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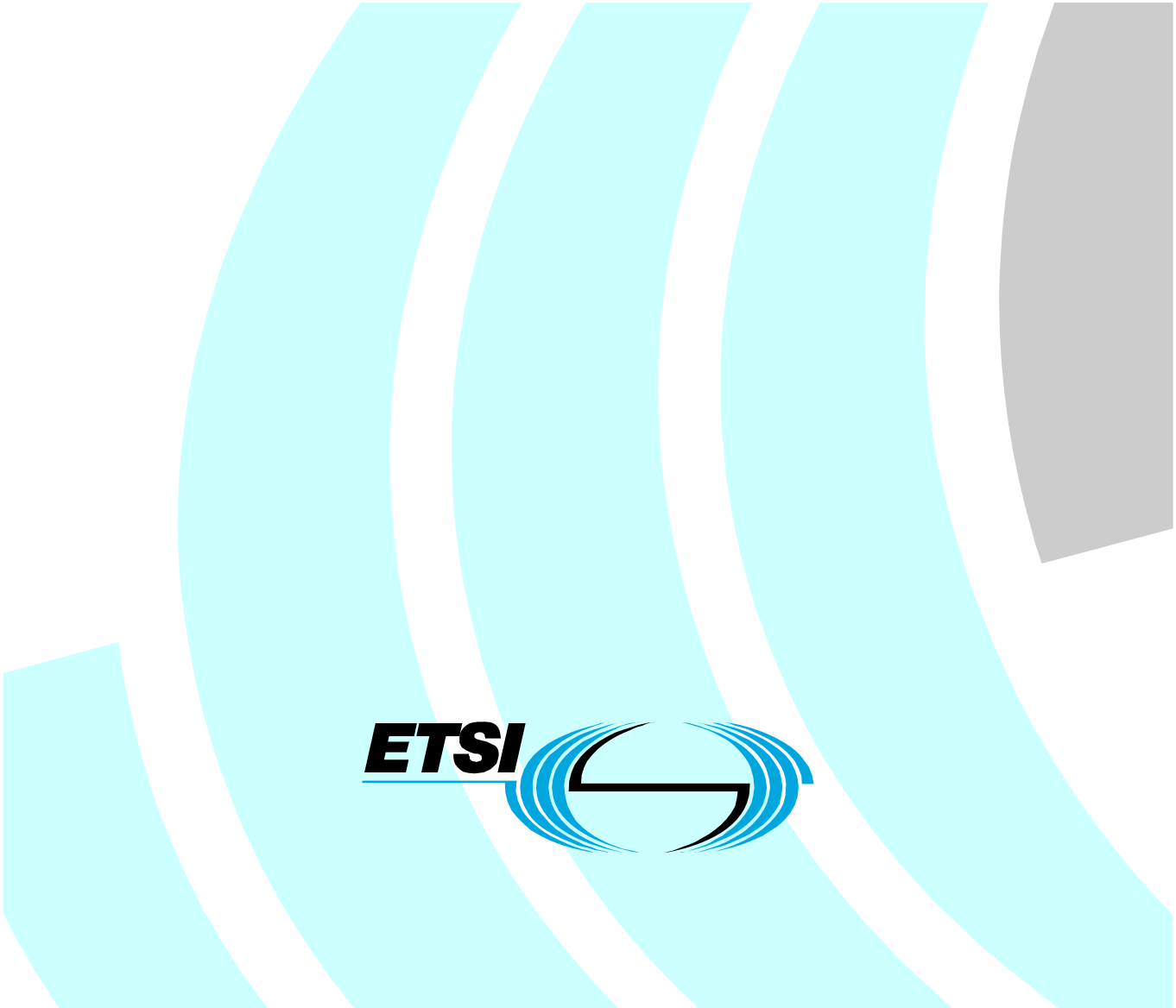
Technical Report

Terrestrial Trunked Radio (TETRA);
User Requirement Specification TETRA Release 2.1;
Part 2: High Speed Data



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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 2 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 High Speed Data (HSD).

The URS is required by TC TETRA to guide the enhancement of the current TETRA standard, mainly the evolution of the HSD standard part towards broadband.

1 Scope

The present document contains the User Requirements Specifications (URS) which are described in non-technical terms and are based on an analysis of the results for High Speed Data from the TETRA Release 2 Market Questionnaire, described in TR 102 021-1 [i.1], clauses 4.2 and 4.3, subsequent results from a joint ETSI/TETRA MoU High Speed Data Workshop held in January 2002, and the Future of TETRA workshop held during the TETRA World Congress 2007 [i.2]. This URS does not offer any technical solutions as they are considered the responsibility of TC TETRA/WG4. The present document provides the user requirements for HSD translated into terms of:

- HSD applications and net data rates to support non-voice applications
- Data rate capacity in addition to TETRA V+D
- RF coverage requirements for HSD
- Frequency spectrum efficiency requirements
- Integration of HSD with TETRA Release 1 V+D services
- Compatibility of HSD with TETRA Release 1 V+D services
- HSD call types
- Backward Compatibility with TETRA Release 1
- Migration from TETRA Release 1
- Availability of HSD
- Relative importance of HSD user requirement criteria

The present document is applicable to the specification of TETRA Release 2.1 equipment.

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 102 021-1: "Terrestrial Trunked Radio (TETRA); User Requirement Specification TETRA Release 2.1; Part 1: General overview".

[i.2] ETSI TR 102 621: "Terrestrial Trunked Radio (TETRA); TWC2007 Future of TETRA workshop report".

[i.3] ETSI TR 102 745: "Reconfigurable Radio Systems (RRS); User Requirements for Public Safety".

[i.4] Analysys Mason/TETRA Association (March 2010): "Public safety mobile broadband and spectrum needs".

NOTE: Available at www.tetra-association.com.

3 Definitions and abbreviations

3.1 Definitions

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

conventional access: HSD access method introduced in TETRA Release 2 where the control channel is on a TETRA 1 bearer

NOTE: This means that each HSD cell have at least one TETRA 1 bearer even if all terminals would use only the HSD service.

direct access: HSD access method introduced in TETRA Release 2.1 where the control channel messaging is done on the HSD bearers

High Speed Data (HSD): net data rates in excess of 28,8 kbit/s being the current capability of TETRA Release 1

TETRA Release 2: Work Programme 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

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:

ANPR	Automatic Number Plate Recognition
ECG	ElectroCardioGram
GoS	Grade of Service
HSD	High Speed Data
kbit/s	kilo (thousand) bits per second
MoU	Memorandum of Understanding
MS	Mobile Station
PAMR	Public Access Mobile Radio
PMR	Private Mobile Radio
RF	Radio Frequency
SwMI	Switching Management Infrastructure
TC	Technical Committee
TEDS	TETRA Enhanced Data Service
TIP	TETRA Interoperability Profile
TMO	Trunked Mode Operation
URS	User Requirement Specification
V+D	Voice and Data
VoIP	Voice over Internet Protocol
WAP	Wireless Application Protocol
WG	Working Group

4 User Requirement Specification

4.1 High Speed Data (HSD) technology solution

The HSD technology solution selected by WG4 will be based on a technology that best meets the User Requirements as described in this URS, balanced against any technology constraints identified in WG4 from the candidate technology proposals submitted into WG4 for HSD standard consideration.

4.2 HSD applications

4.2.1 Point-to-point HSD for non-voice applications

The net data rates to support non-voice applications on HSD are listed in table 1. For ease of understanding requirements, the table has been sorted in order of net data rates. It is important to note that the original list of HSD applications was derived from the work done by WG1 in May 2001 and from a joint ETSI/TETRA MoU High Speed Data Workshop held in January 2002. The list did not take into consideration the needs of other TETRA and PMR users organizations who did not participate in the questionnaire, workshop, or WG1 work in early 2001. The table has been updated for Release 2.1 based on e.g. Public Safety user requirements gathered by RRS [i.3] and a paper published by the TETRA Association in 2010 [i.4].

The table focuses on net transfer needs as gross bandwidth requirements depend on the technology chosen. For example, mainstream public mobile communications technologies often use a significant amount of bandwidth for error correction to provide a reasonable service at cell edge etc. The '2005 Voice % impact' column in table 1 indicates how the 2002 workshop expected introduction of the named service to impact on voice capacity requirements by 2005, i.e. if an application would have been expected to halve the voice requirement the entry would be -50 %. This column is empty for those applications that were not included in the 2002 workshop.

Table 1 has been updated for Release 2.1 where indicated.

Table 1: Net data rates to support non-voice applications

Applications	2005 Voice % impact	Size (kByte)	Size (kbit)	Transfer time (s)	Rate (kbit/s)	Application group	Notes
Location Services	-2 %	0,1	0,8	1	0,8	Real time short data	
Telemetry (real time transfer)	0 %	0,2	1,6	0,5	3,2	Real time short data	
Operation and control	0 %	0,2	1,6	0,5	3,2	Real time short data	
Biodynamic vital data sampling, inc. ECG	0 %	5	40	10	4	Real time short data	
Telemetry (Real time - 5 kbyte)	0 %	5	40	10	4	Real time short data	
WAP/on-line forms	0 %	3	24	5	4,8	Database Interaction	
ANPR - text and picture of the number plate		3,8	30,4	4	7,6	File transfers	
ANPR - response (downlink)		2	16	2	8	File transfer	
People and Vehicles status/location/messaging(1 kbyte)	-2 %	1	8	1	8	Real time short data	
Data tasking e.g. command and control/work management	-5 %	5	40	5	8	Database Interaction	
Fingerprint data abstracted from the fingerprint image	0 %	10	80	10	8	File transfer	
Remote controlled devices					low	Remote control	Not including image transfer
Content Push (10 kbyte)	1 %	10	80	4	20	File Transfer	

Applications	2005 Voice % impact	Size (kByte)	Size (kbit)	Transfer time (s)	Rate (kbit/s)	Application group	Notes
Interagency Communications inc. Intranet (10 kbyte)	0 %	10	80	4	20	File Transfer/Office Application	
Database inquiries 10 kbyte to 100 kbyte	0 %	12,5	100	5	20	Database Interaction	
Mobile computing - office applications	0 %	12,5	100	5	20	Office Application	
Connect to hospitals and national health comm. network	0 %	100	800	20	40	File Transfer	
Connect to hospitals and national health comm. network	1 %	50	400	10	40	Office Application	
Internet incl. web browsing 10 kbyte to 50 kbyte (per page)	0 %	50	400	10	40	Office Application	
Sensor networks				delay a few seconds	medium	Image transfer	
ANPR - picture of the car		25	200	4	50	Image transfer	
Graphics, maps, location 100 kbyte to 1 Mbyte	-1 %	125	1 000	20	50	Image Transfer	
Video Conferencing 64 kbit/s	0 %				64	Video Transfer	
Image transfer (image JPEG ± 50 kbyte)	0 %	100	800	10	80	Image Transfer	
Fingerprint image	0 %	100	800	10	80	Image Transfer,	
Video streaming (surveillance)	0 %			delay a few seconds	high	Video Transfer	Previously 50 kbit/s
e-mails incl. Attachments 2 Mbytes	0 %	2 000	16 000	60	267	File Transfer	Previously 300 s and 53 kbit/s
Video clips 1 Mbytes to 2 Mbytes	0 %	2 000	16 000	32	500	Video Transfer	

From the table it can be seen that a significant percentage of applications can be supported with net data rates of 80 kbit/s and below. Some as yet undefined applications may require higher data rates. Higher data rates may also be required to improve transfer time of applications identified above. Many of the listed applications could also be supported on a V+D network.

Although the information provided on this table is useful, it is important to note that the mix of applications supported on a network and the amount of non voice traffic is unknown. When the use of mobile data applications over TETRA becomes daily routine, the available data speeds and capacity will quickly be exhausted even with low speed applications. Therefore, the net speed of the air interface should be calculated based not only on the top speeds required by the applications listed, but also thinking of how to cope if there are several users requiring the fast service plus other users requiring a slower service simultaneously within a small area.

For example, in the UK normally an Automatic Number Plate Recognition (ANPR) mobile camera is set to only send the picture of the licence plate and a text file including the interpretation, date, time etc. But it may be required that the the picture of the vehicle is sent too, within the same time given. If situated next to a busy motorway (more than one vehicle per second) this setup alone would create a steady near real time uplink bandwidth requirement of close to 100 kbit/s.

It is also important to note that the applications listed could be rationalized further within categories. However, as the GoS requirements (transfer time in seconds as shown in the table) vary between the identical applications, their individuality has been retained.

Lastly, it should be remembered that as the mainstream data technologies move towards web based applications that are not bandwidth optimized due to ever increasing bandwidth available both in the fixed and wireless networks, the applications to be run over TETRA are likely to be built in a similar manner to avoid paying significantly more for special development tools and environments. This in turn will increase the true amount of bits transmitted per transaction sometimes significantly.

The feedback from the 2007 workshop [i.2] places "increased speed, capacity, and efficiency of TEDS" to the number 1 position in almost all participant categories, only being left second in a couple, behind "RF coverage compatibility between TETRA V+D and TEDS". This is a clear indication of the general feeling that TEDS as defined for Release 2 will not cover future needs when it comes to speed, capacity, and efficiency of the HSD service and more is required.

4.2.2 Point-to-multipoint HSD for non-voice applications

Although a typical use case, point-to-point communication is not the only data need the users have. Especially user organisations working on group basis, e.g. police in many cases, have a need to inform several people at virtually the same time. The most effective way of doing this is to utilize point-to-multipoint functionality, instead of sending the same information multiple times using point-to-point functionality. TETRA supports group addressed short data messaging already in Release 1 and to take full advantage of the enhanced data rates Release 2.1 brings, point-to-multipoint HSD is required. It is believed that this service isn't widely available from competing technologies.

Some examples of application areas where point to multipoint data could be used are listed below:

- Sending a picture of a lost person with accompanying text to all police officers within a given area maximizes the chances of locating the person soon.
- Updates on road closures to drivers of vehicles would be useful for any TETRA user group. It is clear that in public safety networks this kind of information is required in good time before the need arises to avoid delays that could potentially mean loss of life. Even though commercial services like public transport don't have the same life-or-death issue, the same service would be of great value for them too. Ideally this information would come with maps showing best alternative routes and/or remotely updating the in-vehicle navigation computers.
- Remote upgrades and/or programming of terminals, computers and other connected equipment in vehicles could possibly be done using a point-to-multipoint data connection. This would significantly improve the terminal management possibilities and minimize the time it takes to upgrade all terminals to support a new functionality or application.

It is assumed that for Release 2.1 it will be enough if the "point" in a point-to-multipoint data session is either a radio or fixed terminal and that role will remain throughout the session, i.e. the session is set up with one participant in a special role compared to the other attendees. Future releases may require full group voice call type of functionality where any party in the group can be the originator and everyone will receive what is being sent.

The membership of a point-to-multipoint data group should be easily manageable in a similar type of manner as talk group memberships are managed in current TETRA systems. This should include both controlling which subscriber can be a member of a group and joining/leaving the group in daily operation, initiated by the user or some controlling entity. However, although management actions similar to those used with talk groups are required, the data groups should not be limited to or automatically linked to voice talk groups.

A typical session could consist of the "point" sending information, e.g. a picture with accompanying textual data or live video, to the other members of this data session. They might not communicate within this session except possibly by positive or negative acknowledgement, i.e. all information received or not.

Several of the application types mentioned in clause 4.2.1 could be used in point-to-multipoint manner.

4.2.3 Voice over HSD

Although not seen as one of the first applications to use HSD technology, it is expected that carrying voice over the same channels as used to carry the fast non-voice applications is likely to be of interest to some operators in the future. The new modulation methods could provide a flexible voice capacity solution providing more capacity near the base station, which typically is a higher user density area than the edge of the cell where the available bit speeds would in turn be lower. The benefits would be most applicable in traffic hotspots like major cities where the area covered by an average TETRA cell is relatively small.

Utilising direct access and avoiding the TETRA 1 carriers completely might provide another incentive for the operator to consider voice over HSD.

Even if new services or codec(s) would be implemented for voice over HSD, for backwards compatibility and migration from TETRA 1 the same voice functionality and codec as provided by TETRA 1 should be maintained, unless an practically instantaneous translation to and from TETRA 1 codec is implemented.

4.3 Data rate capacity in addition to TETRA V+D

Analysis of the non-voice application requirements listed in table 1 has identified that the new HSD service will have very little impact in reducing voice traffic levels in TETRA networks. For this reason, the provision of HSD on existing networks will require separate capacity to support non-voice applications dependent on type of applications, levels of traffic and GoS.

Based on past experience, the types of non-voice applications, traffic levels and GoS will vary greatly between different user organizations. As a result, some organizations will have a low demand for HSD services and others a high demand.

For these reasons, the HSD technology solution should be designed to support varying amounts of data as spectrum efficient as possible balanced against technology constraints. In addition, the HSD solution should be such as to minimize impact on network RF planning and compatibility with TETRA Release 1 networks already deployed and/or being deployed.

In the 2007 workshop [i.2] the overall highest ranking area of improvement for developing TETRA beyond Release 2 was to increase the speed, capacity, and efficiency of TEDS (as specified for Release 2). When the results were analysed based on the background of the responders, this area scored highest in four out of six groups, whilst being second for the remaining two groups.

There is a clear expectation that the data speed needs will grow past what Release 2 can deliver and Release 2.1 should aim to fulfil that need. Very little real data on the professional data use exists at the time of writing, but it is believed that the actual need for capacity will come from a combination of new essential and potentially bandwidth hungry applications and wide use of them, i.e. although requirements placed by a single application possibly could be fulfilled by Release 2 HSD, the network could not support the numbers of users without having a faster HSD service.

Release 2 HSD provides a good high speed data solution for many TETRA users. For those users that require more Release 2.1 should introduce a significant improvement in the HSD service in terms of speed, capacity and efficiency. A small improvement is not likely to justify the extra investment required by both manufacturers and users. Another reason to clearly exceed Release 2 HSD capabilities is to be able to convincingly compete against using alternative services, e.g. commercial mainstream mobile networks.

4.4 RF coverage requirements for HSD

The coverage of HSD service should match that of TETRA Release 1 for Voice and Data as evidenced by the 2007 workshop where this was considered the most important TMO enhancement area [i.2]. Exact user requirements of RF coverage needs for HSD applications vary greatly between different user organizations. For example, some users want total RF coverage, others would trade off data rate as distance increases from the base station and others would be satisfied with only urban (high population density) coverage. Solutions that rely on e.g. special fill-in cells for the (very) high speed data service could potentially be accepted.

Based on these user requirements, the HSD technology solution adopted should consider a mechanism for meeting these varying needs.

4.5 Frequency spectrum efficiency requirements

As mentioned in clause 4.3, analysis of non-voice applications identified that the new HSD service will have very little impact in reducing voice traffic levels in TETRA networks. For this reason, if the Grade of Service for voice services is to remain unchanged, the provision of HSD on existing networks will require additional frequency spectrum to support non-voice applications dependent on type of applications, levels of traffic and GoS. Alternatively, HSD services may be introduced by reducing the Grade of Service of existing voice services and hence freeing network capacity to maximize user benefits within existing network resources. This will not be acceptable to all users.

Also, as mentioned in clause 4.3, the demand for non-voice applications will vary greatly between different user organizations. For these reasons, the HSD service should utilize the minimum amount of RF spectrum required to meet the non-voice application, capacity and GoS needs of individual user organizations.

In addition, there is a need to retain the narrow band characteristics of TETRA for co-existence with other TETRA V+D networks and other narrow band technologies sharing the same frequency bands.

In areas where an effective modulation scheme can be used, moving voice traffic to be carried over TEDS in a capacity optimized manner could possibly enable more real payload per kHz than using a combination of TETRA 1 for voice and HSD for non-voice data, improving the spectrum efficiency of the TETRA solution in urban areas and other traffic hot spots where the cell sizes are relatively small.

For the reasons above, the HSD technology solution should consider a design that provides flexibility to meet these requirements.

4.6 Integration of HSD with TETRA Release 1 V+D services

The 2001 user requirements for HSD services are marked by a strong need for integration with the V+D services of TETRA Release 1. The degree of integration varies from very high for simultaneous Voice and HSD operation, to moderate and low respectively for voice communication priority over HSD to independent operation of Voice and HSD. These respective user integration requirements for all markets combined are listed in table 2.

Table 2: User integration requirements

Integration criteria	Importance (Percentage)	Respondent (Min/Max)
Simultaneous HSD and V+D operation	55	0/100
Non-Simultaneous HSD with V+D service priority	34	0/100
Non-Simultaneous HSD and V+D operation	10	0/50

As well as the importance weighting for each criteria, a column showing the Minimum (Min) and Maximum (Max) weighting from the respondents is provided.

As these integration requirements will vary between user organizations, the implementation of HSD should be such as to support all three requirements.

NOTE 1: It is expected that the extent of service interaction requirements will be considered by ongoing work within WG1. For example further work may be required to confirm that simultaneous voice and HSD within TETRA Release 2 should have the same meaning as simultaneous Voice and Data within TETRA Release 1.

NOTE 2: Standardisation of High Speed Data using a multicarrier solution on different bandwidths has made simultaneous Voice using TETRA Release 1 air interface and high speed Data complicated due to the group communication.

NOTE 3: An approach for simultaneous voice and HSD could be using the high speed data modulation also for voice.

4.7 Compatibility of HSD with TETRA Release 1 V+D services

Although outside the scope of the TETRA Release 2 Questionnaire, it has been requested by WG4 to consider the following three aspects as part of the HSD URS where HSD needs to be compatible with TETRA Release 1 as near as practically possible. These three areas are:

- VoIP or some other transportation method for voice.
- Network data interface.
- Speed of MS unit.

Although the internal aspects of a SwMI are not in the scope of any TETRA standard (except for external interfaces), consideration should be given in the HSD technology solution as to the impact to VoIP networks in terms of GoS and data capacity provision within the SwMI. If VoIP solution is applied, then the voice coding should be the same as is TETRA Release 1 in order to preserve voice quality and to support end-to-end encryption. VoIP may not provide a good solution at the air interface due to high overhead and some other solutions may need to be studied.

With regard to network data interfaces, consideration should be given in the HSD technology solution as to the variety of interfaces that would need to be supported for HSD. The main data interface is considered to be Internet Protocol and interfaces implemented e.g. in public networks should be supported.

With regard to the velocity of MS units, it is important that the HSD technology solution should not greatly differ in performance from that already offered in TETRA Release 1.

In addition to the above, it is important that the HSD technology solution should not degrade the performance of any TETRA Release 1 network and should be compliant with the TETRA Release 1 standard and TETRA Interoperability Profiles (TIPs) where applicable.

4.8 HSD call types

The user requirement for HSD call types has many variants within the "one to one" and "one to many" categories. The communications matrix in table 3 shows the variety of call types required for HSD.

Table 3: HSD call type communications matrix

One to one (Call Initiator)	**MS**	**Dispatcher**	**Data network**
MS	Yes	Yes	Yes
Dispatcher	Yes	Yes	Yes (see note)
Data network	Yes	Yes (see note)	N/A
One to many (Call Initiator)			
MS	Yes	Yes	Yes
Dispatcher	Yes	Yes	Yes (see note)
Data network	Yes	Yes (see note)	N/A
NOTE: Although this call is valid, it is not related to the HSD air interface.			

Based on this requirement, the HSD technology solution should support both "one to one" and "one to many" call types from both MS and fixed users within a TETRA network and from user operating in externally connected networks. For data "one to many" can be broadcast type unidirectional communication.

4.9 Backward compatibility with TETRA Release 1

For reasons of evolution and utilization of TETRA Release 1 services, a TETRA Release 2 network provisioned with conventional access HSD should support TETRA Release 1 terminals while not causing any degradation of services, facilities and operational performance to TETRA Release 2 terminals on the network.

Likewise a TETRA Release 1 network should support TETRA Release 2 terminals provisioned with Release 2 conventional access HSD while not causing any degradation of services, facilities and operational performance to TETRA Release 1 terminals on the network.

A network supporting TETRA Release 2.1 direct access HSD may but does not need to support TETRA 1 services.

It has been identified that there can be three different types of terminals in TETRA networks:

- TETRA terminal supporting Release 1;
- TETRA terminal supporting Release 2 and/or Release 2.1 HSD;
- TETRA terminal supporting Release 1 and at least one version of HSD (Release 2 conventional access HSD and/or Release 2.1 direct access HSD).

TETRA systems and base stations may provide:

- TETRA Release 1 Voice and Data services;
- TETRA Release 2.x HSD services;
- TETRA Release 1 Voice and Release 2.x HSD services.

In the above lists Voice service means TETRA Release 1 air interface and voice codec. Voice service for high speed data is not yet defined.

TETRA services evolution and user needs indicate that voice service will be important to most of the users and a transparent (bit exact) TETRA coded voice transport is essential, when voice service is used. Support of the TETRA Release 1 air interface may be less important in long term.

Some users need high speed data for their service and may not need voice at all in the same equipment that is optimized for data services. These equipment may be simple to implement, if they can access services without TETRA Release 1 control channels. These equipment are called direct access terminals.

The principal objective of Release 2.1 direct access HSD is to provide more efficient packet data TEDS systems.

- A direct access system does not need the 25 kHz TETRA 1 MCCH. This avoids the need to provide a set of 25 kHz channels in a direct access network which may be in a different frequency band from any existing TETRA 1 network. This should result in lower system cost and easier spectrum allocation for data-only direct access networks.

Other advantages that arise from direct access include:

- (Where the TETRA 1 MCCH is retained) Potentially reduces the load on the TETRA 1 MCCH because MSs can move to TEDS channels without TETRA 1 MCCH signalling (i.e. direct access MSs do not make random access attempts on the TETRA 1 MCCH).
- Mobility based on C/I instead of RSSI becomes possible. This could provide greater immunity to interference and jamming. It could also give better frequency re-use.
- Additional "fill-in" TEDS cells to supplement coverage and capacity for the TEDS service where the TETRA 1 service is adequate.

The direct access method can continue to use the security and much of the signalling already designed for TETRA.

TETRA direct access allows additional TEDS cells to be added to a TETRA network without the need for their own TETRA 1 MCCHs, to supplement coverage and capacity, etc. However the packet data channels in such additional direct access cells may not be accessible to an conventional access MS. If there is a general requirement to extend the coverage of QAM packet data channels, other methods may be used that would be accessible by conventional access MSs (e.g. by using sectored channels, as already specified in the standard).

Long-term evolution could lead to provision of all present TETRA services, including individual and group voice calls, over a direct access TEDS system. There would be no requirement for a TETRA 1 MCCH in such a network.

Table 4 is provided to further explain these user requirements.

Table 4: Compatibility

Terminal type	TETRA R1 network	TETRA R2 conventional access network	TETRA R2 direct access network
V+D Terminal	Yes	Yes (see note 1)	No
V+D and HSD Terminal	Yes (see note 2)	Yes (see note 4)	Yes (see note 5)
HSD Terminal only	No	Yes (see note 4)	Yes (see note 5)
NOTE 1: As per Release 1 services and facilities supported on network. NOTE 2: May be provisioned on network before the network upgrade to R2 and therefore HSD operation should not affect Release 1 performance. NOTE 3: Void. NOTE 4: Only if the HSD terminal supports Release 2 conventional access. NOTE 5: Only if the HSD terminal supports Release 2.1 direct access.			

4.10 Migration from TETRA Release 1

User organizations have expressed a need to utilize HSD services as economically as possible on existing TETRA V+D networks. For this reason, the implementation of HSD should be as economical as possible.

In addition, the field upgrade and provision of HSD on TETRA V+D networks should be carried out with the minimum of disruption to existing communication services.

It is assumed that the introduction of HSD may not initially significantly release base station channels from the existing TETRA services, especially voice, and HSD equipment is added to the base station that needs to support more data services. Although HSD equipment cell coverage on the service point of view is at least the same as voice service coverage, the highest speed may need fill in base stations.

4.11 Availability of HSD

From the user requirement's analysis by WG1 in May 2001 a number of respondents saw a market for HSD in 2005 onwards, with a similar number requiring a service before 2005. There is a section of the market that sees a need for HSD as early as 2002. Table 5 shows the respondent breakdown for HSD availability to support this requirement.

Table 5: Availability of HSD as identified in 2001

Year of availability	Respondent indication
2002	2
2003	1
2004	1
2005	1
> 2005	4
NOTE: Due to lack of market interest, TEDS was not available until 2010.	

In order to understand how these different market needs may be accommodated more work is needed by WG1 to identify if an evolutionary approach to implementation can be specified, in view of potentially competing technologies such as UMTS/3G.

Recognizing the importance of standard evolution to support HSD services, the total requirement for the complete HSD suite of standards should be well understood to ensure that possible early implementation of basic HSD services do not impact future standard development work.

For Release 2.1 the time to market is more important than ever - even the traditionally very demanding traditional TETRA users, emergency services, are increasingly having to rely on commercial GPRS/3G networks for their mobile data needs while waiting for Release 2 HSD. For Release 2.1 to be a success it should be available within a shorter timescale from URS to implementation than Release 2.

4.12 Relative importance of HSD user requirement criteria

As part of the TETRA Release 2 Questionnaire respondents were requested to indicate the relative importance of criteria relating to HSD. The results of this question are listed in table 6.

Table 6: Criteria importance

HSD criteria	Importance (Percentage)	Respondent (Min/Max)
Compatibility with TETRA Release 1 V+D	40	0/100
Field upgrade capability with minimal disruption	24	0/90
Minimal need for new base station sites	21	0/80
Minimal need for new frequency spectrum	15	0/50

NOTE: Although this "relative importance weighting" is useful as a selection criteria for the HSD technology solution, there are other non-user requirement criteria that also needs to be considered. For example:

- Co-existence with other TETRA networks and analogue and digital technologies sharing the same frequency band:
  - Regulatory (CEPT and National Administrations).
  - Manufacturer needs for maximum re-use of existing TETRA technology.

It is also important to note that the number of respondents to the TETRA Release questionnaire was relatively small reflecting only a small number of large Public Safety and PAMR TETRA user organizations, and/or potential TETRA user organizations in Western Europe. Although the investment in TETRA by these user organizations is estimated to represent over 70 % of the TETRA market in Western Europe at the time, it is recognized that TETRA is being deployed in other regions of the world in a number of market segments outside Public Safety and PAMR. For this reason, a further review of user requirements may be necessary in order to provide an "overall importance weighting" for user requirements which should be used as part of the HSD technology selection within WG4.

History

Document history		
V1.1.1	December 2001	Publication (Historical)
V1.2.1	October 2002	Publication
V1.3.1	December 2010	Publication