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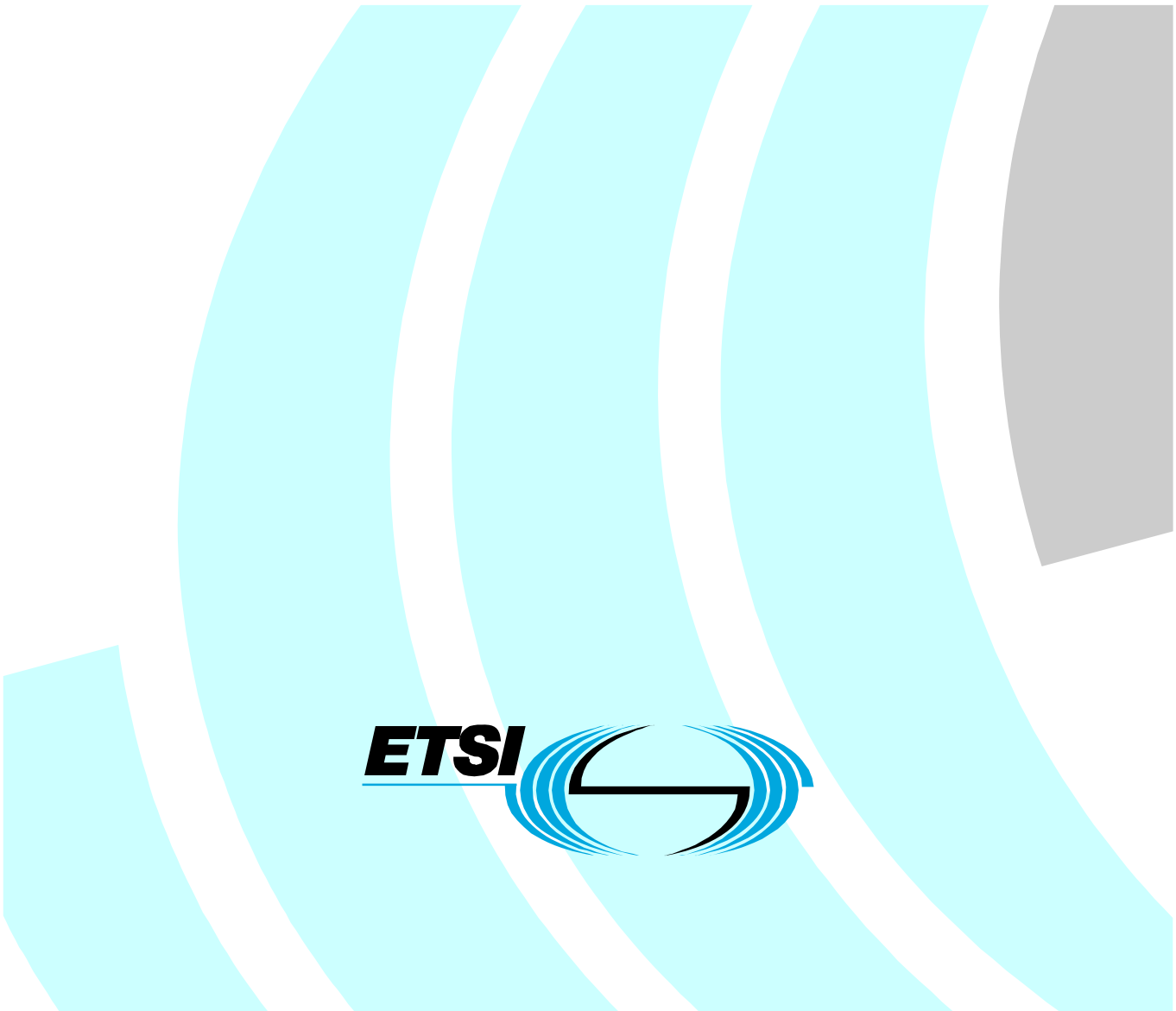
Technical Report

Terrestrial Trunked Radio (TETRA); User Requirement Specification TETRA Release 2.1; Part 10: Local Mode Broadband



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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Terrestrial Trunked Radio (TETRA).

The present document is part 10 of a multi-part deliverable covering the User Requirement Specifications (URSs) for TETRA Release 2 and Release 2.1, as identified below:

Part 1: "General overview" (Release 2.1);

Part 2: "High Speed Data" (Release 2.1);

Part 3: "Codec" (Release 2);

Part 4: "Air Interface Enhancements" (Release 2.1);

Part 5: "Interworking and Roaming" (Release 2.1);

Part 6: "Subscriber Identity Module (SIM)" (Release 2.1);

Part 7: "Security" (Release 2.1);

Part 8: "Air - Ground - Air services" (Release 2);

Part 9 "Peripheral Equipment Interface" (Release 2.1);

Part 10: "Local Mode Broadband" (Release 2.1);

Part 11: "Over The Air Management" (Release 2.1);

Part 12: "Direct Mode Operation" (Release 2.1).

Introduction

The Terms of Reference for TC TETRA approved at ETSI Board meeting #69, November 2008 are to produce ETSI deliverables (and maintenance thereafter) in accordance with the following requirements:

- The provision of user driven services, facilities and functionality as required by traditional Professional Mobile Radio (PMR) user organizations such as the Emergency Services, Government, Military, Transportation, Utility and Industrial organizations as well as Public Access Mobile Radio (PAMR) Operators.
- The evolution and enhancement of TETRA as required by the market with the provision of new services, facilities and functionality made possible by new technology innovations and standards.
- Further enhancements of the TETRA standard in order to provide increased benefits and optimization in terms of spectrum efficiency, network capacity, system performance, quality of service, security and other relevant parameters.

- The backward compatibility and integration of the new services, facilities and functionality with existing TETRA standards in order to future-proof the existing and future investments of TETRA users.

Technical Objective

TETRA is one of a number of digital wireless communication technologies standardized by ETSI.

ETSI TC TETRA produces standards and/or adapts existing standards for efficient digital PMR and PAMR voice and data services, including broadband evolution.

The present document provides the User Requirement Specifications for the TETRA Local Mode Broadband.

Background

Before the initiation of TETRA Release 2, limited attention has been paid to the provision of IP-based wideband multimedia services in Private Mobile Radio (PMR) wireless networks, such as those used by public safety organizations in TETRA release 1. However, TETRA Release 2 has changed this by development of TEDS, which intends to broaden the spectrum of multimedia services offered to TETRA users. As TEDS offers data rates comparable to that of 2,5G/3G networks, then using real-time multimedia applications will be feasible in TETRA.

This is however only a development which improves fixed trunking network, based on an architecture which assumes a fixed infrastructure with connections to a central intelligent switch, the SwMI. There are also needs to cover ad-hoc incident area's with IP-based networks which should support all current services of TETRA (voice, SDS and IP) and allow applications like sensor data and real-time multimedia applications like video images to be used.

TC TETRA organised a workshop at the TETRA World Congress 2007 to discuss the candidate TETRA enhancement areas for TETRA Release 2 evolution. The workshop enhancement area are detailed in annex A.

Regarding to Local Mode Broadband, 2 enhancement areas were identified and specified as:

- Local Mode Broadband
  Even though the TETRA standard has been enhanced for "wide-band" applications with the introduction of TEDS, some suggestions have been made to further increase data throughput to match that offered by broadband data services. For example, some suggestions have been to provide access to broadband services in certain "hot zones" within a TETRA Voice and Data network coverage area. It was also suggested that "hot zone" coverage should dynamically increased and/or decreased as required for communication purposes.

- Networking capability for Local Mode Broadband area to Local Mode Broadband area
  To further enhance the capability of broadband services in certain "hot zones" as suggested above, there have also been suggestions to increase "hot zone" coverage by interconnecting different "hot zones" together via the TETRA Voice and Data network.

1 Scope

The present document provides the User Requirement Specifications for the TETRA Local Mode Broadband.

To improve TETRA on-site communication capabilities, the LMB aims at allowing the intervention teams to dynamically deploy an ad-hoc wireless network within the incident area, supporting voice, video and data communication (e.g. sensor-based data such as oxygen, gas, temperature). The ad-hoc wireless network should be made robust and redundant, securely supporting intervention teams of different disciplines within the same incident area. This ad-hoc wireless network should be capable of being securely connected, extended and integrated into the into a larger outdoor TETRA network.

NOTE: Further study may be required before a standardization effort is initiated.

2 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 reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://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.

2.1 Normative references

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

Not applicable.

2.2 Informative references

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 TR 102 621: "Terrestrial Trunked Radio (TETRA); TWC2007 Future of TETRA workshop report".

3 Definitions and abbreviations

3.1 Definitions

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

TETRA Release 2.1: Work Programme within TC TETRA to enhance the services and facilities of TETRA in order to meet new user requirements, utilize new technology and increase the longevity of TETRA within the traditional market domains of PMR and PAMR

3.2 Abbreviations

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

API	Application Programming Interface
DMO	Direct Mode of Operation
GoS	Grade of Service
IP	Interner Protocol
LMB	Local Mode Broadband
LMW	Local Mode Wideband
SDS	Short Data Service
SwMI	Switching and Management Infrastructure
TEDS	TETRA Enhanced Data Service
TMO	Trunked Mode Operation
VPN	Virtual Private Network

4 Local Mode Broadband (LMB)

4.1 Local

The coverage area of LMB is (in the start-up) limited to "on-site", meaning the "incident area". LMB is an ad-hoc wireless network that can be deployed anywhere very quickly by "intervention" teams. This means that the equipment should be small and "simple", not needing people with technical knowledge.

For large scale disasters, the communication in general complies with the "hourglass model".

With the "hourglass model" the following is meant:

- At the incident area, a lot of information is gathered (video footage from different cameras, the different conversations that are recorded, sensor data, etc.) In general, it is unnecessary and impossible to transmit all this information to the crisis centre. The crisis centre has no use for individual sensor data, nor for every individual conversation that takes place in the incident area.
- On the other hand, if the link between the local command and the crisis centre is a narrowband or even wideband link the bandwidth provided by this link is insufficient to transmit all the data.
- Similarly, the crisis centre collects a lot of information from many different sources. It is not feasible and even not wanted to send all this information to the local command. Hence the "hourglass model": a lot of information is available at both sides, but only a narrow "pipe" is available to transfer information between both sides.
- Therefore, only the most relevant information is transmitted between the local command and the crisis centre. This includes e.g. the voice communication between the local command and the crisis centre, and aggregated information containing the number of people injured, aggregated sensor data, information about how many hospital beds are available, whether or not to evacuate a certain region.
- This pipe can also be used to exchange "delta" information on information already available (e.g. previously synchronized before departure of the vehicles).
- When enough bandwidth is available, more data (e.g. video footage from a helicopter that gives a good overview of the incident area) can be transferred between the local command and the crisis centre. This data, however, has lower priority than the voice communication and the aggregated data mentioned above. When bandwidth becomes limited, these streams will be dropped.

4.2 Broadband

The "data-throughput" of the LMB is expected to at least support the TETRA 1 (voice, SDS, IP) and TETRA 2 (wide-band applications introduced with TEDS) services and throughputs if the used frequencies don't allow high bandwidth ("channels").

The "data-throughput" of the LMB is expected to support real broadband services and throughputs if the used frequencies allow high bandwidth ("channels").

This probably means a flexible solution with 2 tracks:

- a local mode "wideband" (LMW) solution which supports the current TETRA 2 services and throughputs (limited to "wideband");
- a local mode "broadband" (LMB) solution which supports new broadband services and throughputs.

5 Networking capability for Local Mode Broadband area to Local Mode Broadband area

It is expected that LMB areas (equipment/network) with overlapping coverage can be connected together to form "one" LMB area (network). Within this new LMB area all services of both initial LMB areas become available over the whole new LMB area.

It is expected that this can happen automatically based on preconfigured settings in the LMB equipment.

It is expected that this can happen also for networks of independent organisations: E.g. a police LMB network and a fire service LMB network "see" each other and automatically, transparently, etc. (without "intervention" team involvement) transform to a single LMB network area supporting all previously supported services over the whole LMB area, whilst maintaining the existing private "VPN" communications.

6 Frequency range and efficiency

The user requirement for frequencies is as little as possible. However this conflicts with the requirement for an as high as possible throughput. This means that the users ask for an as high as possible frequency efficiency.

Asking for a higher throughput (bandwidth) usually means that the possible frequency bands are "higher". However higher frequencies also usually mean less LMB range (smaller LMB coverage area) and also less reliable (indoor) LMB communication.

Studies have shown that it is challenging/costly to provide reliable (public safety GoS expectations) wideband/broadband communications indoor on frequencies above 1 GHz.

Consequently there is probably a requirement for Local Mode Wideband (LMW) with very reliable TETRA 2 services (and throughput) and a "large" coverage area on frequencies below 1 GHz and another requirement for Local Mode Broadband (LMB) with real broadband services and throughput, but smaller coverage area and less reliability indoor on higher frequency bands.

7 Service reliability/availability

As already indicated above, the users expect a very high reliability and availability of all LMB services at all times and in an as big as possible LMB coverage area.

In areas where the LMB coverage is good the users expect the same service reliability/availability as with the current TETRA services in perfect coverage conditions. An important service like group call should have a similar call setup time as in the current TETRA.

Regarding the reliability of the coverage, the users expect that the coverage is as predictable as possible. This means that the signal strength should change a slowly as possible in function of the distance from the transmitter and preferable almost only in function of the distance from the transmitter. This is especially important for indoor communication. The user expects that also indoor the signal strength is (very) slowly changing and also preferable mainly based on distance to the transmitter. E.g. going around a corner wall should not result in a sudden complete loss of the communication. Moving indoor in a closed room (no new walls or corners) should certainly not suddenly affect the available services (communication). E.g. physical dimensions of indoor objects should not create unreliable communication when small movements are made.

8 Data rate

As already indicated, the "data-throughput" of the LMB is expected to at least support the TETRA 1 (voice, SDS, IP) and TETRA 2 (wide-band applications introduced with TEDS) services and throughputs. If the used frequencies allow high bandwidth ("channels") the LMB is expected to support real broadband services and throughputs.

For the already mentioned LMW version this means that the data rate is comparable with the TEDS data rates.

For the "real" LMB the data rate should be comparable with what is currently available and under development in the commercially wireless local area technologies.

9 Voice

LMB (and LMW) is expected to support all TETRA voice services.

LMB (and LMW) is expected to behave like a TETRA base station, which means that multiple simultaneous TETRA voice call are supported, (pre-emptive) emergency call is supported, group scanning is supported.

It is expected that GoS for these TETRA voice services are comparable (at least those) of the current TETRA.

10 Data

LMB (and LMW) is expected to support all TETRA data services, including SDS.

LMB (and LMW) is expected to behave like a TETRA base station, which means that multiple simultaneous TETRA data services are supported.

It is expected that GoS for these TETRA data services are comparable (at least those) of the current TETRA.

11 Voice and data interaction

LMB (and LMW) is expected to support all TETRA services simultaneously.

LMB (and LMW) mobiles are expected to support TETRA voice and data simultaneously.

12 Service transparency between TMO and LMB to allow seamless operation

LMB is expected to behave like a TETRA base station. This means that the users can continue to use all their current TETRA services when being in LMB.

If the LMB is in isolated mode (no connection to a non-ad hoc TETRA network), some mobiles or applications could of course be unreachable.

13 LMB gateway

The LMB network should be capable of being securely connected, extended and integrated into the non ad-hoc fixed TETRA network.

It is expected that this can happen automatically based on preconfigured settings in the LMB equipment.

It is expected that this integrated LMB can support communications of independent organisations: support all fixed TETRA network communications over the LMB area, whilst maintaining the existing private "VPN" communications.

14 Security

The LMB network should be as secure as current TETRA networks.

The LMB network should be made robust and redundant, securely supporting intervention teams of different disciplines within the same incident area.

Annex A:
TETRA World Congress 2007 workshop

A.1 TETRA World Congress 2007 workshop enhancement area's

TC TETRA organised a workshop at the TETRA World Congress 2007 to discuss the candidate TETRA enhancement areas for TETRA Release 2 evolution.

The objectives of TC TETRA for the workshop were:

- to provide a clear indication to TC TETRA of the weighting and relative importance of all candidate TETRA enhancement areas identified;
- to produce a set of User Requirement Specifications (URSs) for use in TC TETRA to initiate new standardisation work by the technical Working Groups as required;
- to further enhance the portfolio of TETRA standards with new services and facilities, as well as performance enhancements, to ensure the continued evolution, success and longevity of TETRA as the technology of choice for traditional PMR user organisations.

Regarding to Local Mode Broadband, 2 enhancement areas were identified and specified as:

- Local Mode Broadband:
  Even though the TETRA standard has been enhanced for "wide-band" applications with the introduction of TEDS, some suggestions have been made to further increase data throughput to match that offered by broadband data services. For example, some suggestions have been to provide access to broadband services in certain "hot zones" within a TETRA TMO network coverage area. It was also suggested that "hot zone" coverage should dynamically increased and/or decreased as required for communication purposes.
- Networking capability for Local Mode Broadband area to Local Mode Broadband area
  To further enhance the capability of broadband services in certain "hot zones" as suggested above, there have also been suggestions to increase "hot zone" coverage by interconnecting different "hot zones" together via the TMO network.

The related identified DMO enhancement areas:

- Increased frequency efficiency
  Some users have expressed a need to increase the number of independent DMO channels within the limited frequency spectrum available.
- Increased call service reliability/availability
  Some users in particular DMO communication scenarios have experienced difficulties in setting up long range DMO calls.
- Increased data rate
  Requirement for DMO Data rates matching those already available on TMO.
- Duplex voice
  Full duplex DMO voice communications as provided on TMO
- Concurrent voice and data
  Even though available in the TETRA V+D standard (though not yet provided by suppliers) a requirement for "concurrent voice and data" in DMO has also been requested.

- Increased service transparency between TMO and DMO to allow seamless operation
  Requirements have been mentioned for increased service transparency between TMO and DMO in, for example, the following areas:
  - Automatic channel assignment.
  - Tx Inhibit.
  - Ambience listening.
  - DGNA.
  - Security (Security Class 3, GCK, and Enable/Disable, etc.).
  - Data services.
- Improved performance behaviour of gateways and repeaters
  Some members of the TETRA community have expressed a need to provide improved performance behaviour of gateways and repeaters, in areas of, for example, call set-up times, increased range, call set-up reliability, etc.
- Multiple call support on gateways and gateway/repeaters
  This enhancement area refers to the capability of a single gateway, repeater or gateway/repeater to support more than one DMO call simultaneously.
- Application Programming Interface (API)
  The API is required in both DMO and TMO terminals to provide a standard interface for use by application providers to supply, for example, internet/intranet access, location information or services applications, etc.
- Accessory interface standard (hardwire and wireless)
  Although this is not a DMO specific enhancement area, it has been placed in this category grouping as it was not considered appropriate to have a separate MS only category. This suggested interface standard covers for example, the type, size, location, appearance of such items as displays, buttons, switches, as well as the type of connectors, pin usages and electrical/electronic levels, impedances and RF signalling protocols and also the type of batteries.
- Networking capability
  This networking capability is the same as that mentioned in the TMO Enhancement grouping under "Networking capability for DMO area to DMO area" and has been placed in the DMO Enhancement area grouping to assess its relevant importance compared with other DMO enhancement areas.
- Mesh Type Enhancement TMO/DMO. (suggested by a participant during the workshop, no description).
- Dual Scanning (suggested by a participant during the workshop, no description).

The related identified TMO enhancement areas:

- Enhancing DMO with the use of TMO. (suggested by a participant during the workshop, no description).

A.2 TETRA World Congress 2007 workshop results

The results are presented in TR 102 621 [i.1].

A.3 Analysis current situation

Currently TETRA radios support 2 methods of operation:

- Trunking Mode Operation (TMO): communication between radios uses a fixed infrastructure with a centralised intelligence (SwMI).
- Direct Mode operation (DMO): communication between radios happens without usage of the fixed infrastructure and without using a centralised intelligence (SwMI).

During interventions TMO is preferred because this offers most features and facilities like voice and data (SDS and IP). It offers of course also connection to remote teams and control rooms. The problem is however that if the base stations are at some distance from the buildings on the incident area, coverage in those areas is not anymore guaranteed. The only more or less guaranteed operation mode becomes then DMO. A disadvantage of having to use DMO is that (with most current implementations) all users have to switch to DMO. Not only is this a cause of human errors, but it also means that a lot of the wanted services are lost (connection towards remote users, control rooms, crisis centre, SDS, IP).

There is the DMO gateway that was supposed to bridge the gap between DMO and TMO but up to now has not succeeded to do so. Not only is the DMO gateway not supporting all wanted services (IP, SDS, scanning of talk groups of remote users, etc.) but also the performance and reliability of the basic service "voice group call" has not been perceived as good. Call setup times seems to be too long, random access collisions seem to cause call setup problems, coverage differences between DMO gateways and DMO radios cause problems.

Currently DMO suffers from trying to be two things at a time and it succeeds in neither of them:

- DMO tries to offer a basic two-way radio (walky-talky service) like available in the ("old") analogue equipment. However, because of the complex modulation it can't offer the range of the "old" analogue equipment. And because of the "non-transparency" between TMO and DMO it can't offer the seamless integration between on site communication and "remote" communication.
- DMO tries to offer data services, but these are very limited and/or not implemented.

Instead of trying to improve the current DMO (including DMO gateways and repeaters) which is based on narrowband technology from more than a decade ago it is probably easier and more efficient to start with a new approach based on the current broadband IP technologies.

History

Document history		
V1.1.1	December 2010	Publication