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Technical Report

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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 9 of a multi-part deliverable covering the User Requirement Specification TETRA Release 2 and Release 2.1, as identified below:

Part 1: "General overview";

Part 2: "High Speed Data";

Part 3: "Codec";

Part 4: "Air Interface Enhancements";

Part 5: "Interworking and Roaming";

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

Part 7: "Security";

Part 8: "Air - Ground - Air services";

Part 9 "Peripheral Equipment Interface";

Part 10: "Local Mode Broadband";

Part 11: "Over The Air Management".

Introduction

The Terms of Reference for TC TETRA approved at ETSI Board meeting #52, May 2005 ([ETSI/B52(05)13 rev.1]) is 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.
- Further enhancements of the TETRA air interface standard in order to provide increased benefits and optimization in terms of spectrum efficiency, network capacity, system performance, quality of service, and other relevant parameters.
- The full 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.

The TETRA Release 2 standard, incorporating the high-speed capability (TEDS) has just been published. This high-speed data capability increases the maximum data rate of the TETRA systems from 28,8 kbit/s to over 500 kbit/s, which has the capability to radically changing the range of data applications available to TETRA users. The current TETRA PEI standard, EN 300 392-5 [i.18] V1.3.1 is a narrow band interface with limited application handling capability for the Release 2 type TETRA networks. Hence, an enhanced PEI with a concurrent multimedia capability is essential to enable access to the system from a range of data terminals (such as laptops, etc.).

The present document provides the User Requirement Specifications for the TETRA Peripheral Equipment Interface enhancements.

The URS is required by WG3 and WG4 of TC TETRA to guide the enhancement of the current TETRA PEI standard.

Background

The PEI standard which was last updated on August 2007 EN 300 392-5 [i.18], defines a point-to-point configuration between a TE2 and a MT2 using a sub-set of ITU-T Recommendations V.24 [i.2] and V.28 [i.3]. The V.24 standard provides list of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE), first agreed in 1964 which is equivalent to a subset of Electronic Industries Association (EIA) Recommended Standard EIA-232. Beside large voltage swings, limitations in noise immunity and low reliability of the flow control mechanisms that this standard introduces, the achievable data rate is also a major bottleneck in wide-band capability of the TETRA release 2.

In order to propose appropriate physical links, an initial study has already been carried out by HW communications Ltd and submitted to ETSI TC TETRA WG4 as a response to the ETSI's call for STF 314 on TETRA Release 2 PEI [i.4]. The present document, recommends wired and wireless physical link candidates that should be used between a Terminal Equipment 2 (TE2) and a Mobile Termination 2 (MT2) at the TETRA reference point RT [i.1].

Need for a Physical Link Update

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 the using real-time multimedia applications will be feasible in TETRA.

For example, in table 1, the average required throughput for real-time video is presented. The video resolution and frame sizes are derived based on ITU-T Recommendation H.264 [i.5]. It is clear that for TETRA2, using outdated physical link technologies such as EIA-232 which supports maximum data rate of 20 kbit/s is no longer a feasible option.

Table 1: Average throughput for real-time video transmission

Multimedia service Real-time video (Resolution/frame)	Average throughput (kbit/s)
128 × 96 / 30,9 176 × 144 / 15,0	64
176 × 144 / 30,3 320 × 240 / 10,0	192

A list of applications with minimum required data rates for transmission is provided in annex A.

1 Scope

The present document provides the User Requirement Specifications (URS) for the enhancements of the TETRA Peripheral Equipment Interface.

The existing TETRA PEI standard has been available since 1998. The TETRA Release 2 standard, incorporating the high-speed data capability (TEDS) has been published. This HSD capability increases the maximum data rate of the TETRA systems from 28,8 kbit/s to over 500 kbit/s, radically changing the range of data applications available to TETRA users. The TETRA users could, from now on, use a range of multimedia applications (with video as a medium) via TEDS channels. One bottleneck to making full use of this new capability is the restrictions imposed by interfacing TETRA Release 2 systems via mobile stations only. Hence, a standard HSD PEI with a concurrent multimedia capability is essential to enable access to the system from a range of data terminals (such as laptops, etc.).

Peripheral Equipment Interface enhancements translated into terms of:

- PEI physical layer aspects;
- Multimedia capability ;
- QoS negotiation

The present document is applicable to the specification of TETRA Release 2 equipment.

The user requirements contained in the present document are described mainly in non-technical terms and are based on discussions in TC TETRA WG1.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] ETSI TR 102 021-1: "Terrestrial Trunked Radio (TETRA); User Requirement Specification TETRA Release 2; Part 1: General Overview".

[i.2] ITU-T Recommendation V.24: "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)".

[i.3] ITU-T Recommendation V.28: "Electrical characteristics for unbalanced double-current interchange circuits".

[i.4] Collective Letter 06-2474 (2006-06): "Preliminary Call for Experts for Specialist Task Force QH (ETSI/ TETRA WG4) on TETRA Release 2 Peripheral Equipment Interface (PEI)".

[i.5] ITU-T Recommendation H. 264: "Advanced video coding for generic audiovisual services".

[i.6] 1394 Trade Association, "1394 Standards and Specifications Summary".

[i.7] Universal Serial Bus.

NOTE: Available at http://www.usb.org.

[i.8] "On-The-Go Supplement to the USB 2.0 Specification".

NOTE: Available at http://www.usb.org/developers/onthego/.

[i.9] "Engineering Department, Electronic Industries Association, EIA Standard RS-485 Electrical Characteristics of Generators and Receivers for Use in Balanced Multipoint Systems, reprinted in Telebyte Technology "Data Communication Library" Greenlawn NY, 1985".

[i.10] http://www.bulgin.co.uk.

[i.11] "Wireless Universal Serial Bus Specification" 1.0 Revision by: Agere Systems Inc., Hewlett-Packard Company, Intel Corp., Microsoft Corp., NEC Corp., Koninklijke Philips Electronics N.V., Samsung Electronics Co. Ltd., May 2005.

[i.12] http://www.wimedia.org/en/index.asp.

[i.13] http://www.cypress.com/.

[i.14] "Specification of the Bluetooth system", Specification Version D, November 2004.

[i.15] http://www.irda.org/.

[i.16] http://www.wi-fi.org/.

[i.17] ITU-T recommendation V.250: "Serial asynchronous automatic dialling and control".

[i.18] ETSI EN 300 392-5: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 5: Peripheral Equipment Interface (PEI)".

3 Definitions and abbreviations

3.1 Definitions

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

function: entity, especially in USB OTG, that is responsible for responding to requests to initiate communications on the PEI

host: entity, especially in USB OTG, that is responsible for initiating the communications on the PEI

3.2 Abbreviations

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

ASN	Abstract Syntax Notation
BER	Bit Error Rate
COM	COMmunications (serial) port
CPU	Central Processing Unit
CWUSB	Certified Wireless USB
DSCP	DiffServ CodePoints
EIA	Electronics Industries Association (USA).
EISA	Extended ISA
FCC	Federal Communications Commission (USA)
FRAND	Fair, Reasonable And Non-Discrimatory terms.
GFSK	Gaussian Frequency Shift Keying
GPL	GNU Public License
GSM	Groupe Special Mobile
HSD	High-Speed Data
IETF	Internet Engineering Task Force
IOP	InterOPerability
IP	Internet Protocol or International Protection
IrDA	Infrared Data Association
IRQ	Interrupt ReQuest
ISA	Industry Standard Architecture
ITU-T	International Telecommunications Union - Telecommunications standardization sector
mA	milliAmpere
MIDI	Musical Instrument Digital Interface
MS	Mobile Station (which comprises both TE and MT)
MT	Mobile Terminal
OSI-RM	Open System Interconnection – Reference Model
PC	Personal Computer
PCI	Peripheral Connection Interface
PD	Packet Data
PDA	Personal Digital Assistant
PEI	Peripheral Equipment Interface
PPP	Point-to-Point Protocol
QoS	Quality of Service
RF	Radio Frequency
SCSI	Small Computer Systems Interface
SDS	Short Data Service
SNR	Signal to Noise Ratio
STATUS	When capitalized, this means TETRA 16-bit status messaging
TCP	Transport Control Protocol
TE	Terminal Equipment, which is used for hosting an application
TEDS	TETRA Enhanced Data Service
TETRA	TErrestrial Trunked RAdio
UART	Universal Asynchronous Receiver / Transmitter
UDP	User Datagram Protocol
USB OTG	USB On The Go
USB	Universal Serial Bus
UWB	Ultra WideBand
WiFi	Wireless Fidelity

4 Background

There are number of criteria to be considered for a suitable physical link. The following criteria are briefly explained.

4.1 Support of High Data Rates

This is a prime requirement that enables wideband transmission of concurrent applications including multimedia.

4.2 Data Reliability

The physical link should provide minimum acceptable data reliability. This is an important feature that almost all applications such as multimedia data rely upon. Unreliable communication does not only affect the data and data quality but also affects the throughput.

4.3 Power Efficiency

Low power physical links which results in longer battery life and connection time of a mobile unit as well as the peripheral equipment is an important factor.

NOTE: It is not straight forward to calculate power efficiency of physical links. This is because almost all chipsets have different operation modes such as "Active or Operating" and "Suspend" modes. Depending on the application"s data rate and times switching between operating and suspend mode, power consumption changes are non trivial to calculate.

It is possible to introduce a function that takes parameters based on the application and derive power consumption of chipsets. Let us consider two parameters as α and β representing percentage of the time that device is in operating or suspended mode, respectively. Then mean power consumption, P_C, of the chipset is defined as:

$$P_C = \alpha \times P_A + \beta \times P_S \qquad \text{(Eq.1)}$$

Where, P_A and P_S are power consumption of the chipset in operating and suspended modes respectively.

4.4 Robustness

The physical link should be robust in harsh environments and protect itself from ingress of hazards such as water, oil and dust. The same time connection should be stable and reliable in harsh conditions such as on-the-move, vibration intensive, scenarios.

4.5 Ease-of-Use

In emergency situations, the user should be able to setup and disconnect a physical connection fast and effectively.

4.6 Widely Adopted in the Information Technology World and Compatibility with Other Data Systems

This is to ensure cost effective, easy and efficient implementation and operations. It is important to ensure that the physical connection is supported by most peripheral equipment such as PCs, video conferencing units, telemedicine platforms and portable clinical devices.

4.7 Security

For wireless solutions, data security is an important issue. The proposed physical links would be compared together where the level of securities that they provide are rated.

5 Wired Solutions - Background

5.1 Firewire

Many computers intended for home or professional audio/video use built-in FireWire [i.6] interfaces.

The Firewire documentation defines a media, topology and protocol for a point-to-point serial cable interface.

5.1.1 Technical Specification and Architecture

The digital interface supports either asynchronous or isochronous data transfers. FireWire can connect together up to 63 peripherals in an acyclic topology (as opposed to Parallel SCSI's Electrical bus topology). It allows peer-to-peer device communication to take place without using system memory or the CPU. FireWire also supports multiple hosts per bus. It is designed to support Plug-and-play and hot swapping. Its six-wire cable is more flexible than most Parallel SCSI cables and can supply up to 45 watts of power per port at up to 30 volts, allowing moderate-consumption devices to operate without a separate power supply.

5.1.2 Power Supply

Based on the electrical specification of a chipset (µPD72852A with data sheet number: S16725EJ2V0DS), recommended operating voltage and current are presented in tables 5.1 and 5.2.

Table 5.1: Power supply voltage

Parameter	Condition	MIN.	TYP.	MAX.	Unit
Power supply voltage	Source power node	3,0	3,3	3,6	V
	Non-source power node	2,7	3,0	3,6	V

Table 5.2: Power supply currents

Parameter	Condition	TYP.	Unit
Supply Current	Transmit maximum packet (all ports transmitting maximum size isochronous packet - 4 096 bytes, sent on every isochronous interval, S400), V = 3,3 V,T_A = 25° C	68	mA
	Repeat typical packet (receiving on one port DV packets on every isochronous interval, S100, and transmitting on the other port), VDD = 3,3 V, TA = 25° C	60	mA
	Idle (one port receiving and one port transmitting cycle starts), VDD = 3,3 V, TA = 25° C	40	mA
	1 port receiving cycle start packet only, V = 3,3 V, TA=25° C	31	mA
	Suspend mode, V = 3,3 V, TA = 25° C	115	mA

NOTE: Exact power supply and power efficiency depends on the chipset and manufacturer. In the present document, we have selected one chipset for each physical link.

5.1.3 Versions and Data Rates

5.1.3.1 Firewire 400

Firewire 400 can transfer data between devices at 100 Mbit/s, 200 Mbit/s or 400 Mbit/s data rates. These different transfer modes are commonly referred to as S100, S200, and S400. Cable length is limited to 4,5 meters (about 15 feet), although up to 16 cables can be daisy chained using active repeaters, external hubs, or internal hubs often present in Firewire equipment.