



**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**

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee TETRA and Critical Communications Evolution (TCCE).

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

Part 1: "General network design";

Part 2: "Air Interface (AI)";

Part 3: "Interworking at the Inter-System Interface (ISI)":

Sub-part 1: "General design";

Sub-part 2: "Additional Network Feature Individual Call (ANF-ISIIC)";

Sub-part 3: "Additional Network Feature Group Call (ANF-ISIGC)";

Sub-part 4: "Additional Network Feature Short Data Service (ANF-ISISDS)";

Sub-part 5: "Additional Network Feature for Mobility Management (ANF-ISIMM)";

Sub-part 6: "Speech format implementation for circuit mode transmission";

Sub-part 7: "Speech Format Implementation for Packet Mode Transmission";

Sub-part 8: "Generic Speech Format Implementation";

Sub-part 9: "Transport layer independent, General design";

Sub-part 10: "General design, PSS1 over E.1";

Sub-part 11: "General design, SIP/IP";

Sub-part 12: "Transport layer independent Additional Network Feature Individual Call (ANF-ISIIC)";

Sub-part 13: "Transport layer independent Additional Network Feature Group Call (ANF-ISIGC)";

Sub-part 14: "Transport layer independent Additional Network Feature Short Data Service (ANF-ISISDS)";

Sub-part 15: Transport layer independent Additional Network Feature, Mobility Management (ANF-ISIMM)";

Part 4: "Gateways basic operation";

Part 5: "Peripheral Equipment Interface (PEI)";

Part 7: "Security";

Part 9: "General requirements for supplementary services";

Part 10: "Supplementary services stage 1";

Part 11: "Supplementary services stage 2";

Part 12: "Supplementary services stage 3";

Part 13: "SDL model of the Air Interface (AI)";

Part 14: "Protocol Implementation Conformance Statement (PICS) proforma specification";

Part 15: "TETRA frequency bands, duplex spacings and channel numbering";

Part 16: "Network Performance Metrics";

Part 17: "TETRA V+D and DMO specifications";

Part 18: "Air interface optimized applications".

NOTE 1: Part 3, sub-parts 6 and 7 (Speech format implementation), part 4, sub-part 3 (Data networks gateway), 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.

NOTE 2: Some parts are also published as Technical Specifications such as ETSI TS 100 392-2 and those may be the latest version of the document.

For all subparts in the TETRA specification ETSI EN 300 392-3, "Interworking at the Inter-System Interface (ISI)" the terms ISI and TETRA ISI are equivalent.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document defines the solution in the speech transportation format that applies in the ISI.

The present document also describes the transportation of ISI speech transmission over E1 time-division multiplexed digital lines using LAPF/HDLC encapsulation (when ISI signalling uses PSS1 as transport layer) and over IP network using RTP and UDP encapsulation (when ISI signalling adopts SIP as transport layer).

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

2.1 Normative 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 referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference/>.

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

- [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".
- [5] IETF RFC 3550: "RTP: A Transport Protocol for Real Time Applications".
- [6] IETF RFC 4566: "SDP: Session Description Protocol".
- [7] ETSI TS 100 392-3-10: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 3: Interworking at the Inter-System Interface (ISI); Sub-part 10: General design, PSS1 over E.1".

2.2 Informative 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 referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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

- [i.2] Recommendation ITU-T G.704: "Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels".
- [i.3] Recommendation ITU-T I.431: "Primary rate User-Network interface - Layer 1 specification".
- [i.4] Recommendation ITU-T I.233.1: "ISDN Frame Relaying Bearer Service".
- [i.5] Recommendation ITU-T Q.922: "Digital subscriber Signalling System No. 1 (DSS 1); Data Link Layer; ISDN Data Link Layer Specification for Frame Mode Bearer Services".
- [i.6] ETSI TS 100 392-1: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 1: General network design".

3 Definitions and abbreviations

3.1 Definitions

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

ISI PDU frame rate: nominal time between start of two consecutive ISI Traffic PDUs

NOTE: There may be gaps in the flow of the ISI speech frames so that a ISI speech 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
AI	Air Interface
BECN	Backward Explicit Congestion Notification
CR	Change Request
CSRC	Contributing Source
DE	Discard Eligibility indicator
DLCI	Data Link Connection Identifier
DMO	Direct Mode Operation
E1	European format for digital transmission
ETS	European Technical Specification
FCS	Frame Check Sequence
FECN	Forward Explicit Congestion Notification
HDLC	High level Data Link Control
IETF	Internet Engineering Task Force
ISDN	Integrated Services Digital Network
IP	Internet protocol
ISI	Inter System Interface
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
LAPF	Link Access Procedures to Frame mode bearer services
MAC	Media Access Control
MS	Mobile Station
PDU	Protocol Data Unit
PEI	Peripheral Equipment Interface
PICS	Protocol Implementation Conformance Statement
PSS1	Private Network Signalling System Number 1
PVC	Permanent Virtual Circuit
RFC	Request For Comment
RoHC	Robust header Compression
RTCP	Real-time Control Protocol
RTP	Real-time Transport Protocol
SDL	Specification and Description Language

SIP	Session Initiation Protocol
SSRC	Synchronization Source
SwMI	Switching and Management Infrastructure
TDMA	Time Division Multiple Access
TETRA	Terrestrial Trunked Radio
UDP	User Datagram Protocol
V+D	Voice plus Data

4 Overview

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

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 ISI Traffic PDU format and procedures

5.1 General on ISI 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 ISI traffic PDU contents and format on the ISI. The main structure of the air interface and speech encoding is retained and ISI traffic PDU supports:

- 170/3 ms (~56,67 ms) and 60 ms ISI traffic PDU rate;
- 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 speech 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 (half slot/ full slot), circuit mode data and U-plane services. However, the present document only describes in detail the ISI traffic PDU formats for TETRA speech codec frames (single and dual) and U-plane services. Generic payload structure is presented in figure 5.1.

Payload Header	Payload Block 1	Payload Block 2
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Figure 5.1: TETRA payload structure

The Payload header (Contents control information element) tells the contents of the Payload blocks 1 and 2, are they carrying TETRA speech, U-Plane payload or no traffic.

5.2.2 ISI 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;
- ISI PDU framing rate: this information element shall identify whether the speech is continuous flow or contains jumps due to the 18th TDMA frame of the air interface [1];
- ISI PDU frame number: this information element shall indicate the sequence of packets (and may indicate where the gap due to the ISI PDU framing rate 170/3 ms occurs); and
- contents control and payload: this information element shall define contents of the payload and the payload blocks.

Table 5.1: ISI Traffic PDU

Information element	Length	Type	C/O/M	Remarks
ISI PDU framing rate	1	1	M	
ISI PDU 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 ISI Traffic PDU information elements

5.3.1 ISI PDU framing rate

The ISI PDU framing rate information element shall be encoded as defined in table 5.2.

The ISI PDU framing rate allows the destination SwMI to determine the characteristics of the speech packet stream. Different buffering schemes may then be applied to optimize audio delay for ISI calls.

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

Table 5.2: Contents of the ISI PDU framing rate information element

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

5.3.2 ISI PDU frame number

The ISI PDU frame number information element shall be encoded as defined in table 5.3.

ISI traffic PDUs are numbered from 1 to 17 for transmission purposes for 170/3 ms and 60 ms rate.

The ISI PDU frame number information element can be used by the destination SwMI to monitor the sequence of speech packets and, with the ISI PDU framing rate 170/3 ms, identify when the frame 18 gap will occur in the packet stream.

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

When the payload message uses ISI PDU framing rate 60 ms, the ISI PDU frame number in the ISI traffic PDU shall be used as a sequence counter only.

NOTE 2: For the ISI PDU framing rate 60 ms each speech item may start with a value Frame 1.

Table 5.3: Contents of the ISI PDU frame number information element

Information element	Length	Value	Remarks
ISI PDU frame number	5	0	Reserved
		1	Frame 1
		2	Frame 2
		etc.	etc.
		17	Frame 17
		18	Reserved
		19	Proprietary
		20	Reserved
		etc.	etc.
		31	Reserved

5.3.3 Information element control

The Information element control 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 values "0" and "1" are 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 ETSI TS 100 392-3-10 [7].

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.