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Technical Report

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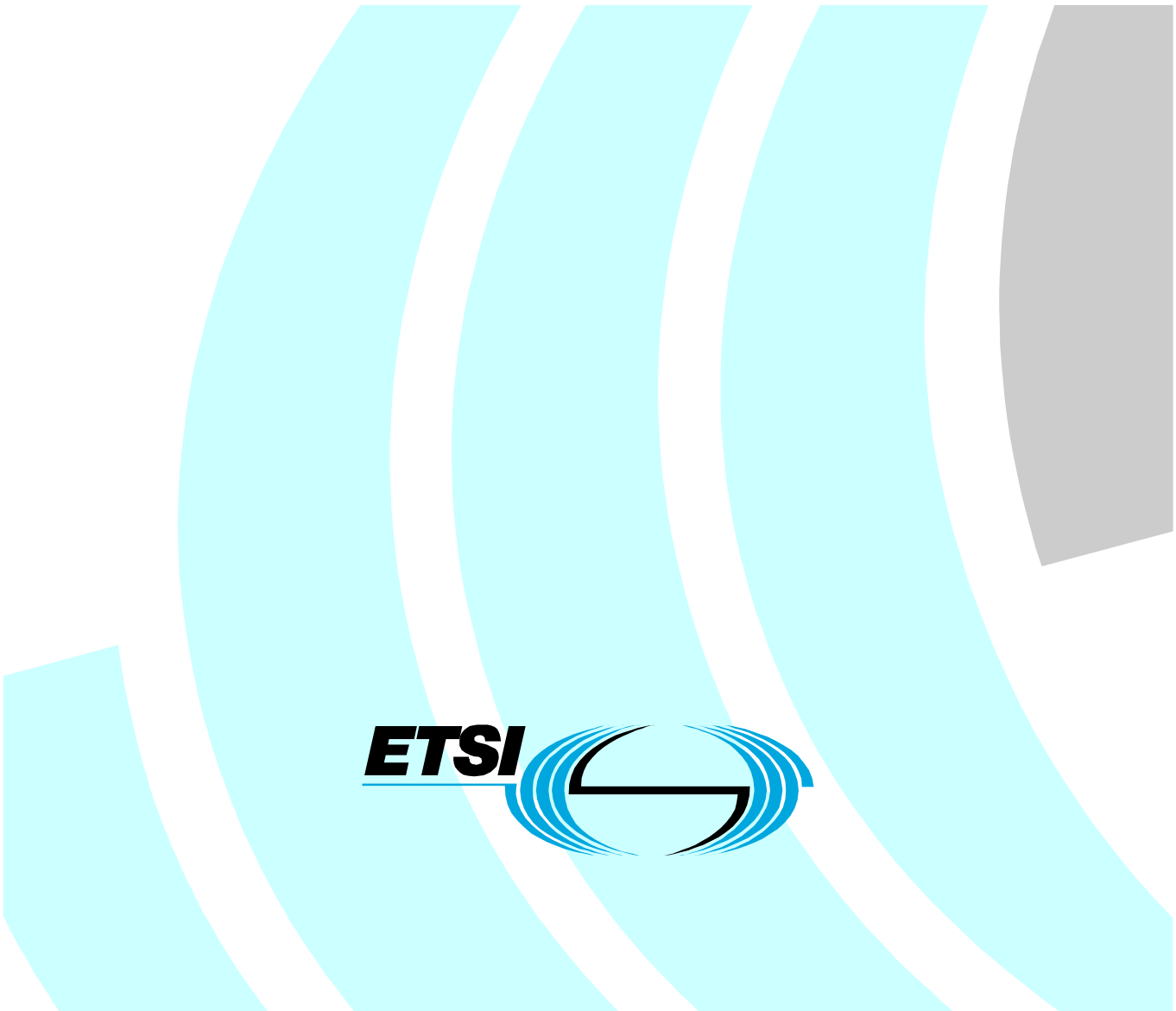

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

1 Scope

The present document defines the requirements for radio frequency usage for TETRA Air-Ground-Air services (AGA) for emergency services.

2 References

For the purposes of this Technical Report (TR) the following references apply:

[1] ETSI TR 102 021-8: "Terrestrial Trunked Radio (TETRA); User Requirement Specification TETRA Release 2; Part 8: Air - Ground - Air services".

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

[3] ERC/DEC(96)01: "ERC Decision of 7 March 1996 on the harmonised frequency band to be designated for the introduction of the Digital Land Mobile System for the Emergency Services".

[4] ERC/DEC(01)20: "ERC Decision of 12 March 2001 on the harmonised frequency bands to be designated for Air-Ground-Air operation (AGA) of the Digital Land Mobile Systems for the Emergency Services".

[5] ERC/DEC(01)19: "ERC Decision of 12 March 2001 on harmonised frequency bands to be designated for the Direct Mode Operation (DMO) of the Digital Land Mobile Systems for the Emergency Services".

3 Definitions and abbreviations

3.1 Definitions

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

TETRA Release 2: Work Programme with new terms of reference within ETSI Project 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:

AGA	Air Ground Air
AI	Air Interface
DMO	Direct Mode Operation
ECC	European Communications Committee
ERC	European Radio Committee (superseded by ECC)
ERM	ETSI Electromagnetic Compatibility and Radio Spectrum Matters
FM	Frequency Management
PAMR	Public Access Mobile Radio
PMR	Private Mobile Radio
RF	Radio Frequency
RM	Radio Matter

TEDS	TETRA Enhanced Data Service
TETRA	TErrestrial Trunked RAdio
TMO	Trunked Mode Operation
V+D	Voice plus Data
WG	Working Group

4 Executive summary

4.1 Status of the System Reference Document

The present document was finally adopted by ERM RM in January 2006 and is forwarded to WG FM for consideration and to ERM for final approval for publication.

4.1.1 Statement from MINEFI - France

While the French Administration does not see any difficulty in participating actively in border coordination with Administrations having a need for additional AGA channels, it does not support that any harmonized measure be taken in this respect since the need expressed by those Administrations are not shared by others, *inter alia* by the French one.

4.2 Technical issues

4.2.1 Short background information

4.2.1.1 System description

TETRA Air-Ground-Air services (TETRA AGA) have been developed to provide TETRA services to air mobiles in response to user needs and according to a mandate issued by the ETSI Board to develop TETRA Release 2. The mandate included the extension of the operating range of TETRA, to provide increased coverage and low cost deployments for applications such as airborne public safety.

TETRA Air-Ground-Air services (TETRA AGA) aims to provide the same TETRA services to air mobiles as to land mobiles. These TETRA services include Mobility Management and all normal TETRA V+D services, but do not include TETRA High Speed Data services (TAPS/TEDS).

TETRA Air-Ground-Air services (TETRA AGA) are delivered by a TETRA AGA overlay network. This AGA overlay network consists of slightly modified TETRA V+D base stations serving modified mobile stations. The modifications are mainly related to cell reselection methods caused by the difference in propagation model between land mobile and air mobile path and larger cell sizes.

The requirements for TETRA Air-Ground-Air services are stated in TR 102 021-8 [1].

4.2.1.2 Applications

TETRA Air-Ground-Air services enable the cost-effective rollout and efficient use of spectrum resources for delivering TETRA services to air mobiles:

- improved handover;
- higher operational flying altitudes;
- fewer cells;
- fewer frequencies;
- easier frequency coordination across borders;
- cross border communication.

4.2.1.3 New technology (if any)

TETRA Long Range is expected before the end of 2006.

4.2.1.4 Short market information

See annex A.

4.2.1.5 Market size, forecasts and timing

TETRA networks for emergency services have the need for Air-Ground-Air services supporting airborne applications. The expectation is that there will be only one overlay network per country. The number of air terminals in a network is typically in the tens (20 to 50). Depending on the country, this can be equated to around one aircraft per several (2 to 5) thousand square km.

Some networks are already offering these services, using network specific implementations such as non harmonized frequencies for AGA and/or using non harmonized techniques for mobility management. This creates difficulties for cross border cooperation and may also create cross border interference.

Others still have to implement their Air-Ground-Air services fully or partially. The faster the harmonized spectrum is available, the more networks will be able to implement a harmonized solution.

TETRA Long Range which is part of TETRA Release 2 is expected to be finalized by end 2006 so it would be ideal if the harmonized spectrum would be available at the same time. TETRA Long Range uses larger cells with a range (radius) of 83 km (see also clause B.1).

4.2.2 Spectrum requirement and justifications

Using the modified TETRA V+D base stations, the overlay network for Air-Ground-Air services can employ a frequency reuse cluster of seven.

For capacity reasons more than one carrier is sometimes needed around major cities and/or airports.

Base station cannot always be installed according to the ideal theoretical cell reuse cluster for reasons such as:

- international/network border situations;
- environmental, legal or architectural obstructions.

These elements cause the need for spare frequencies on top of the basic seven. The current situation with 8 channels, leaving only one spare frequency is not offering sufficient margin to cope with the above constraints. Having 10 channels would offer three spare frequencies to cope with the above elements. This is still a small margin, but should allow for most practical situations.

4.2.3 Spectrum parameters

4.2.3.1 Radiated power

The transmitter powers for the mobile and base stations are the same as specified in EN 300 392-2 [2] for TETRA V+D.

4.2.3.2 Transmitted bandwidth

The transmitted bandwidth is 25 kHz as specified in EN 300 392-2 [2] for TETRA V+D.

4.2.3.3 Frequency considerations

It is expected that most AGA services implementations will be possible within 2 × 10 channels. The current allocation for Emergency Services are structured in a way to allow DMO (both national and international), TMO and AGA (both national and international) services to operate without producing undue interference to each other. To maintain this situation it is preferred that additional AGA channels would be in an adjacent frequency range to the already assigned AGA channels.

4.2.3.4 Frequency usage

TETRA Air-Ground-Air services (AGA) are fully integrated services for TETRA V+D. The frequency usage will be dependent on the specific local constraints of the network specific implementation (number of major cities, number of airports, number of airborne applications, environment etc.).

4.2.4 Current regulations

The frequency band 380 MHz to 400 MHz is covered by ERC/DEC(96)01 [3] (harmonized frequency band designated for the introduction of the digital land mobile system for the emergency services) and a part of the frequency band is also covered by ERC/DEC(01)20 [4] and ERC/DEC(01)19 [5].

4.2.5 Compatibility issues

See annex C.

5 Main conclusions

Issues of prominence in consideration of this SRDoc are the need for harmonized spectrum and open standards.

The new allocation of additional channels would ensure that in the future other countries will follow this planning, making cross-border communication possible.

5.1 Business importance

Based on a very urgent need by the emergency services, in some countries networks delivering TETRA Air-Ground-Air services are already in place.

These networks are using network specific implementations like non harmonized frequencies for AGA and/or using non harmonized techniques for mobility management, in addition to the harmonized frequencies available for AGA.

This non harmonized approach creates risks for cross border cooperation and may also create cross border interference.

Airborne emergency services from one country may interfere with terrestrial emergency services in another country. Airborne emergency services from one country may also encounter difficulties in cooperating with airborne or terrestrial emergency services from another country.

A harmonized solution using harmonized frequencies is needed to be enable cross border cooperation between emergency services and to protect the terrestrial emergency service users. In this context, it should be noted that this is also a goal of the Schengen Treaty.

5.2 Expected timing for products to market

The needed features to make optimal AGA services possible in TETRA are expected to be available before the end of 2006.

5.3 Requested ECC actions

ETSI requests the support of the ECC to enable the users to take advantage of the TETRA Air-Ground-Air services around the end of 2006. Specifically this request comprises:

- Identify a preferred extension of 2×2 channels for AGA, i.e. a supplement of 2×2 channels for countries that require additional channels for airborne applications.

- The addition of 2×2 channels for AGA in the frequency range 380 to 385/390 to 395 MHz to ERC/DEC(01)20 [4] (as a supplement to the AGA frequencies already available to emergency services), whereby the preferable solution is in the adjacent frequency range 384,750 to 384,800 MHz and 394,750 to 394,800 MHz.

Annex A:
Detailed market information

A lot of projects in the 380 to 400 frequency band have been started some years ago or are now in the preparation phase and in some cases provide operational services.

Examples are Airwave in the UK, Virve in Finland, Astrid in Belgium, C2000 in The Netherlands, Rakel in Sweden, Acropol in France, the network in Spain, the recent projects in Austria and Poland etc.

Projects which are in preparation are Norway, Ireland, Germany, Denmark, Hungary etc.

Almost all EU countries already have an emergency services radio project or are starting it.

The existing projects are based on the TETRA standard or on the Tetrapol technique.

A.1 Range of applications

All airborne applications of the Digital Land Mobile Systems for the emergency services.

A.2 Market size and value

The value of the communication systems of the emergency services for the society and the economy is not directly related to the market size and the monetary value of these communication systems.

Emergency services provide immediate and rapid assistance in situations where there is a direct risk to life or limb, individual or public health or safety, to private or public property or the environment but not necessarily limited to these situations.

Emergency Services are the primary protector of life and property in cities, towns, and beyond, throughout the world. These organizations provide individual and professional response to incidents and disaster situations.

In order to cooperate between emergency services within and across borders in all circumstances, one of the strong requirements is fully interoperable networks with availability in all circumstances.

Without a sufficient number of harmonized AGA channels, network operators of digital land mobile systems for the emergency services will individually have to find extra channels for AGA operation. In most countries they will take these channels in the frequency band covered by ERC/DEC(96)01 [3].

As indicated before, this may result in airborne emergency services from one country interfering with terrestrial emergency services in another country. Airborne emergency services from one country may also encounter difficulties to cooperate with airborne or terrestrial emergency services from another country.

A harmonized solution using harmonized frequencies is needed to enable cross border cooperation between emergency services and to protect the terrestrial emergency service users.

Without well functioning AGA operational communication systems, the performance of emergency services is in danger. The economical impact of this could be huge.

A.3 Traffic evaluation

See clause 4.2.2.

Annex B:
Technical information

B.1 Detailed technical description

TETRA Air-Ground-Air services (TETRA AGA) have been developed to provide TETRA services to air mobiles in response to user needs and according to a mandate issued by the ETSI Board to develop TETRA Release 2. The mandate included the extension of the operating range of TETRA, to provide increased coverage and low cost deployments for applications such as airborne public safety.

TETRA Air-Ground-Air services (TETRA AGA) aim to provide the same TETRA services to air mobiles as to land mobiles. These TETRA services include Mobility Management and all normal TETRA V+D services, but do not include TETRA High Speed Data services (TAPS/TEDS).

TETRA Air-Ground-Air services (TETRA AGA) are delivered by a TETRA AGA overlay network. This AGA overlay network consists of slightly modified TETRA V+D base stations serving modified mobile stations. The modifications are mainly related to cell reselection methods caused by the difference in propagation model between land mobile and air mobile path. The other modification is that the TETRA Air-Ground-Air base stations support an extended cell range (radius) of about 83 km.

Based on cells with a range (radius) of 83 km, a seven cell frequency reuse cluster allows for operating heights up to about 3 000 metres, which fulfils the user requirement.

A typical TETRA Air-Ground-Air base station would only contain one carrier, delivering one control channel and three traffic channels. This capacity is considered to be sufficient for rural areas, villages and average cities. Metropolitan areas and/or airport regions may require more capacity and thus more than one carrier.

Base stations cannot always be installed according to the ideal theoretical seven cell reuse cluster. This happens at international/network border and also because of environmental, architectural or legal obstructions.

These elements cause the need for spare frequencies on top of the basic seven. The current situation with eight frequencies, leaving only one spare frequency is not offering sufficient margin to cope with the above constraints. Having 10 channels would offer three spare frequencies to cope with the above elements. This is still a small margin, but should enable solutions to be found for most practical situations.

The requirements for TETRA Air-Ground-Air services are stated in TR 102 021-8 [1].

B.2 Technical justifications for spectrum

Additional information on technical justification is contained in clause B.1, particularly the information on the cell frequency reuse clustering.

B.2.1 Power

The transmitter powers for the mobile and base stations are the same as specified in EN 300 392-2 (Air Interface) [2] for TETRA V+D.

B.2.2 Frequency

The currently harmonized frequency bands for TETRA Air-Ground-Air operation (AGA) for the Emergency Services are the bands 384,800 to 385,000 MHz and 394,800 to 395,000 MHz. It is proposed to add 2×2 channels in the adjacent frequency range below.

B.2.3 Bandwidth and other radio parameters

The transmitted bandwidth is 25 kHz as specified in EN 300 392-2 (Air Interface) [2] for TETRA V+D.

B.2.3.1 Transmission mask

The transmission mask is the same as specified in EN 300 392-2 (Air Interface) [2] for TETRA V+D.

B.2.3.2 Reception mask

The reception mask is the same as specified in EN 300 392-2 (Air Interface) [2] for TETRA V+D.

Intermodulation and spurious response are the same as specified in EN 300 392-2 (Air Interface) [2] for TETRA V+D.

B.2.3.3 Spurious emissions

The spurious emissions are the same as specified in EN 300 392-2 (Air Interface) [2] for TETRA V+D.

B.2.3.4 Spectrum Power Density

The spectrum power density is the same as specified in EN 300 392-2 (Air Interface) [2] for TETRA V+D.

B.3 Information on current version of relevant ETSI standard

The requirements for TETRA Air-Ground-Air services are stated in TR 102 021-8 [1].

Annex C:
Expected compatibility issues

C.1 Coexistence studies (if any)

The need for new coexistence studies is not envisaged.

The requested action to ECC is to widen the already harmonized frequency band for AGA in order to add 2 channels to the emergency services AGA band. The channels are currently assigned for emergency services land mobile use.

The TETRA V+D Air-Ground-Air base stations will have the same RF characteristics as the TETRA V+D land mobile base stations.

For the TETRA V+D land mobile base stations all needed coexistence studies have already been done.

C.2 Current ITU allocations

None affected.

The current allocations are shown in the table below (duplex frequencies paired with 390,0 to 395,0 MHz):

FREQUENCY BAND	ALLOCATIONS	APPLICATIONS
380,0 to 385,0 MHz	MOBILE	Defence systems (335,4 to 399,9 MHz) DMO (380,0 to 380,15 MHz) Emergency services AGA communications (civil) (384,8 to 385,0 MHz)

C.3 Sharing issues

Sharing with defence systems in the identified frequency range for the additional AGA channels.

History

Document history		
V1.1.1	May 2006	Publication