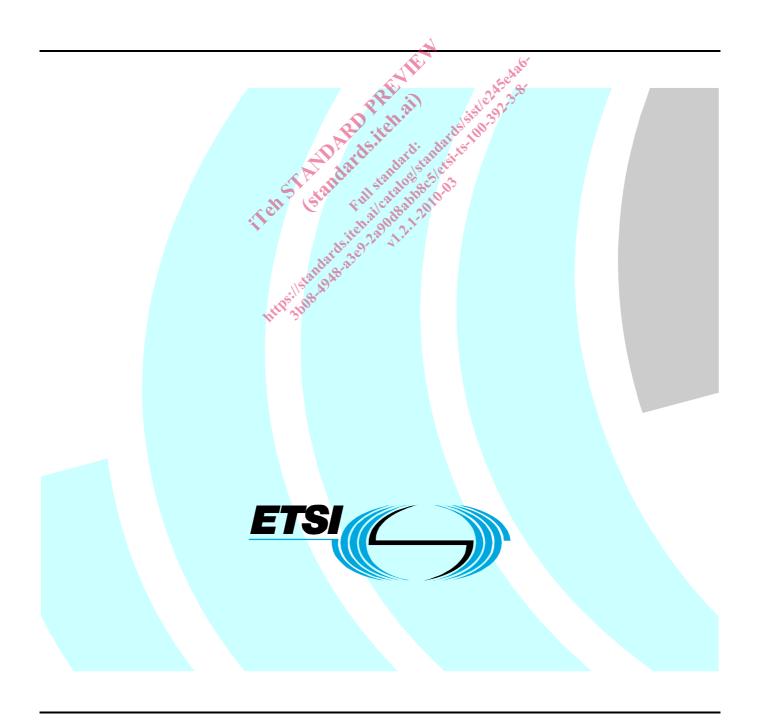# ETSI TS 100 392-3-8 V1.2.1 (2010-03)

Technical Specification

Terrestrial Trunked Radio (TETRA);
Voice plus Data (V+D);
Part 3: Interworking at the Inter-System Interface (ISI);
Sub-part 8: Generic Speech Format Implementation

ETSI

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Terrestrial Trunked Radio (TETRA).

The present document is part 3, sub-part 8 of a multi-part deliverable covering Voice plus Data (V+D), as identified below:

EN 300 392-1: "General network design";

EN 300 392-2: "Air Interface (AI)";

EN 300 392-3: "Interworking at the Inter-System Interface (ISI)";

    EN 300 392-3-1: "General design";

    EN 300 392-3-2: "Additional Network Feature Individual Call (ANF-ISIIC)";

    EN 300 392-3-3: "Additional Network Feature Group Call (ANF-ISIGC)";

    EN 300 392-3-4: "Additional Network Feature Short Data Service (ANF-ISISDS)";

    EN 300 392-3-5: "Additional Network Feature Mobility Management (ANF-ISIMM)";

    TS 300 392-3-6: "Speech Format Implementation for circuit mode transmission";

    TS 300 392-3-7: "Speech Format Implementation for Packet Mode Transmission";

    TS 300 392-3-8: "Generic Speech Format Implementation";

ETS 300 392-4: "Gateways basic operation";

EN 300 392-5: "Peripheral Equipment Interface (PEI)";

EN 300 392-7: "Security";

EN 300 392-9: "General requirements for supplementary services";

EN 300 392-10: "Supplementary services stage 1";

EN 300 392-11: "Supplementary services stage 2";

EN 300 392-12: "Supplementary services stage 3";

ETS 300 392-13: "SDL model of the Air Interface (AI)";

ETS 300 392-14: "Protocol Implementation Conformance Statement (PICS) proforma specification";

TS 100 392-15: "TETRA frequency bands, duplex spacings and channel numbering";

TS 100 392-16: "Network Performance Metrics";

TR 100 392-17:   "TETRA V+D and DMO specifications";

TS 100 392-18:   "Air interface optimized applications".

   NOTE: Part 10, sub-part 15 (Transfer of control), part 13 (SDL) and part 14 (PICS) of this multi-part deliverable
            are in status "historical" and are not maintained.

Introduction

Originally there were two different speech transportation format options defined for the TETRA InterSystem Interface (ISI) speech transmission one for circuit mode support and another for packet mode support.

The two options allow different techniques in designing and interconnecting TETRA Switching and Management Infrastructure (SwMIs). Those based on circuit mode transmission technology can use the complementary circuit mode based option, and those based on packet mode transmission technology can take advantage of the present document of the ISI.

The reason for having two options is found in the nature of existing TETRA SwMIs from various manufacturers. The existing SwMIs can generally be divided into two types: those that use packet switched technology and those that are using a circuit switched technology.

When connecting a circuit switched SwMI to a packet switched SwMI there must be a conversion performed from one technology to the other.

The present document defines a compromise solution in the speech transportation format so that no additional conversion is required. The present document should be applied in new designs instead of TS 100 392-3-6 [i.7] and TS 100 392-3-7 [i.8].

1 Scope

The present document specifies speech transmission format implementation independent of SwMI type.

The present document defines the format of user information that is transported between two SwMIs using the TETRA ISI.

The present document covers how TETRA air interface circuit mode traffic is encoded for transport over various media.

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.

- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:

    - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;

    - for informative references.

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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 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.

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

[2] ETSI EN 300 392-3-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 1: General Design".

[3] ETSI EN 300 395-2: "Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel; Part 2: TETRA codec".

[4] ETSI ETS 300 402-3: "Integrated Services Digital Network (ISDN); Digital Subscriber Signalling System No. one (DSS1) protocol; Data link layer; Part 3: Frame relay protocol specification".

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] ITU-T Recommendation G.703: "Physical/electrical characteristics of hierarchical digital interfaces".

[i.2] ITU-T Recommendation G.704: "Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels".

[i.3]   ITU-T Recommendation Q.920: "ISDN user-network interface data link layer -General aspects".

[i.4]   ITU-T Recommendation Q.920 Amendment 1: "ISDN user-network interface data link layer - General aspects".

[i.5]   ITU-T Recommendation Q.921: "ISDN user-network interface - Data link layer specification".

[i.6]   ITU-T Recommendation Q.921 Amendment 1: "ISDN user-network interface - Data link layer specification".

[i.7]   ETSI TS 100 392-3-6: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 6: Speech format implementation for circuit mode transmission".

[i.8]   ETSI TS 100 392-3-7: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 7: Speech Format Implementation for Packet Mode Transmission".

[i.9]   ITU-T Recommendation I.431: "Primary rate User-Network interface - Layer 1 specification".

[i.10]   ITU-T Recommendation I.233.1: "ISDN Frame Relaying Bearer Service".

[i.11]   ITU-T Recommendation Q.922: "Digital subscriber Signalling System No. 1 (DSS 1); Data Link Layer; ISDN Data Link Layer Specification for Frame Mode Bearer Services".

3   Definitions and abbreviations

3.1   Definitions

For the purposes of the present document the following terms and definition applies:

frame rate: nominal time between start of two consecutive frames

NOTE: There may be gaps in the flow of the frames so that a frame is missing in its normal time position.

3.2   Abbreviations

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

ACELP   Algebraic CELP
DLCI   Data Link Connection Identifier
DMO   Direct Mode Operation
E1   European format for digital transmission
FCS   Frame Check Sequence
HDLC   High level Data Link Control
ISDN   Integrated Services Digital Network
ISI   Inter System Interface
LAPF   Link Access Procedures to Frame mode bearer services
MS   Mobile Station
PDU   Protocol Data Unit
PVC   Permanent Virtual Circuit
SwMI   Switching and Management Infrastructure
TETRA   Terrestrial Trunked Radio
V+D   Voice plus Data

4 Overview

Independently of SwMI implementation, TETRA speech and circuit mode data traffic is carried in packets between two TETRA systems. The TETRA traffic is carried in PDUs that may be transported in various media.

In ISI phase 1 one TETRA ISI call may be carried per 64 kbit/s slot on the 2 Mbit/s E1 link. Other transport mechanisms and scenarios are outside the present document.

Since the transmission defined in the present document is "packet mode", packets may be subject to jitter. The maximum jitter is a SwMI specific characteristic. The value of the allowable maximum jitter value is outside the scope of the present document.

5 PDU format and procedures

5.1 General on traffic PDU contents

As TETRA is a radio system normally at least one end of the communication is using air interface. The structure of the TETRA air interface sets some requirements on the traffic ISI PDU contents and format on the ISI. The main structure of the air interface and speech encoding is retained and traffic ISI PDU supports:

- 30 ms and 60 ms speech frames;

- 170/3 ms (~56,67 ms) and 60 ms frame rates;

- ACELP speech coding and reservation for other codecs; and

- Call reference.

The call reference is used to link the traffic and call instance together especially in scenarios where no virtual connection is applied.

Optionally a fully stolen or otherwise not available frame may be indicated to help an easier re-use of that timeslot for other signalling purposes at the terminating system.

5.2 TETRA ISI payload

5.2.1 TETRA ISI payload encoding

The protocol has been designed to support TETRA speech codec frames (single/dual), circuit mode data and U-plane services. However, the present document only describes in detail the PDU formats for TETRA speech codec frames (single and dual) and U-plane services. Nevertheless, this principle applies equally to the other U-plane services. Generic payload structure is presented in figure 5.1.

Payload Header	Payload Block 1	Payload Block 2	etc.

Figure 5.1: TETRA payload structure

NOTE: More than two payload blocks may be used in future versions of the present document.

5.2.2 Traffic PDU

The traffic PDU is comprised of the following information elements, see table 5.1:

- Call reference: this information element links the traffic PDU and call instance together;

- Traffic type: this information element shall identify the type of circuit mode speech/data service;

- Framing rate: this information element shall identify whether the circuit mode speech/data is continuous flow or contains jumps due to the 18th frame of the air interface;

- Frame Number: this information element shall indicate the sequence of packets (and may indicate where frame 18 occurs); and

- Contents control and payload: this information element shall define contents of the payload and the payload blocks.

Table 5.1: Traffic PDU

Information element	Length	Type	C/O/M	Remarks
Framing rate	1	1	M	
Frame number	5	1	M	
Information element control	2	1	M	Shall be set to a value with "Additional information information element is not present"
Additional information	8		C	See notes 1 and 2
Call reference	24		C	See note 2
Traffic type	4	1	M	
Contents control and payload	Variable	1	M	
NOTE 1: The Additional information information element allows future expansion of the PDU.				
NOTE 2: This information element shall be present as defined in the Information element control information element.				

5.3 Traffic PDU information elements

5.3.1 Framing rate

The Framing rate information element shall be encoded as defined in table 5.2.

The Framing rate allows the destination SwMI to determine the characteristics of the circuit mode speech/data packet stream. Different buffering schemes may then be applied to optimize audio delay for ISI calls.

NOTE: Any other jitter in addition to the gap due to the 18th frame in the air interface is outside the scope of the present document.

Table 5.2: Contents of the framing rate information element

Information element	Length	Value	Remarks
Framing rate	1	0	170/3 ms i.e. there is a gap at the 18th frame position
		1	60 ms i.e. regular frame rate without a gap for the 18th frame

5.3.2 Frame number

The Frame number information element shall be encoded as defined in table 5.3.

Frames are numbered 1 to 17 for transmission purposes for 170/3 ms and 60 ms rate.

The Frame number information element can be used by the destination SwMI to monitor the sequence of packets and, when used in conjunction with the Framing rate information element, identify when the frame 18 gap will occur in the packet stream.

NOTE 1: The frame numbering can be used to optimize buffering on 170/3 ms frame rate.

When the payload message originates from an MS i.e. uses Framing rate 170/3 ms, the frame number in the payload header shall represent the frame number associated with the packet when base station received it over the air interface.

When the payload message originates from the SwMI i.e. uses Framing rate 60 ms, the Frame number in the payload header shall be used as a sequence counter only.

NOTE 2: For the Framing rate 60 ms each speech item may start with a Frame number 1.

Table 5.3: Contents of the Frame number information element

Information element	Length	Value	Remarks
Frame number	5	0	Reserved
		1	Frame 1
		2	Frame 2
		etc.	etc.
		17	Frame 17
		18	Reserved
		19	Frame number not available, see note
		20	Reserved
		etc.	etc.
		31	Reserved
NOTE: This unnumbered frame option may be used, if the Frame rate is 60 ms. It is provided for internal usage and should not be used over ISI.			

5.3.3 Information element control

The Information element control present information element shall be encoded as defined in table 5.4.

Table 5.4: Contents of the information element control information element

Information element	Length	Value	Remarks
Information element control	2	0	Additional information information element is not present and Call reference information element is not present, see note
		1	Additional information information element is not present and Call reference information element is present, see note
		2	Additional information information element is present and Call reference information element is not present, see note
		3	Additional information information element is present and Call reference information element is present, see note
NOTE: For the present document only the value "Additional information information element is not present" is applicable.			

5.3.4 Additional information

The Additional information information element shall be encoded as defined in table 5.5.

Table 5.5: Contents of the Additional information information element

Information element	Length	Value	Remarks
Additional information	8	0	Reserved for additional information
		etc.	etc.
		255	Reserved for additional information

5.3.5 Call reference

The optional Call reference information element shall identify the call (CC instance) to which the traffic PDU belongs to. Refer to EN 300 392-3-1 [2].

NOTE: Depending on the scenario the Call reference information may be redundant, if an individual explicit or implicit (virtual) circuit is used to carry traffic PDUs.

5.3.6 Traffic type

The Traffic type information element shall be encoded as defined in table 5.6.