANF-ISIIC allows TETRA signalling information to be passed from TETRA SwMI to TETRA SwMI in accordance with the TETRA Individual Call procedures as defined in ETSI EN 300 392-2 [1]. In addition ANF-ISIIC participates in call restoration when a user has migrated to another TETRA network during an established call.

The entities with which ANF-ISIIC interacts are the originating, the terminating and transit SwMI CCAs, and in addition, some SwMI databases, especially that of the called user home SwMI.

4.1.2 Qualifications on applicability to telecommunication services

ANF-ISIIC is applicable to all point-to-point circuit mode tele- and bearer services defined in ETSI EN 300 392-2 [1]:

- point-to-point TETRA clear mode speech;
- point-to-point TETRA end-to-end encrypted speech;
- point-to-point one slot 2,4 kbit/s, 4,8 kbit/s or 7,2 kbit/s TETRA circuit mode data;
- point-to-point $N \times 2,4$ kbit/s, $N \times 4,8$ kbit/s or $N \times 7,2$ kbit/s TETRA circuit mode data, with $N = 2, 3$ or 4 ;
- point-to-point end-to-end encrypted one slot 2,4 kbit/s, 4,8 kbit/s or 7,2 kbit/s TETRA circuit mode data;
- point-to-point end-to-end encrypted $N \times 2,4$ kbit/s, $N \times 4,8$ kbit/s or $N \times 7,2$ kbit/s TETRA circuit mode data, with $N = 2, 3$ or 4 .

4.2 Procedures

4.2.1 Provision/withdrawal

ANF-ISIIC shall be permanently available or controlled by provision/withdrawal.

4.2.2 Normal procedures

4.2.2.1 Activation/deactivation/registration/interrogation

ANF-ISIIC shall be permanently activated on provision and permanently deactivated on withdrawal.

Registration and interrogation are not applicable to this ANF.

4.2.2.2 Invocation and operation

4.2.2.2.1 General

ANF-ISIIC shall be invoked by SwMI A CCAp, its served user, when a request from a TETRA user for an individual call to another TETRA network is received by this SwMI. The other network SwMI being called SwMI B by definition, SwMI A CCAp will identify SwMI B either:

- through analysis of the destination number when the called user home SwMI is SwMI B; or
- by a migration information when the called user home SwMI is SwMI A and this user has migrated to SwMI B.

In either case, the invoked ANF-ISIIC shall route the call over an inter-TETRA connection to TETRA network B.

4.2.2.2.2 Call routing

If the called user is registered in TETRA network B, SwMI B will know the location of this user; ANF-ISIIC shall then allow this SwMI to complete the call with this user, by ensuring the necessary transfer of information with SwMI A.

If the called user has migrated to another SwMI (SwMI C), then ANF-ISIIM as defined in ETSI TS 100 392-3-15 [6] will ensure that this is known from its home SwMI.

NOTE 1: SwMI C cannot exist when the called user home SwMI is SwMI A. This is because when a user has migrated first in a given TETRA network 1, and then migrates into a new TETRA network, SwMI A database will now hold the identity of this new network as being that of SwMI B.

NOTE 2: Thus SwMI C as defined in clause 3.1 will only exist when the home SwMI of the called user is SwMI B and when this user has migrated or the call has been forwarded in SwMI B to another user.

Then the call shall be either re-routed (from SwMI A) or forward switched (through SwMI B).

The invoked ANF-ISIIC should detect the specific case where SwMI C coincides with SwMI A. The ANF-ISIIC should then instruct SwMI A to establish the call as an intra-TETRA call (i.e. avoiding a loop connection) and clear the inter-TETRA call.

4.2.2.2.3 Control of call time-out timers

Call time-out either for the call establishment phase or once the call has been established may be negotiated between SwMI A CCAp and the terminating SwMI (i.e. SwMI B or C) CCAp: for such negotiation SwMI A CCAp shall indicate its time-out for both durations, and the terminating SwMI CCAp should either use these values or if it decides to have a larger one for any of its corresponding timers, send it to SwMI A CCAp. SwMI A CCAp should then use the latter values (for its corresponding timers).

NOTE: While the exchange of time-out values between the two CCAs has been specified in the protocol (see clauses 6.1.2.2, 6.1.2.8, 6.1.2.9 and 6.1.2.15), the use of the time-out values of one CCAp by the other is optional. However if this other CCAp does not use them, the risk of call attempt failure (due to premature call establishment time-out) or call interruption (due to premature call duration time-out) will be increased.

4.2.2.2.4 Transmission control

ANF-ISIIC shall remain operational for the duration of the call, sending and receiving TETRA signalling messages as appropriate under direction of the controlling and terminating SwMI CCAs.

The originating SwMI shall be designated as the controlling SwMI for half-duplex operation, and all requests to transmit from the called user shall be directed to this SwMI to be granted.

4.2.2.2.5 Setup modification

Individual call setup modifications (direct <-> hook, duplex <-> simplex) as described in clause 14.5.1.1 of ETSI EN 300 392-2 [1] are also applicable to ISIIC.

4.2.2.2.6 Call modification

Call modification as defined in clause 14.5.1.2 of ETSI EN 300 392-2 [1] shall have no impact on the basic ISI connection(s) established by the invoked ANF-ISIIC.

NOTE: The reason for this is first that the various cases of call modification defined in clause 14.5.1.2 of ETSI EN 300 392-2 [1] never cause to exceed the capacity of such basic ISI connection, and second, it is not possible to reduce the ISI connection information transfer rate defined at ANF-ISIIC set-up.

However call modification shall result in a change in the 8 kbit/s encoding of the user information when the data rate of this information changes, because of e.g. a change from data call to speech call, or from 4,8 kbit/s to 7,2 kbit/s or 2,4 kbit/s, and vice-versa.

4.2.2.2.7 Call restoration after migration

If the calling or the connected user migrates and registers in a new TETRA network once an inter-TETRA call has been established, ANF-ISIMM of the SwMI where this migrating user was previously registered (hereafter called the "old SwMI") is informed (by ANFISI-MM RSI service) of the possible call restoration support of the new location SwMI. Upon request of call control application, the ANF-ISIIC in the old SwMI may then establish a connection towards the new SwMI, if the call restoration is supported by the new SwMI. The call restoration request by the migrating user in the new SwMI (see clause 14.5.1.2.4 of ETSI EN 300 392-2 [1]) may result in the call being routed via the old SwMI to this migrating user.

NOTE 1: Using re-routing for call restoration has been considered to be too complex.

Figure 1 illustrates this in the case where the calling user has migrated and its home SwMI is not SwMI A.

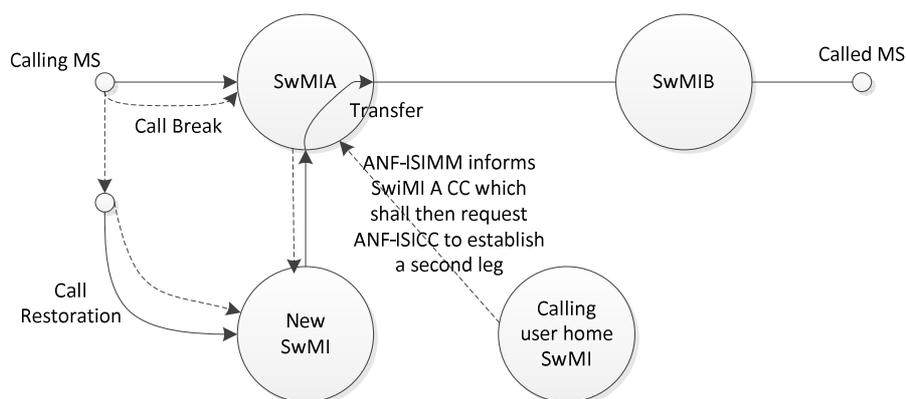


Figure 1: Call restoration by the calling user having migrated, with its home SwMI being different from SwMI A

If the migration of the calling or of the connected user happens once an intra-TETRA call in a given SwMI has been established, ANF-ISIMM will be informed (by ANFISI-MM RSI service) of the possible call restoration support of the new location SwMI. This SwMI CC may invoke ANF-ISIIC to perform call restoration if the call restoration is supported by the new SwMI.

NOTE 2: As opposed to the former case of call restoration, where ANF-ISIIC has already been invoked and is then extended to the "new" SwMI by transfer, the latter is a very specific case of ANF-ISIIC invocation.

NOTE 3: When migration takes place during the establishment of the call, the call will be cleared by the MS, as a result of the detection of the corresponding (radio path) break by its MLE.

4.2.2.2.8 Call clearing

When clearing the call on its side, either the controlling or the terminating SwMI call control applications shall inform the invoked ANF-ISIIC. This ANF-ISIIC shall then request to clear the whole ISI call from all involved SwMIs.

NOTE: In the controlling SwMI, the call may be cleared either by the calling user or by the call control application (e.g. if the SwMI can no longer support the call). Similarly, in the terminating SwMI, the call may be cleared either by the connected user or by the call control application.

4.2.2.2.9 Interaction between ANF-ISIICs

Due to the fact that a single ANF-ISIIC shall handle the routing of the call either to the called user, even when this user has migrated, only one ANF-ISIIC shall be invoked per individual call. And thus, no interaction can possibly take place in the case of a single individual call.

As stated in the corresponding clauses, this is also applicable in case of interactions with supplementary services, including those which modify the routing of the call (e.g. call forwarding, see clauses 4.3.6 to 4.3.9).

On the other hand, two invoked ANF-ISIIC using or needing a connection between two given SwMIs can interact through some supplementary services:

- the Include Call supplementary service for merging two individual calls into a group call (see clause 4.3.22);
- the Pre-emptive Priority Call supplementary service (see clause 4.3.21) for the invocation of ANF-ISIIC for a new call, to choose whether to operate such newly invoked ANF-ISIIC in clearing an active one, or to reject it.

4.2.2.2.10 Resource queuing and allocation policies

Due to the TETRA requirement for a fast call set-up time the invoked ANF-ISIIC shall ensure that any queuing for resources occurs virtually simultaneously in both the originating, forward switching and terminating SwMIs. Each of the SwMIs shall fully and immediately understand the full state of the call so that the calling and called parties can be kept up to date on any queuing situation.

During call set-up a SwMI may operate one of two resource allocation policies, these are:

- not to release the radio traffic channel during call set-up, unless the call is cleared (permanent allocation); or
- make the radio traffic channel available for release during call set-up if the call cannot be connected (temporary allocation).

The invoked ANF-ISIIC shall ensure that SwMIs operating different allocation policies can set-up a call between each other. The additional signalling required for the full support of the temporary allocation may be supported by a particular SwMI.

4.2.3 Exceptional procedures

4.2.3.1 Activation/deactivation/registration/interrogation

Not applicable.

4.2.3.2 Invocation and operation

ANF-ISIIC may reject the call request with an appropriate failure indication for any of the following reasons:

- no inter-TETRA connection available, permanently;

- no inter-TETRA connection available, temporarily;
- failed call restoration (see clause 4.2.2.2).

In addition, if the called user has migrated and is now registered in SwMI A but SwMI A had not detected it, the ANF-ISIIC should then inform SwMI A about it in avoiding that the call attempt be established with a trombone or loop connection (see definitions of these terms in clause 3.1). SwMI A call control application shall then clear the invoked ANF-ISIIC and the call is established as an intra-SwMI call.

NOTE: According to the way ANF-ISIMM operates, the latter case cannot arise when the called user home SwMI is SwMI A, since in such a case SwMI A call control application would not have invoked ANF-ISIIC.

The called SwMI or the terminating SwMI shall clear the invoked ANF-ISIIC in the following cases:

- unsuccessful outcome of the transport layer during call establishment;
- no details concerning the location of the called user are available or they are outdated.

4.3 Interactions with other TETRA supplementary services and ANFs

4.3.1 Introduction

Interactions with other TETRA supplementary services and ANFs for which TETRA Standards were available at the time of publication of the present document are specified in the following clauses.

4.3.2 Calling Line Identification Presentation (SS-CLIP)

No interaction.

NOTE: The fact that the ISI SETUP PDU contains the calling party identity is not to be considered as an interaction with the SS-CLIP.

4.3.3 Connected Line identification Presentation (SS-COLP)

No interaction.

NOTE: The fact that the ISI CONNECT PDU contains the connected party identity is not to be considered as an interaction with the SS-COLP.

4.3.4 Calling/connected Line Identification Restriction (SS-CLIR)

No interaction.

NOTE: The fact that the ISI SETUP PDU contains the Calling party presentation indicator information element defining is CLIR activated for the calling party address or not and ISI CONNECT PDU contains the Connected party presentation indicator information element defining is CLIR activated for the connected party address or not, is not to be considered as an interaction with the SS-CLIR.

4.3.5 Call Report (SS-CR)

No interaction.

4.3.6 Talking Party Identification (SS-TPI)

No interaction.

NOTE: Talking Party Identities are not included in ISI TX PDUs.

4.3.7 Call Forwarding Unconditional (SS-CFU)

Whenever ANF-ISIIC has been invoked, it shall interact with SS-CFU if the latter has been activated (e.g. by the called user, this user being the SS-CFU served user), unless the incoming call is barred to the called user - by the barring of incoming calls or the call authorized by dispatcher supplementary services.

In addition, when the home SwMI of the called user is SwMI A, SS-CFU shall invoke ANF-ISIIC for forwarding the call if the forwarded-to user home SwMI is SwMI A and the forwarded-to user has migrated or if the forwarded-to user home SwMI is different from SwMI A, except possibly when the forwarded-to user happens to be registered in SwMI A after having migrated.

The full specifications of the interactions between SS-CFU and ANF-ISIIC are given in clause 5.6.7 of ETSI EN 300 392-12-4 [8].

When the called user home SwMI is SwMI A, the main interaction is the invocation of ANF-ISIIC already mentioned. When the called user home SwMI is SwMI B, the interactions can be summarized as follows:

- unless the called user has migrated and is now registered in SwMI A, the ANF-ISIIC originally invoked for attempting to route the call to the called user shall invoke SS-CFU if it has been activated (in SwMI B) and that ANF-ISIIC shall ensure SS-CFU routing if the forwarded-to user is registered in another SwMI;
- if the called user has migrated and is now registered in SwMI A, then the invoked ANF should check whether another SS-CFU, a local SS-CFU, has been activated in SwMI A for the called user, and if so, it shall not invoke the SS-CFU activated in the home SwMI (thus letting SwMI A CMCE invoke this local SS-CFU);

Still if the called user has migrated and is now registered in SwMI A, if SS-CFU has been activated in the home SwMI for that user and no local SS-CFU, in SwMI A for that same user, then SwMI A call control application shall invoke ANF-ISIIC even if it can route directly calls to called users registered in that SwMI when it is not their home SwMI (i.e. as intra-TETRA calls). The invoked ANF-ISIIC shall itself invoke the SS-CFU activated in the home SwMI.

- if the forwarded-to user has itself activated a call forwarding unconditional supplementary service towards another forwarded-to user and if an ANF-ISIIC had already been invoked, that invoked ANF-ISIIC shall invoke that new call forwarding supplementary service and operate its routing. It shall do so as for the previous SS-CFU provided that:
 - the new forwarded-to user home SwMI is considered as the new SwMI B;
 - if the new forwarded-to user has migrated, the SwMI where he is registered is considered as the new SwMI C; and
 - the last SwMI on the path through which the call attempt has been forward switched is considered as the new SwMI A, i.e. if the new SS-CFU is only the second one, that last SwMI shall be:
 - the originating SwMI if only re-routing has taken place;
 - the home SwMI of the new SS-CFU served user if the call attempt has been forward switched through it; or if different from the previous ones;
 - the home SwMI of the first SS-CFU served user, i.e. the originally called user;
- if the forwarded-to user has itself activated another call forwarding supplementary service than the call forwarding unconditional supplementary service towards another forwarded-to user registered in another SwMI and if an ANF-ISIIC had already been invoked it shall ensure the further routing of the call attempt if necessary, according to the specification of the interaction between ANF-ISIIC and that other call forwarding supplementary service specified in the corresponding clause below provided that:
 - the new forwarded-to user home SwMI is considered as the new SwMI B;
 - if the new forwarded-to user has migrated, the SwMI where he is registered is considered as the new SwMI C; and
 - the last SwMI on the path through which the call attempt has been forward switched is considered as the new SwMI A, i.e. if the new call forwarding supplementary service is only the second call forwarding supplementary service invoked for the call, that last SwMI shall be:

- the originating SwMI if only re-routeing has taken place;
 - the home SwMI of the forwarded-to user for the new call forwarding if the call attempt has been forward switched through it; or if not
 - the SwMI where the forwarded-to user for the initial SS-CFU is currently registered if the call attempt has been forward switched through it; or if different from the previous ones (e.g. if the forwarded-to user for the initial SS-CFU had migrated);
 - the home SwMI of the initial SS-CFU served user, i.e. the originally called user;
- when ensuring the SS-CFU routeing mentioned above, the invoked ANF-ISIIC shall try to avoid loop connection between the originating and the terminating SwMIs (e.g. SwMI where the forwarded-to user is registered coinciding with SwMI A).

In addition, the invoked ANF-ISIIC shall operate the barring of incoming calls supplementary service not only for the originally called user when that user is a SS-CFU served user but for each SS-CFU forwarded-to user (i.e. the SS-CFU forwarded-to user if only one call forwarding unconditional supplementary service is operated for the call, and each of them if many call forwarding unconditional supplementary services are operated for the call).

NOTE: No requirement is included in clause 5.6.7 of ETSI EN 300 392-12-4 [8], on the interaction between the call forwarding supplementary services (SS-CF) and SS-BIC, because such interaction has no impact on the definition of SS-CF protocol.

4.3.8 Call Forwarding on Busy (SS-CFB)

The interactions between SS-CFB and ANF-ISIIC are similar to those between SS-CFU and ANF-ISIIC, with the main difference that whereas ANF-ISIIC invoked SS-CFU, it shall not invoke SS-CFB: SS-CFB will be invoked by the CMCE entity of the SwMI where its served user is registered (if it has been activated and if that user is busy).

NOTE 1: Thus when the SS-CFB served user has migrated, contrary to SS-CFU, SS-CFB is not invoked in the served user home SwMI.

Another difference, which is a consequence of the main one mentioned above, is that ANF-ISIIC shall not operate any SS-BIC activated for a SS-CFB served user, whether the originally called user or the forwarded-to user for a SS-CF invoked just previously.

The full specifications of these interactions are given in clause 5.6.7 of ETSI EN 300 392-12-4 [8]. They are summarized below:

- When the called user is registered in another SwMI than SwMI A, i.e. SwMI B or SwMI C, and that SwMI has invoked SS-CFB (the called user being thus busy) the same ANF-ISIIC invoked for routeing the call attempt from SwMI A to that other SwMI (SwMI B or SwMI C) shall further route the call towards the SwMI where the forwarded-to user is registered when that SwMI is different from the SwMI where the called user is registered (SwMI B or SwMI C). The same ANF-ISIIC invoked for routeing the call attempt from SwMI A to that SwMI may also be used to further route the call in the specific case where the forwarded-to user happens to be registered in that same SwMI after having migrated (i.e. that SwMI is not the forwarded-to user home SwMI but its call control application cannot route directly calls to called users registered there when it is not their home SwMI, i.e. as intra-TETRA calls).
- When the called user is registered in SwMI A, ANF-ISIIC shall be invoked for routeing the call the SwMI where the forwarded-to user is registered if that SwMI is different from SwMI A. It may also be invoked for routeing the call attempt from SwMI A to the forwarded-to user home SwMI in the specific case where the forwarded-to user happens to be registered in SwMI A after having migrated (i.e. SwMI A is not the forwarded-to user home SwMI but its call control application cannot route directly calls to called users registered there when it is not their home SwMI, i.e. as intra-TETRA calls).

NOTE 2: In that specific case where the called user is registered in SwMI A, another SS-CFB, a local SS-CFB, may have been activated in that SwMI. It will then be up to the CMCE entity of that SwMI to invoke that local SS-CFB instead of the general one. Once that local SS-CFB will have been invoked, ANF-ISIIC will be invoked for routing the call to the forwarded-to user exactly as if the general SS-CFB had been invoked with the same forwarded-to user.

- If the forwarded-to user has itself activated a call forwarding on busy supplementary service towards another forwarded-to user, if an ANF-ISIIC had already been invoked it shall further route the call attempt if necessary as for the previous SS-CFB provided that:
 - the new forwarded-to user home SwMI is considered as the new SwMI B;
 - if the new forwarded-to user has migrated, the SwMI where he is registered is considered as the new SwMI C; and
 - the last SwMI on the path through which the call attempt has been forward switched is considered as the new SwMI A, i.e. if the new SS-CFB is only the second one, that last SwMI shall be:
 - the originating SwMI if only re-routing has taken place;
 - the home SwMI of the new SS-CFB forwarded-to user if the call attempt has been forward switched through it; or if not
 - the SwMI where the new SS-CFB has been invoked if the call attempt has been forward switched through it; or if not and if different from the previous ones (e.g. if the new SS-CFB served user, i.e. the forwarded-to user of the first SS-CFB, had migrated);
 - the home SwMI of the new SS-CFB served user if the call attempt has been forward switched through it; or if not and if different from the previous ones;
 - the SwMI where the first SS-CFB has been invoked if the call attempt has been forward switched through it; or if not and if different from the previous ones (e.g. if the first SS-CFB served user, i.e. the originally called user, had migrated);
 - the home SwMI of that originally called user.
- If the forwarded-to user has itself activated a call forwarding unconditional supplementary service and ANF-ISIIC had already been invoked for the routing of the call attempt, that ANF-ISIIC shall invoke this new supplementary service and operate its routing according to clause 4.3.6, provided that:
 - the new forwarded-to user home SwMI is considered as the new SwMI B;
 - if the new forwarded-to user has migrated, the SwMI where he is registered is considered as the new SwMI C; and
 - the last SwMI on the path through which the call attempt has been forward switched is considered as the new SwMI A, i.e. if the new SS-CFU is only the second call forwarding supplementary service invoked for the call, that last SwMI may be:
 - the originating SwMI if only re-routing has taken place;
 - the home SwMI of the new SS-CFU forwarded-to user if the call attempt has been forward switched through it; or if not
 - the home SwMI of the new SS-CFU served user, i.e. the forwarded-to user of the initial SS-CFB, if the call attempt has been forward switched through it; or if not and if different from the previous ones;
 - the SwMI where the initial SS-CFB has been invoked if the call attempt has been forward switched through it; or if not and if different from the previous ones (e.g. if the initial SS-CFB served user, i.e. the originally called user, had migrated);
 - the home SwMI of that originally called user.

- When ensuring the SS-CF routing mentioned above, this invoked ANF-ISIIC shall avoid loop connection between the originating and the terminating SwMIs (e.g. SwMI where the forwarded-to user is registered coinciding with SwMI A).

In addition, the invoked ANF-ISIIC shall operate the barring of incoming calls supplementary service not only for the originally called user when that user is a SS-CFB served user but for each SS-CFB forwarded-to user (i.e. the SS-CFB forwarded-to user if only one call forwarding on busy supplementary service is operated for the call, and each of them if many call forwarding on busy supplementary services are operated for the call).

NOTE 3: See note in clause 4.3.7.

4.3.9 Call Forwarding on No Reply (SS-CFN_{Ry})

The interactions between SS-CFN_{Ry} and ANF-ISIIC shall be the same as those between SS-CFB and ANF-ISIIC (see clause 4.3.8).

4.3.10 Call Forwarding on Not Reachable (SS-CFN_{Rc})

There are two cases for the invocation and operation of SS-CFN_{Rc}:

- when the served user home SwMI has been previously informed that the SS-CFN_{Rc} served user is not reachable (e.g. he has deregistered). This case is qualified in clause 5.6.6 of ETSI EN 300 392-12-4 [8] as "early" CFN_{Rc};
- when it is only when attempting to set-up the call to the SS-CFN_{Rc} served user, as called party, that the SwMI where that user is registered finds out that such user is not reachable. This case is qualified in clause 5.6.6 of ETSI EN 300 392-12-4 [8] as "late" CFN_{Rc}.

These interactions between SS-CFN_{Rc} and ANF-ISIIC shall be the same as the same as those:

- between SS-CFU and ANF-ISIIC (see clause 4.3.7) in the case of "early" CFN_{Rc}; and
- between SS-CFB and ANF-ISIIC (see clause 4.3.8) in the case of "late" CFN_{Rc}.

4.3.11 List Search Call (SS-LSC)

No interaction.

NOTE 1: SS-LSC will interact with SwMI A CC, which itself will invoke the ANF for calling a user in the list. But this is not an interaction between ANF-ISIIC and SS-LSC.

NOTE 2: The statement that there is no interaction implies that the choice has been made to invoke ANF-ISIIC every time a call is attempted to the next user (registered in another SwMI) in SS-LSC list (i.e. ruling out the possibility of invoking ANF-ISIIC only once for two consecutive users in this list, in the case where these two users would be registered in the same SwMI).

4.3.12 Call Authorized by Dispatcher (SS-CAD)

SS-CAD shall interact with ANF-ISIIC as follows:

- for source restricted calls, the SS-CAD control entity in the originating SwMI shall invoke ANF-ISIIC when SS-CAD operation requires that the outgoing call be diverted to the dispatcher and when this dispatcher is located in a SwMI different from the SwMI in which the restricted (calling) user is registered (i.e. this dispatcher would then be able to discuss with the calling user before allowing or not the establishment of the requested call, as opposed to a simple authorization based only on sending to this dispatcher the calling and called numbers by signalling);

NOTE 1: The call establishment will then be suspended by the originating SwMI call control and supplementary service control applications.

- once the dispatcher has approved the call, if a call had been established with this dispatcher, the ANF-ISIIC invoked towards the dispatcher shall transfer the call to the called user;

NOTE 2: If no call has been established with a dispatcher, SS-CAD will request the SwMI call control and supplementary service control applications which suspended the call establishment to resume it.

- for destination restricted calls, the same procedure as for source restricted calls shall apply for the calls for which ANF-ISIIC has not already been invoked. This shall be the case for intra-TETRA calls either source restricted but with a "local" dispatcher, or not source restricted. It shall also be the case for inter-TETRA calls to a called user who has migrated with his home SwMI being the originating SwMI;
- for destination restricted inter-TETRA calls to a called user the home SwMI of which is the called SwMI (i.e. the called user SwMI is not SwMI A, but SwMI B), the invoked ANF-ISIIC shall invoke and operate SS-CAD. Notably when this operation requires that the incoming call be diverted to the dispatcher and when this dispatcher is located in a SwMI different from the called SwMI, this ANF-ISIIC shall divert the call to the dispatcher. If this call is authorized by SS-CAD, this ANF-ISIIC shall transfer the call to the called user in re-routeing it from the called user home SwMI (i.e. SwMI B). And if in addition the called user has migrated to SwMI A, the invoked ANF-ISIIC shall pass the necessary information to call control and supplementary service control applications of this SwMI e.g. so that no local SS-BIC may be invoked for this call;

NOTE 3: If SS-CAD has been activated for both the outgoing call and the incoming call, it will be invoked separately for each.

NOTE 4: In the special case where the called user (has migrated and) is now registered in SwMI A and where SwMI A call control application can route directly (i.e. without invoking ANF-ISIIC) calls to called users registered in this same SwMI when it is not their home SwMI (i.e. they have migrated), SwMI A call control and supplementary service control applications need to be informed about the activation of SS-CAD in the called user home SwMI, to invoke it. This is why ANF-ISIMM will ensure that whenever a user which has activated SS-CAD in his home SwMI migrates to another network, the SwMI of this other network will be informed about this SS-CAD activation.

- contrary to its normal operation, ANF-ISIIC shall make no attempt to avoid any trombone connection or more generally loop connection in routeing the diverted call to the dispatcher from SwMI B;

NOTE 5: The reason for this is that the resulting re-routeing would by-pass SwMI B, wherefrom the ANF-ISIIC call establishment will continue after it has been authorized by the dispatcher; this continuation being either by transfer:

- internal to SwMI B if the called user has not migrated;
 - by forward switching in SwMI B if the called user has migrated to another SwMI than SwMI A; or
 - by transfer with re-routeing in SwMI A if the called user has migrated into SwMI A.
- if the call has been diverted to the dispatcher, after the dispatcher has authorized the call establishment to be resumed, the SS-CAD diverting SwMI shall ensure that the transmission permission granting to the terminating SwMI does not result in any change for the originating SwMI call control application, i.e.:
 - if the calling user had been granted permission to transmit when the dispatcher authorizes the call to be resumed, the diverting SwMI shall ensure that the set-up message that it is sending to the terminating SwMI does not grant transmission permission to the called user;
 - if it is the dispatcher who had been granted permission to transmit when the dispatcher authorizes the call to be resumed, the diverting SwMI shall ensure that the set-up message that it is sending to the terminating SwMI grants transmission permission to the called user;
 - when the originating SwMI call control application receives the response from the terminating SwMI after the call has been diverted to a dispatcher, it shall act as if the call had not been diverted for all applicable supplementary services which it supports, e.g. SS-CLIP, SS-COLP, SS-CLIR, SS-TPI, SS-CCBS and SS-CCNR. This shall hold even if for the originating SwMI does not support SS-CAD.

4.3.13 Short Number Addressing (SS-SNA)

No interaction.

4.3.14 Area Selection (SS-AS)

The SwMI shall use this information to set-up the individual call and may also be used during call restoration.

NOTE 1: When Area Selection is invoked for an individual call, the SS-AS signalling is transported transparently between the originating SwMI and the terminating SwMI and is not considered to be an interaction.

NOTE 2: The area selection is encoded differently in the ISI protocol than in the air interface and the corresponding information element is named as "selected area number".

4.3.15 Access Priority (SS-AP)

No interaction (since SS-AP applies only locally at the radio access).

4.3.16 Priority Call (SS-PC)

If SS-PC has been activated, ANF-ISIIC shall interact with SS-PC if this operates by queuing for accessing inter-TETRA connection(s) necessary for its routing. Such interaction shall consist in having every newly invoked ANF-ISIIC competing with the other invoked ANF-ISIIC and ANF-ISIGC still in the inter-TETRA connection allocation queue, when the number of those connections available has fallen below a certain threshold. In such a case, it shall inform SwMI A CC about this.

NOTE: In the case where there is a risk of congestion due to an insufficient number of inter-TETRA connections between two SwMIs for the offered traffic, it would be recommended to split these inter-TETRA connections into two groups, one of which would be reserved to priority calls (i.e. these calls could be routed on any connection of the two groups, while the "ordinary" could only be routed on a connection of the second group).

If SS-PC has been invoked for the call and if SwMI B supports SS-PC, in the case where the ANF-ISIIC invoked for this same call routes it to SwMI C by forward switching, such queuing shall be operated first in SwMI A, and second in SwMI B.

4.3.17 Call Waiting (SS-CW)

No interaction.

4.3.18 Call Hold (SS-HOLD)

No interaction.

4.3.19 Call Completion to Busy Subscriber (SS-CCBS)

When the calling user and the called user are registered in different SwMIs, SS-CCBS shall invoke an ANF-ISIIC for its operation, either for (SS-CCBS) path reservation, or if the latter is not implemented (by SS-CCBS), when the call to the called user is reinitiated.

NOTE: When the called user migrates while remaining busy (e.g. its established call is restored - see clause 4.2.2.2), all SS-CCBS pending invocations (i.e. not yet completed or cancelled) to this called user will be passed to the new SwMI where this user has registered. But this passing is not an interaction between SS-CCBS and ANF-ISIIC, since it will not be done by the latter.

4.3.20 Late Entry (SS-LE)

No interaction (since SS-LE does not apply to TETRA individual calls).

4.3.21 Pre-emptive Priority Call (SS-PPC)

SS-PPC shall interact with ANF-ISIIC to pre-empt the inter-TETRA connection with the lowest Call Retention Value (CRV) among those which may be used to route the priority call. SS-PPC shall operate such pre-emption first in forcing the clearing of this inter-TETRA connection (with its normal operation for the connected parties to be released), and then in invoking a new ANF-ISIIC at the corresponding ISI.

4.3.22 Include Call (SS-IC)

SS-IC and ANF-ISIIC shall interact whenever the SS-IC served user is engaged with a user registered in a different SwMI in an individual call to be included in a group call (by SS-IC).

The requirement for this interaction is to be able to change the call bearer capability from point-to-point (for the individual call) into point-to-multipoint. Such change shall be controlled by SS-IC.

In the case where the other user engaged in an individual call with the served user, is not the only group call participant registered in its SwMI, either the inter-TETRA connection established by ANF-ISIIC for this individual call shall be released, or it shall be used for the new group call.

In addition whatever SwMI was controlling the simplex transmission in the individual call shall release this control to the controlling SwMI of the new group call.

4.3.23 Barring of Outgoing Calls (SS-BOC)

No interaction.

NOTE: SS-BOC is operated by SwMI A call control and supplementary service control applications.

4.3.24 Barring of Incoming Calls (SS-BIC)

No interaction when the called user home SwMI is SwMI A (i.e. SS-BIC shall be invoked and operated by SwMI A call control and supplementary service control applications).

When the called user home SwMI is SwMI B, the ANF-ISIIC invoked to establish the call with the called user shall invoke SS-BIC, except in the special case presented below.

In the special case where the called user (has migrated and) is now registered in SwMI A, where it has activated another SS-BIC in SwMI A for intra-TETRA calls and where SwMI A call control application has invoked ANF-ISIIC to establish the call with the called user, then this ANF-ISIIC shall operate as follows:

- it shall check whether a local SS-BIC has been activated;
- if so, it shall by-pass the invocation of the home SwMI SS-BIC (i.e. if a local SS-BIC has been activated, the home SwMI SS-BIC will not be invoked for this special case of intra-TETRA call) in invoking and operating this local SS-BIC;
- only if no local SS-BIC has been activated, shall the invoked ANF-ISIIC invoke and operate the home SwMI SS-BIC;
- if the operation of the relevant SS-BIC results in having the call barred, the invoked ANF-ISIIC shall clear the call;
- if the operation of the relevant SS-BIC results in having the call authorized, there shall be no more interaction between SS-BIC and ANF-ISIIC.

NOTE 1: As stated in clause 4.2.3.2, the invoked ANF-ISIIC will clear itself in informing SwMI A Call Control Application about the situation.

NOTE 2: On the other hand another issue arises if SwMI A call control application can route directly (i.e. without invoking ANF-ISIIC) calls to called users registered in this same SwMI when it is not their home SwMI (i.e. they have migrated). This issue is that, if no local SS-BIC has been activated, SwMI A Call Control and Supplementary Service control applications needs to be informed about the activation of SS-BIC in the called user home SwMI, to invoke it. This is why ANF-ISIMM will ensure that whenever a user which has activated SS-BIC in its home SwMI migrates to another network, the SwMI of this other network will be informed about this SS-BIC activation.

NOTE 3: When SS-CAD has also been activated for the called user (see clause 4.3.11), its invocation will take precedence over that of SS-BIC, according to the definition of the interaction between these two supplementary services - in ETSI EN 300 392-10-19 [i.2].

4.3.25 Discreet Listening (SS-DL)

When SS-DL has been invoked, if the user being listened to and the monitoring user are registered in two different SwMIs, SS-DL shall invoke an ANF-ISIIC for its operation.

Only one ANF-ISIIC shall be invoked by SS-DL, even when the call being listened to by the invoked SS-DL is an inter-TETRA individual call.

NOTE: In the latter case, SS-DL will use a listening bridge in the SwMI where the user being listened to is registered, so that the same invoked ANF-ISIIC will be used independently of which user is talking/sending.

But in the specific case where the other party engaged in the inter-TETRA individual call being listened to by the invoked SS-DL is registered in the same SwMI as the listening user, SS-DL shall still use a specifically invoked ANF-ISIIC for its operation.

4.3.26 Ambience Listening (SS-AL)

Then the SS-AL served user (i.e. the monitoring party) monitors an MS/LS registered in a given SwMI, if this user is registered in a different SwMI, SS-AL shall invoke an ANF-ISIIC for its operation.

4.3.27 Dynamic Group Number Assignment (SS-DGNA)

No interaction (since SS-DGNA is not applicable to individual calls).

4.3.28 Call Completion on No Reply (SS-CCNR)

When the calling user and the called user are registered in different SwMIs, SS-CCNR shall invoke an ANF-ISIIC for its operation, either for (SS-CCNR) path reservation, or if the latter is not implemented (by SS-CCNR), when the call to the called user is reinitiated.

NOTE: When the called user migrates, all SS-CCNR pending invocations (i.e. not yet completed or cancelled) to this called user will be passed to the new SwMI where this user has registered. But this passing is not an interaction between SS-CCNR and ANF-ISIIC, since it will not be done by the latter.

4.3.29 Call Retention (SS-CRT)

SS-CRT shall interact with the ANF-ISIIC in having the Call Retention Value (CRV) of the call for which both have been invoked assigned to the inter-TETRA connection(s) over which this call will have been routed.

4.3.30 Additional Network Feature - Inter System Interface Group Call (ANF-ISIGC)

The only interactions between ANF-ISIGC and ANF-ISIIC shall be through the include call supplementary service (see clause 4.3.23).

NOTE: Even when all "group participants" but one have left a group call (i.e. only the group call owner and the last "group participant" are remaining in the call active state), the call remains a group call - so as to allow the easy introduction of a new (participant) user in this group.

4.3.31 Additional Network Feature - Inter System Interface Short Data Service (ANF-ISISDS)

No interaction.

4.3.32 Additional Network Feature - Inter System Interface Mobility Management (ANF-ISIMM)

No interaction.

NOTE 1: Even in the case of call restoration, ANF-ISIMM does not interact with ANF-ISIIC: it interacts only with the call control application of the SwMI concerned - and it is this call control application which interacts with ANF-ISIIC.

NOTE 2: All updating of the SwMI databases used for the operation of ANF-ISIIC are not to be considered as interactions between ANF-ISIMM and ANF-ISIIC.

4.3.33 Additional Network Feature - Inter System Interface Supplementary service (ANF-ISISS)

No interaction.

NOTE: The fact the ANF-ISISS can be invoked for carry such supplementary service information together with some specific TETRA basic call one (e.g. in the TETRA set-up message) is not an interaction.

4.4 Interworking considerations

ANF-ISIIC and external telephone networks PSTN/PABX/ISDN shall interwork in the case a TETRA user is involved in a call with an external subscriber through a PSTN/PABX/ISDN gateway located in a SwMI different from that where the TETRA user is registered.

For an outgoing call (i.e. from a TETRA calling user), SwMI A call control application may invoke an ANF-ISIIC to route the call over an ISI based on the Called party TSI. This ANF shall send to SwMI B call control application the external subscriber called number (received from SwMI A call control application), and indicate whether the call is a telephony call or a data call (through a bearer service request).

NOTE 1: A TETRA speech (tele-) service call will result in a standard PSTN/PABX/ISDN telephony call. But a TETRA data service call to a PSTN/PABX/ISDN may result in a TETRA bearer service negotiation.

For an incoming telephony call (i.e. to a TETRA called user), the external calling user will have to send the number of the called user to the PSTN/PABX/ISDN gateway. The PSTN/PABX/ISDN gateway will convert the received called user number into an ITSI or GTSI number. Then if the analysis made by the call control application of the SwMI where this gateway is located shows first that the SSI of the called user corresponds to an ITSI number, and not to a GTSI one (i.e. the type of call requested is an individual call and not a group call), and second that the called user is registered in another SwMI, and third that the call is allowed to the user, this shall result in a standard invocation of an ANF-ISIIC to extend the individual call requested to the called user.

NOTE 2: A telephony call will result in a TETRA speech (tele-) service call.

A similar procedure will apply for an incoming data call, with the difference that this call would first be connected by the gateway to some modem.

NOTE 3: For such data calls from TETRA bearer service negotiation will be possible with the called SwMI or the TETRA called user, but only if the called SwMI can inform fast enough the gateway modem on the bearer service that it supports (otherwise the negotiation phase between the two modems involved in the call establishment will be over).

5 ANF-ISIIC stage 2 specification

5.1 Functional model

5.1.1 Functional model description

The functional model shall comprise the following Functional Entities (FE):

- FE1 Originating/Controlling SwMI individual call control application functional entity;
- FE2 Originating/Controlling SwMI ISI individual call functional entity (ANF-ISIIC);
- FE3 Called/Forward Switching SwMI call control functional entity;
- FE4 Called/Forward Switching SwMI ISI individual call functional entity (ANF-ISIIC);
- FE5 Terminating SwMI individual call control functional entity;
- FE6 Terminating SwMI ISI individual call control functional entity (ANF-ISIIC);
- FE7 New SwMI call restoring functional entity;
- FE8 New SwMI ISI call restoring functional entity (ANF-ISIIC).

In figure 2 it is represented the logical deployment of the functional entities in the SwMI and in the ANF-ISIIC.

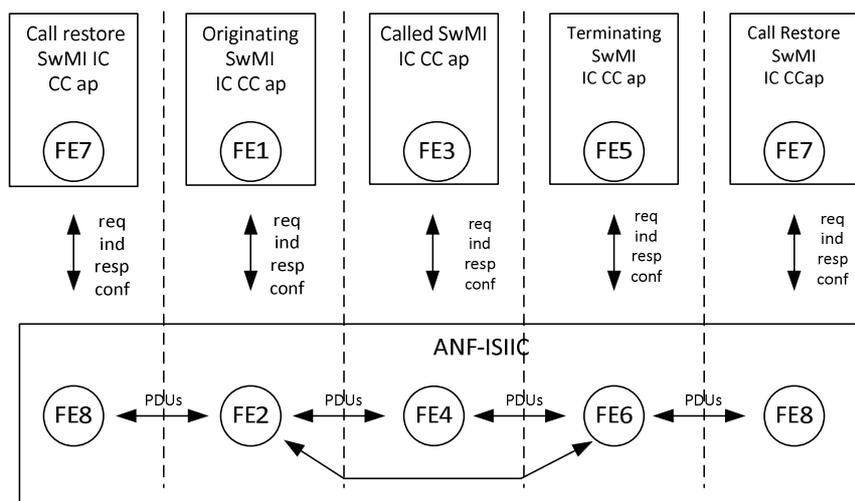


Figure 2: Deployment of the functional entities in the SwMI and in the ANF-ISIIC

The following functional relationships shall exist between these FEs:

- ra between FE1 and FE2;
- rc between FE2 and FE4;

- rd between FE4s;
- re between FE4 and FE3;
- rf between FE4 and FE6;
- rg between FE2 and FE6;
- rh between FE6 and FE5;
- rj between FE2 and FE8;
- rk between FE7 and FE8;
- rl between FE6 and FE8.

Figure 3 shows these FEs and the logical relationships in the case where the called user home SwMI is the originating SwMI (i.e. the called user home SwMI is SwMI A) and the called party has migrated to SwMI B or when the called party belongs to SwMI B and is located in its home SwMI. The interfaces rc and re are used until the SwMI B changes its role from Called SwMI to Terminating SwMI and the interfaces rg and rh are used after that. After changing the role the FE4 and FE3 cease to exist.

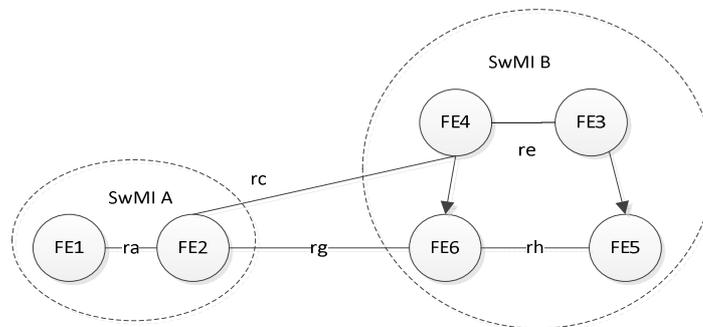


Figure 3: Functional model for ANF-ISiIC when the called user is located in SwMI B

NOTE: The Called SwMI is also the terminating SwMI.

Figures 4 and 5 show the FEs and the logical relationships in the case where the called user home SwMI is different from the originating SwMI (i.e. the called user home SwMI is SwMI B) and the called party has migrated to a third SwMI or the called party has an active call forwarding and the forwarding-to user is located in SwMI C.

In figure 4 the call is rerouted from SwMI A to SwMI C. The interfaces rc and re are used between SwMI A and SwMI B and also between SwMI A and SwMI C during the call establishment until the SwMI C changes role from Called SwMI to Terminating SwMI. After that interfaces rg and rh are used between SwMI A and SwMI C.

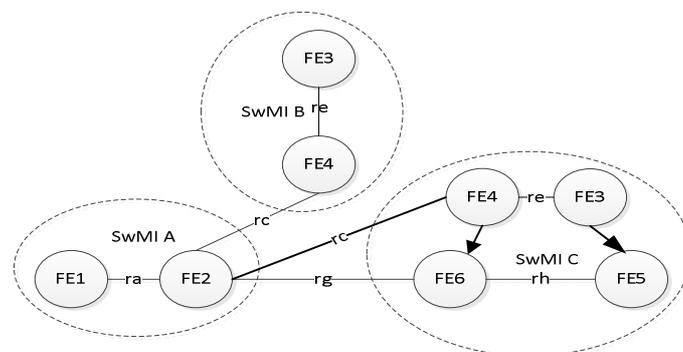


Figure 4: Functional model for ANF-ISiIC when the called user is located in a third SwMI, call rerouted

In figure 5 the call is forward switched by SwMI B. The interfaces rc, re and rd are used during the call establishment until the SwMI C changes role from Called SwMI to Terminating SwMI. After that interfaces rc, re, rf and rh are used as the call is forward switched by SwMI B and the FE4 and FE3 cease to exist in SwMI C.

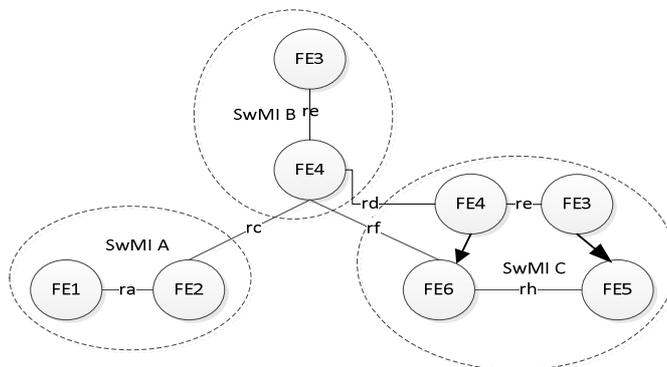


Figure 5: Functional model for ANF-ISIIC when the called user is located in a third SwMI, call forward switched

In figure 6 the call is forward switched by SwMI B to a SwMI C when the called party migrates to a new SwMI. The interfaces rg, rh, rl and rk are used during the call restoration until the SwMI C changes role to newTerminating SwMI. After that interfaces rc, re, rf and rh are used as the call is forward switched by SwMI B and the FE5 and FE6 cease to exist in SwMI B and the FE7 and FE8 cease to exist in SwMI C.

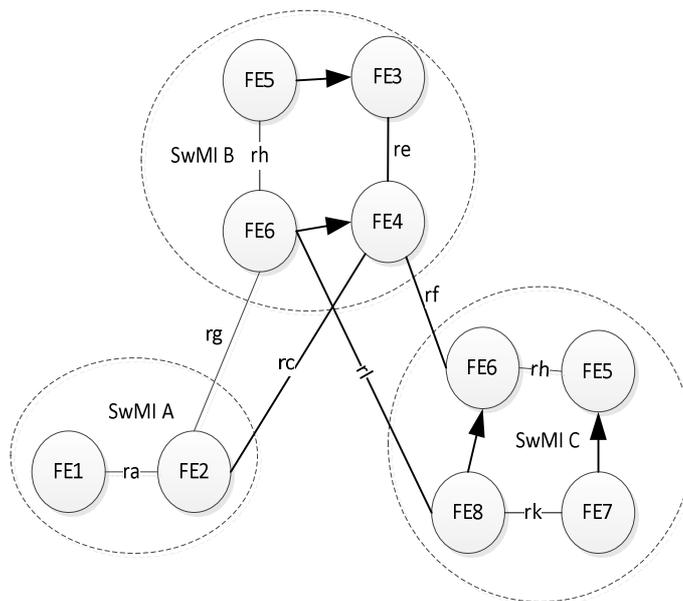


Figure 6: Functional model for ANF-ISIIC when the called user has migrated during the call to a new SwMI, call forward switched through the previous Terminating SwMI

In figure 7 the call is forward switched by SwMI A to a SwMI C when the calling party migrates to a new SwMI. The interfaces ra (in SwMI A), rl, rk and rg are used during the call restoration until the SwMI C changes role to Controlling SwMI. After that interfaces ra (in SwMI C), rc, re and rf are used as the call is forward switched by SwMI A and the FE1 and FE2 cease to exist in SwMI A and the FE7 and FE8 cease to exist in SwMI C.

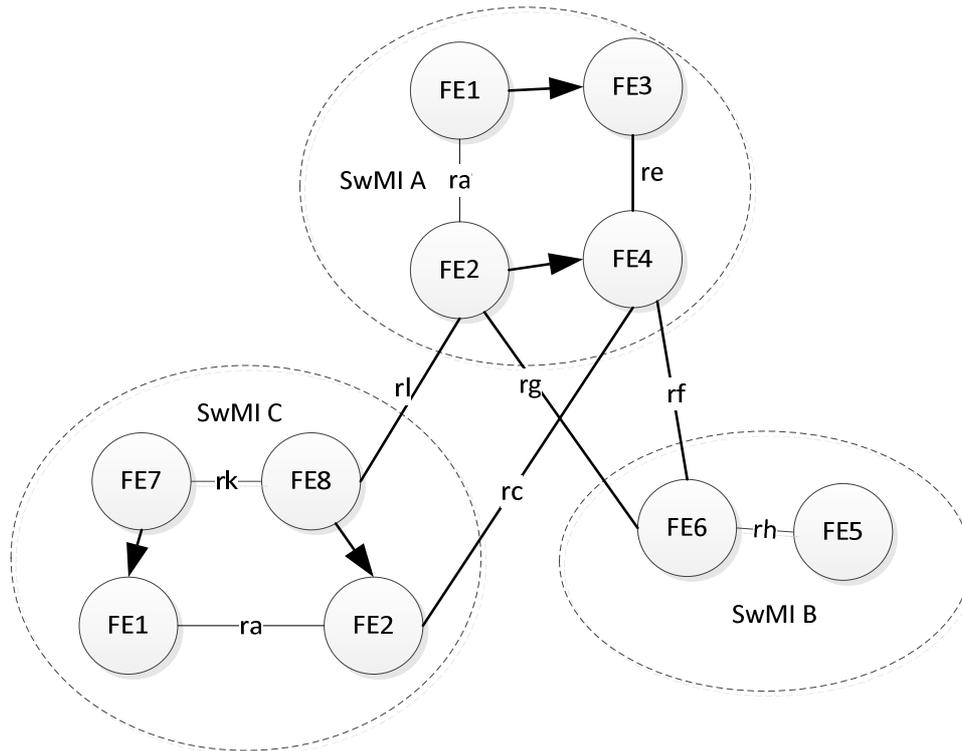


Figure 7: Functional model for ANF-ISIIC when the calling user has migrated during the call to a new SwMI, control of the call is transferred to the new SwMI

In figure 8 the call has been forward switched by SwMI B to a SwMI C and SwMI A is taken out of the call when the calling party migrates to SwMI B. The interfaces *rj* and *rl* are used during the call restoration until the SwMI B changes role to be Controlling SwMI. After that *ra* interface (in SwMI B) and *rg* are used and the FE1 and FE2 cease to exist in SwMI A and the FE3, FE4, FE7 and FE8 cease to exist in SwMI B.

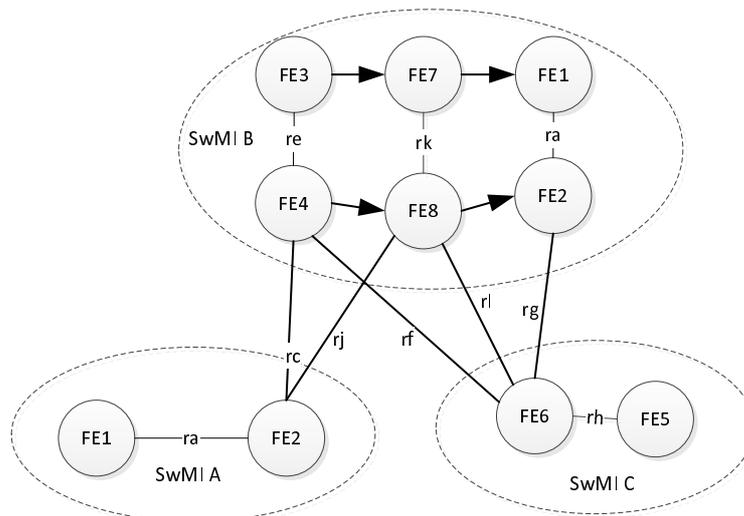
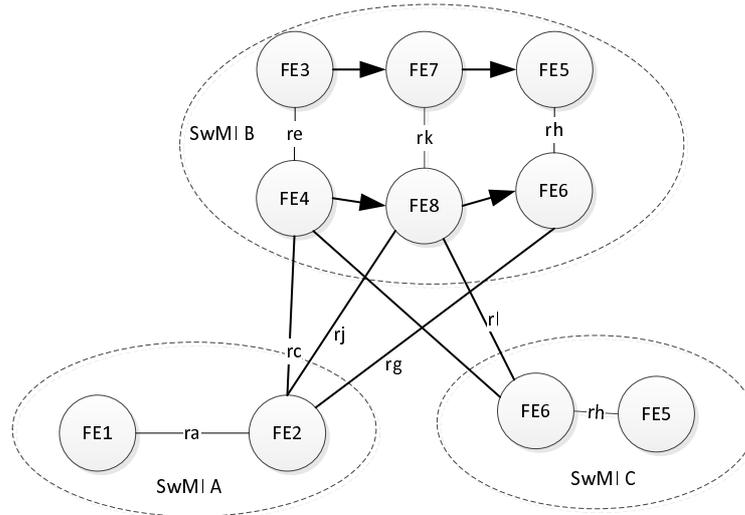


Figure 8: Functional model for ANF-ISIIC when the calling user has migrated during the call to the forward switching SwMI

In figure 9 the call has been forward switched by SwMI B to a SwMI C and SwMI C is taken out of the call when the called party migrates to SwMI B. The interfaces *rj* and *rl* are used during the call restoration until the SwMI B changes role to be the Terminating SwMI. After that interfaces *rg* is used between SwMI A and SwMI B and the FE5 and FE6 cease to exist in SwMI C and the FE3, FE4, FE7 and FE8 cease to exist in SwMI B.



**Figure 9: Functional model for ANF-ISIIC
when the called user has migrated during the call to the forward switching SwMI**

5.1.2 Description of functional entities

5.1.2.1 Originating/Controlling SwMI individual call control application functional entity, FE1

The functional entity FE1 invokes ANF-ISIIC when it receives a set-up information flow from a calling user requesting the establishment of a call to another user which to its knowledge is registered in another TETRA network. It relays call setup information from the calling user via FE2 to the called user through ANF-ISIIC functional entities of other SwMIs. The call establishment response information flow(s) is received from functional entities in the called SwMI via FE2. Once the call has been established, FE1 controls the call maintenance (as defined in clause 14.5.1.2 of ETSI EN 300 392-2 [1]) of the call by exchanging related control information flows with FE5 for the necessary co-ordination.

If FE1 is informed by ANF-ISIMM that the calling user is now registered in another network (where the calling user would have migrated during the call), it shall request FE2 to establish a connection leg with FE7 through FE8 both newly created. As the controlling role for the call is transferred to the new SwMI then after the call has been connected (following the call restoration request by the calling user) between FE7 and FE1, FE1 shall become FE3 (call control entity of forward switching SwMI), and FE7 shall then become the new FE1.

However, if a loop connection is detected by FE1, i.e. both parties of the call now locate in the same end SwMI or the call has been forward switched and the calling party has migrated to nearest forward switching SwMI, then FE1 may prevent the loop connection by informing FE7 via FE2 and FE8 about the situation:

- If FE5 and FE7 are co-located then the ANF-ISIIC call may be disconnected by FE7 as the call becomes an intra-SwMI call.
- If FE3 and FE7 are co-located then the FE7 may become the new FE1, and FE3 and old FE1 are not anymore needed. Based on request from FE7, FE1 may ask FE2 to remove connection towards FE3 and leave the call.

5.1.2.2 Originating/Controlling SwMI ISI individual call originating functional entity, FE2

The functional entity FE2 is the originating/controlling ANF-ISIIC entity that ensures an ISI outgoing gateway function for individual calls from originating/controlling SwMI call control application. This includes the following capabilities:

- the ability to establish an ISI individual call upon request of FE1 and release it notably upon request of FE1;
- the ability to associate and mediate between FE1 and the other ANF-ISIIC functional entities (FE4, FE6, FE8) involved in a particular call, notably to transfer to FE1 any information received from FE3, FE5 or FE7, and vice-versa;

- the ability, when the called SwMI is not the terminating SwMI, to decide, on the basis of the information received from FE4, either to re-route the call over ISI to the new destination SwMI or to have it forward switched by the called SwMI.

Upon request from FE1 to prepare for call restoration, FE2 shall establish a connection toward FE7 through FE8, both newly created.

When informed by FE1 that the call control responsibility is given to the new SwMI then FE2 shall become FE4 (forward switching ANF-ISIIC entity) and FE8 shall then become the new FE2.

Based on request from FE1 indicating that this SwMI is released from the call to prevent a loop or trombone connection, FE2 shall remove connection towards FE3 via FE4 and then cease to exist.

5.1.2.3 Called/Forward Switching SwMI call control functional entity, FE3

The functional entity FE3 ensures the handling of individual calls in the the following cases:

- incoming call from FE1 in the home SwMI of the called user;
- incoming call from FE1 in the location SwMI of the called user;
- forward switching determining the routing of a call towards the location SwMI of the called user or the home/location SwMI of the forwarded-to-party;
- incoming (forward switched) call from FE3 in the home SwMI of the called user;
- incoming (forward switched) call from FE3 in the location SwMI of the called user;
- acting as forward switching SwMI after call restoration of ongoing call due to migration of calling or connected party.

This includes the following capabilities in case of incoming call from FE1 or FE3 or another (forward switching) SwMI:

- the ability to ensure the interactions with the supplementary services SS-BIC, SS-CAD and SS-CF if activated for the called user, the first two, to restrict his incoming calls, and the last one, to forward his calls. If SS-CF is applied the FE shall regard the forwarded-to-party as the new called party;
- the ability to handle together with FE4 the specific interactions which apply in the case where the called user or the forwarded-to-party has migrated into the controlling SwMI (i.e. this SwMI coincides with the controlling SwMI);
- the ability to handle together with FE4 the specific interactions which apply in the case where the forwarded-to-party belongs to the originating SwMI (i.e. the home SwMI of the forwarded-to-party coincides with the originating SwMI);
- the ability, if the called user has migrated, to determine if the call is to be re-routed by the previous SwMI or forward switched by this SwMI or is the decision left to FE2/FE4 of the previous SwMI;
- if the call is not forward switched then the ability to indicated to FE2/FE4:
 - in which SwMI the called user is registered now or what is the home SwMI of the forwarded-to-party (new called/terminating SwMI);
 - whether or not forward switching is possible;
- the ability, if this FE3 decides or FE2/FE4 of the previous SwMI requests this SwMI to forward switch the call, to operate as call control entity of forward switching SwMI.

If the called party is located in this SwMI then FE3 shall become FE5 (terminating SwMI call control entity). If call is rerouted then FE3 of this SwMI ceases to exist and FE3 is invoked in another SwMI. If the call is forward switched then FE3 of this SwMI remains in the call.

This functional entity also ensures the handling of trombone prevention when the calling or called user has migrated during the call. This includes the following capabilities:

- the ability to terminate the individual call in this SwMI upon request of FE1 or FE5; or
- the ability to release the existing connection towards FE1/FE5 when the calling/called user has migrated into this SwMI and change role to FE1/FE5.

5.1.2.4 Called/Forward Switching SwMI ISI individual call functional entity, FE4

The functional entity FE4 is the called ANF-ISIIC entity that ensures an ISI gateway function for individual call towards FE3.

FE4 includes the following capabilities:

- the ability to associate and mediate between FE3 and the other ANF-ISIIC entities involved in a call;
- the ability to forward switch an individual call upon request of FE3 (the ability to establish a connection towards FE4 of another SwMI and release it upon request of FE3).

FE3 informs which role the FE4 shall take depending its own role. If the called party is located in this SwMI the FE4 shall become FE6 (terminating SwMI ANF-ISIIC entity) If call is rerouted by the previous SwMI then FE4 of this SwMI ceases to exist and FE4 of the new destination SwMI is invoked. If the call is forward switched then FE4 of this SwMI remains in the call.

When the calling or called user has migrated during the call, and the FE8 is invoked, the call restoration support due to migration includes the following capabilities:

- the ability to forward switch the call to the FE8 if requested by FE3; or
- the ability to release the existing connection towards FE2/FE6 if requested by FE3 when the calling/called user has migrated into this SwMI and change role to FE2/FE6.

5.1.2.5 Terminating SwMI individual call control functional entity, FE5

The functional entity FE5 is invoked by FE3 when it is decided that this SwMI is the terminating SwMI. It informs FE1 through FE6 and FE2 (and possibly FE4) about the completion (or failure) of this call establishment. As the called party may have been changed due to SS-CF applied, the FE5 informs the actual connected party to FE1 through FE6 and FE2 (and possibly FE4). FE5 ensures call maintenance (as defined in clause 14.5.1.2 of ETSI EN 300 392-2 [1]) for the connected user, exchanging related control information flows with FE1 for the necessary co-ordination.

If FE5 is informed by ANF-ISIMM that the connected user is now registered in another network (where this user would have migrated during the call), it shall request FE6 to establish a connection towards FE7 through FE8, both newly created.

If a loop connection is detected by FE5, i.e. both parties of the call now locate in the same end SwMI or the call has been forward switched and the called or calling party has migrated to nearest forward switching SwMI, then FE5 may prevent the loop connection by informing the situation to the FE7:

- If FE1/FE5 and FE7 are co-located then the whole ISIIC call should be disconnected by FE7 as the call becomes an intra-SwMI call.
- If FE3 and FE7 are co-located then based on request from FE7, FE5 shall ask FE6 to remove connection towards FE3 and leave the call. The FE7 will become the new FE5.

Otherwise, if loop/trombone connection is not detected/prevented, then after the call has been connected (following the call restoration request by the user) between FE7 and FE5, FE5 shall become FE3 (call control entity of forward switching SwMI), and FE7 shall become the new FE5.

5.1.2.6 ISI individual call terminating functional entity, FE6

The functional entity FE6 is the terminating ANF-ISIIC entity that ensures an ISI incoming gateway function for individual calls towards FE5. This includes the following capabilities:

- the ability to associate and mediate between FE5 and the other ANF-ISIIC functional entities.

Upon request from FE5 to prepare for call restoration, FE6 shall establish a connection towards FE7 through FE8, both newly created.

Based on request from FE5 indicating that this SwMI is released from the call to prevent a loop or trombone connection, FE6 shall remove connection towards FE3 via FE4 and then cease to exist.

Otherwise once informed by FE5 that the call has been connected between FE7 and FE5, FE6 shall become FE4 (ANF-ISIIC entity of forward switching SwMI) and FE8 shall then become the new FE6.

5.1.2.7 New terminating SwMI call restoring functional entity, FE7

The functional entity FE7 is the call restoring functional entity that manages the call restoration of an ongoing individual call using information received from the FE1 or FE5 via FE8. The functional entity includes the following capabilities:

- the ability to prepare the call restoration based on information received from the FE1 or FE5;
- the ability to include the migrating user in the call on request from the user;
- the ability to handle together with FE1 or FE5 the specific interactions which apply in the case where the calling or called user has migrated into the other end SwMI or the nearest forward switching SwMI;
- the ability to determine the role of this SwMI (controlling / terminating) together with FE1 and FE5 and indicate it to FE8.

If a loop connection has been indicated by FE1 or FE5 where FE1/FE5 and FE7 are co-located then FE7 shall convert the call to an intra-SwMI call and terminate the ISIIC call.

If a loop connection has been indicated by FE1 or FE5 where FE3 and FE7 are co-located, the FE7 shall inform FE1/FE5 to release the existing connection towards FE3 and leave the call.

When the call is restored, then:

- if the controlling role for the call is transferred to this SwMI, FE7 becomes FE1;
- otherwise, FE7 becomes the new FE5.

5.1.2.8 New terminating SwMI ISI call restoring functional entity (ANF-ISIIC), FE8

The functional entity FE8 is the ANF-ISIIC individual call restoration entity that ensures an ISI gateway function for restoration of calls towards FE7. The functional entity includes the following capability:

- the ability to associate and mediate between FE7 and FE2 or FE6.

When the call is restored, then either:

- FE8 becomes either a new FE6 and shall communicate with previous FE6 which has become an FE4; or
- FE8 becomes a new FE2 and shall communicate with previous FE2 which has become an FE4.

FE7 informs which role the FE8 shall take depending on its own role.

5.2 Information flow

5.2.1 Examples of information flow sequences

5.2.1.1 Introduction

The MSCs will show the information flow of the primitives used between the SwMI internal elements and the PDUs used in ANF-ISIIC. The stage 3 description of ANF-ISIIC provides signalling procedures in support of the information flow sequences specified below.

NOTE 1: The information flow scenarios in stage 2 do not cover all possible signalling scenarios.

NOTE 2: Stage 2 information flows for the basic call contents are used as a starting point in standardization for TETRA application, but the contents of ISI PDUs as defined in stage 3 are not presented in the stage 2 information flows. The stage 3 PDUs should be studied with the stage 2 information flows to get a full picture of the TETRA application behaviour.

The following abbreviations are used:

- req request.
- ind indication.
- resp response.
- conf confirmation.

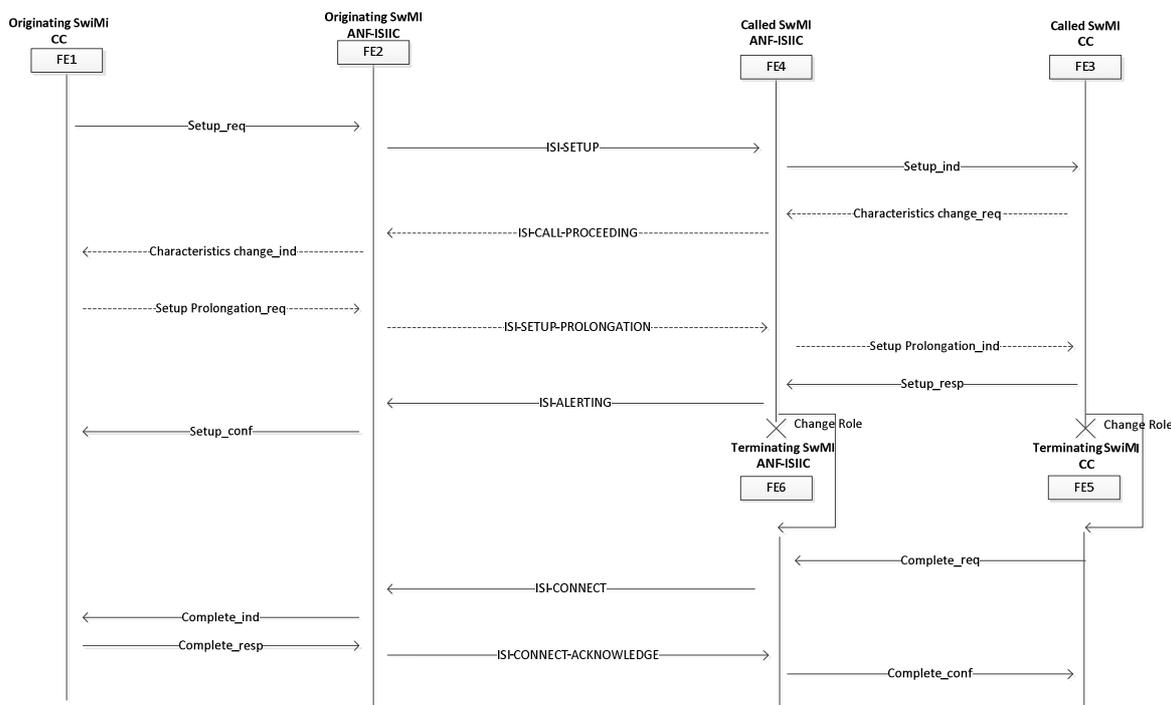
NOTE 3: Request primitive is issued by the originating entity. The request is notified to the destination entity through the indication primitive. The destination entity produces a response message to acknowledge the indication that is notified to the originating entity through a confirm primitive.

5.2.1.2 Successful call set-up when the called user is registered in SwMI B and uses on/off hook signalling

Figure 10 shows the information flow sequence for ANF-ISIIC call set-up when the called user uses on/off hook signalling and when its home SwMI is SwMI B and it has not migrated.

The information flow sequence corresponds also to the case where the called user home SwMI is the originating SwMI and this user has migrated and is registered in another SwMI.

MSC Successful_call_set_up_on_off_hook_no_migr



NOTE 1: The ISI-IC-SETUP PROLONGATION and -CHARACTERISTIC CHANGE request/indication information flows shown on the figure are optional.

NOTE 2: The role will be changed from FE3 to FE5 (and from FE4 to FE6) as soon as the terminating SwMI role is known, it may depend e.g. on CFNRy and CFNRc being activated for the called party.

Figure 10: Information flow sequence - successful call set-up using on/off hook signalling

5.2.1.3 Successful call set up when the called user is registered in SwMI B and uses direct set-up signalling

Figure 11 shows the information flow sequence for ANF-ISIIC call set-up when the called user uses direct set-up signalling and is located in SwMI B.

MSC Successful_call_set_up_direct

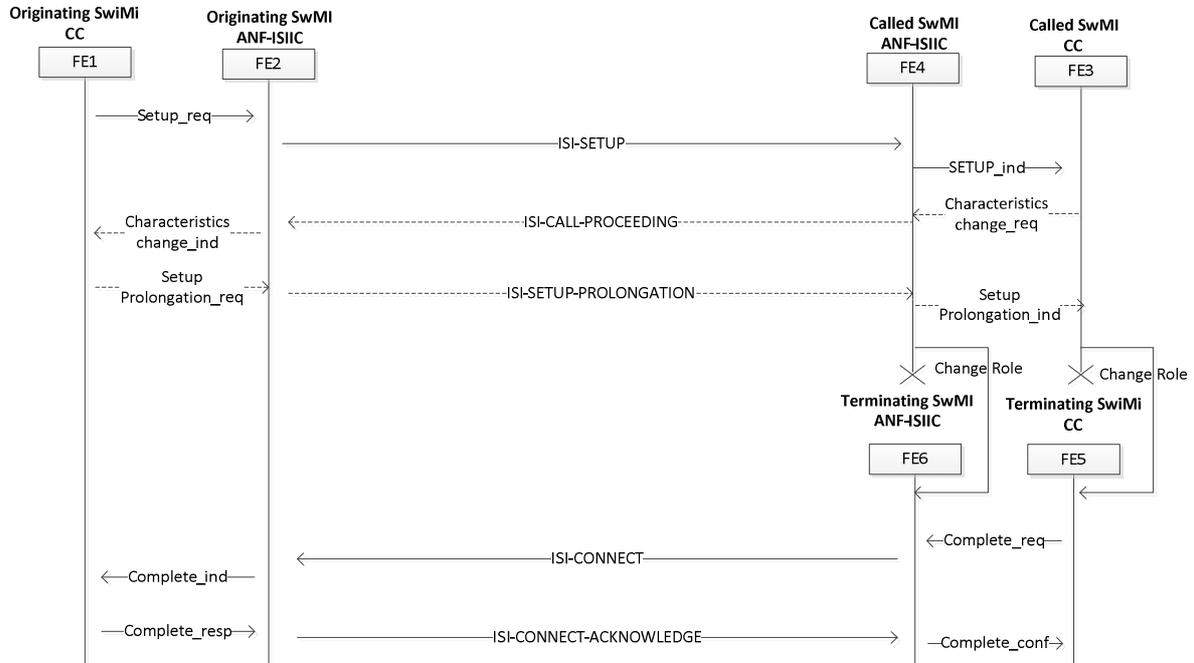


Figure 11: Information flow sequence - successful call set-up using direct set-up signalling

5.2.1.4 ANF-ISIIC set-up to a called user having migrated from SwMI B, using forward switching

Figure 12 shows the information flow sequence for ANF-ISIIC call set-up when the called user has migrated from SwMI B, its home SwMI, and when the called SwMI B decides to have the call forward switched (in SwMI B).

MSC Successful_call_set_up_Forward_Switching

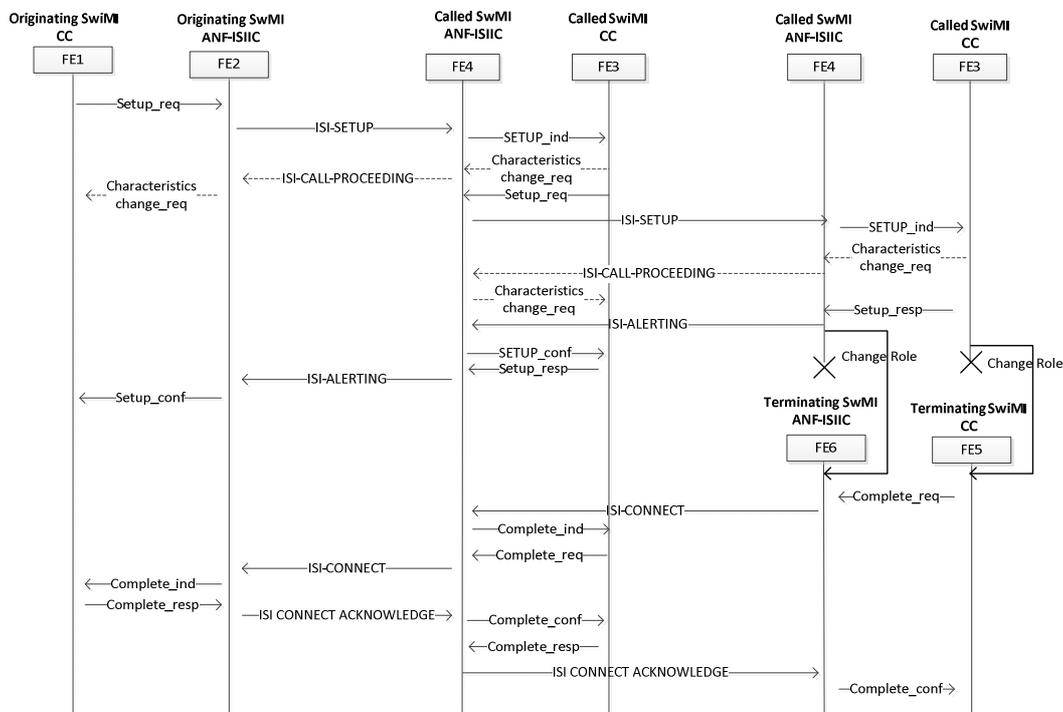


Figure 12: Information flow sequence - call set-up to a called user having migrated from SwMI B, using forward switching

5.2.1.5 ANF-ISIIC set-up to a called user having migrated from SwMI B, using re-routing

Figure 13 shows the information flow sequence for ANF-ISIIC call set-up when the called user has migrated from SwMI B, its home SwMI, and when either the Called SwMI decides to re-route the call or the originating SwMI has indicated that it wants to choose the routing method in case of migration of the called user, and the originating SwMI decides to re-route the call.

MSC Successful_call_set_up_migration_rerouting

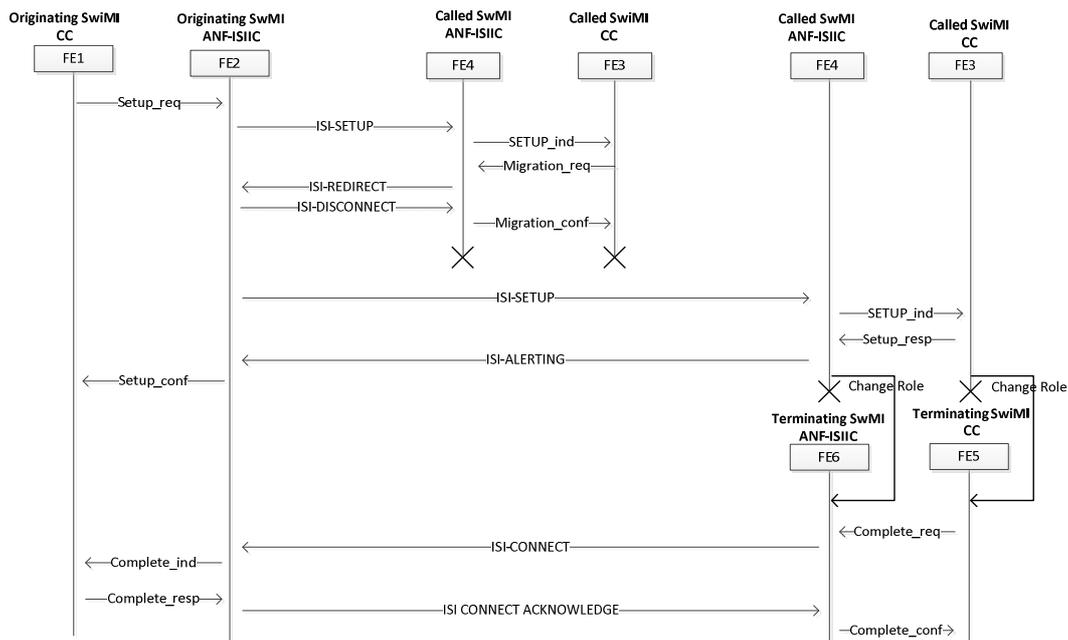


Figure 13: Information flow sequence - call set-up to a called user having migrated from SwMI B, using re-routing

5.2.1.6 Loop avoidance in case of intra-TETRA call

Figure 14 shows the information flow sequence when the home SwMI of the called user is SwMI B and when this user is registered in the originating SwMI, after having migrated. The invoked ANF-ISIIC is then cleared, and the information passed to the originating SwMI to continue the call as an intra-TETRA call.

The information flow sequence corresponds also to the case where the called user has unconditional call forwarding towards to a user (homed in called SwMI) migrated to the originating SwMI or towards a user whose home SwMI is the originating SwMI.

MSC Loop_detection_intra_TETRA_call

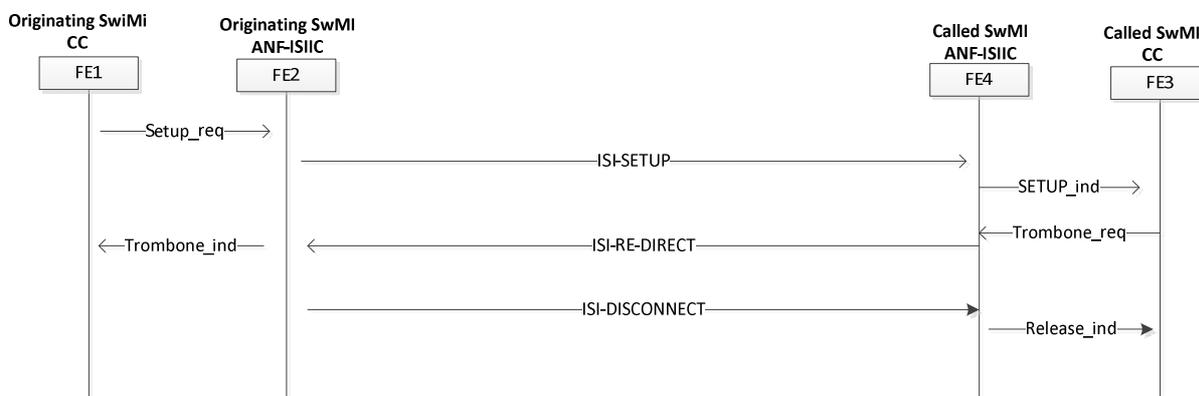


Figure 14: Information flow sequence - loop avoidance in case of intra-TETRA call

5.2.1.7 Unsuccessful ANF-ISIIC call set-up

Figure 15 shows the information flow sequence for an unsuccessful ANF-ISIIC call set-up when the call attempt is rejected either by the terminating SwMI CC entity or by the called user.

MSC Unsuccessful_call_setup

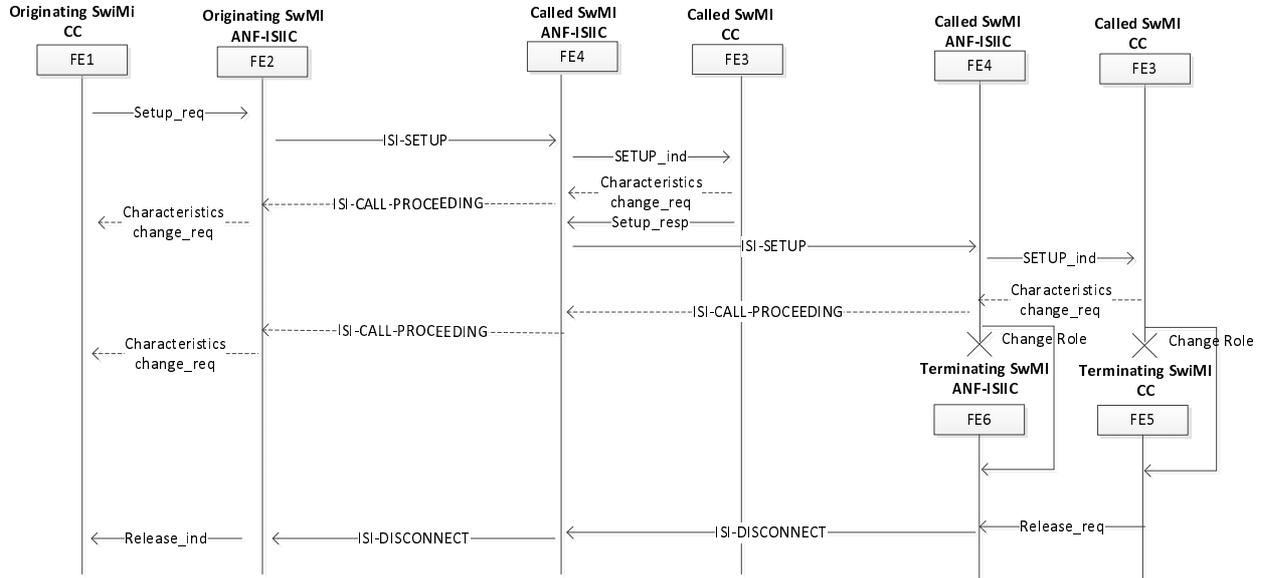


Figure 15: Information flow sequence - call rejected by the terminating SwMI or by the called user

Figure 16 shows the information flow sequence for an ANF-ISIIC call set-up rejected by the called SwMI (i.e. SwMI B) as a result of the information provided by FE3.

MSC Call_setup_rejection

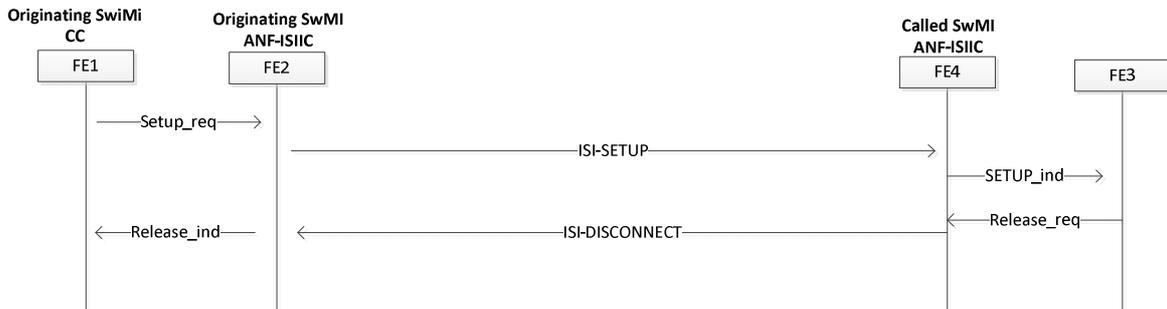


Figure 16: Information flow sequence - call rejected by the called SwMI

Figure 18 shows the information flow sequence for half-duplex operation, when nobody has transmission rights assigned. The called user requests to transmit and the request is granted. While the called user is transmitting the calling user demanding transmission permission and interrupts the called user. While the calling user is transmitting the called user demand transmission permission and interrupts the calling user.

MSC Half_duplex_operation_2

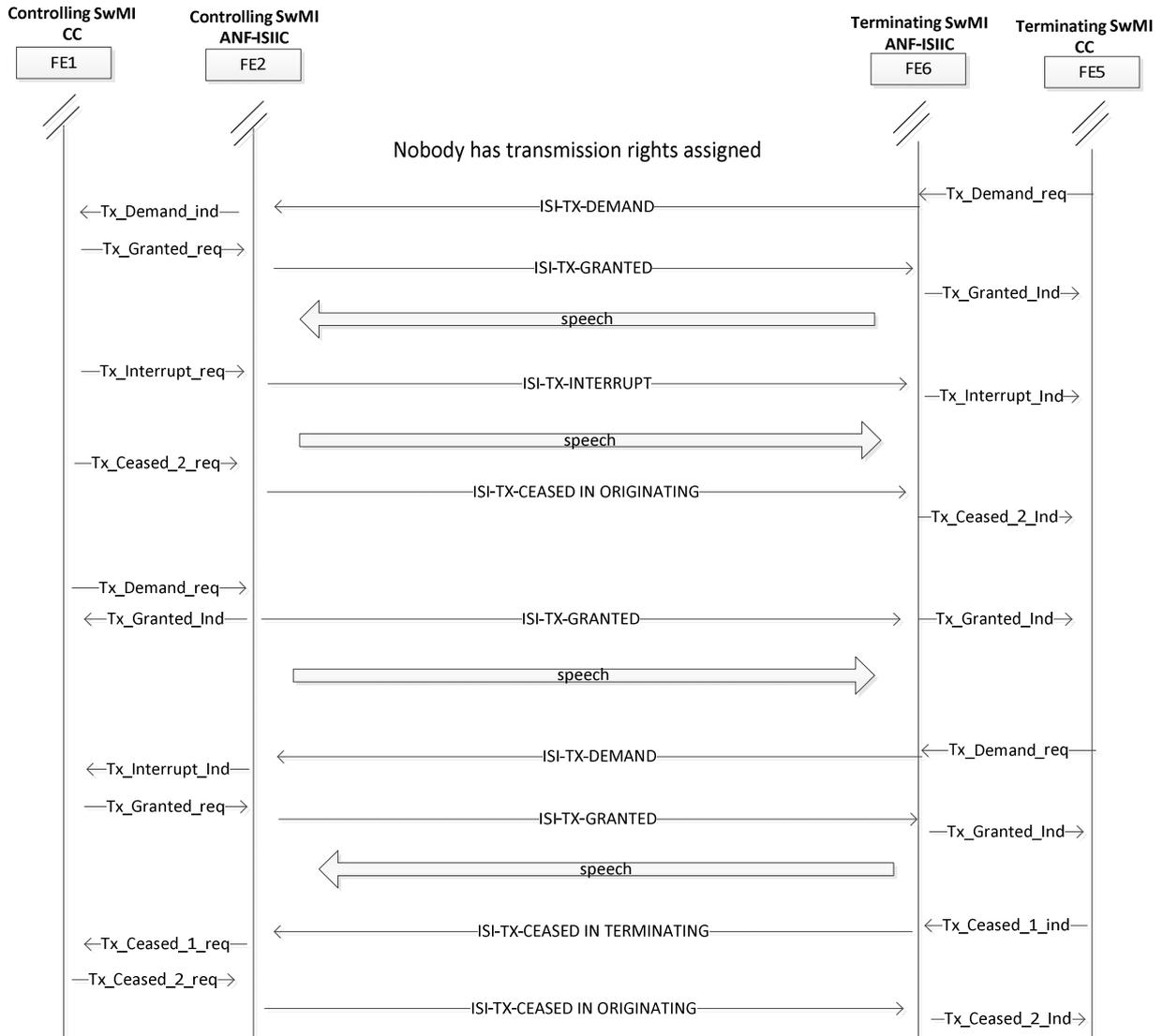


Figure 18: Information flow sequence - half-duplex operation 2

Figure 19 shows the information flow sequence for half-duplex operation, when the Controlling SwMI decides to pause the call and then to continue the conversation.

MSC Half_duplex_operation_3

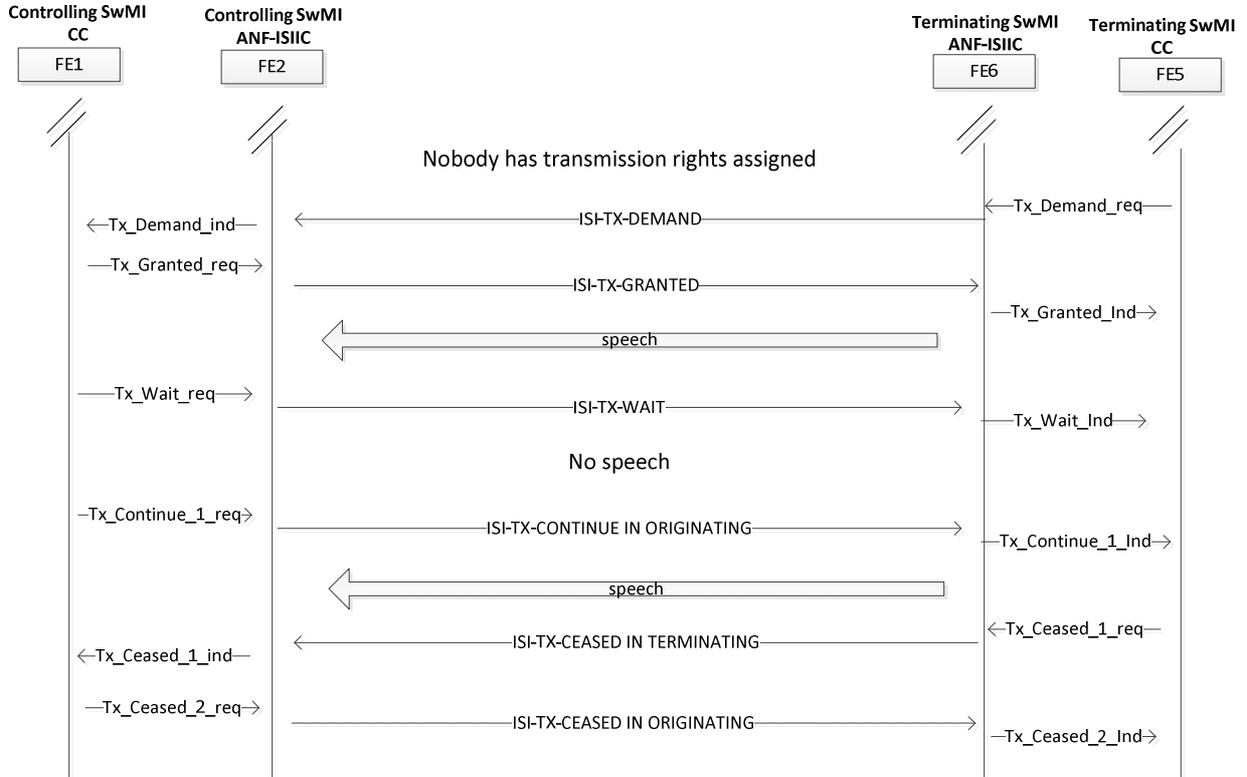
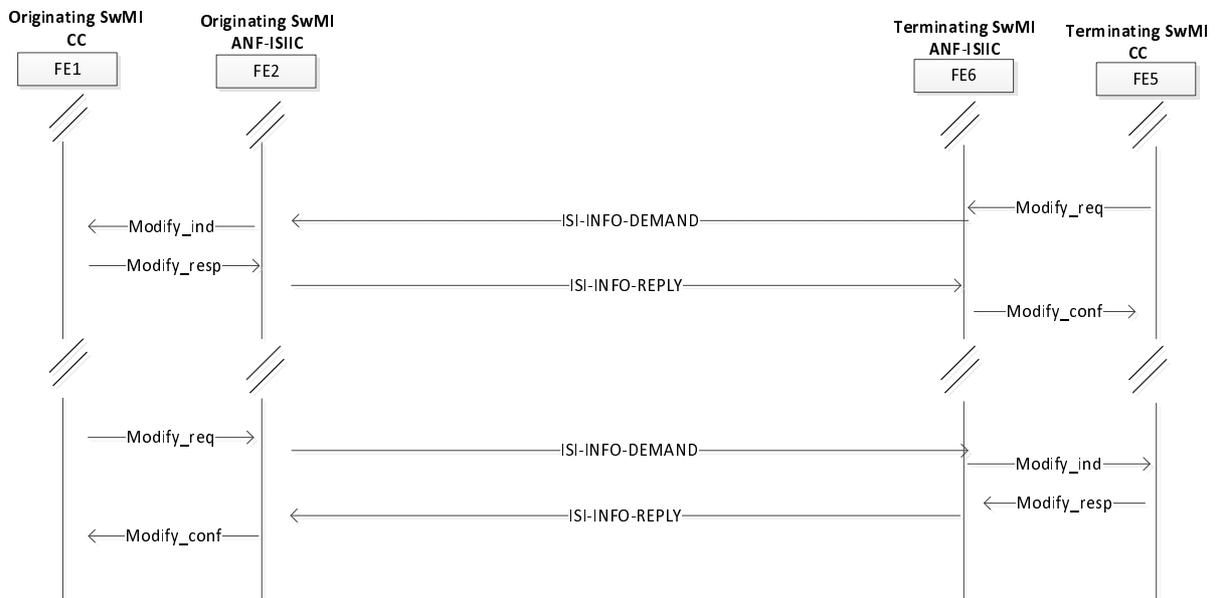


Figure 19: Information flow sequence - half-duplex operation 3

5.2.1.9 Call modify

Figure 20 shows the information flow sequence for call modification, when the modification request comes from the terminating SwMI and when it comes from the originating SwMI.

MSC Call_modify



NOTE: The MODIFY request/indication information flow sends a request to modify the existing basic service into another one, and/or to change from duplex to half-duplex, or vice-versa, and/or to change the call duration.

Figure 20: Information flow sequence - call modification

5.2.1.10 Call restoration after migration

Figure 21 shows the information flow sequence for call restoration of the calling party in a new SwMI. The role of the new SwMI changes to be the originating/controlling SwMI (FE1 and FE2) and the old originating/controlling SwMI turns to be forward switching SwMI (FE3 and FE4).

MSC Call_Restoration_of_the_calling_party_in_a_new_SwMI

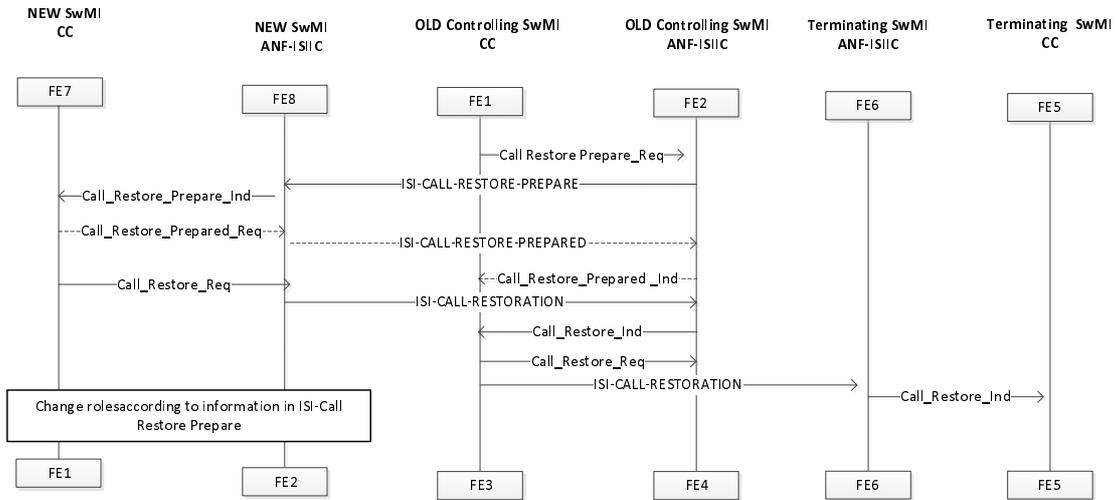


Figure 21: Information flow sequence - call restoration of the calling party in a new SwMI

Figure 22 shows the information flow sequence for a call restoration of a connected party. The role of the new SwMI changes to be the terminating SwMI (FE5 and FE6) and the old terminating SwMI turns to be forward switching SwMI (FE3 and FE4) once the call has been routed to the new SwMI.

MSC Call_Restoration_of_the_connected_party_in_a_new_SwMI

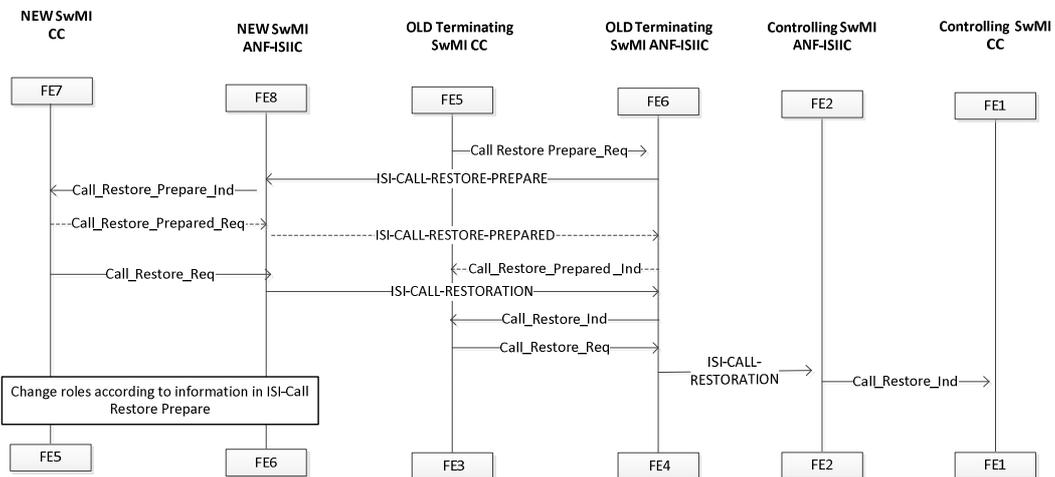


Figure 22: Information flow sequence - call restoration of the connected party in a new SwMI

Figure 23 shows the information flow sequence for the call restoration when the calling party migrates to a forward switching SwMI already in the call and the OLD SwMI requests to be released from the call. The previous forward switching SwMI will become the NEW SwMI during the call restoration with the functional entities FE7 and FE8. After the call restoration the FE7 and FE8 will turn to FE1 and FE2.

MSC Call_Restoration_SwMI_on_the_path

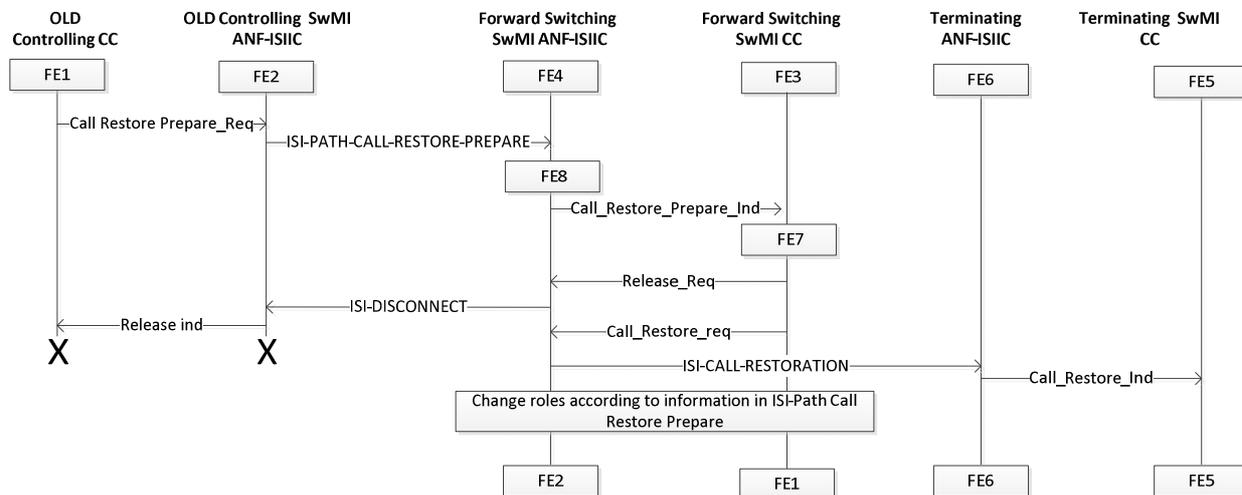


Figure 23: Information flow sequence - call restoration of the calling party in a SwMI on the path

Figure 24 shows the information flow sequence for the call restoration when the connected party migrates to a forward switching SwMI already in the call and the OLD SwMI requests to be released from the call. The previous forward switching SwMI will become the NEW SwMI during the call restoration with the functional entities FE7 and FE8. After the call restoration the FE7 and FE8 will turn to FE5 and FE6.

MSC Call_Restoration_SwMI_on_the_path

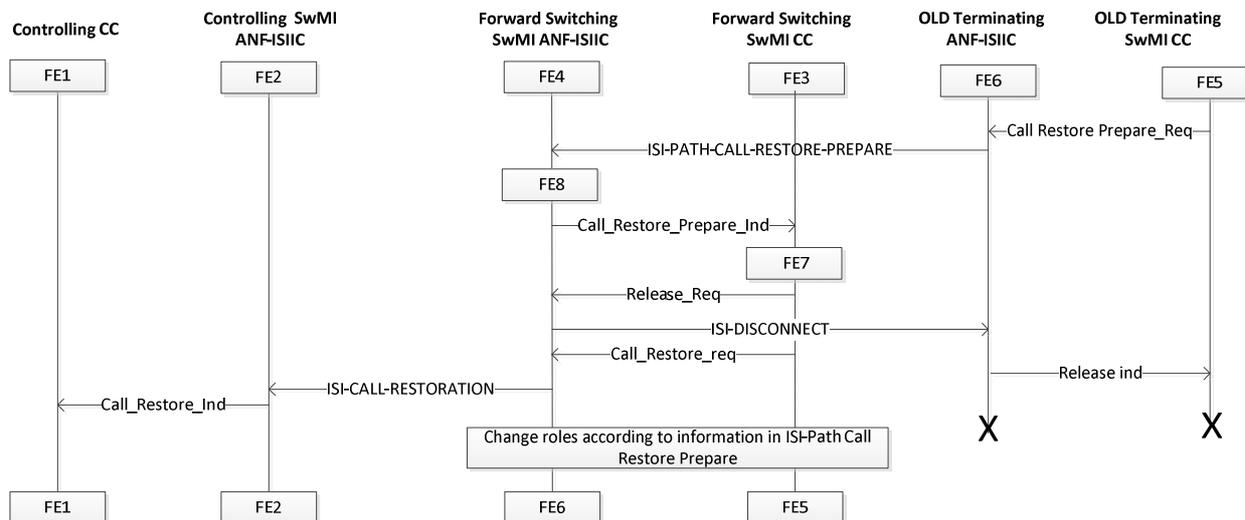


Figure 24: Information flow sequence - call restoration of the connected party in a SwMI on the path

Figure 25 shows the information flow sequence for call restoration in the other end SwMI. The whole ISI call will be terminated as the call becomes an intra-TETRA call.

MSC Call_Restoration_other_end_SwMI

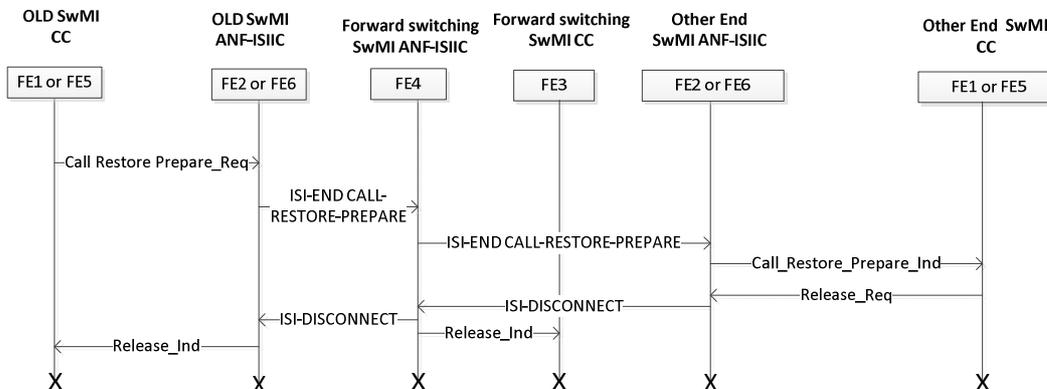


Figure 25: Information flow sequence - call restoration of an established inter-TETRA call in the other end SwMI

Figure 26 shows the information flow sequence for call restoration of an intra-TETRA call that becomes an ISI-TETRA call because either the calling or the connected party migrates in another SwMI. In this case the NEW SwMI could be either the terminating SwMI if the connected party moves into new SwMI or the NEW Controlling SwMI if the calling party moved.

MSC Call_restoration_intra_TETRA_call

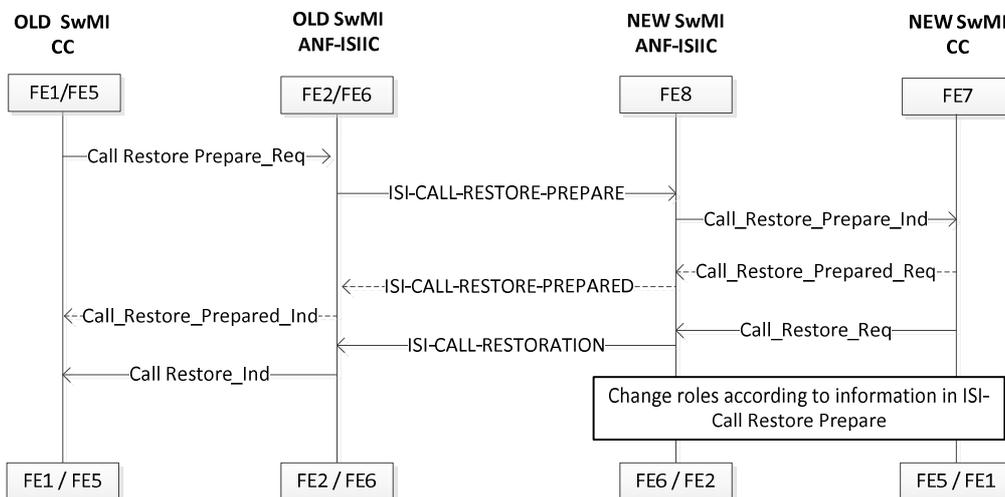


Figure 26: Information flow sequence - call restoration of an established intra-TETRA call

5.2.1.11 Call clearing

Figure 27 shows the information flow sequence when a call is cleared by its calling user. Call may also be disconnected by either SwMI.

MSC Call_clearing

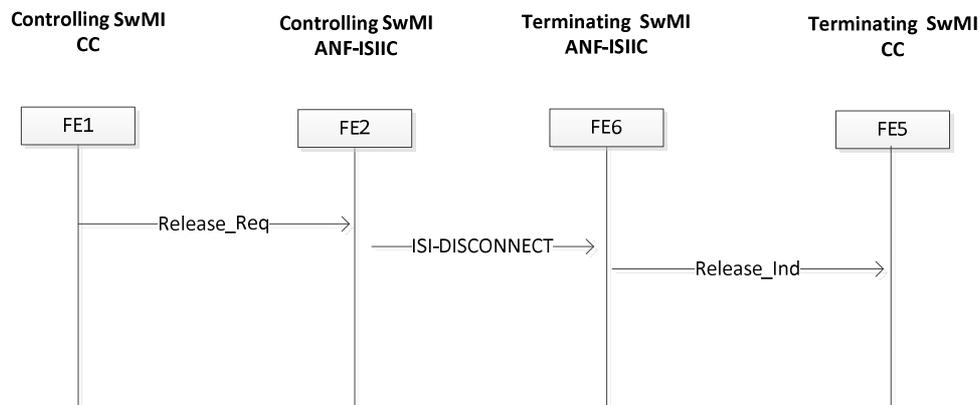


Figure 27: Information flow sequence - call clearing

5.2.1.12 Resource queuing and allocation

Before the originating SwMI can through connect the call, the resources for the call have to be reserved in all involved SwMIs. The terminating SwMI shall inform the preceding SwMI (a forward switching SwMI or the originating SwMI) in the call setup phase about the resource allocation policy supported and whether it has all needed resources for the call or if the request for resources is queued. If there are forward switching SwMIs involved they shall also inform the originating SwMI about the resource situation in the terminating SwMI and the forward switching SwMIs (resources are available in all SwMIs or the resource requests are queued at least in one SwMI). This way the originating SwMI knows the overall resource situation when the calling and called parties are ready for the call to be throughconnected. Should there be no queuing for resources in any of the involved SwMIs then the call can be through connected and the call then enters its maintenance phase.

NOTE: A forward switching SwMI cannot indicate that resources are reserved based on its own availability. The resources should also be available in the next SwMI(s) (another forward switching SwMI or terminating SwMI) in the chain.

If there is any queuing for resources, in any SwMI, the originating SwMI indicates queuing towards the terminating SwMI. If the terminating/forward switching SwMI did not have its resources immediately available then when they do become available the SwMI passes this status information towards the originating SwMI.

The resource allocation policy in call setup phase can be either permanent or temporary:

- Permanent resource allocation policy means that resources which are allocated, remains allocated until the call is terminated.
- Temporary resource allocation policy means that the resources can be released, if permitted by the preceding SwMI, while waiting for resource allocation in another SwMI.

A SwMI operating a policy of temporary resource allocation shall support the check of the reservation status of resources and it shall always indicate temporary resource allocation policy to the preceding SwMI (originating or another forward switching SwMI).

As a SwMI operating a policy of permanent resource allocation during call setup may or may not support the check the reservation status of the resources in other SwMIs, thus the logic to indicate resource allocation policy is as follows:

- If a forward switching SwMI operating a policy of permanent resource allocation during call setup does not support the check of the resource reservation status in other SwMIs, it shall always indicate permanent resource allocation policy to the preceding SwMI.

- If a forward switching SwMI operating a policy of permanent resource allocation during call setup supports the check of the resource reservation status in other SwMIs, it shall indicate temporary resource allocation policy to the preceding SwMI (originating or another forward switching SwMI) if the next SwMI (forward switching or terminating SwMI) has indicated temporary resource allocation policy.

The latter procedure permits the originating SwMI to know that there is a SwMI in the chain with temporary resource allocation policy and the originating SwMI can permit, for example, the terminating SwMI to release its resources if the originating SwMI does not yet have resources even if a forward switching SwMI is operating a policy of permanent resource allocation and supporting a check of the resource reservation status.

When there is a delay caused by resource request queuing then the support of the check of the reservation status of the resources in other SwMIs is indicated to the next SwMI, i.e. the information is sent from the originating SwMI to a forward switching SwMI and from a forward switching SwMI to the next forward switching SwMI or terminating SwMI.

The originating SwMI may release its resources if there are queued resource requests in some other SwMI.

If the originating SwMI does not have the needed resources when it gets the information that the other involved SwMIs do have, the originating SwMIs may give the permission to release the already reserved resources if the originating SwMI supports the check of the reservation status of the resources in other SwMIs, provided that it has received indication that there is a SwMI in the chain supporting temporary resource reservations during the call setup.

When the originating SwMI then gets its own resources for the call and it has allowed the succeeding SwMI(s) to release already reserved resources it shall request the state of the resource reservations in other SwMIs and, if it not currently allocated, request it to be allocated. The originating SwMI will send this request to check if the other SwMIs are also in a state where the call can be connected. The response of a SwMI is either to immediately indicate that it has the resources it needs or firstly indicate that it does not immediately have its resources, and then later indicate when it does.

Also a forward switching SwMI may use the same procedure. If a forward switching SwMI does not have the needed resources when it gets the information that the next SwMI in chain (up to the terminating SwMI) do have, the forward switching SwMIs may give the permission to release the already reserved resources if the forward switching SwMI supports the check of the reservation status of the resources in other SwMIs, provided that it has received indication that there is a SwMI in the chain supporting temporary resource reservations during the call setup.

5.2.2 Definition of information flows

5.2.2.1 General

In the following clause all the tables listing the service elements in information flows, the column headed "Request" indicates which of these service elements are Mandatory (M) and which are Optional (O) in a request/indication information flow, and the column headed "Confirm" indicates which of these service elements are Mandatory (M) and which are Optional (O) in a response/confirmation information flow.

5.2.2.2 CALL RESTORE

CALL RESTORE is an unconfirmed information flow across the following relationships:

- rk from FE7 to FE8, rj from FE8 to FE2, ra from FE2 to FE1, rg from FE2 to FE6 (or rc from FE2 to FE4 and rf from FE4 to FE6) and rh from FE6 to FE5, if the user restoring the call is the calling user;
- rk from FE7 to FE8 rl from FE8 to FE6, rh from FE6 to FE5, rg from FE6 to FE2 (or rf from FE6 to FE4 and rc from FE4 to FE2) and ra from FE2 to FE1, if the user restoring the call is the connected or calling user.

It informs the SwMI where the user was previously registered that it is not going to be anymore an end SwMI and that it should take the actions specified for call restoration (e.g. in the general case: joining the leg with the new SwMI and the existing ISI call path with the other end SwMI).

It also informs the SwMI at the other end about the call restoration and the new end SwMI, with possible call modifications proposed by the new SwMI.

Table 1 lists the service elements within the CALL RESTORE information flow.

Table 1: Contents of CALL RESTORE

| Service element | Request |
|--|--------------|
| New SwMI MNI | M |
| Simplex/duplex selection | M |
| Call priority | M |
| Basic service information | M |
| Transmission request permission | O (see note) |
| Transmission grant | O (see note) |
| Call status | O |
| NOTE: Mandatory if this information flow is sent by FE1' (corresponding to controlling SwMI). Not to be included if this information flow is sent by FE8'. | |

5.2.2.3 CALL RESTORE PREPARE

CALL RESTORE PREPARE is a confirmed information flow across the following relationships:

- ra from FE1 to FE2, rj from FE2 to FE8 and rk from FE8 to FE7, if the user restoring the call is the calling user;
- rh from FE5 to FE6, rl from FE6 to FE8 and rk from FE8 to FE7, if the user restoring the call is the connected or calling user.

It informs the SwMI where the user is now registered to prepare for call restoration.

NOTE: CALL RESTORE PREPARE is confirmed:

- by the CALL RESTORE request/indication information flow, in the general case where the call restoration has been successful;
- by call RELEASE message in the specific cases where the call restoration takes place in a SwMI on the path of the call, including the end SwMIs (originating and terminating SwMIs).

The case where the call restoration has not been successful can only be detected by the expiry of a timer for the reception of the information flows mentioned above in the cases of successful call restoration.

Table 2 lists the service elements within the CALL RESTORE PREPARE information flow.

Table 2: Contents of CALL RESTORE PREPARE information flow

| Service element | Request |
|--|----------------|
| Other end SwMI MNI | M |
| Basic service information | M |
| Speech services supported | O (see note 1) |
| Security level at calling user air interface | M |
| Call priority | M |
| Call time-out | M |
| Simplex/duplex selection | M |
| Transmission request permission | O (see note 2) |
| Transmission grant | O (see note 2) |
| NOTE 1: May be sent if the service requested (in the service element basic service information) is a speech service. | |
| NOTE 2: Mandatory if this information flow is sent by FE1 (corresponding to controlling SwMI). Not to be included if this information flow is sent by FE5. | |

5.2.2.4 CHARACTERISTIC CHANGE

CHARACTERISTIC CHANGE is an unconfirmed information flow across the following relationships:

- rh from FE5 to FE6, rg from FE6 to FE2 and ra from FE2 to FE1.

- rh from FE5 to FE6, rf from FE6 to FE4, rc from FE4 to FE2 and ra from FE2 to FE1.

It is an advance indication to the originating one that the terminating SwMI wants to change some of the characteristics requested in the SETUP information flow (e.g. basic service not supported, or simply call set-up time-out extension). The sending of this information flow by FE5 is optional.

Table 3 lists the service elements within the CHARACTERISTIC CHANGE information flow.

Table 3: Contents of CHARACTERISTIC CHANGE

| Service element | Request |
|---|--------------|
| Call time-out in set-up phase | O |
| Simplex/duplex selection | O |
| Call status | O |
| Basic service information | O (see note) |
| NOTE: Only if different from requested. | |

5.2.2.5 COMPLETE

COMPLETE is a confirmed information flow:

- across relationship ra, between FE1 and FE2;
- across relationship rh, between FE6 and FE5; and:
 - if the called user is registered in SwMI B across relationship rc, between FE2 and FE4;
 - if the called user is registered in SwMI C (after having migrated):
 - if the call is forward switched, across relationships rc, between FE2 and FE4, re, between FE3 and FE4, and rf, between FE4 and FE6;
 - if the call is re-routed, across relationship rg, between FE2 and FE6.

Table 4: Contents of COMPLETE information flow

| Service element | Request | Response |
|---------------------------------|---------|----------|
| Terminating SwMI MNI | M | - |
| Call amalgamation | O | - |
| Call time-out | M | M |
| Connected party identity | M | - |
| Simplex/duplex selection | M | - |
| Transmission request permission | - | M |
| Transmission grant | - | M |

5.2.2.6 MIGRATION

MIGRATION is both confirmed or unconfirmed information flow across relationships re from FE3 to FE4 and rc from FE4 to FE2. The MIGRATION request information flow is sent by FE3 when the called user is registered in SwMI C (i.e. the home SwMI of the called user is SwMI B and this user has migrated). The MIGRATION information flow shall not be sent when SwMI C coincides with SwMI A.

NOTE: It is then replaced by the TROMBONE information flow - see hereafter.

Table 5 lists the service elements within the MIGRATION information flow when it is a confirmed flow, and table 6 lists them when it is an unconfirmed flow.

Table 5: Contents of confirmed MIGRATION information flow

| Service element | Request | Confirm |
|---|---------|---------|
| Identity of the SwMI where the called user is registered | M | - |
| Forward switching (see note) | M | M |
| NOTE: In the request information flow, this information element indicates whether forward switching is supported or not (or possibly if FE3 refuses that forward switching takes place). In the response information flow, it indicates that FE2 wants that the call shall be forward switched or not, i.e. the call is going to re-routed. | | |

Table 6: Content of unconfirmed MIGRATION information flow

| Service element | Request |
|--|---------|
| Identity of the SwMI where the called user is registered | M |

5.2.2.7 MODIFY

MODIFY is a confirmed information flow across relationships ra, rg and rh, from FE1 to FE5 via FE2 and FE6 and vice-versa. The MODIFY request/indication information flow sends a request to modify the existing basic service into another one, and/or to change from duplex to half-duplex, or vice-versa, and/or to change the call duration. The MODIFY response/confirmation information flow indicates the response to this request. FE2 or FE6 may reject such request if the ISI gateways in which they are located do not support the user information 8 kbit/s encoding entailed by a request to change the basic service.

Table 7 lists the service elements within the MODIFY information flow.

Table 7: Contents of MODIFY

| Service element | Request | Confirm |
|---|--------------|--------------|
| Basic service information: | | |
| Circuit mode service | O | O |
| Communication type | O | O |
| Data call capacity | C (see note) | C (see note) |
| Data service | C (see note) | C (see note) |
| Encryption flag | O | O |
| Speech service | C (see note) | C (see note) |
| Call time-out | O | O |
| Simplex/duplex selection | O | O |
| NOTE: Depending on the value of circuit mode service. | | |

5.2.2.8 RELEASE

RELEASE is an unconfirmed information flow across relationships ra, rh, rc, rf and rg. It shall be sent to clear the call (together with the invoked ANF-ISIIC).

Table 8 indicates the only service element within the RELEASE information flow.

Table 8: Contents of RELEASE

| Service element | Request |
|------------------|---------|
| Disconnect cause | M |

5.2.2.9 SETUP

SETUP is a confirmed or unconfirmed information flow:

- across relationship ra from FE1 to FE2;

- across relationship rh from FE6 to FE5 and:
 - if the called user is registered in SwMI B across relationship rc from FE2 to FE4;
 - if the called user is registered in SwMI C (after having migrated):
 - if the call is forward switched, across relationships rc from FE2 to FE4, re between FE3 and FE4, and rf from FE4 to FE6;
 - if the call is re-routed, across relationship rg from FE2 to FE6.

The SETUP request/indication information flow enables the TETRA call to be set-up by the originating SwMI up to the terminating SwMI. The SETUP response/confirmation information flow may be sent by the terminating SwMI upon the call type, i.e.:

- in the case of on/off hook signalling, this first response will generate a U-ALERT PDU. The SETUP response/confirmation information flow shall then be generated by the terminating SwMI. The TNCC ALERT primitive may be sent to the calling user by SwMI A call control application;
- while in the case of direct set-up signalling, this first response from the connected party will be a U-CONNECT air interface PDU. The SETUP response/confirmation information flow in this case is not generated by the terminating SwMI.

Table 9 lists the service elements within the SETUP information flows.

Table 9: Contents of SETUP

| Service element | Request | Confirm |
|--|----------------|----------------|
| Originating SwMI MNI | M | - |
| Routeing method choice | O | - |
| Terminating SwMI MNI | - | O (see note 2) |
| Call time-out, set-up phase | M | O (see note 3) |
| Basic service information: | - | - |
| Circuit mode service | M | O (see note 2) |
| Communication type | M | O (see note 2) |
| Data call capacity | C (see note 1) | C (see note 1) |
| Data service | C (see note 1) | C (see note 1) |
| Encryption flag | M | O (see note 2) |
| Speech service | C (see note 1) | C (see note 1) |
| Speech services supported | O (see note 4) | - |
| Security level at calling user air interface | M | M |
| Call priority | M | O (see note 2) |
| Call amalgamation | - | O (see note 2) |
| Call time-out | M | O (see note 2) |
| Called/Connected party number | M | O (see note 2) |
| Calling party number | M | - |
| Hook method selection | M | M (see note 5) |
| Request to transmit/send data | M | - |
| Simplex/duplex selection | M | M |
| Transmission request permission | M | - |
| Transmission grant | M | - |
| Call queued | - | O (see note 6) |
| NOTE 1: Depending on the value of circuit mode service. | | |
| NOTE 2: Mandatory in the case of direct set-up signalling. Not to be included in the case of on/off hook signalling. | | |
| NOTE 3: Mandatory in the case of on/off hook signalling. Not to be included in the case of direct set-up signalling. | | |
| NOTE 4: May be sent if the service requested is a speech service. | | |
| NOTE 5: Mandatory to indicate the actual choice made by the called user: in other words, it indicates whether the called user has accepted or changed the hook selection method requested. | | |
| NOTE 6: Optional in the case of on/off hook signalling. Not to be included in the case of direct set-up signalling. | | |

5.2.2.10 SETUP PROLONGATION

SETUP PROLONGATION is an unconfirmed information flow across relationships ra, rg and rh, from FE1 to FE5 via FE2 and FE6 and vice-versa, and possibly also across rc and rf if the call is forward switched, to request a set-up time-out extension. Table 10 shows the service element within the SETUP PROLONGATION information flow.

Table 10: Content of SETUP PROLONGATION

| Service element | Request |
|-----------------------------|---------|
| Call time-out, set-up phase | M |

5.2.2.11 TROMBONE

TROMBONE is an unconfirmed information flow across relationships re from FE3 to FE4 and rc between FE4 and FE2. The TROMBONE request information flow is sent by FE3 when FE3 has identified that SwMI C coincides with the originating SwMI . The TROMBONE request is then a indication that the invoked ANF-ISIIC entities should be cleared.

Table 11 lists the service elements within the TROMBONE request/indication information flow (sent by FE3).

Table 11: Contents of TROMBONE request/indication information flow

| Service element | Request |
|--|-----------------------|
| Terminating and originating SwMIs coinciding | M |
| Results of possible SS-BIC and SS-CAD (for incoming calls) | M (see notes 1 and 2) |
| SS-CF invoked | M |
| SS-CF "definition" | C (see note 3) |
| NOTE 1: If none of these supplementary services has been activated, this shall be indicated. | |
| NOTE 2: The case where the result would be that the call is not authorized by SS-CAD is excluded, since it would not result in the sending of a TROMBONE request information flow, but in the ANF-ISIIC call establishment being rejected. | |
| NOTE 3: Mandatory if SS-CF has been invoked. | |

NOTE: According to ETSI EN 300 392-12-4 [8] of the call forwarding supplementary services, the only call forwarding supplementary services which may be invoked in the home SwMI of the SS-CF served user when that user has migrated (in the specific case where TROMBONE is sent, that user has migrated into SwMI A) are SS-CFU or SS-CFNRc.

5.2.2.12 TX-CEASED

5.2.2.12.1 TX-CEASED 1

TX-CEASED 1 is a confirmed information flow across ri from FE5 to FE1 to indicate that transmission from the called user has ceased.

Table 12 lists the service elements within the TX-CEASED 1 information flow.

Table 12: Contents of TX-CEASED 1

| Service element | Request |
|------------------------|---------|
| Notification indicator | O |
| Proprietary | O |

5.2.2.12.2 TX-CEASED 2

TX-CEASED 2 is an unconfirmed information flow across ri from FE1 to FE5 to indicate that transmission from the calling user has ceased. It is also used as a response to a TX-CEASED 1 when transmit permission has not been allocated to the calling party and the connected party has ceased talking.

Table 13 lists the service elements within the TX-CEASED 2 information flow.

Table 13: Contents of TX-CEASED 2

| Service element | Request |
|---------------------------------|---------|
| Transmission request permission | M |
| Notification indicator | O |
| Proprietary | O |

5.2.2.13 TX-CONTINUE 1

TX-CONTINUE 1 is an unconfirmed information flow across ri from FE1 to FE5 to indicate that transmission has resumed.

Table 14 lists the service elements within the TX-CONTINUE 1 information flow.

Table 14: Contents of TX-CONTINUE 1

| Service element | Request |
|---------------------------------|---------|
| Continue | M |
| Transmission request permission | M |
| Notification indicator | O |
| Proprietary | O |

5.2.2.14 TX-CONTINUE 2

TX-CONTINUE 2 is an unconfirmed information flow across ri from FE5 to FE1 to indicate that transmission may resume.

Table 15 lists the service elements within the TX-CONTINUE 2 information flow.

Table 15: Contents of TX-CONTINUE 2

| Service element | Request |
|------------------------|---------|
| Notification indicator | O |
| Proprietary | O |

5.2.2.15 TX-DEMAND

TX-DEMAND is a confirmed information flow across ri from FE5 to FE1. It is a request from the terminating SwMI to the originating/controlling SwMI for transmission grant (following the corresponding request received from the called user).

Table 16 lists the service elements within the TX-DEMAND information flow.

Table 16: Contents of TX-DEMAND

| Service element | Request |
|------------------------|---------|
| TX demand priority | M |
| Encryption control | M |
| Notification indicator | O |
| Proprietary | O |

5.2.2.16 TX-GRANTED

TX-GRANTED is an unconfirmed information flow across ri from FE1 to FE5. It is an indication to the terminating SwMI from the originating/controlling SwMI that permission to transmit has been granted to either the calling or the called user.

Table 17 lists the service elements within the TX-GRANTED information flow.

Table 17: Contents of TX-GRANTED

| Service element | Request |
|---------------------------------|---------|
| Transmission grant | M |
| Transmission request permission | M |
| Encryption control | M |
| Notification indicator | O |
| Proprietary | O |

5.2.2.17 TX-INTERRUPT

TX-INTERRUPT is an unconfirmed information flow across ri from FE1 to FE5. It is an indication to the terminating SwMI from the originating/controlling SwMI that permission to transmit has been withdrawn and may have been granted to the other party.

Table 18 lists the service elements within the TX-INTERRUPT information flow.

Table 18: Contents of TX-INTERRUPT

| Service element | Request |
|---------------------------------|---------|
| Transmission grant | M |
| Transmission request permission | M |
| Encryption control | M |
| Notification indicator | O |
| Proprietary | O |

5.2.2.18 TX-WAIT

TX-WAIT is an unconfirmed information flow across ri from FE1 to FE5 or from FE5 to FE1 to indicate that transmission has been paused.

Table 19 lists the service elements within the TX-WAIT information flow.

Table 19: Contents of TX-WAIT

| Service element | Request |
|--|--------------|
| Transmission request permission | M (see note) |
| Notification indicator | O |
| Proprietary | O |
| NOTE: When sent by FE8 this service element has no control function and the contents of it shall be ignored. | |

5.3 Functional entity actions

The FE actions in the figures 10 to 27 in clauses 5.2.1.2 to 5.2.1.11 shall fulfil the requirements set to the functional entities.

5.4 Allocation of functional entities to physical equipment/SwMIs

The different scenarios for the allocation of FEs to physical equipment/SwMIs are shown in table 20.

Scenario 1 corresponds to the case where the called user is registered in SwMI B, SwMI B first as Called SwMI becomes the Terminating SwMI.

Scenario 2 corresponds to the case where the called user has migrated before the call setup from SwMI B to a third SwMI (SwMI C), and the call is forward switched (in SwMI B). SwMI B first as Called SwMI becomes the Forward Switching SwMI.

Scenario 3 corresponds to the case where the called user has migrated during the ongoing call (established between SwMIs A and B) from SwMI B to a third SwMI (SwMI C), and the call is forward switched (in SwMI B). SwMI B first as Called then Terminating SwMI becomes the Forward Switching SwMI when the call is restored in SwMI C. SwMI C becomes the new Terminating SwMI.

Scenario 4 corresponds to the case where the calling user has migrated during the ongoing call (established between SwMIs A and B) from SwMI A to a third SwMI (SwMI C), and the controlling role for the call is forwarded to the new SwMI C. SwMI A first as Originating SwMI becomes the Forward Switching SwMI when the call is restored in SwMI C. SwMI C becomes the new Controlling SwMI.

Table 20: Scenarios for the allocation of FEs to physical equipment/SwMIs

| | FE1/Originating SwMI CCAp or Controlling SwMI CCAp | FE2/Originating SwMI ISI gateway or Controlling SwMI ISI GW | FE3/Called SwMI CCAp | FE4/Called SwMI ISI gateway | FE3/Forward Switching SwMI CCAp | FE4/Forward Switching SwMI ISI gateway | FE6/Terminating SwMI ISI gateway | FE5/Terminating SwMI CCAp |
|------------|---|--|-----------------------------|------------------------------------|--|---|---|----------------------------------|
| Scenario 1 | SwMI A CCAp | SwMI A ISI gateway | SwMI B CCAp | SwMI B ISI gateway | | - | SwMI B ISI gateway | SwMI B CCAp |
| Scenario 2 | SwMI A CCAp | SwMI A ISI gateway | SwMI B CCAp | SwMI B ISI gateway | SwMI B CCAp | SwMI B ISI gateway | SwMI C ISI gateway | SwMI C CCAp |
| Scenario 3 | SwMI A CCAp | SwMI A ISI gateway | SwMI B CCAp | SwMI B ISI gateway | SwMI B CCAp | SwMI B ISI gateway | SwMI C ISI gateway | SwMI B CCAp SwMI C CCAp |
| Scenario 4 | SwMI A CCAp | SwMI A ISI gateway | SwMI B CCAp | SwMI B ISI gateway | - | - | SwMI B ISI gateway | SwMI B CCAp |

6 ANF-ISIIC stage 3 specification

6.1 ANF-ISIIC coding requirements

6.1.1 General

TETRA specific messages shall be sent using an Invoke APDU of the ISI operation `tetraIsiMessage` defined in table 1 of ETSI TS 100 392-3-9 [2].

More precisely:

- the TETRA specific messages shall be the TETRA PDUs defined in clause 6.1.2; and
- those PDUs shall be included in the `tetraMessage` data element of the ISI operation `tetraIsiMessage`.

6.1.2 TETRA PDUs

6.1.2.1 General encoding rule

The TETRA PDUs referred to in the ASN.1 definition in table 25 shall be encoded using the same rule as defined in annex E of ETSI EN 300 392-2 [1] (for TETRA air interface PDUs).

NOTE: As a general rule, the definition of those PDUs has been done on the basis of the corresponding air interface downstream messages. Thus generally those PDUs include the same information elements as air interface messages. However, no facility information elements are included in those PDUs since ANF-ISISS is used instead (see clauses 9 and 10 of ETSI EN 300 392-9 [7]).

The definitions of all ANF-ISIIC TETRA PDUs are given below.

6.1.2.2 ISI-SETUP PDU message sent by the originating or the forward switching SwMI

The contents and the encoding of the ISI-SETUP PDU sent by the originating or forward switching SwMI to give information about call setup request shall be as defined in table 21.

Table 21: Contents of ISI-SETUP PDU

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|----------|------|-------|-------|---------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-SETUP |
| Selected area number | 8 | 1 | ANF | M | |
| Originating SwMI MNI | 24 | 1 | ANF | M | |
| Call has been forward switched | 1 | 1 | ANF | M | |
| Last Forwarding SwMI MNI | 24 | | ANF | C | (see note 1) |
| Routeing method choice | 3 | 1 | ANF | M | |
| SS-CF invocation counter | 5 | 1 | SS | M | |
| Call time-out, set-up phase | 3 | 1 | CCAp | M | |
| Call time-out | 4 | 1 | CCAp | M | |
| Hook method selection | 1 | 1 | CCAp | M | |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Basic service information | 8 | 1 | CCAp | M | |
| Speech service requested | 3 | | CCAp | C | (see note 2) |
| Security level at air interface | 2 | 1 | MM | M | (see note 3) |
| Call priority | 4 | 1 | CCAp | M | |
| Called/forwarded-to party SSI | 24 | 1 | CCAp | M | (see note 4) |
| Called/forwarded-to party extension | 24 | 1 | CCAp | M | (see notes 4 and 5) |
| Number of digits in called/forwarded-to external subscriber number | 5 | 1 | CCAp | M | (see note 6) |
| Called/forwarded-to external subscriber number | variable | | CCAp | C | (see note 7) |
| Calling party presentation indicator | 2 | 1 | SS | M | |
| Calling party SSI | 24 | 1 | CCAp | M | (see note 8) |
| Calling party extension | 24 | 1 | CCAp | M | (see note 8) |
| Number of digits in calling external subscriber number | 5 | 1 | CCAp | M | (see note 9) |
| Calling external subscriber number | variable | | CCAp | C | (see note 10) |
| MSISDN present as external subscriber number | 1 | | CCAp | C | (see note 11) |
| Calling external subscriber number parameters | 9 | | CCAp | C | (see note 11) |
| Call identified as fleet call | 1 | 1 | CCAp | M | |
| Calling party fleet number SSI | 24 | | CCAp | C | (see note 12) |
| Called/forwarded-to party fleet number SSI | 24 | | CCAp | C | (see note 12) |
| Override SS-CAD invocation | 1 | 1 | SS | M | (see note 13) |
| Speech services supported | 8 | 2 | CCAp | O | (see note 14) |

| Information element | Length | Type | Owner | C/O/M | Remark |
|---|--------|------|-------|-------|--------|
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |
| <p>NOTE 1: Conditional on the value of the information element call has been forward switched indicating that the call has been routed by forward switching (at some stage).</p> <p>NOTE 2: Conditional on the binary value of the information sub-element circuit mode type in the information element basic service information being equal to 0 (i.e. the call requested is a speech call).</p> <p>NOTE 3: In the case of incoming calls from PSTN/ISDN/PISN, the name of this information element should be understood as "security level used in the other network". Indicates if air interface encryption is being used at the calling air interface.</p> <p>NOTE 4: In the case of an external outgoing call, the called/forwarded-to party SSI and the called/forwarded-to party extension shall be those of the outgoing gateway SwMI.</p> <p>NOTE 5: Is the same as last forwarding SwMI MNI in the case of migration of the called/forwarded-to party when the invoked ANF-ISIIC has been forward switched through the home SwMI of that party.</p> <p>NOTE 6: Shall be equal to 0 when no called/forwarded-to external subscriber number is present, or to N, N being the number of digits which the called/forwarded-to external subscriber number comprises.</p> <p>NOTE 7: The length in bits of this information element shall be equal to $4 \times N$, N being the number of digits in the called/forwarded-to external subscriber number (see note 6), i.e. this information element shall be conditional on the value of N.</p> <p>NOTE 8: In the case of an external incoming call, the calling party SSI and the calling party extension shall be those of the incoming gateway SwMI.</p> <p>NOTE 9: Shall be equal to 0 when no calling external subscriber number is present, or to N, N being the number of digits which the calling external subscriber number comprises.</p> <p>NOTE 10: The length in bits of this information element shall be equal to $4 \times N$, N being the number of digits in the calling external subscriber number (see note 9), i.e. this information element shall be conditional on the value of N.</p> <p>NOTE 11: Conditional on the value of the information element number of digits in calling external subscriber number being different from 0.</p> <p>NOTE 12: Conditional on the value of the information element call identified as fleet call indicating that the call has been identified as being a fleet call.</p> <p>NOTE 13: See interaction between SS-CCBS and SS-CAD.</p> <p>NOTE 14: May be present only when the information element speech service requested is present (see note 2).</p> | | | | | |

NOTE 1: The originating SwMI MNI information element has been included in the definition of the TETRA PDU in table 21 to ease the identification of the originating SwMI for the called SwMI or the terminating SwMI. Such identification is necessary:

- for enforcing some security mechanisms agreed between operators; or
- to be able to identify whether a proprietary feature can or cannot be used over an ISI; or
- to allow loop connection (notably trombone connection) detection.

NOTE 2: The information element last forwarding SwMI MNI is only needed for the routing operation of the call forwarding supplementary services by the invoked ANF-ISIIC. In addition, even when no call forwarding supplementary service is invoked for the called user, it is helpful for the terminating SwMI to identify that the call has been routed by forward switching through the home SwMI of the called user when that SwMI is SwMI B and that user has migrated (to SwMI C, the terminating SwMI).

The information element SS-CF invocation counter is present only because of the interactions between the call forwarding supplementary services and ANF-ISIIC: to limit the number of invocations (and operations) of those supplementary services for the same call.

NOTE 3: See clauses 6.1.3.3.45 and 6.1.3.3.50 for the definitions of the information elements routing method choice and speech services supported, respectively.

NOTE 4: The Call time-out information element indicates the suggested value for T310.

6.1.2.3 ISI-PROGRESS PDU used to give information about the call progress

ISI-PROGRESS message shall only be sent in the case of interworking with a non-TETRA network, i.e. in the case the ISI individual call is forwarded as an external call. In case some requested services are not supported the terminating SwMI may inform the originating SwMI before the ISI-ALERTING or ISI-CONNECT message has been sent about the the modification for some characteristics requested in the set-up that it does not support for the call. The ISI-PROGRESS PDU is forwarded by a possible forward switching SwMI in the call chain towards the originating SwMI. The contents of ISI-PROGRESS PDU and its encoding shall be as defined in table 22.

ISI- PROGRESS message may be sent instead of the ISI- CALL PROCEEDING PDU defined in table 27.

Table 22: Contents of ISI-PROGRESS PDU

| Information element | Length | Type | Owner | C/O/M | Remark |
|-----------------------------|---|------|-------|-------|--------------|
| PDU type | 6 | 1 | CCAp | M | ISI-PROGRESS |
| Call time-out, set-up phase | 3 | 1 | CCAp | M | |
| Hook method selection | 1 | 1 | CCAp | M | |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Call status | 3 | 2 | CCAp | O | |
| Basic service information | 8 | 2 | CCAp | O | (see note) |
| Speech service chosen | 3 | 2 | CCAp | O | (see note) |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |
| NOTE: | Mandatory when it is different from requested and when this information element has not already been sent. Otherwise, this information element shall not be included. | | | | |

6.1.2.4 ISI-REDIRECT PDU sent by the called SwMI when it is not the terminating SwMI because of migration or SS-CF invocation

When no call forwarding supplementary service is invoked for the call, the called SwMI is different from the terminating SwMI only when:

- the called SwMI is the home SwMI of the called user; and
- the called user has migrated.

The called SwMI may be different from the terminating SwMI as a result of the operation of a call forwarding supplementary service invoked for the call.

The called SwMI will then send a ISI-REDIRECT PDU, the contents and the encoding of which shall be as defined in table 23.

Table 23: Contents of ISI-REDIRECT PDU sent by the called SwMI in case it is not the terminating SwMI because of migration of the called user or of SS-CF invocation

| Information element | Length | Type | Owner | C/O/M | Remark |
|---|----------|------|-------|-------|------------------------|
| PDU-Type | 6 | 1 | CCAp | M | ISI-REDIRECT |
| Possible ISI trombone or loop connection detected | 1 | 1 | ANF | M | |
| Routeing method response | 3 | | ANF | C | (see note 1) |
| Called/forwarded-to user having migrated | 1 | | ANF | C | (see note 1) |
| Visited/forwarded-to SwMI MNI | 24 | | ANF | C | (see note 2) |
| Number of digits in visited/forwarded-to SwMI PISN number | 5 | | ANF | C | (see notes 2 and 3) |
| Visited/forwarded-to SwMI PISN number | variable | | ANF | C | (see notes 2, 4 and 5) |
| SS-CF invocation counter | 5 | 1 | SS | M | |
| SS-CF invoked | 1 | 1 | SS | M | (see note 6) |
| Forwarded-to user SSI | 24 | | SS | C | (see note 7) |

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|----------|------|-------|-------|-----------------------|
| Forwarded-to user extension | 24 | | SS | C | (see note 7) |
| Number of digits in forwarded-to external subscriber number | 5 | | SS | C | (see notes 7 and 8) |
| Forwarded-to external subscriber number | variable | | SS | C | (see note 9) |
| Call identified as fleet call | 1 | 1 | CCAp | M | |
| Calling party fleet number SSI | 24 | | CCAp | C | (see note 10) |
| Called/forwarded-to party fleet number SSI | 24 | | CCAp | C | (see note 10) |
| PDU addressed to originating SwMI | 1 | 1 | ANF | M | (see note 11) |
| Cause for PDU addressed to originating SwMI | 3 | | ANF | C | (see note 12) |
| Incoming call barring status | 2 | | ANF | C | (see notes 12 and 13) |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |
| <p>NOTE 1: Present if the value of the information element "Possible ISI trombone or loop connection detected" has value "0".</p> <p>NOTE 2: Present if the value of the information element "called/forwarded-to user having migrated" has value "1" indicating: if no SS-CF is invoked, that the called user (or the SS-CF served user if SS-CF has been invoked previously) has migrated; if SS-CF is invoked, that the forwarded-to user has migrated. Note that in either case, the case where such migration would take place into the originating SwMI will be excluded since in that case the information element "called/forwarded-to user having migrated" shall not be present (see note 1) if ISI trombone connection has been detected.</p> <p>NOTE 3: Shall be equal to N, N being the number of digits which the visited/forwarded-to SwMI PISN number comprises.</p> <p>NOTE 4: The length in bits of this information element shall be equal to $4 \times N$, N being the number of digits in the visited/forwarded-to SwMI PISN number (see note 3).</p> <p>NOTE 5: Present if the value of the information element "Number of digits in forwarded-to external subscriber number" has any other value than value "0". Number of digits in visited/forwarded-to SwMI PISN number information element can be set to value "0" by the sending SwMI and then the PISN number locally available in the "routing table" shall be used in the originating SwMI.</p> <p>NOTE 6: Allows to distinguish between migration of the called user indicated in the corresponding ISI-SETUP PDU and operation of a call forwarding supplementary service invoked in the SwMI sending this ISI-REDIRECT PDU; if SS-CF has been invoked, if the SwMI sending this ISI-REDIRECT PDU is the forwarded-to user and if that user has migrated, this PDU shall contain elements pertaining to both.</p> <p>NOTE 7: Conditional on the value of the information element SS-CF invoked indicating that such SS-CF information is present.</p> <p>NOTE 8: Shall be equal to 0 when no forwarded-to external subscriber number is present, or to N, N being the number of digits which the forwarded-to external subscriber number comprises.</p> <p>NOTE 9: The length in bits of this information element shall be equal to $4 \times N$, N being the number of digits in the forwarded-to external subscriber number (see note 8), i.e. this information element shall be conditional on the value of N.</p> <p>NOTE 10: Conditional on the value of the information element call identified as fleet call indicating that the call has been identified as being a fleet call.</p> <p>NOTE 11: The value of this information element shall correspond to the addressing of this ISI-REDIRECT PDU to the originating SwMI: – in the cases of possible ISI trombone or loop connection with the originating SwMI as provided in note 1 above; or – in the specific cases of SS-CF served user migration in the originating SwMI identified by specific values of the following information element: cause for PDU addressed to originating SwMI.</p> <p>NOTE 12: Conditional on the value of the information element "PDU addressed to originating SwMI" indicating that this ISI-REDIRECT PDU is addressed to the originating SwMI.</p> <p>NOTE 13: Conditional on the binary value of the information element cause for PDU addressed to originating SwMI being smaller than 011₂. It shall then apply to the called user (or if SS-CF has been invoked, to the SS-CF served user) - to take into account the interactions with local SS-BIC and SS-CAD.</p> | | | | | |

6.1.2.5 ISI-FORWARD SWITCH PDU sent by the originating or the forward switching SwMI to request forward switching

After having received the message defined in table 23 (whereby the called SwMI informs the originating/forward switching SwMI that the call is to be re-directed to another SwMI), the nominated SwMI may decide to have the call forward switched in the called SwMI. It will then send a ISI-FORWARD SWITCH PDU, the contents and the encoding of which shall be as defined in table 24.

Table 24: Contents of TETRA PDU possibly sent by the SwMI in response to ISI-REDIRECT PDU

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------|--------|------|-------|-------|--------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-FORWARD SWITCH |
| Proprietary | | 3 | - | O | |

6.1.2.6 ISI-ALERTING PDU sent by by the terminating or the forward switching SwMI to give information about the connected party alerted

The ISI-ALERTING PDU is sent by the terminating SwMI as soon as the U-ALERT is received from the connected party. The ISI-ALERTING PDU is forwarded by a possible forward switching SwMI in the call chain towards the originating SwMI. The contents of this PDU and its encoding shall be as defined in table 25.

Table 25: Contents of ISI-ALERTING PDU

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|--------|------|-------|-------|--------------|
| PDU type | 6 | 1 | CCAp | M | ISI-ALERTING |
| Call time-out, set-up phase | 3 | 1 | CCAp | M | |
| Reserved | 1 | 1 | CCAp | M | (see note 3) |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Call status | 4 | 2 | CCAp | O | (see note 1) |
| Basic service information | 8 | 2 | CCAp | O | (see note 2) |
| Speech service chosen | 3 | 2 | CCAp | O | (see note 2) |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |
| NOTE 1: If present this information element shall take only the values corresponding to call queued or call waiting (the latter corresponding to SS-CW being invoked by the called user). | | | | | |
| NOTE 2: Mandatory when it is different from requested or from that already sent in another TETRA PDU (i.e. in a ISI-CALL PROCEEDING or ISI-PROGRESS PDU). Otherwise, this information element shall not be included. | | | | | |
| NOTE 3: The value of the reserved information element shall be set to "0". | | | | | |

6.1.2.7 ISI-CONNECT PDU sent by by the terminating or the forward switching SwMI to give information that the connected party has answered the call

The ISI-CONNECT PDU is sent by the terminating SwMI as soon as the connected party has answered the call and an attempt is made to get the resources. The ISI-CONNECT PDU is forwarded by a possible forward switching SwMI in the call chain towards the originating SwMI. The contents of this PDU and its encoding shall be as defined in table 26.

Table 26: Contents of TETRA PDU sent in the ISI-CONNECT message

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------------------|--------|------|-------|-------|--------------|
| PDU type | 6 | 1 | CCAp | M | ISI-CONNECT |
| Terminating SwMI MNI | 24 | 1 | ANF | M | |
| Call diverted to a dispatcher | 1 | 1 | ANF | M | |
| Call time-out | 4 | 1 | CCAp | M | |
| Hook method selection | 1 | 1 | CCAp | M | |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Call ownership | 1 | 1 | CCAp | M | (see note 1) |
| Security level at air interface | 2 | 1 | MM | M | |
| Resource indicator | 2 | 1 | CCAp | M | |
| Setup resource allocation | 1 | 1 | CCAp | M | |

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|----------|------|-------|-------|--------------|
| Connected party presentation indicator | 2 | 1 | SS | M | |
| Connected party SSI | 24 | 1 | CCAp | M | (see note 2) |
| Connected party extension | 24 | 1 | CCAp | M | (see note 3) |
| Number of digits in connected external subscriber number | 5 | 1 | CCAp | M | (see note 4) |
| Connected external subscriber number | variable | | CCAp | C | (see note 5) |
| MSISDN present as external subscriber number | 1 | | CCAp | C | (see note 6) |
| Connected external subscriber number parameters | 9 | | CCAp | C | (see note 6) |
| Call identified as fleet call | 1 | 1 | CCAp | M | |
| Connected party fleet number SSI | 24 | | CCAp | C | (see note 7) |
| Call priority | 4 | 2 | CCAp | O | (see note 8) |
| Basic service information | 8 | 2 | CCAp | O | (see note 8) |
| Speech service chosen | 3 | 2 | CCAp | O | (see note 8) |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

NOTE 1: This element is needed in the case of call collision.

NOTE 2: In the case of an external outgoing call, the connected party SSI shall be that of the outgoing gateway SwMI.

NOTE 3: In the case of an external outgoing call, the connected party extension shall be that of the outgoing gateway SwMI.

NOTE 4: Shall be equal to 0 when no connected external subscriber number is available or applicable, or to N, N being the number of digits which the connected external subscriber number comprises.

NOTE 5: The length in bits of this information element shall be equal to $4 \times N$, N being the number of digits in the external subscriber number (see note 5), i.e. this information element shall be conditional on the value of N.

NOTE 6: Conditional on the value of the information element number of digits in connected external subscriber number being different from 0.

NOTE 7: Conditional on the value of the information element call identified as fleet call indicating that the call has been identified as being a fleet call.

NOTE 8: Mandatory when it is different from requested or from that already sent in another TETRA PDU. Otherwise, this information element shall not be included.

NOTE 1: The term "connected party" has been preferred to "called party" in the definition of two information elements in table 26. It anticipates possible interactions with supplementary services which modify the addressee of the call (e.g. supplementary services call forwarding or call authorized by dispatcher). In the absence of such interaction, the connected party will be the called party.

NOTE 2: The Security level at air interface information element value indicates if air interface encryption is being used at the connected party air interface.

NOTE 3: The Call time-out can be different to the value suggested in the ISI-Setup if the terminating SwMI wishes to use a different value to that suggested by the originating SwMI.

NOTE 4: The Resource indicator information element indicates if all resources needed to connect the connected party are available or not.

6.1.2.8 ISI-CALL PROCEEDING sent by the terminating SwMI before the ISI-ALERTING or ISI-CONNECT message

By sending an ISI-CALL PROCEEDING PDU the terminating SwMI may inform the originating SwMI before the ISI-ALERTING or ISI-CONNECT PDU has been sent about the modification for some characteristics requested in the set-up that it does not support. The ISI- CALL PROCEEDING PDU is forwarded by a possible forward switching SwMI in the call chain towards the originating SwMI. The contents and the encoding of ISI- CALL PROCEEDING PDU shall be as defined in table 27.

Such ISI-CALL PROCEEDING PDU may also be sent instead of the ISI-PROGRESS PDU defined in table 22.

Table 27: Contents of ISI-CALL PROCEEDING PDU

| Information element | Length | Type | Owner | C/O/M | Remark |
|-----------------------------|--------|------|-------|-------|---------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-CALL PROCEEDING |
| Call time-out, set-up phase | 3 | 1 | CCAp | M | |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Call status | 3 | 2 | CCAp | O | |
| Basic service information | 8 | 2 | CCAp | O | see note |
| Speech service chosen | 3 | 2 | CCAp | O | see note |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

NOTE: Mandatory when it is different from requested. Otherwise, this information element shall not be included.

NOTE: Except for the value of the PDU type information element and for the absence of the information element hook method selection, this PDU definition is the same as that in table 22.

6.1.2.9 ISI-SETUP PROLONGATION PDU sent to prolong the call setup time

If the originating or terminating SwMI decides to prolong the call set-up time on its side while no other information is to be sent to the other SwMI, it may send a ISI-SETUP PROLONGATION PDU, the contents and the encoding of which shall be as defined in table 28. The ISI-SETUP PROLONGATION PDU is forwarded by a possible forward switching SwMI in the call chain towards the originating/terminating SwMI.

Table 28: Contents of ISI-SETUP PROLONGATION PDU sent to inform about prolongation of the call set-up time

| Information element | Length | Type | Owner | C/O/M | Remark |
|-----------------------------|--------|------|-------|-------|------------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-SETUP PROLONGATION |
| Call time-out, set-up phase | 3 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

6.1.2.10 ISI CONNECT ACKNOWLEDGE PDU sent by the originating SwMI

To acknowledge the ISI-CONNECT PDU (in guaranteeing that resources for the call are available), the originating SwMI will send an ISI-CONNECT ACKNOWLEDGE PDU, the contents and the encoding of which shall be as defined in table 29. The ISI-CONNECT ACKNOWLEDGE PDU is forwarded by a possible forward switching SwMI in the call chain towards the terminating SwMI.

Table 29: Contents of ISI-CONNECT ACKNOWLEDGE PDU sent to acknowledge the ISI-CONNECT PDU

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------------------|--------|------|-------|-------|-------------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-CONNECT ACKNOWLEDGE |
| Call time-out | 4 | 1 | CCAp | M | |
| Transmission grant | 2 | 1 | CCAp | M | |
| Transmission request permission | 1 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

NOTE: The "Call time-out" information element contains the value of T310 to be used in the call.

6.1.2.11 Transmission control PDUs sent by the controlling SwMI

All of these PDUs are forwarded by a possible forward switching SwMI in the call chain towards the terminating SwMI.

To inform the terminating SwMI that permission to transmit has now been granted, queued or not granted to the connected user or granted to the calling user, the controlling SwMI will send an ISI-TX GRANTED PDU the contents and the encoding of which shall be as defined in table 30.

Table 30: Contents of ISI-TX GRANTED PDU sent to grant transmission permission

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------------------|--------|------|-------|-------|----------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-TX GRANTED |
| Transmission grant | 2 | 1 | CCAp | M | |
| Transmission request permission | 1 | 1 | CCAp | M | |
| Encryption control | 1 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

To inform the terminating SwMI that the calling or connected user is interrupted, the controlling SwMI will send an ISI-TX INTERRUPT PDU, the contents and the encoding of which shall be as defined in table 31.

Table 31: Contents of TETRA ISI-TX INTERRUPT sent to interrupt transmission

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------------------|--------|------|-------|-------|------------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-TX INTERRUPT |
| Transmission grant | 2 | 1 | CCAp | M | |
| Transmission request permission | 1 | 1 | CCAp | M | |
| Encryption control | 1 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

To inform the terminating SwMI that transmission has ceased and that the user may request transmission permission, the controlling SwMI will send an ISI-TX CEASED PDU, the contents and the encoding of which shall be as defined in table 32.

Table 32: Contents of ISI-TX CEASED IN ORIGINATING SwMI PDU sent by the controlling SwMI to inform that transmission has ceased

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------------------|--------|------|-------|-------|-----------------------------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-TX CEASED IN ORIGINATING SwMI |
| Transmission request permission | 1 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

To inform the terminating SwMI regarding continuation of transmission (after it has been paused), the controlling SwMI will send an ISI-TX CONTINUE IN ORIGINATING PDU, the contents and the encoding of which shall be as defined in table 33.

Table 33: Contents of ISI-TX CONTINUE IN ORIGINATING SwMI PDU sent by the controlling SwMI on transmission continuation

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------------------|--------|------|-------|-------|-------------------------------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-TX CONTINUE IN ORIGINATING SwMI |
| Continue | 1 | 1 | CCAp | M | |
| Transmission request permission | 1 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

6.1.2.12 ISI-TX WAIT PDU possibly sent by either the controlling or the terminating SwMI

These PDUs are forwarded by a possible forward switching SwMI in the call chain between the controlling and the terminating SwMI and the controlling and the originating SwMI.

To inform the other end SwMI that the SwMI has paused transmission, the controlling or the terminating SwMI will send an ISI-TX WAIT PDU, the contents and the encoding of which shall be as defined in table 34. When the terminating SwMI sends the ISI-TX WAIT PDU, then it shall set the Transmission request permission to value "Allowed to request for transmission" and the controlling SwMI shall ignore its content.

Table 34: Contents of ISI-TX WAIT PDU sent to interrupt transmission

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------------------|--------|------|-------|-------|-------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-TX WAIT |
| Transmission request permission | 1 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

6.1.2.13 ISI-INFO DEMAND and ISI-INFO REPLY PDU possibly sent by either the originating or the terminating SwMI

These PDUs are forwarded by a possible forward switching SwMI in the call chain between the controlling and the terminating SwMI.

To inform the other end SwMI that the SwMI wants some call modification or simply call continuation (both as specified in clause 14.5.1.2 of ETSI EN 300 392-2 [1]) and/or to send DTMF information and/or notifications, the originating or the terminating SwMI will send an ISI-INFO DEMAND PDU, the contents and the encoding of which shall be as defined in table 35.

Table 35: Contents of ISI-INFO DEMAND PDU sent to request some call modification

| Information element | Length | Type | Owner | C/O/M | Remark |
|---|----------|------|-------|-------|---------------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-INFO DEMAND |
| Call time-out | 4 | 2 | CCAp | O | (see note 1) |
| Modify request | 9 | 2 | CCAp | O | |
| Speech service requested/chosen | 3 | 2 | CCAp | O | (see notes 2 and 3) |
| Speech services supported | 8 | 2 | CCAp | O | (see note 4) |
| Notification indicator | 6 | 2 | SS | O | |
| Call status | 4 | 2 | SS | O | (see note 5) |
| DTMF | variable | 3 | CCAp | O | |
| Proprietary | | 3 | - | O | |
| NOTE 1: Shall only be sent if the sending SwMI has decided to change the duration of the call in updating the equivalent information element to the user that it controls (by a D-INFO air interface PDU). | | | | | |
| NOTE 2: Mandatory if the value of the information element modify request corresponds to a change from a data call to a speech call. Also mandatory to change the speech service during a speech call. Otherwise, this information element shall not be included. | | | | | |
| NOTE 3: The meaning of this information element is speech service chosen when this PDU is used instead of ISI-ALERTING PDU (see e.g. SS-CAD). | | | | | |
| NOTE 4: May be present only when the information element speech service requested(/chosen) is present (see note 2). | | | | | |
| NOTE 5: This information element is used by the SS-CFNRY, SS-CAD, SS-CW and SS-HOLD protocols (only with the value corresponding to call queued by the SS-CFNRY protocol, with the value corresponding to call waiting by the SS-CW protocol and with the values corresponding to call put on hold and call on hold retrieved by the SS-HOLD protocol). | | | | | |

When receiving the ISI-INFO DEMAND PDU, the other end SwMI will send a ISI-INFO REPLY PDU, the contents and the encoding of which shall be as defined in table 36.

Table 36: Contents of ISI-INFO REPLY PDU sent in reply to a call modification request

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|--------|------|-------|-------|----------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-INFO REPLY |
| Call time-out | 4 | 2 | CCAp | O | (see note 1) |
| Modify accepted | 9 | 2 | CCAp | O | (see note 2) |
| Speech service chosen | 3 | 2 | CCAp | O | (see note 3) |
| Notification indicator | 6 | 2 | SS | O | |
| DTMF | | 3 | CCAp | O | |
| Proprietary | | 3 | - | O | |
| NOTE 1: Mandatory when it is different from that sent by the other end SwMI in the preceding ISI-INFO DEMAND PDU. Otherwise, this information element shall not be included. | | | | | |
| NOTE 2: Mandatory when it is different from requested. Otherwise, this information element shall not be included. | | | | | |
| NOTE 3: Mandatory when it is different from that sent by the other end SwMI in the preceding ISI-INFO DEMAND PDU. Otherwise, this information element shall not be included. | | | | | |

NOTE: The DTMF information element is used when the DTMF digits in the ISI-INFO DEMAND PDU are not supported or subscribed. The DTMF digits themselves are never returned.

6.1.2.14 Transmission control PDUs sent by the terminating SwMI

All of these PDUs are forwarded by a possible forward switching SwMI in the call chain towards the controlling SwMI.

To request transmission grant from the controlling SwMI, the terminating SwMI will send an ISI-TX DEMAND PDU, the contents and the encoding of which shall be as defined in table 37.

Table 37: Contents of ISI-TX DEMAND PDU sent to request transmission grant

| Information element | Length | Type | Owner | C/O/M | Remark |
|------------------------|--------|------|-------|-------|---------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-TX DEMAND |
| TX demand priority | 2 | 1 | CCAp | M | |
| Encryption control | 1 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

To inform the controlling SwMI that transmission has ceased, the terminating SwMI will send an ISI-TX CEASED IN TERMINATING PDU, the contents and the encoding of which shall be as defined in table 38.

Table 38: Contents of ISI-TX CEASED IN TERMINATING SwMI PDU sent to inform that transmission has ceased

| Information element | Length | Type | Owner | C/O/M | Remark |
|------------------------|--------|------|-------|-------|-----------------------------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-TX CEASED IN TERMINATING SwMI |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

To inform the controlling SwMI that it is ready to continue transmission (after having paused it), the terminating SwMI will send an ISI-TX CONTINUE IN TERMINATING PDU, the contents and the encoding of which shall be as defined in table 39.

Table 39: Contents of ISI-TX CONTINUE IN TERMINATING SwMI PDU sent by the terminating SwMI on transmission continuation

| Information element | Length | Type | Owner | C/O/M | Remark |
|------------------------|--------|------|-------|-------|-------------------------------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-TX CONTINUE IN TERMINATING SwMI |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

6.1.2.15 TETRA PDUs to restore the call after the calling or the connected user has migrated in a new SwMI

6.1.2.15.1 Case where no connection between the old SwMI and the new SwMI already exists or has not been identified

If the connection between the old SwMI and the new SwMI does not already exist or has not been identified, the old SwMI will send a ISI-CALL RESTORE PREPARE PDU, the contents and the encoding of which shall be as defined in table 40.

Table 40: Contents of ISI-CALL RESTORE PREPARE PDU sent by the old SwMI in the case of migration during an established call

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|--------|------|-------|-------|--------------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-CALL RESTORE PREPARE |
| Other end SwMI MNI | 24 | 1 | ANF | M | |
| Call time-out | 4 | 1 | CCAp | M | |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Basic service information | 8 | 1 | CCAp | M | |
| Speech service used | 3 | | CCAp | C | (see note 1) |
| Security level at air interface | 2 | 1 | MM | M | (see notes 2 and 3) |
| Controlling SwMI | 1 | 1 | CCAp | M | |
| Transmission grant | 2 | 1 | CCAp | M | |
| Transmission request permission | 1 | 1 | CCAp | M | |
| Call priority | 4 | 1 | CCAp | M | |
| Call identifier | 14 | 1 | CCAp | M | |
| Restoring party SSI | 24 | 1 | CCAp | M | (see note 4) |
| Restoring party extension | 24 | 1 | CCAp | M | (see note 4) |
| SS-CLIR invoked for other party | 1 | 1 | SS | M | |
| Other party SSI | 24 | 1 | CCAp | M | (see note 5) |
| Other party extension | 24 | 1 | CCAp | M | (see note 5) |
| Speech services supported | 8 | 2 | CCAp | O | (see note 6) |
| Proprietary | | 3 | - | O | |
| NOTE 1: Conditional on the binary value of the information sub-element circuit mode type in the information element basic service information being equal to 0 (i.e. the call requested is a speech call). | | | | | |
| NOTE 2: The Security level information element value indicates if air interface encryption is being used at the air interface in the new SwMI. | | | | | |
| NOTE 3: In the case of an external incoming call from PSTN/ISDN/PISN, the name of this information element should be understood as "security level used in the other network". | | | | | |
| NOTE 4: The case where the restoring party SSI and the restoring party extension would be those of a gateway is excluded. | | | | | |
| NOTE 5: In the case of an external call, the other party SSI and the other party extension shall be those of the gateway. | | | | | |
| NOTE 6: May be present only when the information element speech service requested is present (see note 1). | | | | | |

NOTE: The two information elements defining the restoring party ITSI have been included in the table above because the call identifier value included in this table might not always allow the new SwMI to associate the connection being established to this party when it restores the call (especially since the call identifier value included in this table is not a new SwMI call identifier).

The two information elements defining the other party ITSI have been included to support the associating of the ISI call to the correct U-CALL RESTORE message (see table 78 of ETSI EN 300 392-2 [1]).

To indicate that it accepts the ISI-CALL RESTORE PREPARE PDU, if it has not yet received the call restoration message from the migrating user, the new SwMI will send a ISI-CALL RESTORE PREPARED PDU as defined in table 41.

Table 41: Contents of ISI-CALL RESTORE PREPARED

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------|--------|------|-------|-------|---------------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-CALL RESTORE PREPARED |

When the new SwMI receives the call restoration PDU from the migrating user, it will send a ISI-CALL RESTORATION PDU to the old SwMI and the other end SwMI, the contents and the encoding of which shall be as defined in table 42. The PDU shall be forwarded by the possible forward switching SwMIs in the chain.

Table 42: Contents of ISI-CALL RESTORATION PDU sent by the new SwMI in the case of call restoration

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|--------|------|-------|-------|----------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-CALL RESTORATION |
| New SwMI MNI | 24 | 1 | ANF | M | |
| Controlling SwMI | 1 | 1 | CCAp | M | |
| Transmission grant | 2 | | CCAp | C | (see note 1) |
| Transmission request permission | 1 | | CCAp | C | (see note 1) |
| Call time-out | 4 | 2 | CCAp | O | (see note 2) |
| Call status | 4 | 2 | CCAp | M | (see note 3) |
| Call priority | 4 | 2 | CCAp | O | (see note 2) |
| Modify request | 9 | 2 | CCAp | O | (see note 4) |
| Speech service chosen | 3 | 2 | CCAp | O | (see note 5) |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |
| NOTE 1: This information element shall be included if and only if the value of the information element controlling SwMI is equal to 1 (i.e. if the new SwMI is going to be the controlling SwMI - for the call). | | | | | |
| NOTE 2: Mandatory when the new SwMI has modified the value of this information element compared to that passed by the old SwMI in the corresponding ISI-CALL RESTORE PREPARE PDU or ISI-PATH CALL RESTORE PREPARE PDU. Otherwise, this information element shall not be included. | | | | | |
| NOTE 3: If present this information element shall take only the values corresponding to call queued or call on hold retrieved (the latter being possibly used only by the SS-HOLD protocol). | | | | | |
| NOTE 4: Mandatory when the new SwMI has modified the simplex/duplex selection or the basic service information of the call before the party restoring it migrated (i.e. when the simplex/duplex selection or the basic service information between the old SwMI and the other end SwMI have been modified by the new SwMI - that SwMI being informed about those used previously by the corresponding ISI-CALL RESTORE PREPARE PDU or ISI-PATH CALL RESTORE PREPARE PDU). Otherwise, this information element shall not be included. | | | | | |
| NOTE 5: Mandatory when the new SwMI has modified the value of this information element compared to that of the information element speech service used passed by the old SwMI in the corresponding ISI-CALL RESTORE PREPARE PDU or ISI-PATH CALL RESTORE PREPARE PDU. Otherwise, this information element shall not be included. | | | | | |

6.1.2.15.2 Cases where no new connection is needed between the old SwMI and the new SwMI

There are two possible cases where no new (ISI) connection is needed between the old SwMI and the new SwMI:

- a) the call has been forward switched and the old SwMI has identified that the new SwMI coincides with the forward switching SwMI;
- b) the new SwMI coincides with the other end SwMI (i.e. either the originating or the terminating SwMI). The call restoration could then result in the call becoming an intra-TETRA call.

In case a), the old SwMI may send to the new SwMI on the path of the call a ISI-PATH CALL RESTORE PREPARE PDU, the contents and the encoding of which shall be as defined in table 43.

Table 43: Contents of ISI-PATH CALL RESTORE PREPARE PDU sent by the old SwMI to the forward switching/new SwMI in the case of migration during an established call to avoid a trombone connection at call restoration

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|--------|------|-------|-------|-------------------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-PATH CALL RESTORE PREPARE |
| Other end SwMI MNI | 24 | 1 | ANF | M | |
| Call time-out | 4 | 1 | CCAp | M | |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Basic service information | 8 | 1 | CCAp | M | |
| Speech service used | 3 | | CCAp | C | (see note 1) |
| Security level at air interface | 2 | 1 | MM | M | (see notes 2 and 3) |
| Controlling SwMI | 1 | 1 | CCAp | M | |
| Transmission grant | 2 | 1 | CCAp | M | |
| Transmission request permission | 1 | 1 | CCAp | M | |
| Call priority | 4 | 1 | CCAp | M | |
| Call identifier | 14 | 1 | CCAp | M | |
| Restoring party SSI | 24 | 1 | CCAp | M | (see note 4) |
| Restoring party extension | 24 | 1 | CCAp | M | (see note 4) |
| SS-CLIR invoked for other party | 1 | 1 | SS | M | |
| Other party SSI | 24 | 1 | CCAp | M | (see note 5) |
| Other party extension | 24 | 1 | CCAp | M | (see note 5) |
| Speech services supported | 5 | 2 | CCAp | O | (see note 6) |
| Proprietary | | 3 | - | O | |
| NOTE 1: Conditional on the binary value of the information sub-element circuit mode type in the information element basic service information being equal to 0 (i.e. the call requested is a speech call). | | | | | |
| NOTE 2: The Security level information element value indicates if air interface encryption is being used at the air interface in the new SwMI. | | | | | |
| NOTE 3: In the case of an external incoming call from PSTN/ISDN/PISN, the name of this information element should be understood as "security level used in the other network". | | | | | |
| NOTE 4: The case where the restoring party SSI and the restoring party extension would be those of a gateway is excluded. | | | | | |
| NOTE 5: In the case of an external call, the other party SSI and the other party extension shall be those of the gateway. | | | | | |
| NOTE 6: May be present only when the information element speech service requested is present (see note 1). | | | | | |

NOTE: The ISI-PATH CALL RESTORE PREPARE PDU has been defined (in table 43) as a specific TETRA PDU, even though its contents is the same as that of the ISI-CALL RESTORE PREPARE PDU, defined in table 40, (except of course for the value of its information element PDU type), to allow the SwMI which receives it to identify that it is on the path of the call.

When the forward switching/new SwMI receives the U CALL RESTORE PDU from its new visiting user, it will send to the other end SwMI (i.e. either the originating/controlling or the terminating SwMI) a ISI-CALL RESTORATION PDU defined in table 42.

In case b) when the new SwMI coincides with the originating/controlling or the terminating SwMI, the old SwMI may send to the new SwMI an ISI-END CALL RESTORE PREPARE PDU, the contents and the encoding of which shall be as defined in table 44.

Table 44: Contents of ISI-END CALL RESTORE PREPARE PDU sent by the old SwMI to the other end/new SwMI to avoid a trombone or a loop connection at call restoration

| Information element | Length | Type | Owner | C/O/M | Remark |
|---------------------|--------|------|-------|-------|------------------------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-END CALL RESTORE PREPARE |
| Proprietary | | 3 | - | O | |

6.1.2.16 ISI-DISCONNECT PDU sent by a SwMI in case of call clearing or call rejection

To clear an invoked ANF-ISIIC an ISI-DISCONNECT PDU is sent, the contents and the encoding of which shall be as defined in table 45.

Table 45: Contents of ISI-DISCONNECT PDU sent by a SwMI in case of call clearing or call rejection

| Information element | Length | Type | Owner | C/O/M | Remark |
|------------------------|--------|------|-------|-------|----------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-DISCONNECT |
| Disconnect cause | 6 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

6.1.2.17 TETRA PDUs specific for interaction with supplementary service protocol sent to the originating SwMI

Due to the interaction with SS-CAD supplementary services, it may happen that the call has been established for the calling user MS/LS and the originating SwMI while it is not established for the called user MS/LS nor for the terminating SwMI (e.g. call diverted to the dispatcher). In such a case, the originating SwMI shall receive:

- the ISI-THROUGH ALERTING PDU if the call is alerting on the called side;
- the ISI-THROUGH CONNECT PDU if the called user answers the call.

The contents of ISI-THROUGH ALERTING PDU and its encoding shall be as defined in table 46.

Table 46: Contents of ISI-THROUGH ALERTING PDU sent for informing the originating SwMI that the call is alerting on the called side

| Information element | Length | Type | Owner | C/O/M | Remark |
|---|--------|------|-------|-------|----------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-THROUGH ALERTING |
| Call time-out, set-up phase | 3 | 1 | CCAp | M | |
| Hook method selection | 1 | 1 | CCAp | M | |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Call status | 4 | 2 | CCAp | M | (see note 1) |
| Basic service information | 8 | 2 | CCAp | O | (see note 2) |
| Speech service chosen | 3 | 2 | CCAp | O | (see note 2) |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |
| NOTE 1: If present this information element shall take only the values corresponding to call queued or call waiting (the latter corresponding to SS-CW being invoked by the called user). | | | | | |
| NOTE 2: Mandatory when it is different from requested or from that already sent in another TETRA PDU. Otherwise, this information element shall not be included. | | | | | |

NOTE: See notes in clause 6.1.2.6.

The contents of ISI-THROUGH CONNECT PDU and its encoding shall be as defined in table 47.

Table 47: Contents of ISI-THROUGH CONNECT PDU sent for informing the originating SwMI that the call is answered

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|----------|------|-------|-------|---------------------|
| PDU type | 6 | 1 | CCAp | M | ISI-THROUGH CONNECT |
| Terminating SwMI MNI | 24 | 1 | ANF | M | |
| Call diverted to a dispatcher | 1 | 1 | ANF | M | |
| Call time-out | 4 | 1 | CCAp | M | |
| Hook method selection | 1 | 1 | CCAp | M | |
| Simplex/duplex selection | 1 | 1 | CCAp | M | |
| Connected party presentation indicator | 2 | 1 | SS | M | |
| Connected party SSI | 24 | 1 | CCAp | M | (see note 1) |
| Connected party extension | 24 | 1 | CCAp | M | (see note 2) |
| Number of digits in connected external subscriber number | 5 | 1 | CCAp | M | (see note 3) |
| Connected external subscriber number | variable | | CCAp | C | (see note 4) |
| MSISDN present as external subscriber number | 1 | | CCAp | C | (see note 5) |
| Connected external subscriber number parameters | 9 | | CCAp | C | (see note 5) |
| Call identified as fleet call | 1 | 1 | CCAp | M | |
| Connected party fleet number SSI | 24 | | CCAp | C | (see note 6) |
| Call priority | 4 | 2 | CCAp | O | (see note 7) |
| Basic service information | 8 | 2 | CCAp | O | (see note 7) |
| Speech service chosen | 3 | 2 | CCAp | O | (see note 7) |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |
| NOTE 1: In the case of an external outgoing call, the connected party SSI shall be that of the outgoing gateway SwMI. | | | | | |
| NOTE 2: In the case of an external outgoing call, the connected party extension shall be that of the outgoing gateway SwMI. | | | | | |
| NOTE 3: Shall be equal to 0 when no connected external subscriber number is available or applicable, or to N, N being the number of digits which the connected external subscriber number comprises. | | | | | |
| NOTE 4: The length in bits of this information element shall be equal to 4 x N, N being the number of digits in the external subscriber number (see note 3), i.e. this information element shall be conditional on the value of N. | | | | | |
| NOTE 5: Conditional on the value of the information element number of digits in connected external subscriber number being different from 0. | | | | | |
| NOTE 6: Conditional on the value of the information element call identified as fleet call indicating that the call has been identified as being a fleet call. | | | | | |
| NOTE 7: Mandatory when it is different from requested or from that already sent in another TETRA PDU. Otherwise, this information element shall not be included. | | | | | |

NOTE: See note 2 in clause 6.1.2.7.

6.1.2.18 ISI-QUEUING PDUs sent towards the terminating SwMI

The ISI-QUEUING PDU can be sent by the originating SwMI, through the call chain, towards the SwMI of the connected party, in response to:

- an ISI-CONNECT PDU; or
- an ISI-RESOURCE-RESPONSE PDU that indicated "resources are reserved";

when an ISI-CONNECT-ACKNOWLEDGE PDU cannot be sent due to queueing of resource allocation in the call.

The ISI-QUEUING PDU can be sent by a forward switching SwMI, through the call chain towards the SwMI of the connected party, in response to:

- an ISI-RESOURCE-RESPONSE PDU that indicated "resources are reserved";

when the forward switching SwMI does not have resources for the call.

Table 48: Contents of the ISI-QUEUING PDU sent to indicate that the call is queueing for resources

| Information element | Length | Type | Owner | C/O/M | Remark |
|--|--------|------|-------|-------|-------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-QUEUING |
| Resource release permission | 1 | 1 | CCAp | M | |
| Resource release signalling support | 1 | 2 | CCAp | O | (see note) |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |
| NOTE: This information element shall only be present in the PDU when an ISI-QUEUING PDU is sent in response to an ISI-CONNECT PDU, otherwise it shall not be included. | | | | | |

6.1.2.19 ISI-RESOURCE PDU sent towards the Terminating SwMI

ISI-RESOURCE PDU is used to check the reservation status of the resources in other SwMIs and it shall be encoded as presented in table 49. It is sent towards the forward switching / terminating SwMI if the nominated SwMI has received information that there is at least one SwMI in the chain supporting temporary resource allocation. It requests that, should resources not be available already, they are made available. The usual response to this PDU is either an ISI-RESOURCE-RESPONSE indicating that "resources could not be reserved, delay requested" followed by another ISI-RESOURCE-RESPONSE when they are available, or a single response indicating that "resources are reserved".

Table 49: Contents of the ISI-RESOURCE PDU sent to request radio traffic channel resource allocation status

| Information element | Length | Type | Owner | C/O/M | Remark |
|------------------------|--------|------|-------|-------|--------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-RESOURCE |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

6.1.2.20 ISI-RESOURCE RESPONSE PDUs sent towards the Called or Originating SwMI after the call has connected

The ISI-RESOURCE-RESPONSE PDU is sent after an ISI-CONNECT PDU has been sent that indicated "resources could not be reserved, delay requested" and the radio traffic channel resources become available. It is also sent in response to an ISI-RESOURCE PDU. In this case the usual response is either a single ISI-RESOURCE-RESPONSE PDU sent indicating that "resources are reserved", or, if radio traffic channel resources are not immediately available, then an immediate response indicating that "resources could not be reserved, delay requested" followed by another response when the radio traffic channel resources are available. The ISI-RESOURCE-RESPONSE PDU shall be encoded as presented in table 50.

Table 50: Contents of the ISI-RESOURCE-RESPONSE PDU sent to indicate radio traffic channel resource allocation status

| Information element | Length | Type | Owner | C/O/M | Remark |
|------------------------|--------|------|-------|-------|-----------------------|
| PDU Type | 6 | 1 | CCAp | M | ISI-RESOURCE-RESPONSE |
| Resource indicator | 2 | 1 | CCAp | M | |
| Notification indicator | 6 | 2 | SS | O | |
| Proprietary | | 3 | - | O | |

6.1.3 TETRA PDU information element coding

6.1.3.1 Introduction

Of the information elements included in the TETRA PDU definitions in clause 6.1.1:

- a number are identical to those defined for air interface messages (same names and definitions). Their definitions have not been reproduced in the present document - see clause 14.8 of ETSI EN 300 392-2 [1] for those definitions;

- some have the same names as those defined for air interface messages but with different definitions, i.e. ISI specific. Their definitions are given in clause 6.1.2.2; and
- the others are new. Their definitions are given in clause 6.1.2.3.

NOTE: A given PDU information element already defined for the air interface may or may not take all its possible values when used in ISI TETRA PDUs.

6.1.3.2 Specific ISI definition of some information elements already defined for air interface messages

6.1.3.2.1 Basic service information

This information element shall be coded as defined in table 90 of ETSI EN 300 392-2 [1]. However when the value of its information sub-element circuit mode type corresponds to speech, the value of its other information sub-element speech service shall be ignored (see clause 6.1.3.3.47).

6.1.3.2.2 Call status

The call status information element shall inform the other end SwMI about the status of the call as defined in table 51.

Table 51: Call status information element contents

| Information element | Length | Value | Remark |
|--|--------|---------------------|--|
| Call status | 4 | 0000 ₂ | Call is proceeding (see note) |
| | | 0001 ₂ | Call is queued (see note) |
| | | 0010 ₂ | Requested subscriber is paged (see note) |
| | | 0011 ₂ | Call continue (see note) |
| | | 0100 ₂ | Hang time expired (see note) |
| | | 0101 ₂ | Reserved (see note) |
| | | 0110 ₂ | Reserved (see note) |
| | | 0111 ₂ | Reserved (see note) |
| | | 1000 ₂ | Call waiting |
| | | 1001 ₂ | Call put on hold |
| | | 1010 ₂ | Call on hold retrieved |
| | | > 1010 ₂ | Reserved |
| NOTE: All values 0XXX ₂ shall be as defined in table 101 of ETSI EN 300 392-2 [1] for the same values (XXX ₂). The definitions given in the present table for those values are a copy of that table, to be considered for information only. | | | |

6.1.3.2.3 Call time-out, set-up phase

This information element is used to inform the other end SwMI about the call time-out in the set-up phase decided by the SwMI which is sending this information.

NOTE 1: The other end SwMI may then decide or not to update the relevant timer in the MS/LS involved in the call attempt.

NOTE 2: While the value of the information element call time-out, set-up phase, sent by the terminating SwMI can be used directly by the originating SwMI to "start" (the meaning of "start" being as defined in clause 14.5 of ETSI EN 300 392-2 [1]) timer T302 with this value, this is not the case for the terminating SwMI with timer T301. How the terminating SwMI handles this information element when it receives it is an implementation matter.

Regarding the coding of this information element, it shall be as defined in table 105 of ETSI EN 300 392-2 [1], except that no predefined value shall be used (i.e. the value 000₂ shall be reserved). The resulting coding is defined in table 52.

Table 52: Call time-out, set-up phase information element contents

| Information element | Length | Value | Remark |
|-----------------------------|--------|------------------|----------|
| Call time-out, set-up phase | 3 | 000 ₂ | Reserved |
| | | 001 ₂ | 1 s |
| | | 010 ₂ | 2 s |
| | | 011 ₂ | 5 s |
| | | 100 ₂ | 10 s |
| | | 101 ₂ | 20 s |
| | | 110 ₂ | 30 s |
| | | 111 ₂ | 60 s |

6.1.3.2.4 Disconnect cause information element

The purpose of the information element disconnect cause is to inform the SwMI to which the ISI-DISCONNECT carrying this information element is sent, of the reason for that clearing. This information element shall be coded as defined in table 53.

Table 53: Disconnect cause information element contents

| Information element | Length | Value | Remark |
|---------------------|---|---------------------|---|
| Disconnect cause | 6 | | Air interface specific disconnect causes |
| | | 000000 ₂ | Refer to ETSI EN 300 392-2 [1], clause 14.8 (see note) |
| | | etc. | etc. |
| | | 011111 ₂ | Refer to ETSI EN 300 392-2 [1], clause 14.8 (see note) |
| | | | ISI specific disconnect causes |
| | | 100000 ₂ | Call rejected by the terminating/called SwMI: cause unspecified |
| | | 100001 ₂ | Call rejected by the terminating/called SwMI because the security level at calling user air interface cannot be matched |
| | | 100010 ₂ | Call re-routed |
| | | 100011 ₂ | No possible routing of the call |
| | | 100100 ₂ | Call restored |
| | | 100101 ₂ | ANF-ISIIC call restoration procedure not supported in new SwMI |
| | | 100110 ₂ | Call rejected by the originating SwMI: cause unspecified |
| | | 100111 ₂ | Reserved for ANF-ISIIC |
| | | etc. | etc. |
| | | 101111 ₂ | Reserved for ANF-ISIIC |
| | | 110000 ₂ | Reserved for ANF-ISIGC, see ETSI TS 100 392-3-13 [5], clause 6.3.2.1.3 |
| | | etc. | etc. |
| | | 111110 ₂ | Reserved for ANF-ISIGC, see ETSI TS 100 392-3-13 [5], clause 6.3.2.1.3 |
| | | 111111 ₂ | Reserved |
| NOTE: | All values 0XXXXX ₂ shall be as defined in table 106 of ETSI EN 300 392-2 [1] for the same values (XXXXX ₂). | | |

NOTE: 6 bits are used for encoding the disconnect cause information element. This is one more bit than what is used at the air interface for the disconnect cause information element. The binary values 000000₂ to 011111₂ have remained unchanged while the values from 100000₂ to 111110₂ will be used as ISI specific definitions.

6.1.3.2.5 PDU type

The purpose of the information element PDU type is to clearly identify the type of TETRA PDU sent over the ISI. This information element shall be coded as defined in table 54.

NOTE: A PDU type value has been defined for every possible TETRA PDU.

Table 54: PDU type information element contents

| Information element | Length | Value | Remark |
|----------------------|--------------------------------------|---------------------|--|
| PDU Type | 6 | 000000 ₂ | ISI-ALERTING (see table 25) |
| | | 000001 ₂ | ISI-CALL PROCEEDING (see table 27) |
| | | 000010 ₂ | ISI-CALL RESTORE PREPARE (see table 40) |
| | | 000011 ₂ | ISI-CALL RESTORE PREPARED (see table 41) |
| | | 000100 ₂ | ISI-CALL-RESTORATION (see table 42) |
| | | 000101 ₂ | ISI-CONNECT (see table 26) |
| | | 000110 ₂ | ISI-CONNECT ACKNOWLEDGE (see table 29) |
| | | 000111 ₂ | ISI-DISCONNECT (see table 45) |
| | | 001000 ₂ | ISI-END CALL RESTORE PREPARE (see table 44) |
| | | 001001 ₂ | ISI-FORWARD SWITCH (see table 24) |
| | | 001010 ₂ | ISI-INFO DEMAND (see table 35) |
| | | 001011 ₂ | ISI-INFO REPLY (see table 36) |
| | | 001100 ₂ | ISI-PATH CALL RESTORE PREPARE (see table 43) |
| | | 001101 ₂ | ISI-PROGRESS (see table 22) |
| | | 001110 ₂ | ISI-REDIRECT (see table 23) |
| | | 001111 ₂ | Reserved |
| | | 010000 ₂ | ISI-SETUP (see table 21) |
| | | 010001 ₂ | ISI-SETUP PROLONGATION (see table 28) |
| | | 010011 ₂ | ISI-THROUGH ALERTING (see table 46) |
| | | 010100 ₂ | ISI-THROUGH CONNECT (see table 47) |
| | | 010101 ₂ | ISI-TX CEASED IN ORIGINATING SwMI (see table 32) |
| | | 010110 ₂ | ISI-TX CONTINUE IN ORIGINATING SwMI (see table 33) |
| | | 010111 ₂ | ISI-TX DEMAND (see table 37) |
| | | 011000 ₂ | ISI-TX GRANTED (see table 30) |
| | | 011001 ₂ | ISI-TX INTERRUPT (see table 31) |
| | | 011010 ₂ | ISI-TX WAIT (see table 34) |
| | | 011011 ₂ | ISI-QUEUING (see table 48) |
| | | 011100 ₂ | ISI-RESOURCE (see table 49) |
| | | 011101 ₂ | ISI-TX CEASED IN TERMINATING SwMI (see table 38) |
| | | 011110 ₂ | ISI-TX CONTINUE IN TERMINATING SwMI (see table 39) |
| 011111 ₂ | ISI-RESOURCE-RESPONSE (see table 50) | | |
| >011111 ₂ | Reserved | | |

6.1.3.3 New information elements used at the ISI

6.1.3.3.1 Call diverted to a dispatcher

This information element shall indicate whether or not the call has been diverted to a dispatcher (as a result of the invocation of SS-CAD). It shall be coded as defined in table 55.

Table 55: Call diverted to a dispatcher information element content

| Information element | Length | Value | Remark |
|-------------------------------|--------|-------|-----------------------------------|
| Call diverted to a dispatcher | 1 | 0 | Call not diverted to a dispatcher |
| | | 1 | Call diverted to a dispatcher |

6.1.3.3.2 Call has been forward switched

This information element shall indicate whether or not the call has already been routed by forward switching (e.g. the called user home SwMI is the called SwMI and the path of the call transits through that SwMI). It shall be coded as defined in table 56.

Table 56: Call has been forward switched information element content

| Information element | Length | Value | Remark |
|--------------------------------|--------|-------|---|
| Call has been forward switched | 1 | 0 | The call has not been forward switched previously |
| | | 1 | The call has been forward switched |

6.1.3.3.3 Call identified as fleet call

This information element shall indicate whether or not the call has been identified as a fleet call (such identification being made by the called user home SwMI). It shall be coded as defined in table 57. Refer to ETSI TR 102 300-5 [i.5], clause 5.4.3 for fleet specific short numbers.

Table 57: Call identified as fleet call information element contents

| Information element | Length | Value | Remark |
|-------------------------------|--------|-------|--|
| Call identified as fleet call | 1 | 0 | The call has not been identified as a fleet call |
| | | 1 | The call has been identified as a fleet call |

6.1.3.3.4 Called/forwarded-to external subscriber number

This information element shall be coded as defined in clause 14.8.20 of ETSI EN 300 392-2 [1] for the air interface information element external subscriber number, except that its length in bits shall be equal to $4 \times N$, N being the value of the associated information element: number of digits in called/forwarded-to external subscriber number.

6.1.3.3.5 Called/forwarded-to party extension

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.6 Called/forwarded-to party SSI

This information element shall be coded as defined in table 96 of ETSI EN 300 392-2 [1] for the air interface information element called party SSI.

6.1.3.3.7 Called/forwarded-to party fleet number SSI

This information element shall be coded as defined in table 96 of ETSI EN 300 392-2 [1] for the air interface information element called party SSI.

6.1.3.3.8 Called/forwarded-to user having migrated

This information element shall indicate whether or not the called or the forwarded-to user, whichever applies in the case considered, has migrated. It shall be coded as defined in table 58.

Table 58: Called/forwarded-to user having migrated information element content

| Information element | Length | Value | Remark |
|--|--------|-------|---|
| Called/forwarded-to user having migrated | 1 | 0 | The called/forwarded-to user has not migrated |
| | | 1 | The called/forwarded-to user has migrated |

6.1.3.3.9 Calling external subscriber number

This information element shall be coded as defined in clause 14.8.20 of ETSI EN 300 392-2 [1] for the air interface information element external subscriber number, except that its length in bits shall be equal to $4 \times N$, N being the value of the associated information element: number of digits in calling external subscriber number.

6.1.3.3.10 Calling external subscriber number parameters

The meaning and the coding of this information element shall be as defined in table 21 of ETSI EN 300 392-9 [7] for the supplementary information element external subscriber number parameters.

6.1.3.3.11 Calling party fleet number SSI

This information element shall be coded as defined in table 96 of ETSI EN 300 392-2 [1] for the air interface information element called party SSI.

6.1.3.3.12 Calling party presentation indicator

This information element shall indicate whether or not the calling party identity can or may be presented to the called party through the supplementary services Calling Line Identification Presentation (SS-CLIP) or Talking Party Identification (SS-TPI). It shall be coded as defined in table 59.

Table 59: Calling party presentation indicator information element contents

| Information element | Length | Value | Remark |
|--------------------------------------|--------|-----------------|--|
| Calling party presentation indicator | 2 | 00 ₂ | Presentation allowed |
| | | 01 ₂ | Presentation restricted |
| | | 10 ₂ | Number not available due to interworking |
| | | 11 ₂ | Reserved |

6.1.3.3.13 Cause for PDU addressed to originating SwMI

This information element shall indicate the reason why the ISI-REDIRECT PDU is specifically addressed to the originating SwMI. Those reasons are presented in table 60, together with the definition of the corresponding coding.

Table 60: Cause for PDU addressed to originating SwMI information element contents

| Information element | Length | Value | Remark |
|---|--------|------------------|---|
| Cause for PDU addressed to originating SwMI | 3 | 000 ₂ | No SS-CF invoked, called user migration in originating SwMI |
| | | 001 ₂ | Called user barred, having migrated in originating SwMI, SS-CFU invoked |
| | | 010 ₂ | Called user barred, having migrated in originating SwMI, SS-CFNR _C invoked |
| | | 011 ₂ | Reserved |
| | | 100 ₂ | Reserved |
| | | 101 ₂ | Reserved |
| | | 110 ₂ | Reserved |
| | | 111 ₂ | SS-CF invoked, SS-CF served user not barred, forwarded-to user not barred and having migrated in originating SwMI |

6.1.3.3.14 Connected external subscriber number

This information element shall be coded as defined in clause 14.8.20 of ETSI EN 300 392-2 [1] for the air interface information element external subscriber number, except that its length in bits shall be equal to 4 x N, N being the value of the associated information element: number of digits in connected external subscriber number.

6.1.3.3.15 Connected external subscriber number parameters

The meaning and the coding of this information element shall be as defined in table 21 of ETSI EN 300 392-9 [7] for the supplementary information element external subscriber number parameters.

6.1.3.3.16 Connected party presentation indicator

This information element shall indicate whether or not the connected party identity can or may be presented to the calling party through the Supplementary Services Connected Line Identification Presentation (SS-COLP) or Talking Party Identification (SS-TPI). It shall be coded as defined in table 27 of ISO/IEC 11572 [9] for the presentation indicator.

The corresponding definition of the connected party presentation indicator information element is reproduced in table 61.

Table 61: Connected party presentation indicator information element contents

| Information element | Length | Value | Remark |
|--|--------|-----------------|--|
| Connected party presentation indicator | 2 | 00 ₂ | Presentation allowed |
| | | 01 ₂ | Presentation restricted |
| | | 10 ₂ | Number not available due to interworking |
| | | 11 ₂ | Reserved |

6.1.3.3.17 Connected party extension

The coding of this information element shall be the same as in table 95 of ETSI EN 300 392-2 [1].

6.1.3.3.18 Connected party SSI

This information element shall be coded as defined in table 96 of ETSI EN 300 392-2 [1] for the air interface information element called party SSI.

6.1.3.3.19 Connected party fleet number SSI

This information element shall be coded as defined in table 96 of ETSI EN 300 392-2 [1] for the air interface information element called party SSI.

6.1.3.3.20 Controlling SwMI

This information element shall indicate to a new SwMI involved in the call (e.g. in case of call restoration) whether or not it is going to be the controlling SwMI for that call (which shall be the case when the user registered in this new SwMI was the calling user). It shall be coded as defined in table 62.

Table 62: Controlling SwMI information element content

| Information element | Length | Value | Remark |
|---------------------|--------|-------|--|
| Controlling SwMI | 1 | 0 | The other end SwMI is the controlling SwMI |
| | | 1 | The new SwMI shall be the controlling SwMI |

6.1.3.3.21 Incoming call barring status

This information element shall be used to inform the ANF-ISIIC entity in the terminating SwMI about the result of SS-BIC barring or SS-CAD authorization of the incoming call. When barred by SS-BIC the incoming call shall then be rejected by the ANF-ISIIC entity in the terminating SwMI unless the call is an intra-TETRA call and a local SS-BIC applies. This information element shall be coded as defined in table 63.

Table 63: Incoming call barring status information element contents

| Information element | Length | Value | Remark |
|------------------------------|--------|-----------------|-------------------------------------|
| Incoming call barring status | 2 | 00 ₂ | Neither SS-BIC nor SS-CAD activated |
| | | 01 ₂ | Call authorized by SS-CAD |
| | | 10 ₂ | Call barred by SS-BIC |
| | | 11 ₂ | Call authorized by SS-BIC |

6.1.3.3.22 Forwarded-to external subscriber number

This information element shall be coded as defined in clause 14.8.20 of ETSI EN 300 392-2 [1] for the air interface information element external subscriber number, except that its length in bits shall be equal to $4 \times N$, N being the value of the associated information element: number of digits in forwarded-to external subscriber number.

6.1.3.3.23 Forwarded-to user extension

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.24 Forwarded-to user SSI

This information element shall be coded as defined in table 96 of ETSI EN 300 392-2 [1] for the air interface information element called party SSI.

6.1.3.3.25 Last Forwarding SwMI MNI

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.26 Modify accepted

This information element shall indicate the modification in the simplex/duplex selection or/and the basic service decided by the controlling SwMI when different from that requested. It shall be coded as defined in table 112 of ETSI EN 300 392-2 [1] for the air interface information element modify.

6.1.3.3.27 Modify request

This information element shall indicate the modification in the simplex/duplex selection or/and the basic service requested to the controlling SwMI. It shall be coded as defined in table 112 of ETSI EN 300 392-2 [1] for the air interface information element modify.

6.1.3.3.28 MSISDN present as external subscriber number

This information element shall indicate whether or not the related information element external subscriber number corresponds to an MSISDN. It shall be coded as defined in table 64.

Table 64: MSISDN present as external subscriber number information element content

| Information element | Length | Value | Remark |
|--|--------|-------|---|
| MSISDN present as external subscriber number | 1 | 0 | The related information element external subscriber number does not correspond to an MSISDN |
| | | 1 | The related information element external subscriber number corresponds to an MSISDN |

6.1.3.3.29 New SwMI MNI

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.30 Number of digits in called/forwarded-to external subscriber number

This information element shall be coded as defined in table 65.

Table 65: Number of digits in called/forwarded-to external subscriber number length information element content

| Information element | Length | Value | Remark |
|---|--------|----------------------|--------------|
| Number of digits in called/forwarded-to external subscriber number | 5 | 00000 ₂ | (see note 1) |
| | | > 00000 ₂ | (see note 2) |
| NOTE 1: The presence of the information element called/forwarded-to external subscriber number in TETRA PDUs after this information element shall be conditional on the value of this information element being different from 0. | | | |
| NOTE 2: The number of digits in the related information element called/forwarded-to external subscriber number shall be equal to N, the decimal number corresponding to the binary value XXXXX ₂ . | | | |

NOTE: Actually, the number of digits in called/forwarded-to external subscriber number is not an information element per se, but it is needed according to the PDU encoding rules defined in annex E of ETSI EN 300 392-2 [1], for encoding the related information element called/forwarded-to external subscriber number (the length of which is variable) as "a type 1 element".

6.1.3.3.31 Number of digits in calling external subscriber number

This information element shall be coded as defined in clause 6.1.3.3.30 for the information element number of digits in called/forwarded-to external subscriber number. The related information element shall then be the information element calling external subscriber number instead of the information element called/forwarded-to external subscriber number.

6.1.3.3.32 Number of digits in connected external subscriber number

This information element shall be coded as defined in clause 6.1.3.3.30 for the information element number of digits in called/forwarded-to external subscriber number. The related information element shall then be the information element connected external subscriber number instead of the information element called/forwarded-to external subscriber number.

6.1.3.3.33 Number of digits in forwarded-to external subscriber number

This information element shall be coded as defined in clause 6.1.3.3.30 for the information element number of digits in called/forwarded-to external subscriber number. The related information element shall then be the information element forwarded-to external subscriber number instead of the information element called/forwarded-to external subscriber number.

6.1.3.3.34 Number of digits in visited/forwarded-to SwMI PISN number

This information element shall be coded as defined in clause 6.1.3.3.30 for the information element number of digits in called/forwarded-to external subscriber number. The related information element shall then be the information element visited/forwarded-to SwMI PISN number instead of the information element called/forwarded-to external subscriber number.

6.1.3.3.35 Originating SwMI MNI

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.36 Other end SwMI MNI

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.37 Override SS-CAD invocation

This information element, used only in the ISI-SETUP PDU, shall indicate whether or not that call may bypass the invocation of SS-CAD. It shall be coded as defined in table 66.

Table 66: Override SS-CAD invocation information element content

| Information element | Length | Value | Remark |
|--|--------|-------|------------------------------------|
| Override SS-CAD invocation | 1 | 0 | No overriding of SS-CAD invocation |
| | | 1 | Overriding of SS-CAD invocation |
| NOTE 1: If a SwMI does not support SS-CAD, or has not applied SS-CAD, then "No overriding of SS-CAD invocation" is used. | | | |
| NOTE 2: If SS-CAD has already been performed in the calling SwMI then "Overriding of SS-CAD invocation" is used. | | | |

6.1.3.3.38 PDU addressed to originating SwMI

This information element shall indicate whether or not the PDU in which this information element is present is addressed to the originating SwMI. It shall be coded as defined in table 67.

Table 67: PDU addressed to originating SwMI information element content

| Information element | Length | Value | Remark |
|-----------------------------------|--------|-------|--|
| PDU addressed to originating SwMI | 1 | 0 | The PDU is not addressed to the originating SwMI |
| | | 1 | The PDU is addressed to the originating SwMI |

6.1.3.3.39 Possible ISI trombone or loop connection detected

This information element shall indicate whether or not the SwMI sending the PDU in which this information element is present has identified that if it routed the call by forward switching, it would result in an ISI trombone or loop connection. This information element shall be coded as defined in table 68.

Table 68: Possible ISI trombone or loop connection detected information element content

| Information element | Length | Value | Remark |
|---|--------|-------|---|
| Possible ISI trombone or loop connection detected | 1 | 0 | No possible ISI trombone or loop connection resulting from forward switching detected |
| | | 1 | Possible ISI trombone or loop connection resulting from forward switching detected |

6.1.3.3.40 Restoring party extension

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.41 Restoring party SSI

This information element shall be coded as defined in table 96 of ETSI EN 300 392-2 [1] for the air interface information element called party SSI.

6.1.3.3.42 Resource release permission

The Resource release permission information element shall be encoded as presented in table 69.

Table 69: Radio traffic channel release permission information element content

| Information element | Length | Value | Remark |
|-----------------------------|--------|-------|----------------------------------|
| Resource release permission | 1 | 0 | Allowed to release resources |
| | | 1 | Not allowed to release resources |

6.1.3.3.43 Resource release signalling support

The Resource release signalling support information element shall be encoded as presented in table 70.

Table 70: Radio traffic channel release signalling support information element content

| Information element | Length | Value | Remark |
|--|--------|-------|---|
| Resource release signalling support | 1 | 0 | Resource release signalling supported |
| | | 1 | Resource release signalling not supported |
| NOTE: Used in an ISI-QUEUING PDU. It indicates if the SwMI is able to support the use of the ISI-RESOURCE PDU. | | | |

6.1.3.3.44 Resource indicator

The resource indicator information element shall be encoded as presented in table 71.

Table 71: Resource indicator information element content

| Information element | Length | Value | Remark |
|---------------------|--------|-----------------|--|
| Resource indicator | 2 | 00 ₂ | Resources are reserved |
| | | 01 ₂ | Resources could not be reserved |
| | | 10 ₂ | Resources could not be reserved, delay requested |
| | | 11 ₂ | Reserved |

6.1.3.3.45 Routing method choice

This information element shall be coded as defined in table 72.

Table 72: Routing method choice information element contents

| Information element | Length | Value | Remark |
|-----------------------|--------|--------------------|--|
| Routing method choice | 3 | 000 ₂ | Re-routeing not supported |
| | | 001 ₂ | Re-routeing supported, forward switching preferred |
| | | 010 ₂ | Re-routeing supported, the called SwMI may choose between forward switching and re-routeing |
| | | 011 ₂ | Rerouting supported, possible choice between forward switching and rerouting to be made by the SwMI sending this SETUP PDU |
| | | > 011 ₂ | Reserved |

6.1.3.3.46 Routing method response

This information element shall be coded as defined in table 73.

Table 73: Routing method response information element contents

| Information element | Length | Value | Remark |
|--|--------|--------------------|--|
| Routing method response | 3 | 000 ₂ | Forward switching not supported |
| | | 001 ₂ | Forward switching supported |
| | | 010 ₂ | Select re-routeing |
| | | 011 ₂ | Congestion in the SwMI sending this ISI-REDIRECT PDU |
| | | 100 ₂ | No N x 8 kbit/s link with next SwMI (see note) |
| | | > 100 ₂ | Reserved |
| NOTE: Corresponds to the case where the ANF-ISIIC information transfer rate is equal to N x 8 kbit/s and where the call cannot be forwarded switched because that information transfer rate is not be available on the second leg of the call. | | | |

6.1.3.3.47 Security level at air interface

The Security level at air interface information element shall be encoded as presented in table 74.

NOTE: The TETRA air interface security level is defined in ETSI EN 300 392-7 [i.1], clause 6.2.

Table 74: Security level at calling user air interface information element contents

| Information element | Length | Value | Remark |
|---------------------------------|--------|-----------------|--------------------------------------|
| Security level at air interface | 2 | 00 ₂ | No air interface encryption required |
| | | 01 ₂ | Air interface encryption required 1 |
| | | 10 ₂ | Air interface encryption required 2 |
| | | 11 ₂ | Reserved |

6.1.3.3.48 Setup resource allocation

The Setup resource allocation information element shall be encoded as presented in table 75.

Table 75: Setup resource allocation information element content

| Information element | Length | Value | Remark |
|---------------------------|--------|-------|---------------------------------------|
| Setup resource allocation | 1 | 0 | Setup permanently allocated resources |
| | | 1 | Setup temporary allocated resources |

6.1.3.3.49 Speech service requested/chosen/used

This information element shall be coded as defined in table 76.

Table 76: Speech service requested/chosen/used information element contents

| Information element | Length | Value | Remark |
|--------------------------------------|--------|--------------------|--|
| Speech service requested/chosen/used | 3 | 000 ₂ | CODEC defined in ETSI EN 300 395-2 [i.3] |
| | | > 000 ₂ | Reserved |

6.1.3.3.50 Speech services supported

This information element is a bit-map field indicating which CODEC are supported. The meaning of each bit setting in this information element shall be as defined in table 77.

Table 77: Speech services supported information element contents

| Information element | Length | Value | Remark |
|---------------------------|--------|-------------------------|--|
| Speech services supported | 8 | 00000000 ₂ | Reserved |
| | | 00000001 ₂ | CODEC defined in ETSI EN 300 395-2 [i.3] supported |
| | | > 00000001 ₂ | Reserved |

6.1.3.3.51 SS-CF invocation counter

The meaning and the coding of this information element shall be as defined in clause 5.2.2.21 of ETSI EN 300 392-12-4 [8].

6.1.3.3.52 SS-CF invoked

This information element shall indicate whether or not SS-CF invoked has been invoked the SwMI sending the PDU in which this information element is present. It shall be coded as defined in table 78.

Table 78: SS-CF invoked information element content

| Information element | Length | Value | Remark |
|---------------------|--------|-------|---|
| SS-CF invoked | 1 | 0 | SS-CF not invoked in SwMI sending the PDU |
| | | 1 | SS-CF not invoked in SwMI sending the PDU |

6.1.3.3.53 SS-CLIR invoked for other party

This information element shall be coded as defined in table 79.

Table 79: SS-CLIR invoked for other party information element contents

| Information element | Length | Value | Remark |
|---------------------------------|--------|-------|---|
| SS-CLIR invoked for other party | 1 | 0 | SS-CLIR not invoked for the other party |
| | | 1 | SS-CLIR invoked for the other party |

6.1.3.3.54 Terminating SwMI MNI

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.55 Visited/forwarded-to SwMI MNI

This information element shall be coded as defined in table 95 of ETSI EN 300 392-2 [1] for the air interface information element called party extension.

6.1.3.3.56 Visited/forwarded-to SwMI PISN number

This information element shall be coded as defined in clause 14.8.20 of ETSI EN 300 392-2 [1] information element external subscriber number, except that its length in bits shall be equal to $4 \times N$, N being the value of the associated information element: number of digits in visited/forwarded-to SwMI PISN number.

6.2 ANF-ISIIC state definitions

NOTE: These states correspond to the SwMI protocol control states for individual (circuit-mode) call. The SwMI protocol states have not been explicitly standardized in ETSI EN 300 392-2 [1].

6.3 ANF-ISIIC signalling procedures

6.3.1 General

The signalling procedures below specify the conditions under which the SwMI ANF-ISIIC entities send or receive the TETRA ISI PDUs.

6.3.2 Call establishment

6.3.2.1 Call request and call proceeding

Call establishment shall be initiated by a primitive sent by the CC entity to the ANF-ISIIC entity in the originating SwMI. This ANF-ISIIC entity shall then send the ISI-SETUP PDU, defined in table 21.

6.3.2.2 Called user migration

6.3.2.2.1 Introduction

When the home SwMI of the called user is different from the originating SwMI (SwMI A), i.e. the called user home SwMI is SwMI B, and that user has migrated, two different cases arise depending on whether that user has migrated into a third SwMI (SwMI C, different from SwMI A) or into SwMI A (i.e. SwMI C coincides with SwMI A).

Also in case of SS-CF the called SwMI may detect that the forwarded to-user (new called user) is migrated into a third SwMI (SwMI C, different from SwMI A) or into SwMI A.

6.3.2.2.2 Called user having migrated in SwMI C different from SwMI A

If the called user has migrated into a third SwMI (SwMI C, different from SwMI A) and SwMI B has decided to continue the establishment of the call, the following shall apply to SwMI B, depending of the value of the information element routing method choice, defined in table 72, in the ISI-SETUP PDU received from SwMI A:

- a) if the value of that information element routing method choice corresponds to re-routing not supported (by SwMI A):
 - if SwMI B supports forward switching and has decided to continue the establishment of the call in routing it by forward switching, it shall send to SwMI C the ISI-SETUP PDU, defined in table 21. Except possibly for the value of the call priority information element (to be used according to the specifications of the supplementary services priority call and pre-emptive priority call), the values of the information elements of that ISI-SETUP PDU shall be identical to those in the ISI-SETUP PDU received from SwMI A except for the following ones (see note 1):
 - the value of the information element call has been forward switched shall indicate that the call has been forward switched;
 - the value of the information element last forwarding SwMI MNI (conditional on the value of the preceding information element indicating that the call has been forward switched) shall be equal to SwMI B MNI (which in that case will also be equal to the value of the information element called party extension);
 - the value of the information elements simplex/duplex selection and/or basic service information may be changed by SwMI B (home SwMI of the called user) if it knows that the called user does not support those in the ISI-SETUP PDU received from SwMI A. If SwMI B changes one of those values, it should inform SwMI A about that change sending the ISI-CALL PROCEEDING PDU, defined in table 27;
 - in addition, if as an option SwMI B supports fleet calling and if it finds out that the value information element called/forwarded-to party SSI in the ISI-SETUP PDU which it has received from the originating SwMI corresponds actually to a fleet call, the value of the information element called/forwarded-to party SSI shall be the actual SSI of the called/forwarded-to party, while the information element called/forwarded-to party fleet number SSI shall be present with the value of the information element called/forwarded-to party SSI in the ISI-SETUP PDU received from the originating SwMI (corresponding to the fleet number of the called/forwarded-to party). In addition the information element calling party fleet number SSI shall be present with a value equal to the fleet number SSI of the calling party;

or

- if SwMI B cannot route the call because it does not support forward switching (therefore cannot continue the establishment of the call) or because of congestion (whether internal or by lack of free ISI connection towards SwMI C), it shall send the ISI-DISCONNECT PDU, defined in table 45 with the values of the information element disconnect cause set to "No possible routing of the call";
- b) if the value of that information element routing method choice corresponds to either "re-routing supported (by SwMI A), forward switching (by SwMI B) preferred" or "re-routing supported (by SwMI B)", the called SwMI (i.e. SwMI B) may choose between forward switching and re-routing":
 - if SwMI B supports forward switching and has decided to continue the establishment of the call in forward switching it, it shall send to SwMI C the ISI-SETUP PDU, defined in table 21. The specification of the values of the information elements of that ISI-SETUP PDU shall be the same as in case a) above (for the same PDU sent by SwMI B - to SwMI C); or
 - if SwMI B cannot route the call because it does not support forward switching (therefore cannot continue the establishment of the call) or because of congestion (whether internal or by lack of free ISI connection towards SwMI C), it shall either send the ISI-DISCONNECT PDU or the ISI-REDIRECT PDU, defined in table 23. The values of the information elements of ISI-REDIRECT PDU shall be as follows:
 - the value of the information element "possible ISI trombone or loop connection detected" shall indicate that SwMI B has not identified that SwMI C coincides with SwMI A;

- the value of the information element visited/forwarded-to SwMI MNI shall be equal to SwMI C MNI (see note 2);
 - the value of the information element routeing method response (see table 73) shall correspond to:
 - forward switching not supported, if SwMI B does not support forward switching; or
 - "select re-routeing" if it supports forward switching but has decided not to forward switch the present call;
 - the value of the information element SS-CF invocation counter shall be the same as that in the ISI-SETUP PDU received from SwMI A, and the value of the information element SS-CF information present shall indicate that no such information is present (see note 1);
 - if the information element notification indicator is present, its value shall correspond to a notification addressed to the called user (and not to the calling user);
 - in addition, if as an option SwMI B supports fleet calling and if it finds out that the value information element called/forwarded-to party SSI in the ISI-SETUP PDU which it has received from the originating SwMI corresponds actually to a fleet call, the value of the information element called/forwarded-to party SSI shall be the actual SSI of the called/forwarded-to party, while the information element called/forwarded-to party fleet number SSI shall be present with the value of the information element called/forwarded-to party SSI in the ISI-SETUP PDU received from the originating SwMI (corresponding to the fleet number of the called/forwarded-to party). In addition the information element calling party fleet number SSI shall be present with a value equal to the fleet number SSI of the calling party;
- c) if the value of that information element routeing method choice corresponds to re-routeing supported (by SwMI A), possible choice between forward switching and re-routeing to be made by originating/preceding SwMI (i.e. SwMI A):
- if SwMI B can handle re-routing it shall send to SwMI A the ISI-REDIRECT PDU, defined in table 23. The specification of the values of the information elements of that PDU shall be the same as in case b) above (for the same ISI-REDIRECT PDU sent by SwMI B), except that the value of the information element routeing method response shall correspond to forward switching supported or to forward switching not supported, depending on whether SwMI B supports forward switching or not (instead of forward switching not supported or select re-routeing in case b) above);
 - if SwMI B cannot handle re-routing but it supports forward switching and it has decided to continue the establishment of the call in routeing it by forward switching, SwMI B shall send to SwMI C, without informing SwMI A, the ISI-SETUP PDU, defined in table 21, the specification of the values of the information elements of that PDU shall be the same as in case a).

NOTE 1: The case of invocation of a call forwarding supplementary service in SwMI B (i.e. for the called user) is excluded in the present clause 6.3 (see clause 6.5 for such a case).

NOTE 2: The sending of the ISI-CALL PROCEEDING to SwMI A is compulsory in such a case because otherwise SwMI A would not be informed about the call modification - since SwMI C, the terminating SwMI, will itself not be aware of it.

NOTE 3: According to ETSI TS 100 392-3-15 [6], the visited SwMI MNI will be delivered to SwMI B, the home SwMI of the migrating called user, from SwMI C, his visited SwMI, by ANF-ISIMM as part of the migration information for that user.

If SwMI A has received the ISI-REDIRECT PDU, depending on the value of the information element routeing method response in that PDU, it shall decide either to re-route the call or to have it forward switched (see note 4), towards SwMI C:

- if routeing method response contained different value than "forward switching not supported" then if SwMI A decides to have the call forward switched, it shall send to the called SwMI the ISI-FORWARD SWITCH PDU defined in table 24. The called SwMI shall then send to the SwMI C the ISI-SETUP PDU defined in table 21. The specification of the values of the information elements of that ISI-SETUP PDU shall be the same as in case a) above (for the same PDU sent by SwMI B - to SwMI C);

- if SwMI A decides to re-route the call, it shall:
 - initiate a new call establishment (see clause 6.3.1.1) to SwMI C sending the ISI-SETUP PDU, defined in table 21. The values of the information elements of that ISI-SETUP PDU shall be the same as those in the ISI-SETUP PDU sent previously to SwMI B except possibly for the values (see note 1):
 - of the call priority information element (to be used according to the specifications of the supplementary services priority call and pre-emptive priority call);
 - of the information element routing method choice, which shall correspond to SwMI A routing method choice (now related to its ISI connection with SwMI C); and/or
 - of the (optional) information element notification indicator, which shall be equal to that of the same information element received in the corresponding ISI-REDIRECT PDU. If that PDU did not include the information element notification indicator, the new ISI-SETUP PDU shall not include it either;

and

- send a ISI-DISCONNECT PDU, defined in table 45, to clear the ISI connection between SwMI A and SwMI B, which has become unnecessary. In that PDU, the value of the information element disconnect cause, defined in table 53, shall correspond to call re-routed.

NOTE 4: While in theory nothing prevents SwMI A to decide to have the call forward switched (by SwMI B) if the value of the information element routing method response in the ISI-REDIRECT PDU which it has received corresponds to select re-routing (see case b) above), SwMI A should avoid it, since otherwise SwMI B could very well reject the corresponding request.

If the value of the information element routing method response in the ISI-REDIRECT PDU does not allow SwMI A to continue the establishment of the call (e.g. SwMI A has indicated that it does not support re-routing and SwMI B has responded in indicating that it does not support forward switching or that it cannot forward switch the call due to congestion), SwMI A shall simply send the ISI-DISCONNECT PDU, defined in table 45. In that PDU, the value of the information element disconnect cause, defined in table 53, should correspond to no possible routing of the call.

6.3.2.2.3 Called user having migrated in SwMI C coinciding with SwMI A

If the called user has migrated into SwMI A (i.e. SwMI C coincides with SwMI A), this shall be identified by SwMI B if it has received the ISI-SETUP PDU from SwMI A (see note 1 below). SwMI B shall then send to SwMI A the ISI-REDIRECT PDU defined in table 23. The values of the information elements of that PDU shall be as follows:

- the value of both information elements "possible ISI trombone or loop connection detected" and "PDU addressed to originating SwMI" shall indicate that SwMI B has identified that SwMI C coincides with SwMI A, thereby forcing the call to be established as an intra-TETRA call (see note 1);
- the value of the information element SS-CF invocation counter shall be the same as that in the ISI-SETUP PDU received from SwMI A, and the value of the information element SS-CF information present shall indicate that no such information is present (see note 2);
- the value of the information element incoming call barring status (see note 3) shall indicate that neither the supplementary service barring of incoming calls nor that of call authorized by dispatcher for the called user have been activated;
- in addition, if as an option SwMI B supports fleet calling and if it finds out that the value information element called/forwarded-to party SSI in the ISI-SETUP PDU which it has received from the originating SwMI corresponds actually to a fleet call, the value of the information element called/forwarded-to party SSI shall be the actual SSI of the called/forwarded-to party, while the information element called/forwarded-to party fleet number SSI shall be present with the value of the information element called/forwarded-to party SSI in the ISI-SETUP PDU received from the originating SwMI (corresponding to the fleet number of the called/forwarded-to party). In addition the information element calling party fleet number SSI shall be present with a value equal to the fleet number SSI of the calling party.

When SwMI A receives the ISI-REDIRECT PDU indicating "possible ISI trombone or loop connection detected" it shall send a ISI-DISCONNECT PDU, defined in table 45, to clear the ISI connection between SwMI A and SwMI B, which has become unnecessary.

If an ISI trombone connection with the preceding transit SwMI occurs but this had not been indicated by the called SwMI in ISI-REDIRECT PDU that preceding transit SwMI (which receives this PDU) will detect it by identifying the MNI in the information element Visited/forwarded-to SwMI MNI as being its own.

NOTE 1: SwMI A may of course detect by itself (i.e. without the need to send the ISI-SETUP PDU to SwMI B and to receive back the ISI-REDIRECT PDU) that the called user is currently registered in that SwMI (after having migrated from SwMI B). However this is not mandatory. Furthermore, SwMI A cannot detect such case e.g. when the calling party addresses the called user using his MSISDN or his fleet number.

NOTE 2: The case of invocation of a call forwarding supplementary service in SwMI B (i.e. for the called user) is excluded in the present clause 6.3 (see clause 6.5 for such a case).

NOTE 3: The case of invocation of the supplementary services barring of incoming calls or call authorized by dispatcher for the called user is excluded in the present clause 6.3 (see clause 6.5 for such cases).

6.3.2.3 Call characteristics and set-up time negotiation by the terminating SwMI

The terminating SwMI may indicate to the originating SwMI modification for some characteristics requested for the call (i.e. duplex selection, N slot bearer requested for a data call in the basic service information element, speech service) in sending the ISI-CALL PROCEEDING PDU, defined in table 27, the ISI ALERTING PDU defined in table 25 or ISI-PROGRESS PDU defined in table 22. These PDUs include the information element call time-out, set-up time, defined in clause 6.1.3.2.3, which allows the terminating SwMI to inform the originating one about its call time-out in the set-up phase.

The terminating SwMI may also send a ISI-SETUP PROLONGATION PDU, defined in table 28, if it only wants to inform the originating SwMI about its call time-out in the set-up phase (a priori, because it wants to have it modified). This call setup phase timer value is used in the terminating SwMI until the terminating SwMI has received the ISI-CONNECT ACKNOWLEDGE PDU, defined in table 29 (see clause 6.1.2.10).

NOTE 1: This call time-out in the set-up phase should be greater than or equal to that indicated by the originating SwMI.

NOTE 2: Having received one of the above messages from the called/terminating SwMI ensures that a nominated SwMI has received the ISI SETUP PDU.

The SwMI restarts the "Call time-out, set-up phase" timer when ISI-CALL PROCEEDING or ISI-SETUP PROLONGATION PDU is received.

Upon receiving new value for call time-out in the set-up phase, the originating SwMI call control application should ensure that the local CC entity extends its timer T302 (see table 58 of ETSI EN 300 392-2 [1], if necessary. If the call has been forward switched, by the called SwMI, the same should apply to the called SwMI.

After having received one of the above messages informing new values for call time-out in the set-up phase, the originating SwMI may send the ISI-SETUP PROLONGATION PDU, defined in table 28, if it uses different value for the set-up phase and it wants to inform the terminating SwMI about it. This setup phase timer value is used in the originating SwMI until the originating SwMI has sent the ISI-CONNECT ACKNOWLEDGE PDU, defined in table 29 (see clause 6.1.2.10).

6.3.2.4 Call through connection

6.3.2.4.1 Call confirmation indication by the terminating SwMI

If the call is using on/off hook signalling, the terminating SwMI shall send the ISI-ALERTING PDU as defined in table 25, when it is confirmed that the connected user is alerted. When the call request is answered from the connected user the terminating SwMI shall send the ISI-CONNECT PDU, defined in table 26. This shall be done immediately on the receipt of the U-CONNECT PDU even if the resources required to support the connected party are not yet available. The reservation state of the resources is included into the ISI-CONNECT PDU and the allocation policy for resources. The ISI-CONNECT PDU is sent immediately to avoid serial queuing for resources.

The terminating SwMI may use either ISI-ALERTING or ISI-CONNECT PDUs to indicate to the originating SwMI the characteristics that the connected party has requested in U-ALERT or U-CONNECT (i.e. duplex selection, N slot bearer requested for a data call in the basic service information element and speech service and hook method selection) that are different compared to the ISI- SETUP PDU received by this SwMI and not yet informed in ISI-CALL PROCEEDING or ISI-PROGRESS PDU to the originating SwMI. Once indicated in a PDU, they shall not be repeated in the next ones.

The resource indicator information element values of ISI CONNECT can have following values:

- **resources are reserved**, means that the resources are available such that the call to the connected party can be connected if required;
- **resources could not be reserved**, means that either previously queued for resources will not be available, or in an immediate response to indicate that resources will never be available even if they were queued for. The call should be disconnected by a SwMI receiving this value. An alternative to sending the ISI CONNECT PDU with this value is to send a direct ISI-DISCONNECT PDU; and
- **resources could not be reserved, delay requested**, means that although resources are not currently available they are expected to be available soon. The resources are being queued for. When the radio traffic channel resources are available a further ISI-RESOURCE-RESPONSE PDU indicating this is sent.

The Setup resource allocation information element indicates the allocation policy that is used by the terminating/forward switching SwMI for its resources:

- **"setup permanently allocated resources"** means that, once allocated, a resource is not released until the call is cleared;
- **"setup temporary allocated resources"** means that, once allocated, resources are eligible for release if an ISI-QUEUING PDU, not forbidding the release of resources, is received.

The terminating SwMI shall include the information element connected party fleet number SSI in that ISI-CONNECT PDU whenever the ISI-SETUP PDU, defined in table 21, which it has received included the information element called/forwarded-to party fleet number SSI (independently of whether or not the terminating SwMI supports fleet calling). The value of that information element connected party fleet number SSI shall be equal to that of the information element called/forwarded-to party fleet number SSI received.

If there are forward switching SwMIs involved the ISI-ALERT and ISI-CONNECT go via these SwMIs towards the originating SwMI and the forward switching SwMI may have to react on the PDUs (see clauses 6.3.2.3 and 6.3.2.4.2). In case there is no call forwarding applied, then there can be only one forward switching SwMI, the home SwMI of the called party, acting as a forward switching SwMI. If call forwarding and forward switching are applied there can be several forward switching SwMIs in the chain between the originating and terminating SwMI.

6.3.2.4.2 Resource queuing and different resource allocation policies when no forward switching SwMIs involved

Both the originating and the terminating SwMIs may start resource reservations already based on the sent/received ISI-SETUP PDU or latest based on sent/received ISI-CONNECT PDU. The reservation state of the needed resources in the terminating SwMI is included into the ISI-CONNECT PDU sent by the terminating SwMI.

If resources are available in both the originating and the terminating SwMI, the originating SwMI shall send to the terminating SwMI the ISI-CONNECT ACKNOWLEDGE PDU, defined in table 29 in order to confirm that the call has actually been established on the calling user side.

If there is resource queuing in the originating SwMI or in the terminating SwMI then an ISI-QUEUING PDU is sent by the originating SwMI instead of ISI CONNECT ACKNOWLEDGE PDU.

If the terminating SwMI sent its ISI-CONNECT PDU before its resources were reserved then, as soon as the resources are reserved it communicates this to the originating SwMI in an ISI-RESOURCE-RESPONSE PDU.

An originating SwMI operating a policy of temporary resource allocation makes its resources eligible for release when there is queuing for resources in the terminating SwMI and it has sent an ISI-QUEUING PDU. Although the resources are eligible for release the actual policy used for releasing the resources is implementation specific. For example, once eligible for release a SwMI may release the resource immediately, release it only if required by another call, release it after a timeout or use some other criteria.

A terminating SwMI receiving an ISI-QUEUING PDU is eligible to release its allocated resources, if the ISI-QUEUING indicates "allowed to release resources". The actual policy for the release of the resources is implementation specific.

If the originating SwMI does not support the check of the resource reservation state of the other SwMIs, i.e. ISI-RESOURCE PDU, it shall set the value of the "Resource release signalling support" information element of the first ISI-QUEUING PDU it sends to "resource release signalling not supported".

If the originating SwMI supports the check of the resource reservation state of the other SwMIs and the value "setup permanently allocated resources" was indicated in the previously received ISI-CONNECT, the "Resource release signalling support" information element of the first ISI-QUEUING PDU it sends shall be set to "resource release signalling not supported" otherwise the value of the "Resource release signalling support" shall be set to "resource release signalling supported".

If the ISI-CONNECT PDU received by the originating SwMI indicated "resources could not be reserved, delay requested" then the first ISI-QUEUING PDU sent by the originating SwMI shall indicate "not allowed to release resources". It ensures that the other SwMI does not release its resources on receipt of the ISI-QUEUING PDU in case the ISI-RESOURCE-RESPONSE PDU indicating "resources are reserved" has just been sent.

When the originating SwMI then receives an ISI-RESOURCE-RESPONSE indicating that resources are reserved it may take one of two actions depending on the state of its own resources. If they are reserved, or can be obtained without queuing, then the call is connected with an ISI-CONNECT-ACKNOWLEDGE. If the resources are not available in the originating SwMI then the call can be delayed again and an ISI-QUEUING PDU sent.

If there is resource queuing only in originating SwMI, that is, the ISI-CONNECT PDU or ISI-RESOURCE-RESPONSE received by the originating SwMI indicated "resources are reserved" then:

- The ISI-QUEUING PDU sent by the originating SwMI shall indicate "not allowed to release resources" if the originating SwMI does not support the (ISI-RESOURCE PDU) check of the resource reservation state of the other SwMI or the ISI-CONNECT PDU received by the originating SwMI indicated "setup permanently allocated resource".
- Otherwise the ISI-QUEUING PDU sent by the originating SwMI shall indicate "allowed to release resources".

After delaying the call (with an ISI-QUEUING PDU) and when the originating SwMI has obtained its resources to connect its party into the call it shall send either the ISI-CONNECT-ACKNOWLEDGE PDU or the ISI RESOURCE PDU. ISI-CONNECT-ACKNOWLEDGE PDU shall be sent if the last sent ISI-QUEUING PDU contained the value "not allowed to release resources". ISI RESOURCE PDU is sent if the last sent ISI-QUEUING PDU contained the value "allowed to release resources". The ISI-RESOURCE PDU is used to ask the other SwMI for the allocation status of its resources and if they are not available, for them to be obtained. If the other SwMI immediately has the resources available it responds with an ISI-RESOURCE-RESPONSE indicating this. If the resources are not available when the ISI-RESOURCE PDU arrives then this non-availability is indicated to the originating SwMI in an ISI-RESOURCE-RESPONSE PDU. When eventually the resources do become available an ISI-RESOURCE-RESPONSE PDU is sent indicating the availability of the resources.

The originating SwMI should not release its resources until it receives an ISI-RESOURCE-RESPONSE PDU to the ISI-RESOURCE PDU it has sent (unless it also clears the call). The originating SwMI on receipt of the ISI-RESOURCE-RESPONSE PDU containing "resources could not be reserved, delay requested" may release its resources. The originating SwMI on receipt of the ISI-RESOURCE-RESPONSE PDU containing "resources are reserved" will either through connect the call (if it has own resources reserved) or (if it has not all needed resources) send another ISI-QUEUING PDU with the Resource release permission information element set to "allowed to release resources" (thus allowing the other SwMI to release its resources) so the other SwMI is not in the "unable to release" state for very long.

This will cause the whole cycle, ISI-QUEUING PDU, ISI-RESOURCE PDU, ISI-RESOURCE RESPONSE PDU, to be repeated again and many repeats are possible before the setup is successful, or is deemed to have failed.

In the usual case where a terminating SwMI has its resources available when it sends the ISI-CONNECT PDU and when the originating SwMI obtains its resources immediately on the receipt of the ISI-CONNECT PDU the call is through connected with ISI-CONNECT-ACKNOWLEDGE straight away. The PDUs ISI-QUEUING, ISI-RESOURCE and ISI-RESOURCE-RESPONSE are not used in this case.

The originating SwMI assumes that the resources are eligible for release in the terminating SwMI only when an ISI-QUEUING PDU indicating "allowed to release resources" has been sent. It is possible (although not recommended), in exceptional circumstances, for the terminating SwMI to release its resources at other times and still allow the call to continue. However it should take account of the fact that the originating SwMI believes it still has its resources. If the originating SwMI tries to connect the call but the terminating SwMI has used these exceptional procedures to release its resources then it will attempt to reacquire its resources immediately and if they cannot be obtained clear the call.

If an originating SwMI does not support check of the resource reservation state of the other SwMI then it will never send the ISI-RESOURCE PDU. If the terminating SwMI has a policy of temporary resource allocation then the call may still setup correctly depending on how the terminating SwMI handles this situation, that is, does it use the exceptional procedures to release its resources without permission from the originating SwMI. This is an implementation specific matter. The originating SwMI will connect the call with an ISI-CONNECT-ACKNOWLEDGE once it has its own resources and an ISI-CONNECT or ISI-RESOURCE-RESPONSE from the terminating SwMI indicating it has too.

Once a call has entered its maintenance phase resources are always permanently allocated.

6.3.2.4.3 Resource queuing and different resource allocation policies if forward switching SwMIs are involved

Each SwMI may start resource reservations already based on the sent/received ISI-SETUP PDU or latest based on sent/received ISI-CONNECT PDU. The reservation state of the needed resources is included into the ISI-CONNECT PDU.

The logic for a forward switching SwMI for the "resource indicator" information element in ISI-CONNECT is as follows:

- If the forward switching SwMI receives ISI-CONNECT PDU with "resources could not be reserved, delay requested" from the terminating SwMI (or another forward switching SwMI) it passes the same information towards the originating SwMI even if it itself has the needed resources for the call.
- If the forward switching SwMI receives ISI-CONNECT PDU with "resources are reserved" from the terminating SwMI (or another forward switching SwMI) when the needed resources are not yet available in the forward switching SwMI the forward switching SwMI shall indicate "resources could not be reserved, delay requested" towards the originating SwMI. Then as soon as the resources are available, the forward switching SwMI shall indicate "resources are reserved" in ISI-RESOURCE RESPONSE PDU towards the originating SwMI.
- If the forward switching SwMI receives ISI-CONNECT PDU with "resources are reserved" from the terminating SwMI (or another forward switching SwMI) when the needed resources are also available in the forward switching SwMI the forward switching SwMI shall indicate "resources are reserved" towards the originating SwMI.

The ISI-CONNECT PDU received by the originating SwMI thus tells if there is resource queuing in any involved SwMI.

The logic for the "setup resource allocation" information element in ISI-CONNECT for a forward switching SwMI is as follows:

- If the forward switching SwMI has permanent resource allocation policy and does not supports signalling for checking of the resource reservation state, the forward switching SwMI shall indicate "setup permanently allocated resources " towards the originating SwMI regardless the contents of received ISI-CONNECT PDU.
- If the forward switching SwMI has permanent resource allocation policy and it supports the check of the resource reservation state and it receives ISI-CONNECT PDU with "setup temporary allocated resources" from the terminating SwMI (or another forward switching SwMI) it shall pass this information towards the originating SwMI.
- If the forward switching SwMI has temporary resource allocation policy the forward switching SwMI shall indicate "setup temporary allocated resources" towards the originating SwMI regardless the contents of received ISI-CONNECT PDU.

This provides a possibility for the originating/forward switching SwMI to know if there are any SwMI in the chain that supports temporary resource allocation policy provided that a SwMI supporting permanent resource allocation policy supports the check of the resource reservation state.

The first ISI-QUEUING PDU from the originating SwMI shall be forwarded unconditionally towards the terminating SwMI.

If the forward switching SwMI does not support the check of the resource reservation state of the other SwMIs, i.e. ISI-RESOURCE PDU, it shall set the value of the "Resource release signalling support" information element of the first ISI-QUEUING PDU it sends to "resource release signalling not supported".

If the forward switching SwMI supports the check of the resource reservation state of the other SwMIs and the value "setup permanently allocated resources" was indicated in the previously received ISI-CONNECT, the "Resource release signalling support" information element of the first ISI-QUEUING PDU it sends shall be set to "resource release signalling not supported" otherwise the value of the "Resource release signalling supported" shall be set to "resource release signalling supported".

The ISI-QUEUING PDU sent by the originating SwMI is relayed towards the terminating SwMI with the following logic, for "Resource release permission" information element, in forward switching SwMI:

- If the ISI-CONNECT PDU received by the forward switching SwMI indicated "setup temporary allocated resources", the last received resource indication (either in ISI-CONNECT or ISI-RESOURCE RESPONSE) contained value "resources are reserved" and the forward switching SwMI does not have its own resources reserved, the forward switching SwMI may indicate "allowed to release resources" if the forward switching SwMI does support the (ISI-RESOURCE PDU) check of the resource reservation state of the other SwMIs.
- Otherwise the ISI-QUEUING PDU sent by the forward switching SwMI shall indicate "not allowed to release resources".

It is also possible for the forward switching SwMI to use ISI-QUEUING and ISI-RESOURCE PDUs in the following case: the forward switching SwMI has not yet reserved resources when ISI-RESOURCE RESPONSE PDU with "resources are reserved" is received from the terminating/another forward switching SwMI. If the forward switching SwMI supports the optional signalling to check the resource reservation state then the forward switching SwMI may send ISI-QUEUING with "allowed to release resources" indication to the terminating/ next forward switching SwMI provided that the forward switching SwMI has received "setup temporary allocated resources" in ISI-CONNECT.

If the ISI-QUEUING PDU sent by the forward switching SwMI indicated "allowed to release resources" then as soon as the forward switching SwMI has reserved the resources the forward switching SwMI shall send ISI-RESOURCE to the next forward switching/terminating SwMI asking for the allocation status of its resources. If the SwMI responds with ISI-RESOURCE RESPONSE PDU indicating that resources are available then this information shall be passed towards the originating SwMI with ISI-RESOURCE RESPONSE PDU.

The forward switching SwMI should not release its resources until it receives an ISI-RESOURCE-RESPONSE PDU to the ISI-RESOURCE PDU it has sent (unless it also clears the call). The forward switching SwMI on receipt of the ISI-RESOURCE-RESPONSE PDU containing "resources could not be reserved, delay requested" may release its resources. The forward switching SwMI on receipt of the ISI-RESOURCE-RESPONSE PDU containing "resources are reserved" shall either forward the ISI-RESOURCE-RESPONSE PDU towards the originating SwMI (if it has own resources reserved) or (if it has not all needed resources) send another ISI-QUEUING PDU with the Resource release permission information element set to "allowed to release resources" (thus allowing the terminating/other forward switching SwMI to release its resources). This will cause the whole cycle, ISI-QUEUING PDU, ISI-RESOURCE PDU, ISI-RESOURCE RESPONSE PDU, to be repeated again and many repeats are possible before the setup is successful, or is deemed to have failed.

If the forward switching SwMI receives additional ISI-QUEUING PDU (after the first one) from the originating SwMI or from another forward switching SwMI it shall forward the PDU towards the terminating SwMI only if the next SwMI has indicated "setup temporary allocated resources" in ISI-CONNECT.

NOTE: There is no need to indicate "queuing continues" by sending additional ISI-QUEUING PDUs towards a SwMI that has indicated permanent resource allocation policy as the already reserved resources are not released until the call is terminated.

If there is no queuing for resources in any SwMI the originating SwMI sends the ISI-CONNECT ACKNOWLEDGE PDU. The forward switching SwMI shall unconditionally pass the ISI-CONNECT ACKNOWLEDGE PDU towards the terminating SwMI (possibly via another forward switching SwMIs). If there is resource queuing in originating SwMI or in some other SwMI then an ISI-QUEUING PDU sent by the originating SwMI is sent towards the terminating SwMI via the forward switching SwMI(s).

6.3.2.5 Failure of call establishment

If the call attempt is rejected by the terminating SwMI (because of e.g. incompatibility between the call characteristics requested/ supported by the SwMIs, or internal congestion), by the called user (because e.g. it is busy, or end-to-end encryption was requested in the set-up and this user does not support it) or by the called SwMI (e.g. the called user not registered or call not authorized)), the SwMI rejecting this call shall send the ISI-DISCONNECT PDU, defined in table 45, with the appropriate disconnect cause.

Also if the originating SwMI cannot accept change of some characteristics for the call as requested in received ISI-CALL PROCEEDING PDU, the ISI ALERTING PDU or ISI-PROGRESS PDU the originating SwMI shall send ISI-DISCONNECT PDU towards the terminating SwMI.

6.3.3 Call maintenance procedures

6.3.3.1 Transmission control procedures

As already stated in the stage 1 description, the originating SwMI shall be the controlling one. Consequently, it shall determine who is allowed to transmit. If there are forward switching SwMIs involved with the call, they shall forward the ISI TX PDUs between the controlling and the terminating SwMI.

The terminating SwMI shall relay to the controlling SwMI the air interface U-TX DEMAND/CEASED PDUs that it receives to request transmission grant or inform that transmission has ceased, by sending the ISI-TX DEMAND and ISI-TX CEASED IN TERMINATING SwMI PDUs as defined in tables 37 and 38, respectively. Controlling SwMI shall send to the terminating SwMI a response for every ISI-TX DEMAND and ISI-TX CEASED IN TERMINATING SwMI PDUs as defined in tables 30 and 32. If the current transmission is to be interrupted the controlling SwMI shall send ISI-TX INTERRUPT as defined in table 31.

Signalling for call paused and resumed:

If either the controlling SwMI or the terminating SwMI decides to pause the call, it shall then the ISI-TX WAIT PDU defined in table 34 to the other end SwMI. The receiving SwMI should then indicate the pause in conversation over the air interface with D-TX WAIT PDU to the user.

Note: The pause indication may be necessary if either party has to queue for resources after cell change or when a user migrates to a new SwMI as there will be no possibility to send/receive traffic within that time.

When the terminating SwMI sends an ISI-TX WAIT PDU, then the Transmission control request information element has no meaning and shall be set to value "Allowed to request for transmission".

After the terminating SwMI has paused the call, to request to the controlling SwMI the authorization to continue the call it shall the ISI-TX CONTINUE IN TERMINATING SwMI PDU defined in table 39. When the controlling SwMI decides to continue the call it shall send an ISI-TX- CONTINUE IN ORIGINATING SwMI defined in table 33 to the terminating SwMI.

The receiving SwMI should then indicate the continuation of the conversation over the air interface with D-TX CONTINUE PDU to the user.

6.3.3.2 Call modification

To inform the other end SwMI that it wants to change the call time-out, the originating or the terminating SwMI shall send the ISI-INFO DEMAND PDU defined in table 35.

NOTE 1: This SwMI should then wait for receiving an agreement from the other end SwMI before requesting the user that it is controlling to start timer T310 using this new call time-out value.

The same message can also be used to request from the other end some call modification (as specified in clause 14.5.1.2 of ETSI EN 300 392-2 [1]). The call time-out information element included in this TETRA PDU shall then be related to the modification requested.

Upon receiving the ISI-INFO DEMAND PDU, the other end SwMI shall send the ISI-INFO REPLY PDU defined in table 36.

NOTE 2: According to the negotiation clauses for incoming call in clause 14.5.1.1 of ETSI EN 300 392-2 [1] and to the definition of the class of MS (information) element in table 167 of ETSI EN 300 392-2 [1], possibly supplemented by information transferred by ANF-ISIMM, this other SwMI should always know whether the user that it controls would support the requested changes before passing the request over ISI. This holds notably if the other user has requested a change (from simplex operation) to duplex operation or (from clear call) to encrypted call, which is possible according to clause 14.5.1.2 of ETSI EN 300 392-2 [1].

6.3.3.3 Call restoration

6.3.3.3.1 General call restoration procedure

6.3.3.3.1.1 Introduction

When one of the two users participating in an established individual call migrates during this call, the call control application in the SwMI in which this user was previously registered will be informed by ANF-ISIMM about this migration. This information will include the MNI of the new SwMI where the user is now registered and may include the address information to be used for establishing a connection between the old SwMI and that new SwMI, to allow a subsequent call restoration, unless such connection already exists because the new SwMI coincides with either the other end SwMI (i.e. either the originating or the terminating SwMI) or the forward switching SwMI. If such address information is not delivered by ANF-ISIMM, then the old SwMI will use the address information corresponding to the new SwMI MNI in its routing table.

6.3.3.3.1.2 Start of general call restoration procedure

When during an established (individual) inter-TETRA call, the call control application in the controlling or in the terminating SwMI receives the information (from ANF-ISIMM) that the user (participating in the call) which was registered in the SwMI has migrated and is now registered in a new SwMI, the ANF-ISIIC entity invoked for that call should send the ISI-CALL RESTORE PREPARE PDU defined in table 40 to the new SwMI if both SwMIs support call restoration..

Similarly, in the case of migration of one of the two users involved in an intra-TETRA call established within a given SwMI, the ANF-ISIIC entity invoked in this SwMI should send to the new SwMI the ISI-CALL RESTORE PREPARE PDU, defined in table 40 if both SwMIs support call restoration.

In the procedure described below, the controlling or terminating SwMI which sent the ISI-CALL RESTORE PREPARE PDU as defined in either of the two preceding paragraphs shall be called the old SwMI.

At the same time that it sends the ISI-CALL-RESTORE PREPARE PDU, the old SwMI shall start timer T1.

6.3.3.3.1.3 Successful general call restoration

After the new SwMI has received the ISI-CALL RESTORE PREPARE PDU, to indicate that it accepts to continue the ANF-ISIIC general call restoration procedure, it shall send the ISI-CALL RESTORE PREPARED PDU, defined in table 41, if it has not yet received the call restoration message from its new visiting user, or the ISI-CALL RESTORATION PDU, defined in table 42, if it has received the call restoration message from its new visiting user in time.

When the old SwMI receives that ISI-CALL RESTORATION PDU it shall connect the call (by forward switching) to the new SwMI, Old SwMI shall also, relay the ISI-CALL RESTORATION PDU towards the other end SwMI and stop timer T1.

When the other end SwMI receives the ISI-CALL RESTORATION PDU it shall know the identity of the new other end SwMI and may use that information to avoid loop connections, see clause 6.3.3.3.2.2.

6.3.3.3.1.4 Failures cases of the general call restoration procedure

If no ISI connection can be established between the old SwMI and the new SwMI, or ISI signalling connection can be established but there is no voice connection possible then ISI-DISCONNECT PDU is sent from the old SwMI to the other end SwMI to clear the call.

Based on the information received from ISIMM the CC in the old SwMI should know if the new SwMI does not support the call restoration procedure.

If not supported, then the old SwMI shall send the ISI-DISCONNECT PDU to the other end SwMI with the (ISI) disconnect cause: "ANF-ISIIC call restoration procedure not supported in new SwMI". If however, the new SwMI not supporting the ANF-ISIIC call restoration procedure receives ISI-CALL RESTORATION PREPARE it should send ISI-DISCONNECT PDU to the old SwMI and the old SwMI should forward the ISI-DISCONNECT PDU to the other end SwMI with the same disconnect cause.

If the new SwMI supports the ANF-ISIIC call restoration procedure (which entails that it supports the air interface call restoration procedure) but decides to reject the call restoration attempt from the old SwMI for any other reason, it shall send the ISI-DISCONNECT PDU, defined in table 45, in clearing the ISI connection seized between the old and the new SwMIs. The value of the disconnect cause in that ISI-DISCONNECT PDU should indicate the reason why the new SwMI has decided to reject the call restoration attempt from the old SwMI. The old SwMI then sends the ISI-DISCONNECT PDU to the other end SwMI with the same disconnect cause.

Upon expiry of timer T1 (i.e. because it has not received the ISI-CALL RESTORATION PDU yet), the old SwMI shall release the ISI connection with the new SwMI that it had seized. The old SwMI sends the ISI-DISCONNECT PDU to the other end SwMI to clear the call.

6.3.3.3.2 Specific call restoration procedure in a SwMI already on the path of the call

6.3.3.3.2.1 Introduction

The following procedure is recommended instead of the general one specified in clause 6.3.3.3.1 above in the special cases where the old SwMI detects that the new SwMI coincides with a SwMI already on the path of the call, i.e. either with the forward switching SwMI if the call has been forward switched or the other end SwMI (terminating or originating SwMI).

The ANF-ISIIC PDUs have been specified, for simplicity purpose, in such a manner that they allow only each end SwMI to know the SwMI nearest from it where the call has been forward switched (e.g. for the originating SwMI, the home SwMI of the originally called user). Therefore if the call has been forward switched twice, the originating SwMI will not know the SwMI where the call has been forward switched for the second time. Also, if the call has been forward switched twice, the terminating SwMI will not know the SwMI where the call has been forward switched for the first time. If the call has been forward switched more than twice, neither the originating SwMI nor the terminating SwMI will know any of the forward switching SwMIs between the first and the last one on the path of the call. This means that the identified scenario is only such that the old SwMI should be left out from the call and the nearest forward switching SwMI will become the new end SwMI.

6.3.3.3.2.2 Specific call restoration procedure to avoid loop / trombone connections

If an inter-TETRA call has been forward switched, if migration of one of the two users engaged in that call occurs and if the new SwMI coincides with the forward switching SwMI, the old SwMI ANF-ISIIC entity may detect this and may then send to the forward switching/new SwMI the ISI-PATH CALL RESTORE PREPARE PDU, defined in table 43.

A transit SwMI receiving ISI- PATH CALL RESTORE PREPARE PDU shall avoid the trombone connection by releasing the old SwMI from the call by sending ISI DISCONNECT PDU as it shall become the new end SwMI. When the old transit SwMI (new end SwMI) then receives U-CALL RESTORE PDU from the migrating user, it shall send ISI-CALL RESTORE PDU to the other end SwMI thus informing the new end SwMI identity.

NOTE 1: If the old SwMI sent the ISI-CALL RESTORE PREPARE PDU instead of the ISI-PATH CALL RESTORE PREPARE, the resulting ANF-ISIIC routeing would be:

- a trombone connection (A-B-C-B) if the called party migrates; or
- a trombone connection (B-A-B-C) if the calling party migrates.

Similarly, if instead of coinciding with the forward switching SwMI, the new SwMI coincides with the other end SwMI, the old SwMI ANF-ISIIC entity should detect this and may then send to the other end/new SwMI the ISI-END CALL RESTORE PREPARE PDU, defined in table 44.

NOTE 2: Clearly, the possibility of trombone (or loop) connection is excluded in the case of migration of one of the two users involved in an established intra-TETRA call.

An end SwMI receiving ISI-END CALL RESTORE PREPARE PDU shall avoid the loop connection by releasing all other SwMIs from the call by sending ISI DISCONNECT PDU as the call becomes intra-SwMI call.

NOTE 3: If the old SwMI sent the ISI-CALL RESTORE PREPARE PDU instead of the ISI-END CALL RESTORE PREPARE, the resulting ANF-ISIIC routing would be:

- a loop connection (A-B-A) if the call has been established with no forward switching (either simply between SwMI A and SwMI B, or systematically re-routed); or
- a loop connection (A-B-C-A) if the call has been forward switched.

6.3.3.3.2.3 Failures cases of the specific call restoration procedure

If the new SwMI has been identified by the old SwMI as being on the path of the call and does not support the ANF-ISIIC specific call restoration procedure (obviously it supports ANF-ISIIC in such a case - and it may or may not support the ANF-ISIIC general call restoration procedure), it shall send to the old SwMI an ISI-Relay ReturnError APDU indicating 'requestNotSupported', as described in ETSI TS 100 392-3-9 [2], clause 7.4.3.

The old SwMI may then attempt the general ANF-ISIIC call restoration procedure. Otherwise it shall send the ISI-DISCONNECT PDU to the other end SwMI with the (ISI) disconnect cause: "ANF-ISIIC call restoration procedure not supported in new SwMI".

If the new SwMI is a SwMI through which the call has been forward switched (i.e. not an end SwMI) and supports the ANF-ISIIC call restoration procedure (which entails that it supports the air interface call restoration procedure) but decides to reject the call restoration attempt from the old SwMI for any other reason, it shall send to the old SwMI the ISI-DISCONNECT PDU, defined in table 45, therefore clearing the call. The old SwMI shall send the ISI-DISCONNECT PDU to the other end SwMI. The value of the disconnect cause in that ISI-DISCONNECT PDU should indicate the other reason why the new SwMI has decided to reject the set-up from the old SwMI.

6.3.4 DTMF procedures

The DTMF information shall be sent over the ISI in the ISI-INFO DEMAND PDU defined in table 35 (see also clause 6.3.3.2).

6.3.5 ANF-ISIIC clearing

Specific cases of ANF-ISIIC clearing have already been addressed:

- in clause 6.3.2.2 and/or 6.3.2.3, i.e. complete clearing when the call turns out to be an intra-TETRA call, or only partial clearing, in case of re-routing;
- in clause 6.3.2.5, because of failure of the call establishment in the terminating SwMI, or in the called SwMI when those two SwMIs are different (i.e. because of called user migration or supplementary service operation - e.g. call authorized by dispatcher or call forwarding); and
- in clause 6.3.3.3, i.e. complete clearing when the call is restored as an intra-TETRA call, or only partial clearing, in case of call restoration in a SwMI already on the path of the call, different from the originating and terminating SwMIs).

The clearing of the invoked ANF-ISIIC may be the result of:

- the clearing of the corresponding call by any TETRA application on the path of the call, either during the establishment of the call or after it has been established (e.g. TETRA application for the calling user, the connected user, the originating SwMI or the terminating SwMI, including when the call is rejected by the called user, or by the terminating SwMI, e.g. because it cannot match the air interface security level requested by the originating SwMI - in the ISI-SETUP PDU);

- the clearing of the invoked ANF-ISIIC because the call has become an intra-TETRA call, because of:
 - the invoked ANF-ISIIC has found out through loop detection that the originating and the terminating SwMIs coincide: the originating SwMI, informed about it through the ISI-REDIRECT PDU, defined in table 23, will then clear the invoked ANF-ISIIC in sending back an ISI-DISCONNECT PDU defined in table 45; or
 - call restoration for one of the two users engaged in the (individual) call when that user has migrated into the other end SwMI (e.g. during the call the connected user migrates into the originating SwMI - where the call is restored). This corresponds to what has been identified as case b) in clause 6.1.2.15.2;
- only the clearing of an ISI connection, previously seized by the invoked ANF-ISIIC, which has become unnecessary. The clearing of the invoked ANF-ISIIC is only partial in such cases, which happen because of:
 - re-routeing during the establishment of the call, e.g. if after having received the ISI-REDIRECT PDU, defined in table 23, because the connected user has migrated in SwMI C, the originating SwMI decides to re-route the call, it will clear the ISI connection to the called SwMI (previously seized by the ISI-SETUP PDU sent to that SwMI) in sending a ISI-DISCONNECT PDU defined in table 45. The same re-routeing operation may take place because of operation of a call forwarding supplementary service; or
 - call restoration for one of the two users engaged in the (individual) call when that user has migrated into a SwMI identified as being on the path of the call (e.g. the connected user was registered in SwMI C, the call has been forward switched through SwMI B, the connected user home SwMI and during the call that user migrates back into SwMI B - where the call is restored). This corresponds to what has been identified as case a) in clause 6.1.2.15.2.

When the calling user or a TETRA application in the originating SwMI clears the call after it has been established, that SwMI shall send the ISI-DISCONNECT PDU, defined in table 45. The information element disconnect cause of that TETRA PDU, defined in table 53, shall indicate the reason for that clearing.

The same shall apply when the call is cleared after it has been established:

- by the connected user or a TETRA application in the terminating SwMI;
- by any TETRA application in a SwMI on the path of the call, different from the originating and terminating SwMIs.

6.4 ANF-ISIIC impact of interworking with ISDN/PISN/PSTN

When a (TETRA) calling user requests the establishment of an external individual call through a PSTN/PABX/ISDN gateway located in a SwMI different from that where that user is registered, the originating SwMI shall include both the ITSI number of this gateway and the external number in its ISI-SETUP PDU, as defined in table 21.

The ISI-PROGRESS PDU defined in table 22 may be used to indicate to the originating SwMI the fallback choice for some characteristics requested for the call in the ISI-SETUP PDU that the PSTN/PABX/ISDN gateway cannot support (i.e. duplex selection, N slot bearer requested for a data call in the basic service information element, speech service). If the called SwMI does not send such fallback choice characteristics in the ISI-PROGRESS PDU, it shall send them in either the ISI-ALERTING PDU or the ISI-CONNECT PDU.

The optional information elements for fallback choice characteristics in the definitions of the ANF-ISIIC PDUs concerned shall not be repeated if information has already been sent.

For an external incoming individual call (i.e. to a TETRA called user) routed over the ISI, the originating SwMI shall send the number of the external calling party to the other network if available, in its ISI-SETUP PDU as defined in table 21.

6.5 Protocol interactions between ANF-ISIIC and supplementary services and other ANFs

6.5.1 Interaction with SS-CLIR

In an individual inter-TETRA call, both the originating and the terminating SwMIs shall support SS-CLIR for the user at the other end (e.g. the terminating SwMI shall support SS-CLIR for the calling user).

If SS-CLIR has been invoked for the calling user, the following shall apply:

- the originating SwMI shall give to the information element "Calling party presentation indicator", defined in clause 6.1.3.3.12, in the ISI-SETUP PDU the value corresponding to presentation restricted;
- then, if the call is re-routed or forward switched, all ensuing ISI-SETUP PDUs shall have the same value of their information elements "Calling party presentation indicator";
- if the connected user migrates during the call and registers in a new SwMI, the terminating SwMI shall give to the information element "SS-CLIR invoked for other party", defined in table 79, in the ISI-CALL RESTORE PREPARE PDU or ISI-PATH CALL RESTORE PREPARE PDU sent to the new SwMI the value corresponding to SS-CLIR invoked for the other party. The same requirement shall then apply to the new SwMI if the connected user migrates again during the call.

If SS-CLIR has been invoked for the connected user, the following shall apply:

- the terminating SwMI shall give to the information element "Connected party presentation indicator", defined in clause 6.1.3.3.16, in the ISI-CONNECT PDU the value corresponding to presentation restricted;
- if the calling user migrates during the call and registers in a new SwMI, the originating SwMI shall give to the information element "SS-CLIR invoked for other party", defined in table 79, in the ISI-CALL RESTORE PREPARE PDU or ISI-PATH CALL RESTORE PREPARE PDU sent to the new SwMI the value corresponding to SS-CLIR invoked for the other party. The same requirement shall then apply to the new SwMI if the calling user migrates again during the call.

6.5.2 Interactions with SS-CF

6.5.2.1 Interaction with SS-CF at call establishment

When SS-CF has been invoked, the ANF-ISIIC procedure specified in clause 6.3 shall apply in replacing the called user by the forwarded-to user, SwMI A being the SwMI where SS-CF has been invoked and SwMI B either the home SwMI of the forwarded-to user or when the home SwMI of the forwarded-to-user is SwMI A, the SwMI where that user has migrated. Notably if the call is re-routed, the following shall apply for the ISI-REDIRECT PDU, defined in table 23, sent by the SwMI where SS-CF has been invoked:

- its corresponding SS-CF information elements shall give the ITSI of the forwarded-to user;
- its migration information elements shall be present only if the home SwMI of that user coincides with the SwMI where SS-CF has been invoked and if that user has migrated: they shall then indicate the SwMI where he has migrated.

NOTE 1: The preceding indented paragraph means notably that if the home SwMI of the forwarded-to user is different from the SwMI where SS-CF has been invoked, the corresponding the ISI-REDIRECT PDU sent by that SwMI if SS-CF is operated by re-routeing will not include migration information elements.

NOTE 2: If the home SwMI of the called user coincides with the originating SwMI and that user has not migrated, clearly the call will be an intra-TETRA call. If in such a case SS-CF has been activated for the called user and if the forwarded-to user is registered in a different SwMI, SS-CF will invoke an ANF-ISIIC for the establishment of the call. The same may hold if the forwarded-to user is registered in the originating SwMI, that SwMI being (still) the home SwMI of the called user but not that of the forwarded-to user.

If SS-CF has been invoked and the call is forward switched at least once, the cases which can occur and be detected by the called SwMI are the following:

- an ISI trombone connection with the preceding SwMI (i.e. the one which has sent the corresponding ISI-SETUP PDU); or
- an ISI loop connection with the originating SwMI.

If called SwMI detects ISI loop connection with the originating SwMI in the case where SS-CF has been invoked and the call forward switched at least once, it may then send ISI-REDIRECT PDU addressed to the originating SwMI (see clause 6.1.2.4). In addition, it should detect the possible ISI trombone connection with the preceding SwMI when that SwMI is different from the originating SwMI, i.e. in the case where SS-CF has been invoked and the call forward switched at least once.

Thus also a transit SwMI may receive ISI-REDIRECT PDU indicating "possible ISI trombone or loop connection detected" if the called SwMI has detected an ISI trombone connection with the preceding transit SwMI. In that case the transit SwMI shall send a ISI-DISCONNECT PDU, defined in table 45, to clear the ISI connection between itself and the called SwMI, which has become unnecessary.

NOTE 3: A trombone connection could also occur without been detected by the called SwMI if there are several transit SwMIs between.

6.5.2.2 Specific interaction with SS-CFNRY at call establishment

When SS-CFNRY has been invoked, if the forwarded-to user MS/LS sends the U-ALERT PDU, the accompanying ISI-ALERTING PDU, defined in table 25, shall not be sent twice across those same signalling connections. The ISI-INFO DEMAND PDU, defined in table 35, may be sent instead.

6.5.2.3 Interaction with SS-CF at call restoration

There shall be no interaction between ANF-ISIIC with SS-CF at call restoration, i.e. when a user migrates and registers in a new SwMI during an individual inter-TETRA call established with or more call forwardings, the call restoration procedure shall be the same as that described in clause 6.3.3.3.

This is applicable also when the new SwMI coincides with a SwMI on the call path, i.e. either some forward switching SwMI if the call has been forward switched or the other end SwMI (terminating or originating SwMI).

NOTE 1: If SS-CF has been invoked only one, than a trombone connection could result when the new SwMI coincides with a SwMI on the call path in the absence of trombone or loop detection by ANF-ISIIC, while a genuine loop connection may occur if many SS-CF have been invoked and more than one has been operated by forward switching. Such a case will arise when e.g. the connected user migrates either in an "upstream" forward switching SwMI (on the call path) or in the originating SwMI.

NOTE 2: The ISI trombone or loop connection detection recommended for the ANF-ISIIC call restoration should avoid such connection:

- in the case where call restoration happens for the connected user in the originating SwMI, or for the calling user, in the terminating SwMI;
- in the case where call restoration happens for the calling user in the forward switching SwMI just after the originating SwMI on the call path; and
- in the case where call restoration for the connected user in the forward switching SwMI just before the terminating SwMI on the call path.

Unfortunately, ANF-ISIIC will not be capable to detect a trombone or loop connection resulting from migration when the new SwMI coincides with any other forward switching SwMI. The reason for that is that neither the originating nor the terminating SwMIs are informed about all (forward switching) SwMIs on the call path.

6.5.3 Interaction with SS-CAD

6.5.3.1 Invocation of a specific ANF-ISIIC

When SS-CAD is invoked for an outgoing individual call and when the dispatcher is located in another SwMI, a specific ANF-ISIIC shall be invoked if the operation of SS-CAD entails the establishment of a call between the calling user and the dispatcher (i.e. diversion to the dispatcher). The corresponding TETRA PDU shall be the standard ISI-SETUP PDU (defined in table 21), i.e. no specific information element identifying this type of call shall be added to this TETRA PDU.

NOTE: Actually a specific SS-CAD PDU (CAD REQUEST PDU) is sent in addition to the ISI-SETUP PDU - which is not an interaction. The same applies if SS-CAD is invoked for an incoming individual intra-TETRA call and if the dispatcher is located in another SwMI.

6.5.3.2 Interception of an already invoked ANF-ISIIC

If SS-CAD has been invoked for an inter-TETRA individual call, the interaction between ANF-ISIIC and SS-CAD shall depend on whether or not SS-CAD operation entails the establishment of a call between the calling user and the dispatcher (i.e. diversion to the dispatcher).

If not, the invoked ANF-ISIIC shall simply be suspended in the SwMI where SS-CAD has been invoked. If yes, the corresponding call to the dispatcher shall be established by the ANF-ISIIC invoked for this inter-TETRA individual call: i.e. no additional ANF-ISIIC shall be invoked. To establish this call if the dispatcher is registered in a SwMI different from the SwMI where SS-CAD has been invoked, the already invoked ANF-ISIIC shall send the ISI-SETUP PDU, defined in table 21, and a specific SS-CAD PDU: CAD REQUEST PDU. The ensuing call to the dispatcher shall be established by forward switching (through the SwMI where SS-CAD has been invoked).

The information element "call diverted to a dispatcher" in the ISI-CONNECT PDU defined in table 26, sent when the call is established with the dispatcher shall be set on.

NOTE: This caters for the case where the originating SwMI would not support SS-CAD, but would support e.g. SS-TPI or lawful intercept.

6.5.3.3 Call authorization by a distant dispatcher

If the dispatcher is registered in a SwMI different from the SwMI where SS-CAD has been invoked and if a call has been established between the calling user and the dispatcher, to authorize the establishment of the call originally requested to be resumed, the dispatcher SwMI shall send a specific SS-CAD PDU: CAD ACCEPT PDU. That message shall be addressed to network address which identifies the SwMI where SS-CAD has been invoked (i.e. where diversion to the dispatcher was initiated). This network address shall be determined using the MNI value of the SwMI received in the CAD REQUEST PDU mentioned in clause 6.5.3.2.

6.5.3.4 Completion of call establishment

6.5.3.4.1 Call not diverted to dispatcher

Upon receiving the authorization to resume the call establishment, if the call has not been diverted to a dispatcher and if the connected user has migrated, the call establishment shall proceed as defined in clause 6.3.2, starting from clause 6.3.2.2.

6.5.3.4.2 Call diverted to dispatcher

Upon receiving the authorization to resume the call establishment, if the call has been diverted to a dispatcher and if the called user has migrated, the diverting SwMI shall send to the terminating SwMI the ISI-SETUP PDU, defined in table 21.

The contents of that ISI-SETUP PDU shall be the same as if the call had simply been forward switched and not been established before with the dispatcher (see paragraph a) of clause 6.3.2.2.2), except for the value of the information element transmission grant. The latter value shall be set in such a manner that it does not result in any change of transmission permission granted to the calling user, i.e.:

- if the calling user had been granted permission to transmit when the dispatcher authorizes the establishment of the call to be resumed, the diverting SwMI shall give to the information element transmission grant the value corresponding to transmission granted to another user (see table 126 of ETSI EN 300 392-2 [1]);
- if it is the dispatcher who had been granted permission to transmit when the dispatcher authorizes the establishment of the call to be resumed, the diverting SwMI shall give to the information element transmission grant the value corresponding to transmission granted (see table 126 of ETSI EN 300 392-2 [1]).

If the diverting SwMI is different from the originating SwMI, it shall:

- send the ISI-TROUGH ALERTING PDU defined in table 46 to the originating SwMI if it receives from the terminating SwMI the ISI-ALERTING PDU (defined in table 25);
- send the ISI-TROUGH CONNECT PDU defined in table 47 to the originating SwMI when it receives from the terminating SwMI the ISI-CONNECT PDU (defined in table 26);
- the diverting SwMI shall then join the connection of the new call to the called/connected user with that of the original call from the calling user (through the originating SwMI) diverted to a dispatcher. In addition if that dispatcher was registered in a SwMI different from the diverting SwMI, the diverting SwMI shall send a ISI-DISCONNECT PDU to the dispatcher SwMI to clear the connection of the original call with the dispatcher.

Whether or not it supports SS-CAD, the originating SwMI shall recognize the ISI-TROUGH ALERTING PDU, defined in table 46, and the ISI-TROUGH CONNECT PDU, defined in table 47, sent by the diverting SwMI as the true ISI-ALERTING PDU, defined in table 25, and the ISI-CONNECT PDU, defined in table 26, for the original call. Notably:

- upon receiving the ISI-THROUGH CONNECT PDU, defined in table 47, it shall send to the terminating SwMI the ISI-CONNECT ACKNOWLEDGE PDU, defined in table 29;
- the originating SwMI shall detect if any modification has occurred in the bearer service definition (i.e. change in the simplex/duplex selection, in the basic service or of CODEC) by analysing the contents of the corresponding information elements in the received ISI-TROUGH ALERTING or ISI-THROUGH CONNECT PDUs.

NOTE: The provision in the last paragraph is in line with the requirement in the stage 1 description (see clause 4.3.11) that the originating SwMI has to handle the set-up response that it receives as if no interception by the dispatcher had taken place; using stage 3 description terminology, this means as if it had received this response from the terminating SwMI in the ISI-CONNECT PDU.

If the called user has migrated and is registered in the originating SwMI, then to avoid the overriding of dispatcher authorization by a local SS-BIC, the information element incoming call barring status, defined in table 63, in the ISI-REDIRECT PDU (see table 23) shall be set to call authorized by SS-CAD.

6.5.4 Interactions with SS-PC, SS-PPC and SS-CRT

To be defined.

6.5.5 Interaction with SS-CW

When, after SS-CW has been invoked by a user MS/LS, that MS/LS sends the U-ALERT PDU (after having become idle), the ISI-ALERTING PDU, defined in table 25, shall not be sent twice. The ISI-INFO DEMAND PDU, defined in table 35, may be sent instead.

NOTE: The definition of the information element call status, in table 51, has taken into account the possibility to inform the originating SwMI that SS-CW has been invoked using the ISI-ALERTING PDU, else the ISI-INFO DEMAND PDU.

6.5.6 Interaction with SS-HOLD

No interaction.

NOTE: The definition of the information element call status, in table 51, has taken into account the possibility to inform the other SwMI that SS-HOLD has been invoked using the ISI-INFO DEMAND PDU.

6.5.7 Interaction with SS-CCBS and SS-CCNR

The only interaction between ANF-ISIIC and SS-CCBS or SS-CCNR lies in the possibility for the originating SwMI to override the invocation of SS-CAD for the SS-CCBS or SS-CCNR recall (i.e. new call for successful SS-CCBS or SS-CCNR operation) if SS-CAD had been invoked for the failed call attempt which has resulted in SS-CCBS or SS-CCNR being invoked. Such overriding request shall be sent (by the originating SwMI) in the ISI-SETUP PDU using the information element override SS-CAD invocation, defined in table 66.

6.5.8 Interaction with SS-BIC

There is no protocol interaction when the terminating SwMI is the SwMI first called by the originating SwMI (because either the terminating SwMI is the called user home SwMI and this user has not migrated, or the originating SwMI is the called user home SwMI).

When the home SwMI of the called user is different from the originating SwMI, when this user has migrated and when SS-CAD for incoming calls has not been invoked, the invoked ANF-ISIIC has to ensure the operation of SS-BIC for the incoming call in the called user home SwMI unless a local SS-BIC applies (which overrules the "general" SS-BIC). Such local SS-BIC can only apply if the called user is registered in the originating SwMI (after having migrated). According to clause 6.3.4, this will be detected by the invoked ANF-ISIIC in the called user home SwMI (using the originating SwMI Mobile Network Identity (MNI)), which will the ISI-REDIRECT PDU defined in table 23.

Consequently, the protocol interaction between ANF-ISIIC and SS-BIC consists only in having the information element incoming call barring status in that ISI-REDIRECT PDU set to either call barred by SS-BIC or call authorized by SS-BIC (see table 63).

NOTE: This applies only if SS-CAD for the incoming call has not been invoked, since it overrides SS-BIC.

6.5.9 Area Selection (SS-AS) and selected area number

The information element "selected area number" shall be carried in the TETRA ISI-SETUP PDU. The "selected area number" information element carries the same information as the "area selection" in the air interface, but adapted to the ISI signalling. The information element shall be used by the terminating SwMI during call set-up and may be used during call restoration. Refer to ETSI EN 300 392-12-8 [10] for the coding and usage of the selected area number information element.

6.5.10 Interactions with other supplementary services

At the time of the writing of the present document, no other supplementary service has been identified which would require for its invocation or its operation an interaction with ANF-ISIIC.

NOTE: Such supplementary services require only the transport of their PDUs (i.e. SS PDUs) through ANF-ISISS, as defined in clauses 9 and 10 of ETSI EN 300 392-9 [7].

6.6 ANF-ISIIC parameter values (timers)

ANF-ISIIC shall use timer T1 as defined in clause 6.3.3.3, to protect against too much delay of call restoration while a connection between the old SwMI and the new SwMI has been established. The minimum value of this timer shall be 10 s, and its maximum value, 30 s.

Annex A (informative): Interactions of SS-CFU with ANF-ISIIC

A.1 Possible SS-CFU activation

Except for a possible local SS-CFU activation which is detailed below, if SS-CFU is activated this will be in the called user home SwMI.

As to the local SS-CFU activation, it may happen when the called user home SwMI is SwMI B (i.e. not SwMI A) and when this user has migrated and is now registered in SwMI A. It then only applies for intra-TETRA calls (within SwMI A).

This local SS-CFU activation is independent from that in the called user home SwMI (e.g. they can both take place).

When the called user migrates further, this local activation (in SwMI A) will be cancelled.

A.2 Invocation and operation

A.2.1 Invocation

Whenever ANF-ISIIC has been invoked, it interacts with SS-CFU if the latter has been activated (by the called user, this user being at the same time the SS-CFU served user). In addition, when the home SwMI of the called user is SwMI A, SS-CFU invokes ANF-ISIIC for forwarding the call if the forwarded-to user home SwMI is different from SwMI A, except possibly when the forwarded-to user happens to be registered in SwMI A after having migrated.

NOTE: In all cases addressed below, notification to the SS-CFU served user will be ensured by SS-CFU, by signalling (i.e. without any need to invoke ANF-ISIIC).

A.2.2 Called user home SwMI being SwMI A

In the case where the called user home SwMI is SwMI A and where this user has activated SS-CFU, the SS-CFU invoked (by SwMI A supplementary service control application) simply invokes ANF-ISIIC to forward the call if the forwarded-to user home SwMI is different from SwMI A, except possibly when the forwarded-to user happens to be registered in SwMI A after having migrated.

NOTE 1: When the forwarded-to user is registered in SwMI A after having migrated, whether or not SS-CFU will invoke ANF-ISIIC towards this user home SwMI depends on how SwMI A routes calls to called users registered in this SwMI when it is not their home SwMI (i.e. they have migrated). If SwMI A routes such calls directly (i.e. without invoking ANF-ISIIC), then SS-CFU will forward the calls directly instead of invoking ANF-ISIIC towards the forwarded-to user home SwMI.

When the forwarded-to user is registered in SwMI A after having migrated, if SS-CFU has invoked ANF-ISIIC (in SwMI A) to forward the call (i.e. SS-CFU has not routed the call directly, as an intra-TETRA call), the possible trombone will be identified by this invoked ANF which will then clear the call attempt.

NOTE 2: SS-CFU will then route the call internally.

A.2.3 Called user home SwMI being SwMI B

A.2.3.1 Introduction

When the called user home SwMI is SwMI B, the ANF-ISIIC originally invoked for establishing the call with the called user invokes SS-CFU if it has been activated (by the called user) in this SwMI. This holds whether or not this user has migrated afterwards, except in the special case presented below.

In the special case where the called user (has migrated and) is now registered in SwMI A, where it has activated another SS-CFU in SwMI A for intra-TETRA calls (local call forwarding) and where SwMI A call control application has invoked ANF-ISIIC (to SwMI B) to establish the call with the called user, then this ANF will not invoke the SS-CFU activated in SwMI B (the called user home SwMI). Instead it reports to SwMI A call control application the information that the called user has migrated and is now registered in SwMI A, and clears itself.

NOTE 1: In such a case, SwMI A supplementary service control application should check whether or not a "local" SS-CFU has been activated for this called user. If yes, when the home SwMI of the forwarded-to user for this "local" SS-CFU is different from SwMI A, this "local" SS-CFU will invoke ANF-ISIIC as defined in clause A.2.1. If no, SwMI A call control application will establish the call to the called user, which would then be an intra-TETRA call.

NOTE 2: The additional condition above (in the last paragraph before note 2) that "the called user has activated another SS-CFU in SwMI A" results in the need for the invoked ANF to check whether a local SS-CFU has been activated before possibly invoking the home SwMI SS-CFU. And if a local SS-CFU has been activated, then, the invoked ANF will by-pass the invocation of the home SwMI SS-CFU (i.e. if a local SS-CFU has been activated, the home SwMI SS-CFU will not be invoked for the special case of intra-TETRA calls addressed in this last paragraph before note 2).

NOTE 3: On the other hand another issue arises if SwMI A call control application can route directly (i.e. without invoking ANF-ISIIC) calls to called users registered in this same SwMI when it is not their home SwMI (i.e. they have migrated). This issue is that, if no local SS-CFU has been activated, SwMI A supplementary service control application needs to be informed about the activation of SS-CFU in the called user home SwMI, to invoke it. This is why ANF-ISIMM will ensure that whenever a user which has activated SS-CFU in its home SwMI migrates to another network, the SwMI of this other network will be informed about this SS-CFU activation.

The definition of further interactions between SS-CFU and ANF-ISIIC depends on whether the forwarded-to user home SwMI:

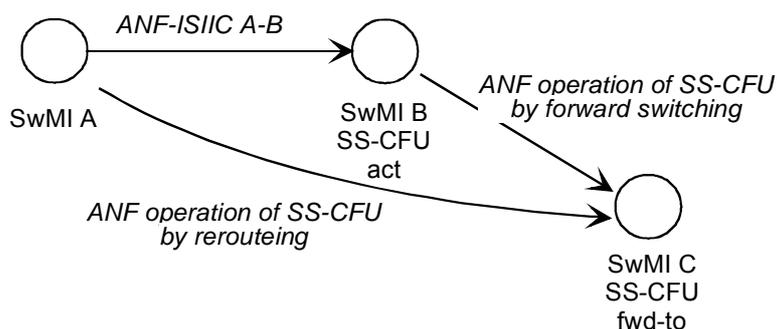
- is SwMI B and this user is registered in its home SwMI;
- is SwMI B and this user has migrated;
- is different from SwMI B and this user is registered in its home SwMI;
- is different from SwMI B and this user has migrated.

In all those cases, if the forwarded-to user has itself activated a call diversion supplementary service, the ANF operation continues in invoking and operating the routing of this new call diversion supplementary service.

A.2.3.2 Forwarded-to user with home SwMI being SwMI B, being registered in its home SwMI

If the forwarded-to user home SwMI is SwMI B and if this user is registered in its home SwMI, the ANF-ISIIC originally invoked to establish the call with the called user ensures SS-CFU routing (after having invoked it): i.e. by changing destination within SwMI B, to the forwarded-to user instead of to the called user.

A.2.3.3 Forwarded-to user with home SwMI being SwMI B, having migrated



**Figure A.1: Interaction with SS-CFU
Forwarded-to user with home SwMI being SwMI B, having migrated**

If the forwarded-to user home SwMI is SwMI B and if this user has migrated, as illustrated by figure A.1, the ANF-ISIIC originally invoked to establish the call with the called user ensures its routing by changing destination, to the forwarded-to user instead of to the called user. This routing is done by the ANF normal operation, that is either by re-routing or by forward switching.

NOTE: Compliance with the standards defining SS-CFU implies that SwMI B should support forward switching.

When SwMI C coincides with SwMI A, this will be identified by the ANF which then informs SwMI A call control application about the possible trombone and clears the call attempt. Moreover, the invoked ANF-ISIIC will also ensure that the routing of this new SS-CFU is established with no loop connection (notably no trombone connection) between the originating and the terminating SwMIs if it has previously invoked one or more call diversion supplementary services.

A.2.3.4 Forwarded-to user with home SwMI different from SwMI B, being registered in its home SwMI

The same provisions as in clause A.2.3.3 apply if the home SwMI of the forwarded-to user is different from SwMI B and this user has not migrated.

A.2.3.5 Forwarded-to user with home SwMI different from SwMI B, having migrated

In what follows, the home SwMI of the forwarded-to user (which is different from SwMI B) will be designated as SwMI B_{anf}, with SwMI C designating the SwMI where this user has registered (after having migrated), and SwMI B_{fwd}, the home SwMI of the SS-CFU served user (i.e. the called user). This is illustrated in figure A.2.

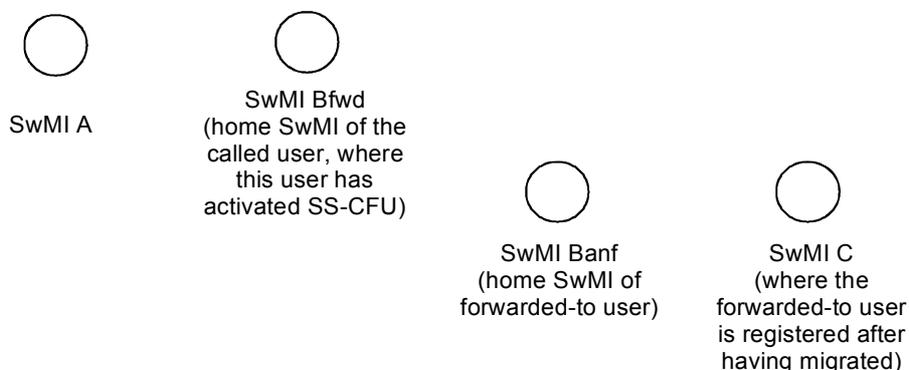


Figure A.2: SwMI identification Forwarded-to user with home SwMI different from SwMI B, having migrated

Case a) SwMI C different from SwMI B_{fwd}

Once the ANF-ISIIC originally invoked to route the call to the called user has invoked SS-CFU, first, as in the case of clause A.2.3.3, it ensures the routing of the call attempt to SwMI B_{anf} by changing destination, to the forwarded-to user instead of to the called user. Then since the forwarded-to user has migrated and is now registered in SwMI C, this ANF completes the routing of the call to the forwarded-to user.

This routing is done by the ANF normal operation, that is either by re-routing or by forward switching. However, instead of having the ANF deciding in a single step whether to re-route or forward switch the call (on the basis of information provided by a single SwMI B), the ANF operates in two steps, using:

- first the information provided by SwMI B_{fwd} to either re-route the call (from SwMI A) to SwMI B_{anf} or forward switch it (through SwMI B_{fwd});
- then the information provided by SwMI B_{anf} to again either re-route (either from SwMI A or from SwMI B_{fwd}, depending on how the first step has been operated) the call or forward switch it (through SwMI B_{anf}).

NOTE: This will result in the call being:

- fully re-routed (from SwMI A) to SwMI C;
- forward switched both through SwMI B_{fwd} and through SwMI B_{anf}; C (this case is shown in figure A.3);
- forward switched in SwMI B_{fwd} and (partially) re-routed from SwMI B_{fwd} to SwMI C; or
- re-routed from SwMI A to SwMI B_{anf} and forward switched through SwMI B_{anf} (this case is shown in figure A.4).

Of course, the choice of whether to re-route or forward switch the call may be restricted if SwMI A, SwMI B_{fwd} and SwMI B_{anf} do not support both modes of operation.

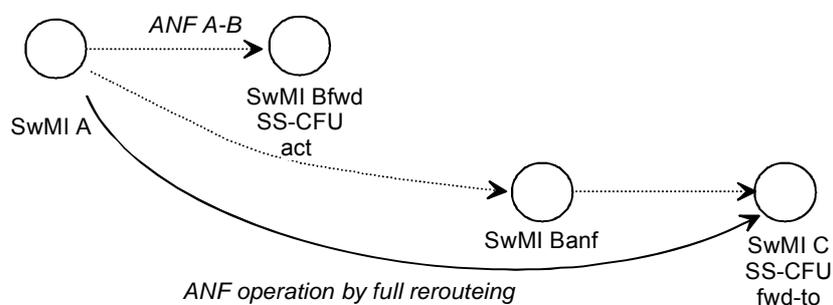
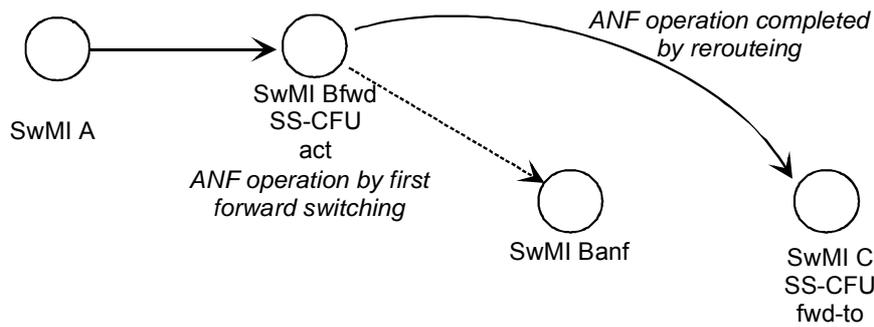


Figure A.3: Interaction with SS-CFU re-routing Forwarded-to user with home SwMI different from SwMI B, having migrated ANF operation by full re-routing



**Figure A.4: Interaction with SS-CFU operated by forward switching
Forwarded-to user with home SwMI different from SwMI B, having migrated
ANF operation by first forward switching and then re-routing**

When SwMI C coincides with SwMI A, this is identified by the ANF which then ensures that the call will be established with no loop connection. Moreover, the invoked ANF-ISIIC also ensures that this is the case between the originating and the terminating SwMIs if it has previously invoked one or more call diversion supplementary services.

Case b) SwMI C coinciding with SwMI B_{fwd}

If SwMI C coincides with SwMI B_{fwd} (i.e. the forwarded-to user is registered in SwMI B_{fwd}), whether or not the invoked ANF-ISIIC routes the call attempt first towards SwMI B_{anf} depends on whether or not SwMI B_{fwd} is able to recognize that a call to a called user registered in this SwMI but with a different home SwMI (i.e. it has migrated into SwMI B_{fwd}) is an intra-TETRA call without invoking ANF-ISIIC to the called user home SwMI.

If SwMI B_{fwd} is not able to route such calls internally, then the interaction between SS-CFU operation and ANF-ISIIC is as specified in case a) above (case of SwMI C different from SwMI B_{fwd}), except that when the call is not rerouted from SwMI A, the invoked ANF will avoid the trombone that would result from forward switching through SwMI B_{fwd}.

If SwMI B_{fwd} routes such calls directly, then the invoked ANF-ISIIC simply ensures the direct routing of SS-CFU (i.e. within SwMI B_{fwd}). Moreover, the invoked ANF-ISIIC also ensures that this is the case between the originating and the terminating SwMIs if it has previously invoked one or more call diversion supplementary services.

Annex B (informative): Change Requests

The present document contains change requests as indicated in table B.1.

Table B.1: Change Requests

| No | CR vers. | Standard Version | Clauses affected | Title | CR Status |
|----|----------|------------------|------------------|-------|-----------|
| | | | | | |

History

| Document history | | |
|-------------------------|----------|-------------|
| V1.1.1 | May 2018 | Publication |
| | | |
| | | |
| | | |
| | | |