ETSI TR 103 565-1 V1.2.1 (2018-12)

TECHNICAL REPORT

**TETRA and Critical Communications Evolution (TCCE);
Interworking between TETRA and 3GPP
mission critical services
Part 1: General considerations for interworking**

Reference
RTR/TCCE-04196

Keywords
mission critical communication, radio, 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 a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners.
GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

Contents

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 Report (TR) has been produced by ETSI Technical Committee TETRA and Critical Communications Evolution (TCCE).

The present document is part 1 of a multi-part deliverable covering interworking between TETRA and 3GPP mission critical services, as identified below:

Part 1: "General considerations for interworking";

Part 2: "Security of interworking between TETRA and Broadband applications".

Modal verbs terminology

In the present document "**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.

Introduction

3GPP is standardizing a set of mission critical services as applications working over 3GPP LTE systems. These services include speech PTT systems (MCPTT), data (MCData) and video (MCVideo) systems. Users have a need to interwork between TETRA and 3GPP MC systems for a number of reasons which can include:

- Communication between different user groups who receive service from the different types of system.
- Use of both systems by the same set of users to allow selection of optimum radio coverage and services in any situation.
- Migration from an existing TETRA system to a 3GPP MC system over a period of time, which may be long.

It is envisaged that an interworking function will be standardized as part of this work within ETSI TCCE to allow communication between TETRA and 3GPP MC systems. The present document provides considerations for realizing this interface.

1 Scope

The present document contains scenarios and considerations for an interworking function between TETRA and 3GPP MC services.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

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 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

NOTE: The latest version of either ETSI EN 300 392-2 or ETSI TS 100 392-2 applies.

[i.2] ETSI TR 102 022-2: "User Requirements Specification; Mission Critical Broadband Communications; Part 2: Critical Communications Application".

[i.3] ETSI EN 300 392-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 1: General network design".

[i.4] Recommendation ITU-T E.218: "Management of the allocation of terrestrial trunk radio Mobile Country Codes".

[i.5] IETF RFC 3986: "Uniform Resource Identifier (URI): Generic Syntax".

[i.6] ETSI EN 300 392-3 (all sub-parts): " Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI)".

NOTE: The referenced document has multiple parts; all parts are relevant.

[i.7] ETSI TS 123 280: "LTE; Common functional architecture to support mission critical services; Stage 2 (3GPP TS 23.280)".

[i.8] ETSI TS 123 379: "LTE; Functional architecture and information flows to support Mission Critical Push To Talk (MCPTT); Stage 2 (3GPP TS 23.379)".

[i.9] ETSI TS 123 281: "LTE; Functional architecture and information flows to support Mission Critical Video (MCVideo); Stage 2 (3GPP TS 23.281)".

[i.10] ETSI TS 123 282: "LTE; Functional architecture and information flows to support Mission Critical Data (MCData); Stage 2 (3GPP TS 23.282)".

[i.11] TETRA + Critical Communications Association: "TETRA Interoperability Profile (TIP); Part 1: Core".

NOTE: Available at https://tandcca.com/interoperability/specifications-for-interoperability/.

[i.12] ETSI TS 126 201: "Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Speech codec speech processing functions; Adaptive Multi-Rate - Wideband (AMR-WB) speech codec; Frame structure (3GPP TS 26.201)".

[i.13] IETF RFC 4867: "RTP Payload Format and File Storage Format for the Adaptive Multi-Rate (AMR) and Adaptive Multi-Rate Wideband (AMR-WB) Audio Codecs".

[i.14] 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.15] ETSI EN 302 109: "Terrestrial Trunked Radio (TETRA); Security; Synchronization mechanism for end-to-end encryption".

[i.16] 3GPP TR 23.781: "Study on migration and interconnection for mission critical services".

[i.17] 3GPP TR 23.782: "Study on mission critical communication interworking between LTE and non-LTE systems".

[i.18] ETSI TS 124 379: "LTE; Mission Critical Push To Talk (MCPTT) call control; Protocol specification (3GPP TS 24.379)".

3 Definition of terms and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 300 392-2 [i.1] and the following apply:

controlling system: system responsible for call control, policy enforcement, floor control management and media distribution in a call

NOTE: A system may take either a controlling or a participating role in different circumstances.

group affiliation: mechanism by which a user's interest in one or more groups is determined

NOTE: Terminology used in 3GPP mission critical services; equivalent to TETRA group attachment.

group attachment: mechanism by which a user's interest in one or more groups is determined

NOTE: Terminology used in TETRA; equivalent to 3GPP group affiliation.

interconnection: means of communication between two systems whereby users obtaining service from one system can communicate with users who are obtaining service from one or more other systems where the systems use similar technologies

interworking: means of communication between two systems whereby users obtaining service from one system can communicate with users who are obtaining service from one or more other systems where the systems use different technologies

MCData: mission critical data service standardized in 3GPP

MCPTT: mission critical push to talk speech service standardized in 3GPP

MCVideo: mission critical video service standardized in 3GPP

migration: means for a user with a subscription to a first system to obtain service directly from a second system whilst making use of the subscription to the first system

participating system: system responsible for call control, floor control management and media distribution on behalf of its served users under the control of the controlling system

NOTE: A system may take either a controlling or a participating role in different circumstances.

3.2 Abbreviations

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

3GPP	3rd Generation Partnership Project
ACELP	Algebraic Code-Excited Linear Prediction
AMR-WB	Adaptive Multi Rate - Wide Band
ASSI	Alias Short Subscriber Identity
BS	Base Station
codec	coder-decoder
DGNA	Dynamic Group Number Assignment
DTX	Discontinuous Transmission
FFS	For Further Study
GSSI	Group Short Subscriber Identity
GTSI	Group TETRA Subscriber Identity
ID	IDentity
IP	Internet Protocol
ISI	Inter System Interface
ISSI	Individual Short Subscriber Identity
ITSI	Individual TETRA Subscriber Identity
IWF	Inter Working Function
MC	Mission Critical
MCC	Mobile Country Code
MCPTT	Mission Critical Push To Talk
MNC	Mobile Network Code
MNI	Mobile Network Identity
MS	Mobile Station
PTT	Push To Talk
QoS	Quality of Service
RFC	Request For Comment
RTP	Real Time Protocol
SDS	Short Data Service
SDS-TL	Short Data Service - Transport Layer
SIP	Session Initiation Protocol
SSI	Short Subscriber Identity
SwMI	Switching and Management Infrastructure
TCCA	TETRA and Critical Communications Association
TETRA	TErrestrial Trunked RAdio
TIP	TETRA Interoperability Profile
TX	Transmitter
URI	Uniform Resource Identifier

4 Service overview

4.1 Services

User requirements are specified in ETSI TR 102 022-2 [i.2].

The following services are required to be carried across an interworking function between TETRA and 3GPP MC services:

a) Individual call - duplex and semi duplex.

b) Group call.

c) Variants of these, such as emergency calls and broadcast calls.

d) Short Data Service.

e) Packet data service (see note).

Users will also require the following supplementary services to be supported:

a) Late entry on either system.

b) Talking party identity, carried between systems.

c) Calling party identity, carried between systems.

d) Restriction of calling and talking party identities carried between systems.

e) Group management on both systems.

f) Further supplementary services as required.

Additional service characteristics to be supported are:

a) Prioritization schemes allowing priority requests to be resolved between systems.

b) Pre-emption.

NOTE: Packet data service interworking is FFS, but may simply make use of IP routing techniques outside the scope of this study.

Security services such as authentication, air interface encryption and end to end encryption need to be maintained appropriately.

Note that the TETRA standard supports a wider range of functionality than the set that is required for interworking with mission critical applications over broadband. Also, some aspects of services within the TETRA standard are not commonly utilized within TETRA implementations, and are not specified for interoperability in the TCCA core TIP [i.11] and accompanying specifications. Aspects of TETRA standard functionality that are not specified for interoperability in [i.11] or not required for interworking in ETSI TR 102 022-2 [i.2] will not be discussed within the present document. Additional functionality specified in the interoperability documentation following publication of the present document may be reflected in future revisions of the present document.

4.2 Interworking realization

The concept of the interworking function can be as shown in figure 4.2-1.

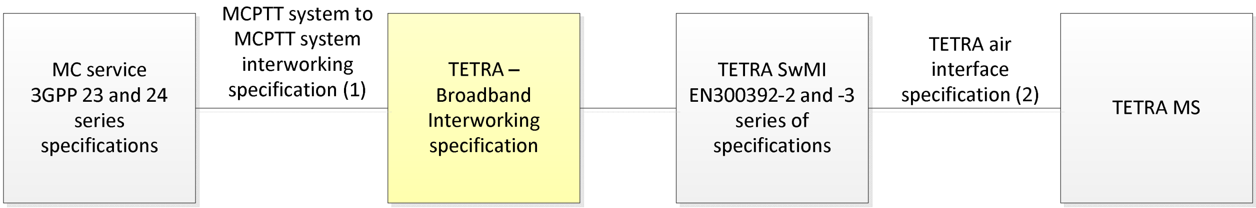

Figure 4.2-1: Concept of the interworking function

The interworking function to be specified as a result of this study will take the TETRA Inter-System Interface, specified in the ETSI EN 300 392-3 series of specifications [i.6] as a model of the functionality possible between TETRA systems, and the MCPTT interworking interface, which is expected to be specified within 3GPP Release 15, as inputs. The interface to the TETRA SwMI could make use of the TETRA ISI, or could be outside the scope of the standardization process.

The present document is intended to lead to a Technical Specification which specifies the interaction between the interface between a TETRA MS and a TETRA SwMI under the conditions of inter-system behaviour (shown as (1) in figure 4.2-1), and the MC system interworking interface (shown as (2) in figure 4.2-1).

The TETRA Inter-System Interface is defined in ETSI EN 300 392-3 [i.6], and an MCPTT to MCPTT interface has been studied in 3GPP TR 23.781 [i.16]. An MCPTT to non MCPTT interworking interface has been studied in 3GPP TR 23.782 [i.17].

For the purposes of this study, the interface will be considered to be a single logical interface between each pair of one MCPTT service and one TETRA SwMI. Any realization of multiple interfaces between a pair of systems e.g. for resilience is FFS.

NOTE: Interface addressing is considered a lower layer function and is outside the scope of the present document.

5 Considerations

5.1 General

Considerations relating to TETRA - 3GPP MC service interworking are described in this clause.

5.2 Addressing

5.2.1 TETRA and MCPTT addressing

The TETRA standard identifies a subscriber by an Individual TETRA Subscriber Identity ITSI. This consists of a 24 bit Mobile Network Identifier MNI (consisting of Mobile Country Code MCC and Mobile Network Code MNC), and an Individual Short Subscriber Identity ISSI. The numbering scheme is described in ETSI EN 300 392-1 [i.3] and the management of MCC and MNC is specified in Recommendation ITU-T E.218 [i.4].

3GPP MCPTT and MCData specify an MCPTT-ID and an MCData-ID which are a URIs; see ETSI TS 123 280 [i.7], ETSI TS 123 379 [i.8] and ETSI TS 123 282 [i.10]. A URI is expected to be an alphanumeric string consisting of individual user part and domain part. The MCPTT-ID and MCData-ID identify the system or systems within which the MCPTT and MCData user subscriptions are located. There may be no limit on length, however IETF RFC 3986 [i.5] recommends a maximum length of 255 characters. The 3GPP MC series of specifications also define an MCPTT Group ID and an MCData Group ID, which are also URIs and which identify both the system and the MCPTT or MCData server within the system where the group is defined. Additional services defined in ETSI TS 123 281 [i.9] and ETSI TS 123 282 [i.10] define further service specific identities with the same structure; and the generic structure for MC service identities from 3GPP Release 14 is defined in ETSI TS 123 280 [i.7].

TETRA is capable of carrying an external subscriber number field to convey an address that uses a numbering system outside that of TETRA, however the limitations specified for this in ETSI EN 300 392-2 [i.1], clause 14.8.20, are that it should have a maximum of 24 digits, where each digit is represented by a 4 bit number which can be numbers 0-9, '*', '#' or '+'. A new external number field could conceivably be added to the TETRA standard, but the carriage of up to 255 characters, which could require 1 785 bits or 2 040 bits (if 7 or 8 bit alphabets were used) could prove problematic, especially in the case of talking party identity. Somewhere around 8 full slots of information sent using the Basic Link are unlikely to be sufficiently reliable, and could delay the start of a call by nearly half a second, hence this is unlikely to be a valid solution.

Group identities have similar structures in each technology: a TETRA group is represented by a Group TETRA Subscriber Identity, the GTSI, which is composed of the MNI and Group Short Subscriber Identity GSSI.

It is likely that an address book facility will be needed as part of the interface to allow an address in one system to be represented as a different address in the other type of system in a way that is compatible with that system. This could also act as a 'whitelist' if needed to gate which users are permitted to communicate on the other system. The address book may only need to function in one direction if a URI is translated to a TETRA ITSI or GTSI, but the TETRA ITSI or GTSI is provided in some form of URI on the MC system (e.g. as SSI@MNI such as 12345@67890). However, it may also be more useful to show a name related to the ITSI or GTSI rather than numerical information on the MC system. An address book translation of a URI representing an MCPTT user or MCPTT group to a TETRA ITSI or GTSI could map the system identity part of the URI to a TETRA MNI, thus allowing different MCPTT systems to be represented as different TETRA system MNIs to users within the TETRA system. As different MC service IDs may be used for the same user when using different services on the 3GPP MC system, the address book in the interface may need more than one service specific identity on the MCPTT side to map to a single ITSI on the TETRA side.

For example, a TETRA user making individual calls and sending SDS messages to a single ITSI which represents a user on the MCPTT system may need that ITSI to be translated into an MCPTT-ID for the individual call, and to an MCData ID for the SDS message.

NOTE: The functionality described within this clause is applicable to MCData as well as to MCPTT.

A single MCPTT or MCData user may also be active on multiple devices at the same time. He may have different profiles active on different devices. However as these are still identified by the same MC service identities, the interworking function may be able to forward calls or SDS messages to the MC system, and let the MC system decide where and how to route the call or message.

More than one MCPTT or MCData user may be active on a single MC device at the same time. However, the interworking function should only need to forward calls to the relevant MC service IDs, and let the MC system decide on the final routing.

If a simple interworking system only required groups to be connected together and no individual services, the address book may not need to list individual users provided talking party identity was not required across systems.

5.2.2 Interconnection and migration

A user may have a subscription to both a TETRA network and an MC service. However due to differences in the naming and addressing, in security aspects and in service differences of the two technologies, a subscriber will not be able to roam from one technology to the other using exactly the same subscription. Therefore, there is no requirement for migration, and interconnection is the focus of the present document.

It is possible that an application will link a subscription on the TETRA network to a subscription on the MC service, linking the two subscriptions to the same user. Such an application could provide some form of seamless connectivity, attempting to complete calls to the user on whichever network he is receiving service, and possibly forwarding calls between networks to complete such calls. It is FFS whether such functionality should be part of a later release of an interworking function.

5.2.3 Identification of calling or talking party

It may be necessary to use an address book, as described in clause 5.2.1 above, to achieve the transmission of calling or talking party across the interworking function if the identities used in one system cannot be conveyed in the other system.

There will be situations where for reasons of confidentiality, the identity of a calling or talking party should be withheld from called parties. The interface solution needs to take this into account and anonymize the talking party if necessary, by indicating to the system of the called parties that the identity should be withheld. The TETRA ISI allows a parameter to be associated with a call request to indicate whether the identity should be presented to called parties, or withheld.

NOTE 1: A similar parameter will be needed within an MCPTT or MCData system to indicate that a calling party identity should be withheld, and the MCPTT server or MCData server will need to be able to withhold the identity.

The restriction of talking party identity may not be needed within the system within which that user is receiving service even if it is desired to anonymize the identity to users in the connected system.

NOTE 2: The controlling system has to trust the participating system not to falsify the identity of a user requesting transmission in the non-anonymous case anyway. The controlling and participating systems are described in clause 5.3.2.

5.3 Speech group calls

5.3.1 Group affiliation (group attachment)

As a pre-requisite to taking part in speech group calls, group affiliation (group attachment) is necessary to express an interest in communications in that group. Any affiliations to a group in the participating system need to result in an affiliation from the participating system to the controlling system. The controlling and participating system are described in clause 5.3.2. The affiliation may be explicit or implicit. If explicit affiliation is used, at least one affiliation is sent to the controlling system. If the controlling system requires knowledge of the identity of all affiliated group members, then the affiliation and de-affiliation of each group member will need to be sent to the controlling system. However if this is not needed, or if there are security constraints such as the participating system members wish to be anonymous as far as the controlling system is concerned, then only the first affiliation to the group within the participating system needs to cause an affiliation to the group to be sent from the participating system to the controlling system, and similarly only the de-affiliation of the last group member needs to result in a disaffiliation be sent from the participating to the controlling system.

If implicit affiliation is used between systems, or a single affiliation sent when the first group member joins the group in the participating system, the controlling system may receive call set up signalling or floor control signalling from a group member whose individual affiliation to the group is not known to the controlling system.

5.3.2 Controlling systems

In order to avoid conflicts in talking parties, one of the two systems will need to be assigned the controlling system for the group. Requests for transmission from the non-controlling, i.e. participating system will be passed to the controlling system, and the controlling system will decide to which party to grant transmission.

It should be possible to configure either the TETRA or the MCPTT system to be controlling system for any cross-system group call. This should be configured on a group by group basis and not dynamically chosen.

NOTE: Any constraints which might prevent either TETRA or MCPTT from acting as controlling system are FFS.

It is possible that the participating system may perform some local arbitration before forwarding a call request to the controlling system, e.g. if two parties request transmission at the same time, the participating system may immediately arbitrate and deny transmission to one party, only forwarding the call request of the successful party to the other system. However, if the group supports queuing for transmission of other parties whilst one party is transmitting, then all call requests should be sent to the controlling system so that it can build the queue appropriately.

If the nominated controlling system has no affiliated members, the nominated controlling system may still need to act as controlling system, for example in case a group member affiliates to the group mid-way through a call.

5.3.3 Group linking

5.3.3.1 Overview

In an inter-system interoperability case within the same technology, for example TETRA - TETRA connection using the ISI, group calls operating between systems can take place either by considering the group to be defined in one system only, such that users affiliate/attach to the group directly in the home/controlling system of that group using the ISI, or group linking can be used so that calls operating across systems can be realized by separate groups in each system which are linked together, with one of the linked groups designated to be the 'master' or controlling part of group. (Actually, it is the system hosting the controlling part of the group that is the controlling entity, but the linked groups can be considered to have a master-slave relationship.)

Group linking could be a solution for TETRA - MCPTT interworking. Each terminal (TETRA MS or MCPTT client) would affiliate to a group in their own system, where the group is linked to a group in the other system. There could be different degrees of control and integration in such a solution.

The naming issues for groups may make a solution based on group linking simpler to achieve.

5.3.3.2 Interworking function as proxy group member

One method of linking TETRA and MCPTT groups would be for the TETRA Group Home SwMI to record the MCPTT group as though it were the address of a single MS; i.e. as a single entry in its list of group members for a particular TETRA group.

The interworking function could be always affiliated to the relevant group on each system, either by active affiliation procedure or by configuration.

When the group home SWMI attempts to set up a group call to such a group, the setup will thus also be sent to the IWF. The IWF will then use a translation table to convert the TETRA-compatible address into the MCPTT compatible group address.

In the MCPTT group management server, the IWF is similarly recorded as a single member of the group, and call setups from the MCPTT server will similarly include the IWF. The IWF will then translate from the MCPTT group address to the matching TETRA group address.

When the call is set up on the MCPTT system, in order to identify the talking party in the call in the TETRA system, the interworking function could use its address book to provide an associated ITSI for the MCPTT user (if an address translation is provided for that user). Thus, the interworking function could provide a talking party identity for the MCPTT user, provided the TETRA SwMI permitted the interworking function to provide talking party identities other than the identity of the interworking function. The same process could work in reverse, with the interworking function providing a translated MCPTT ID for a TETRA talking party.

If the interworking function acts as a true client, nomination of a controlling system and contention resolution in race conditions could be an issue. However, if both systems permit either no talking party interruption, or any party to interrupt any other regardless of any priority setting, and if the interworking function was configured to always give one system priority over the other, the behaviour could remain predictable except in a race condition. To avoid race conditions, one system would need to be given priority over the other, and the interworking function would need to have permission to interrupt any other talking party within that system. This could imply that the interworking function would need to have higher priorities than a dispatcher within the system.

In summary, the issues with race conditions and contention management are likely to make this an unsuitable solution.

5.3.3.3 Interworking function as proxy TETRA SwMI/MCPTT server

Another method would be for the interworking function to act as another TETRA SwMI, connected using an ISI which employs group linking. The same situation would be the case on the MCPTT system, with the interworking function acting as if it were another MCPTT system.

Using group linking behaviour, one of the two systems would be nominated to be the controlling system, which should result in predictable behaviour in race conditions and pre-emption cases, as the interworking function would forward any pre-emption requests to the controlling system.

There are three possibilities for affiliation where groups are linked by an interworking function that acts as a proxy second SwMI/proxy second MCPTT system:

1) The interworking function is always affiliated to a group in both systems. In this case, the systems are always linked in order to carry group calls across the interface whether there are users affiliated in both systems or not. Individual affiliations from group members are not passed to the controlling system.

   The system nominated to be the participating system would be expected to send call setup requests to the controlling system even when the controlling system has no affiliated members.

   The system nominated to be the controlling system would be expected to send call setup requests to the participating system, even if the participating system has no affiliated members, allowing the participating system to reject a call setup in this case.

2) The interworking function affiliates to the group in each system as soon as the first affiliation is received in the connected system, and disaffiliates when the last group member leaves the group in the connected system. Individual affiliations from group members are not passed to the controlling system.

   The system nominated to be the controlling system will set up the call on request from the participating system, even when the controlling system does not have any affiliated group members.

   The controlling system may decide to not involve the participating system in calls if the participating system has not informed the controlling system of any affiliated members.

3) Each affiliation in the participating system is passed on to the controlling system, using the address book or temporary identities such that each group member in the participating system is separately represented in the controlling system.

   As in case (2), the controlling system will set the call up on request from the participating system, even if the controlling system has no affiliated members. The controlling system may refrain from sending call setups to the participating system if the participating system has not informed the controlling system of any affiliated members.

In the linked group case described in this clause, the participating system always requests the controlling system to make the call setups. However, the participating system may be expected to set up group calls in the event that the IWF is not operational, and call requests cannot be sent to the controlling system.

NOTE: Where a particular behaviour is accepted practice defined in TETRA Interoperability testing, such behaviour should be replicated at the interworking interface.

5.3.4 Single group across both systems

As an alternative to a linked group approach, a group could be defined in a single system only, and the interworking function could forward requests for affiliation and call set ups, and could be considered to act as a participating server within the non-controlling system of a group. The interworking function would cause the MCPTT system to behave as if it were another TETRA system connected by the ISI.

In the case of the MCPTT system acting as the controlling function for the group:

- Affiliations would need to be sent from the TETRA system via the interworking function to the MCPTT server for each MS that wished to affiliate. The MCPTT group identity would need to be configured as a GTSI within the interface, to allow affiliation from the TETRA system. Each affiliating MS would need to be represented as an MCPTT ID in the MCPTT system by the addressing function discussed in clause 5.2.
- Group call setup from the MSs in the TETRA system would need to be sent to the MCPTT system by the interworking function, making use of the appropriate addressing function for talking party identity.
- Affiliations and call setup signalling would need to be accepted from MCPTT identities belonging to a different MCPTT system.

In case of the TETRA system acting as the controlling function for the group:

- Affiliations will need to be sent from the MCPTT system via the interworking function, with the MCPTT ID of the user and the MCPTT group identity of the group being translated to an ITSI and a GTSI respectively.
- Group call setup signalling from the clients in the MCPTT system would need to be sent to the TETRA system by the interworking function.
- Affiliations and call setup signalling within the TETRA system would need to be accepted from ITSIs belonging to a different TETRA system.

NOTE: The TETRA group linking approach adopted for interoperability only requires the SwMI to accept signalling for affiliation or call setup an SSI from the same system (where that SSI may be an ASSI associated with a visiting migrating MS).

5.3.5 Group patching

Within a TETRA system, groups can be patched together to allow communication between all members of all constituent groups. The term 'group patching' can be used where the Dynamic Group Number Association (DGNA) supplementary service is used, or can apply where some internal mechanism is used within the SwMI to cross connect audio between groups. The service can be activated by a dispatcher, or by some other means within the SwMI.

An audio patch could be another means of connecting an MCPTT group to a TETRA group. In this case, the interworking function becomes a member of the group on both systems, and connects call and transmission requests between the systems. Affiliation becomes a local matter within each system, with the interworking function acting as an affiliated user, albeit possibly with different priority compared to other users. It is likely that the identity of the patching device (the interworking function) will be sent as part of a call request to one system on behalf of a user on the other system.

NOTE 1: A similar approach was used to interconnect TETRA systems in the 3 Countries Pilot project, which was used to test user operational scenarios and derive requirements for the TETRA ISI.

In such an interworking function connected arrangement, one system could still be considered the controlling system. The controlling system would need to consider the priority of the interworking function as a group member with respect to other local group members when deciding who to grant transmission rights during contention or pre-emption, and there may be some interruption cases which are not achievable. Alternatively, neither system need be considered controlling, in this case the contention resolution may be more variable depending on which user has the floor or requests the floor.

NOTE 2: A patching system alone does not provide a solution for individual/private call, without further intervention of a human or intelligent application.

The mechanism to make the interworking function a member of groups and both systems, and the means of connecting audio between the groups does not need a standardized approach, and so because of this together with the limitations described above this potential approach will not be considered further within the present document.

5.3.6 Group regrouping

Group regrouping will be needed at least within each system. It is possible that a group on one system could be joined to multiple groups on the other system by the interworking function. However, it may be preferable to perform the group regrouping function independently within each system and simply link the regrouped groups together at the interworking function.

There should be a controlling system nominated for the combined regrouped groups, as there will be for normal groups. Any limitations of either TETRA or MCPTT which would prevent either from becoming a controlling or participating system for regrouped groups are FFS.

If regrouped groups on either system use temporary identities, the system may present the temporary identity to the interface. In this case, it may be difficult to determine which group(s) on the other system should be connected to the temporary group if this is needed.

There may be issues if groups are patched together within one system where those groups are also separately interconnected with groups on the other system. Further patches on the interconnected system will compound the problem. Problems will increase if the controlling system is defined differently for linked groups which are then patched. Patches at the same time on both systems could result in multiple connections across the interworking function carrying the same group information; and mechanisms may be needed to prevent this, and/or to be able to identify duplicate media flows and filter these accordingly; and to deal with any contention situations that arise. Thus, a maximum of one linked group should be included in a group regroup in either system to prevent duplicate media flows and floor control requests.

Therefore, there will be a number of limitations in group patching situations:

- regrouping signalling addressed to temporary groups cannot be carried via the IWF because of the addressing difficulty with temporary groups;

- regrouping can only take place within a system if:
    - the re-grouped groups are not linked groups; or
    - the system in which the regrouping is performed is the controlling system for those linked groups involved in the re-grouping; or
    - the system in which the regrouping is performed in a participating system and only one of the groups included in the re-grouping is a linked group;
- if a linked group is regrouped into a temporary group, group calls including floor control and media need to be sent to the IWF using addressing related to the original linked group, in order to preserve the linkage to the linked group in the other system.

The speech codec used in each group needs to be considered in group regrouping scenarios. If groups are connected through the interworking function which pass speech in a transparent mode, using the ACELP codec for speech, then the regrouped group should also be able to use this codec. See also clause 5.10.

5.3.7 Group call types

TETRA group calls can be unacknowledged or acknowledged. An acknowledged group call is a call in which the user is expected to make some response on receipt of the call request.

Interoperable TETRA systems according to the TCCA Core TIP [i.11] do not support acknowledged group calls, and - this mode does not need to be supported at the interworking function.

TETRA group calls may include a presence check to interrogate for the presence of specific users, e.g. if a call owner other than the SwMI is nominated. It is expected that where presence checking is used within a TETRA system, the presence check will not be carried across the interworking function. However, when a TETRA system is a participating entity in a call, the TETRA SwMI may decide not to go ahead with the call should a presence check fail. In such circumstances, it is FFS whether the MCPTT system should also not proceed with a group call in progress.

NOTE: It may be possible to link TETRA presence check behaviour with MCPTT acknowledged group calls to provide a similar service.

MCPTT calls can be defined as chat model or pre-arranged model. The different models will affect the interworking process, and it is possible that signalling may need to be different as far as the interworking function is concerned depending on the definition of the MCPTT group.

It is FFS whether there will actually be any limitations, for example of one type of MCPTT group call is not supportable via the interworking function. This is a potential consideration for MCPTT, and is captured in Annex A of the present document.

A TETRA system will implement a hang time after which channel resources are cleared. This hang time is configured to give a reasonable response time for users to respond to a transmission, but to be short enough to avoid wasting channel resources. The interaction of this hang time with MCPTT session times, and the call model used on MCPTT, is FFS.

5.3.8 Call queuing

A TETRA SwMI may queue calls, usually if a channel resource is not available on one or more BSs. Intermediate responses can be sent to MSs or to connected SwMIs to maintain the state whilst waiting to complete a call.

MCPTT does not support queuing at Stage 2 in 3GPP Release 13 other than queuing a user for transmission for a group call in a transmission interrupt situation. The only facility to delay within MCPTT is a timer in SIP signalling, which is be used at session start (noting that this is not call start for a chat model call), which is set to 64 × estimated round trip time. There is no facility for a 'waiting' state in the call setup process.

It is therefore unlikely that delaying the start of a call due to queuing can be supported with the interworking function, and therefore in conditions where the TETRA system cannot immediately start a call because of a shortage of channel resources at base stations, the call will be started on the MCPTT system before the TETRA system is ready at all sites.

5.4 Individual calls

Individual calls will have the similar considerations to group calls concerning the translation and potential restriction of identities, and the need for one of the two systems to act as the controlling system. Rules for the controlling system may be required to be derived from the location of one of the users, e.g. the system of the called or calling party, or may need some fixed rule, e.g. TETRA or MCPTT system always needs to be controlling party.

NOTE: Any requirements for deriving such rules are outside the scope of the present document.

Both systems support half and full duplex calls (where full duplex is referred to as 'without floor control' on MCPTT), and therefore both types may be supported at an interworking function.

Support for discontinuous transmission (DTX) is FFS.

5.5 Floor control

Floor control is used to determine the transmitting party in both individual and group calls.

The controlling system for a combined group operating across both systems would be expected to decide to which user to grant the floor when floor requests are received from an idle condition, where contention occurs, or where transmission interrupt is requested. In an interworking scenario particularly, it may be preferable for the participating system to first arbitrate between talking party requests, and to reject a request immediately from a user not authorized to interrupt, or from the user who loses the race in a race condition without forwarding failed requests to the controlling system.

Local arbitration of floor requests in the participating system is outside the scope of the TETRA ISI specifications. In general, the standard expects floor requests to always be forwarded to the controlling SwMI.

The interworking function could be provided with some information to also help deal with floor control in these or other conditions; for example, to reject requests for transmission interrupt if a linked group is configured not to allow this.

5.6 Emergency calls and alerts

Both TETRA and MCPTT support emergency individual/private calls and emergency group calls. These can be completed through the interworking function.

It is FFS whether the interworking function needs to be aware that a particular individual or group can be the target of an emergency call.

MCPTT supports an emergency alert. TETRA supports a defined pre-coded status value (= 0) to indicate an emergency condition. It is probable that these two functions can be mapped together.

The emergency state of an MCPTT client is defined in ETSI TS 123 379 [i.8] following an emergency alert, and the user is expected to be the only person capable of resetting the emergency condition. TETRA does not define the behaviour of the MS or expected actions of the user in an emergency condition, although behaviour is expected to be similar to that of MCPTT. The implementation will be responsible for ensuring that behaviour is as expected in actual systems.

5.7 Priorities

TETRA can send and receive call priorities as part of call setup information across the air interface. However, TETRA systems may also implement their own priority schemes and assign these to individuals and to groups for the purpose of deciding which individuals or groups can transmit during resource congestion; these mechanisms are outside the scope of the present document.

MCPTT systems may assign configured priorities to users and groups, which can include assigning a user a priority as a group member within each group. See ETSI TS 123 379 [i.8], Annex A. MCPTT systems support three separate priority call types: normal, imminent peril and emergency calls, which can be distinguished by signalling between client and server.

The interworking function will need to map TETRA priorities and 3GPP priorities such that groups and individuals are treated similarly by the priority mechanisms on both systems.

It is FFS whether a mapping of MCPTT configured priorities to TETRA SwMI proprietary internal priorities will have any impact on an interworking function standard.

5.8 Supplementary services

5.8.1 General

TETRA has a number of supplementary services including call forwarding, call completion, call hold, call wait, late entry etc. In general, MCPTT has none except where these are embedded in a call procedure (late entry, prioritization of calls, talking party identity, calling party identity) or related to group regrouping.

It is FFS which supplementary services can be provided at an interworking function.

5.8.2 Call forwarding

MCPTT in Releases 13 and 14 has no call forwarding services. It is FFS whether a call can be forwarded within a TETRA system to an address which translates to an address in an MCPTT system across the interworking function.

5.8.3 Late entry

5.8.3.1 Late entry for clients within each system

If the interworking function provides an acknowledged service for signalling between the two systems, then late entry signalling within an established call should not need to cross the interworking function.

The TETRA system would be expected to provide late entry signalling internally for a call sourced from an MCPTT system.

Where an MCPTT system provides late entry over unicast services for users affiliating to the group or returning from coverage loss whilst a call is in progress, the participating system which is the home system for the user would be expected to provide the late entry signalling even if another system was the controlling system (see ETSI TS 123 379 [i.8], clauses 10.6.2.3.1.1.4, 10.6.2.3.1.2.4 and 10.6.2.4.3).

It is assumed that where multicast services are used for group call, the participating server will be responsible for sending late entry signalling over the multicast channel to its served users.

Therefore, it can be assumed that late entry for clients within an established call can be a local matter within each system.

5.8.3.2 Late entry between systems

Late entry situations can also take place between systems. For example, if a system defined as a participating system for a group had no participants at the start of a call, but subsequently a group member joined the group whilst the call was ongoing, the system would need to bring into the call and supplied with media.

If affiliation is used between systems such that the controlling system is made aware when a participant joins the group, this affiliation is the trigger to start sending media to the connected system via the IWF.

If affiliation is not used, then the controlling system needs to periodically check whether the participating system has acquired any group members. The TETRA ISI specifications take this into account, but similar functionality will be required from the MCPTT system.

The controlling system also needs to take the possibilities of colliding calls into account. If a call request is received from a participating system due to a newly affiliated group member, or if calls are received from two systems at the same time the controlling system needs to arbitrate. In general, the controlling system is expected to grant the first (or existing) call request and reject the second, bringing the system of the rejected party into the call. However, if one of the two calls is an emergency call, then the other call request or ongoing transmission will be rejected or pre-empted as appropriate.

The behaviour of the MCPTT system should be similar to the TETRA system in this case.

5.8.4 DGNA

5.8.4.1 User regrouping

It is likely that user regrouping can take place within each system. It is FFS whether there is any requirement, or any possible solution, for issuing regroup commands from one system concerning users on the connected system. If it were possible, such a service is likely to be subject to security constraints. It is unlikely that the service is supportable, and is currently not available in the TETRA ISI.

5.8.4.2 Group regrouping

If groups are regrouped within each system as proposed in clause 5.3.5, there needs to be a way of linking together the separate temporary groups on each system unless there is a reserved pool of linked groups (i.e. linked between the interconnected systems) which can be used as parent groups for group regrouping. Clause 5.3.5 discusses constraints for a group regrouping service.

NOTE: ETSI TS 124 379 [i.18], clause 6.3.5.2 allows a call setup to a group to be transferred to a regrouped group.

5.9 Short Data Service

5.9.1 General

MCData SDS is a feature within 3GPP Release 14, specified in ETSI TS 123 282 [i.10]. The services described are similar to those of TETRA SDS. However, there are different length constraints, with MCData requiring up to 1 000 characters of 8 bit text (8 000 bits) whereas TETRA Basic Link services being limited to approximately 1 120 bits, and the Advanced Link service of the order of 2 048 bits. Therefore, there will need to be either length limitation on the 3GPP SDS messages, or adaptation to the multi part SDS format within TETRA.

TETRA offers both a simple SDS service, and a richer SDS-TL service offering store and forward, message receipt acknowledgement and other such services. TETRA SDS (including SDS-TL) contains assigned Protocol Identifiers which can be used to identify the higher layer application which is using the SDS service as a bearer service.

It is FFS how application service bearer messages using 3GPP SDS will be formatted, and whether these will be easily transformable into SDS or SDS-TL service messages. It is likely that the IWF will need to reformat such that the relevant protocol identifiers are used on each system, and to observe length constraints on TETRA. The IWF will need to reject SDS messages, using an appropriate reason code, that cannot be formatted within the constraints of the other system.

End to end encrypted long SDS messages require consideration, to ensure continuity of the encryption process.

5.9.2 Format conversion in the IWF of TETRA SDSs to MCData SDSs

When the IWF receives a TETRA SDS from a TETRA user that is addressed to an MCData user or MCData group that is within the allowable size limits for MCData SDSs, the IWF converts the data into an MCData SDS payload format. It converts the source and destination addresses provided by the TETRA MS into a source MCData ID and a destination MCData ID or MCData Group ID.

Conversion of the data into the MCData SDS payload format involves the IWF determining which MCData application identifier matches the TETRA SDS format (for example, TETRA SDS-TL messages contain a protocol identifier (see ETSI EN 300 392-2 [i.1], clause 29.4.3.9) which the IWF can attempt to match to an MCData SDS application identifier). Alternatively, the IWF can decide to send an unconverted TETRA SDS inside an MCData SDS payload that contains the application identifier "TETRA SDS".

NOTE: 3GPP Release 14 does not support MCData SDS application identifiers.

It is optional and dependent on IWF configuration (including information about the destination address) as to whether the IWF uses "TETRA SDS" application identifiers, or whether the IWF converts the SDS into the format of one of the yet-to-be-defined MCData SDS application identifiers.

TETRA SDS-TL messages can contain delivery report requests, and these are converted into corresponding MCData disposition requests in the MCData SDS messages.

5.9.3 Format conversion in the IWF of MCData SDSs to TETRA SDSs

When the IWF receives an MCData SDS from an MCData client, the IWF attempts to convert the MCData SDS payload into a TETRA SDS format. The IWF converts the source and destination MCData addresses into TETRA addresses. If the MCData SDS includes an MCData disposition request, the IWF should attempt to convert the MCData SDS into an SDS-TL message that includes the equivalent of the disposition request in the TL-header. If the conversion is successful, the IWF then sends the SDS or SDS-TL message to the destination TETRA MS or group of TETRA MSs.

Conversion of the MCData SDS payload into a format suitable for delivery to the TETRA MS involves the IWF determining whether the payload can be sent as a TETRA SDS (probably not if an MCData disposition request was included) or whether there is a TETRA SDS-TL protocol identifier that matches the MCData SDS application identifier(s) in the MCData SDS payload. Alternatively, the IWF can reject the MCData SDS with reason "application not supported". In the event that the MCData SDS payload contains multiple application identifiers, the IWF can elect to send multiple messages to the TETRA MS, one per application identity.

NOTE: 3GPP Release 14 does not support MCData SDS application identifiers.

5.9.4 Message references

MCData SDSs include a "transaction identifier" information element. Disposition notifications contain a "reply identifier" that has to match the transaction identifier to which the disposition notification refers. Similarly, TETRA SDS-TL messages contain an 8-bit message reference that allows TETRA SDS-TL messages and reports to be linked.

The IWF will need to create translation tables between TETRA message references and MCData conversation identifiers that take into account the original source address. In TETRA the combination of the message reference and the original source address (ITSI) is intended to uniquely identify each message being transported by a TETRA network (ETSI EN 300 392-2 [i.1], clause 29.3.2.5).

5.9.5 Delivery reports

MCData SDSs can contain the disposition request "delivered", "read", or "both" (see ETSI TS 123 282 [i.10], clause 7.4.2.1.3). These translate directly into the TETRA SDS-TL header message report requests "delivered", "consumed", or "received and consumed" (see ETSI EN 300 392-2 [i.1], clause 29.4.3.3). The TETRA SDS delivery reports are sent in the TETRA SDS-TL "Short report" and TETRA SDS-TL "SDS-Report" PDUs, and the MCData SDS disposition reports are sent in MCData data disposition notification messages. It should be possible to translate these between TETRA and MCData.

5.9.6 SDS length management by the IWF

The IWF is configured with the MCData system-maximum size limits for MCData SDSs and with the TETRA SwMI system-maximum size limits for SDS and SDS-TL messages. If the TETRA concatenated text messaging protocol (ETSI EN 300 392-2 [i.1], clause 29.5.10) is supported by the IWF and the TETRA SwMI, the IWF is configured with the maximum number of SDS text messages that is permitted for a concatenated SDS text message. If the TETRA concatenation of SDS-TL messages protocol (ETSI EN 300 392-2 [i.1], clause 29.5.14) is supported by the IWF and the TETRA SwMI, the IWF is configured with the maximum permitted number of SDS-TL message slices.

When the IWF receives an SDS delivery request from a TETRA MS to a chosen MCData user that is within the allowable size limits for MCData SDSs, the IWF converts the SDS into an MCData SDS payload format and sends the MCData SDS to the MCData server for delivery to the intended MCData user.

When the IWF receives an SDS delivery request from a TETRA MS to a chosen MCData user that exceeds the allowable size limits for MCData SDSs, the IWF can:

- deny the request; or
- convert the TETRA SDS message into an MCData SDS that exceeds the maximum size of an individual MCData SDS, cut the over-sized MCData SDS into slices that fit within the MCData SDS maximum size and then send each MCData SDS to the intended MCData user (only useful if the MCData user supports an evolved MCData service that includes SDS concatenation and if the number of MCData SDS slices does not exceed any MCData SDS server data limit); or
- truncate the data at or below the MCData system maximum size limit for the corresponding MCData SDS and then send the truncated data to the chosen MCData user in an MCData SDS. (However, it is not likely that truncation will be acceptable.)

NOTE: 3GPP Release 14 does not support MCData SDS concatenation.

Whether the IWF denies the request, truncates the message or slices the message depends on IWF configuration and the type of message (for example, the IWF configuration could indicate if the destination MCData user supports MCData SDS concatenation and could indicate that it is acceptable to truncate a message containing text but not acceptable to truncate other types of message).

When the IWF receives an MCData SDS delivery request from an MCData user that is within the allowable size limits for the TETRA system, the IWF converts the MCData payload into a TETRA SDS or TETRA SDS-TL and sends the message to the intended TETRA MS(s).

When the IWF receives an MCData SDS delivery request from an MCData user that exceeds the allowable size limits for the TETRA system, the IWF can:

- deny the request; or
- convert the MCData SDS payload into a TETRA SDS-TL message that exceeds the maximum size of an individual TETRA SDS-TL message and send the message using the TETRA concatenation of SDS-TL messages protocol (ETSI EN 300 392-2 [i.1], clause 29.5.14) (only possible if the TETRA SwMI supports data message concatenation and if the number of SDS-TL message slices does not exceed the TETRA SwMI limit for SDS-TL slices); or
- truncate the data at or below the system maximum size limit for the corresponding TETRA SDS or SDS-TL and then send the truncated data to the chosen TETRA MS(s) in a TETRA SDS or SDS-TL message. (However, it is not likely that truncation will be acceptable.)

The method used by the IWF depends on IWF configuration and the type of message (for example, the IWF configuration might indicate that it is acceptable to truncate a message containing text but not acceptable to truncate other types of message).

5.10 Status and alerts

5.10.1 Status coding

TETRA only standardizes the emergency pre-coded status in ETSI EN 300 392-2 [i.1], clause 14. However further values agreed within industry are specified in the TCCA Core TIP for interoperability, [i.11]. These are intended for purposes such as call back request, TX inhibit indication, etc.

MCData enhanced status is described in ETSI TS 123 282 [i.10], clause 7.9. It is FFS whether the facility will be completed in 3GPP Release 14 MCData stage 3 standardization.

Until such functionality has completed the standardization process, status functions will not operate across the interworking function.

5.10.2 Emergency alert

Emergency alert is standardized as a specific function in MCPTT specifications. For an emergency alert to be sent between systems, the interworking function will need to manage the status protocol using the defined 'emergency' value within the TETRA system, and the emergency alert procedures in the MCPTT system.

MCPTT provides an alert request and an alert response message; and can optionally include the location of the requesting party in the alert request. TETRA uses a specific status value for emergency. Behaviour is specified in the TCCA Core TIP [i.11]. TETRA would have no means of carrying location within the emergency alert status.

The interworking function will need to manage the disparity in the two protocols, and some situations this may not be completely achievable. A simple emergency alert sent from the MCPTT system to the TETRA system could be acknowledged by the interworking function provided it is informed when a downlink status has been successfully delivered across the air interface. In the TETRA to MCPTT direction, no response will be expected by a TETRA user. To enhance the service on the TETRA side, a further status would need to be defined for acknowledgement response - but this could prove problematic to add to a deployed fleet of MSs. Alternatively, a defined status response (e.g. destination not reachable) or an SDS message with suitable text (e.g. "Warning: emergency alert not deliverable") could be used in negative response cases only, with the assumption of success when no response is received.

In many deployed cases, emergency alert is used between the MS and SwMI only on a TETRA system, addressed to the serving group address or some other pre-defined address. If an emergency alert within the TETRA SwMI is desired by some fixed network server attached to the MCPTT system only, then provided that the relevant address is contained in an address book in the interworking function, the alert could be forwarded to the MCPTT system for that system to process as it desired. The same functionality could operate in reverse, and in practice an emergency alert from the MCPTT system sent to an appropriate address could be consumed within the TETRA system.

5.10.3 Callback request

Callback request is also a specific function added to in MCPTT standards in 3GPP Release 14, which allows a response from the called user. This will need to be mapped to the TETRA status function by the interworking function.

The interworking function would need to manage the disparity in the two protocols, for example sending an application level response back to an MCPTT client when a lower layer acknowledgement has been received over the TETRA air interface, and either ignoring a response to a TETRA user when an MCPTT user is called, or only sending a negative status response in case of failure.

5.11 Speech coding

It is likely that native calls in each system will continue to use their assigned codec, AMR-WB in the case of MCPTT and ACELP in the case of TETRA. The interworking function will be expected to perform transcoding of the speech where this is required. The quality impact of transcoding between the two codecs is FFS. It may be advisable to use the TETRA ACELP codec end to end for calls in interworking groups as a matter of configuration to avoid quality loss issues. It is not recommended to dynamically change the codec in an MCPTT system according to whether there are TETRA group members present or not, as the change in perceived speech quality may have a negative impact on receiving users, especially those in poor background noise conditions.

The codec to be used in an MCPTT group call is negotiated at the setup of the call or the session. It is inadvisable to allow call by call negotiation of different codecs depending on whether a TETRA system is included in the call or not. Thus, MCPTT group configuration should specify the default codec to be used for a call.

If an end to end encrypted call is required without decryption at the interface, the MCPTT system will need to support the TETRA ACELP codec and End to End encryption mechanisms as it is unlikely that TETRA would be able to support a higher bandwidth codec.

To allow end to end encryption key management, there needs to be a means to provide the MCPTT client with TETRA key management messages. These could make use of the MCData SDS service if there is support for SDS messages being carried between a TETRA and an MCPTT system, or could use a different mechanism. One alternative may be to use the group management server to distribute key material for groups.

5.12 Media encapsulation

AMR-WB frame encapsulation is specified in ETSI TS 126 201 [i.12]. Packing of AMR-WB frames into RTP packets is specified in IETF RFC 4867 [i.13].

TETRA ISI encapsulation of media is defined in ETSI TS 100 392-3-8 [i.14]. A further encapsulation of ACELP media for use in broadband systems will be defined, using this specification as a basis.

The interworking function will need to encapsulate media passing to the other system in the correct media format for that system.

Where end to end media is to be encoded in TETRA ACELP, a packet format will be specified for the MCPTT system to contain this media.

The rate at which the TETRA encoded speech is supplied to the IWF could be related to the TETRA vocoder frame rate (30 msec or 60 msec for pairs of frames, as bundled at the TETRA air interface), or at the TETRA air interface frame rate (56,667 msec) including a gap every 18^{th} frame. There may need to be optimizations in QoS and bearer selection to send these audio frame rates efficiently.

5.13 Security aspects

5.13.1 Service authorization

Users will be expected to be authorized to interwork across the interworking function with users in the other type of system.

If group call affiliations are managed locally, then each system can be responsible for authorizing its users to join groups which are connected to groups in the other system, without involvement of the interworking function.

If identity translation is needed by an address book in order to interwork with individual services, then being present in this address book can provide additional authorization for interworking, in addition to any authorization within the local system. If the MC system uses different addresses for different services (e.g. MCPTT-ID, MCData ID) then the presence of a service specific address will also provide some degree of service level authorization.

5.13.2 User authentication

Each system carries out its own authentication locally. The TETRA system authenticates the MSs, the MCPTT system authenticates the user. Each system will have to trust that the connected system has correctly authenticated any user or the device as appropriate that makes a call request that is carried by the interworking function.

5.13.3 Interface authentication

The authenticity of the interworking function will have to be verified by each system independently.

Users making calls across the interworking function will have to trust that their local system has verified the authenticity of that interface.

5.13.4 Media encryption and key management

TETRA air interface encryption applies between the BS and MS of the TETRA system only, and will not be present at the interworking function.

MCPTT uses end to end media encryption as a matter of course, with session keys distributed between parties to the call protected by an identity based encryption protocol. The session key for a group call is the Group Master Key, and this is persistent within a crypto period. The session key for a private call is newly established for each private call.

Where transcoding is used at the interworking function, the interworking function will need to decrypt the encryption present on the MCPTT side, which requires the interface to act as an end point for the identity based encryption. This in turn will require the interface to be named in some way which provides a valid name by which MCPTT clients can key manage session keys for private calls, and to which a Group Management Server can provide Group Master Keys.

As a calling MCPTT client will be expecting to place a call to a user in a different MCPTT system, this implies that the IWF, will need to have identity based keys for each of the configured users within its address book. Alternatively, MCPTT clients will need to understand that the target address is via an IWF, and some alternative encryption solution is used such as having a single common identity based key set for all users reachable via the same IWF (i.e. on the same TETRA system).

Where end to end encryption is used with ACELP between MCPTT clients and TETRA users, the media encapsulation on the MCPTT side needs to allow for transfer of the relevant parameters relating to encryption synchronization for encrypted ACELP speech, including allowing for use of the frame stealing mechanism by TETRA terminals to carry such synchronization. The synchronization format is described in ETSI EN 302 109 [i.15].

NOTE: The MCPTT system could make use of ACELP with end to end encryption without needing to use frame stealing, allowing the additional bandwidth of the MCPTT system to be used to carry encryption synchronization in addition to the encrypted speech. The interworking function could carry out frame stealing on a transmission originating from an MCPTT client and carried to TETRA terminals, provided the originating MCPTT client indicated appropriate opportunities for frame stealing to be carried out by the interface. This functionality should not affect the TETRA system, or the ISI specifications. The MCPTT clients would need to mitigate for frame stealing when end to end encrypted speech originated from the TETRA system, as there is no way for the interworking function to replace lost speech frames.

Where end to end encryption is used with ACELP between MCPTT clients and TETRA users, key management will be needed for the MCPTT clients to ensure interoperable keys are used. This implies one of the following approaches:

1) The MCPTT system defines its own key management protocol to carry the relevant key management functions for provision of keys, association of key material and use of encryption to individual and group addresses. Key management system(s) will need to be able to provide key material and the appropriate configuration in the relevant formats to both the MCPTT clients and the TETRA terminals.

2) The MC system and clients could carry key management messages in the formats used in TETRA networks, and would need to provide a similar transport mechanism to TETRA SDS, which provides the transport for TETRA key management mechanism where the SDS protocol identifier is set according to ETSI EN 300 392-2 [i.1], clause 29. As TETRA key management is coupled to both ISSIs and GSSIs for the managed groups, the MCPTT client will need to be assigned an SSI, and will need to be aware of a relationship between GSSIs and MCPTT group identities to allow TETRA key management practices to take place.

3) The MC system and clients use TETRA defined key management messages, and are configured with ISSIs and GSSIs as necessary, as suggested in alternative (2) above. However, delivery of the key management messages could be over another protocol native to MCPTT, such as a configuration management interface.

Annex A: Implications for MCPTT from interworking service

A.1 General

This annex lists implications for the MCPTT service arising from the need for interworking with TETRA.

A.2 Interworking implications for MCPTT

A.2.1 MCPTT group call models

MCPTT supports chat model and pre-arranged session model. It needs to be considered:

- Whether there is a difference in how these need to be handled at the IWF in conjunction with a TETRA system, for example interacting with floor control messages at call setup, and whether there are any issues with delays and timers.
- Whether both models can be supported when interworking with TETRA, or whether the MCPTT system needs to only use one of these for interworking.
- Whether there will be any interaction with the call hang time on a TETRA system, and whether any timers need to be optimized on either system to take this into account.

A.2.2 Talking party identity restriction

If the TETRA facility to withhold talking party identity to users in a connected SwMI is desired for interworking, this will need to be added to MCPTT specifications.

A.2.3 Resource queuing

A TETRA system may queue a call to wait for channel resources to become available at the serving base stations for the called party or called group members. The calling party can be notified of a call that is proceeding in this case. If a service is required whereby a call start is delayed until all users have an available channel or resource, a waiting state for a calling party or party requesting the floor may need to be introduced to the MCPTT system.

A.2.4 SDS message rejection

If the MC system sends an SDS message to the IWF that cannot be translated into a TETRA SDS message, for example because the protocol identifier is not recognized, or the length is too great, the IWF will need to be able to reject such messages with an appropriate reason code. The MC system will need to recognize the rejection and reason codes, and potentially provide these to the MCData client that initiated the data transaction. Thus, rejection reasons relevant to interworking need to be incorporated in the MCData server to client protocol as well as in the interworking interface protocol.

A.2.5 Codec configuration

MCPTT group configuration should allow the TETRA ACELP codec to be configured as the default codec for groups assigned to interworking.

Appropriate quality of service characteristics will be needed to carry the ACELP vocoded speech, which could be sent in intervals relating to the vocoder rate (30 msec or 60 msec) or the TETRA air interface frame rate (56,667 msec).

The acceptable rates for delivery of ACELP frames within an MCPTT system need investigation; specific delivery rates for unicast and multicast may not match TETRA frame rates.

A.2.6 Private call keys

To terminate encryption in an MCPTT private call, the IWF will need identity based keys for the called party, which could be a large number of keys. Alternatively, the MCPTT client will need to be aware that a called user is actually a TETRA user called via an IWF, and will need to use a single key (or smaller set of keys) which are associated with the IWF. When terminating a call from a TETRA user, the MCPTT client will also need to recognize the signature as originating from the IWF.

A.2.7 Delivery of TETRA keys

The MCPTT system will need to be able to deliver TETRA key management messages if end to end encryption using the TETRA ACELP codec is needed. The mechanism may make use of an existing configuration management mechanism, or could use a different mechanism such as MCData SDS.

A.2.8 Late entry

If affiliation signalling is sent to a controlling MCPTT system from a participating system which previously had no affiliated group members whilst a group call is ongoing in the relevant group, the MCPTT system would be expected to send late entry signalling to bring the participating system and its group member into the call.

If affiliation is not used, and a participating system had rejected a call at the start of that call because it had no affiliated group members, the MCPTT system needs to periodically poll the participating system whilst a call is ongoing to check that no group member has joined the group during the call. The trigger for the poll could be each floor request during the call, or based on a timer, or some other suitable strategy. The MCPTT system also needs to take into account the case where call collisions could occur, for example due to a group member affiliating and immediately making a call setup request from a participating system which previously had no affiliated group members, whilst a call is ongoing in the same group.

History

Document history		
V1.1.1	October 2017	Publication as ETSI TR 103 565
V1.2.1	December 2018	Publication