Draft ETSI EN 300 392-3-8 V1.4.0 (2019-08)

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

Reference
REN/TCCE-03256

Keywords
interworking, radio, TETRA, V+D

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status.
Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Contents

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This draft European Standard (EN) has been produced by ETSI Technical Committee TETRA and Critical Communications Evolution (TCCE), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

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";

Part 19: "Interworking between TETRA and Broadband systems".

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.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

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/.

NOTE 1: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

NOTE 2: Note that for the TETRA standards, the reference is always to a European Standard (ETSI EN 300 xxx) if such has been published, but the latest version of that standard can be either an EN or a Technical Specification (ETSI TS 100 xxx), even if this is not visible in the reference list.

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] Void.

[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 EN 300 392-3-10: "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 1: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

NOTE 2: Note that for the TETRA standards, the reference is always to a European Standard (ETSI EN 300 xxx) if such has been published, but the latest version of that standard can be either an EN or a Technical Specification (ETSI TS 100 xxx), even if this is not visible in the reference list.

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".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

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 Symbols

Void.

3.3 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.

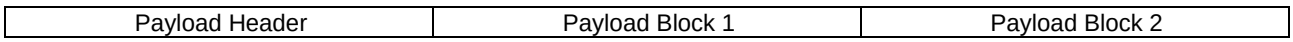

Figure 5.1: TETRA payload structure

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 18th TDMA frame position
		1	60 ms i.e. regular frame rate without a gap for the 18th 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 EN 300 392-3-10 [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.

5.3.6 Traffic type

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

NOTE: Circuit mode data is outside the scope of the present document.

Table 5.6: Contents of the Traffic type information element

Information element	Length	Value	Remarks
Traffic type	4	0	ACELP, refer to ETSI EN 300 395-2 [3]
		1	Reserved for codec 2
		2	Reserved for codec 3
		3	Proprietary codec
		Other	Reserved

5.3.7 Contents control

The contents control information element shall be encoded as defined in table 5.7.

NOTE: Traffic 1 and U-plane 1 identify contents of sub-slot 1, and traffic 2 and U-plane 2 identify contents of sub-slot 2 in the air interface timeslot.

Table 5.7: Contents of the Contents control information element

Information element	Length	Value	Remarks
Contents control	4	0	Traffic 1 + Traffic 2
		1	U-plane 1 + Traffic 2
		2	U-plane 1 + U-plane 2
		3	Reserved
		4	Traffic 2 single 30 ms, second half-slot, see notes 1 and 2
		5	Null i.e. traffic is not available, may be used to indicate a fully stolen 60 ms speech frame
		6	U-plane 1, the second half-slot is not available, see note 2
		7	U-plane 2, the first half-slot is not available, see note 2
		8	Reserved
		etc.	etc.
		15	Reserved
NOTE 1: Traffic 1 is not available. NOTE 2: Typically the unavailable half-slot has been stolen for a C-plane message.			

5.3.8 Contents control and payload

The Contents control and payload information element shall be encoded as defined in tables 5.8 to 5.14.

Table 5.8: Contents of the Contents control and payload information element for traffic 1 and traffic 2

Information element	Length	Value	Remarks
Contents control	4	0	Traffic 1 and traffic 2
Speech payload 1	137		
Speech payload padding bits	7		Padding bits shall be set to "0"
Speech payload 2	137		
Speech payload padding bits	7		Padding bits shall be set to "0"

Table 5.9: Contents of the Contents control and payload information element for U-plane 1 and traffic 2

Information element	Length	Value	Remarks
Contents control	4	1	U-plane 1 and traffic 2
U-stealing payload 1	124		See note
U-plane payload padding bits	4		Padding bits shall be set to "0"
Speech payload 2	137		
Speech payload padding bits	7		Padding bits shall be set to "0"
NOTE: This information element contains the MAC-U-SIGNAL contents, that is, including the MAC header.			

Table 5.10: Contents of the Contents control and payload information element for U-plane 1 and U-plane 2

Information element	Length	Value	Remarks
Contents control	4	2	U-plane 1 and U-plane 2
U-stealing payload 1	124		See note
U-plane payload padding bits	4		Padding bits shall be set to "0"
U-stealing payload 2	124		See note
U-plane payload padding bits	4		Padding bits shall be set to "0"
NOTE: This information element contains the MAC-U-SIGNAL contents, that is, including the MAC header.			

Table 5.11: Contents of the Contents control and payload information element for Traffic 2

Information element	Length	Value	Remarks
Contents control	4	4	Traffic 2
Speech payload 2	137		
Speech payload padding bits	7		Padding bits shall be set to "0"

Table 5.12: Contents of the Contents control and payload information element for Null

Information element	Length	Value	Remarks
Contents control	4	5	Null

Table 5.13: Contents of the Contents control and payload information element for U-plane 1

Information element	Length	Value	Remarks
Contents control	4	6	U-plane 1
U-stealing payload 1	124		See note
U-plane payload padding bits	4		Padding bits shall be set to "0"
NOTE: This information element contains the MAC-U-SIGNAL contents, that is, including the MAC header.			

Table 5.14: Contents of the Contents control and payload information element for U-plane 2

Information element	Length	Value	Remarks
Contents control	4	7	U-plane 2
U-stealing payload 2	124		See note
U-plane payload padding bits	4		Padding bits shall be set to "0"
NOTE: This information element contains the MAC-U-SIGNAL contents, that is, including the MAC header.			

Annex A (informative): TETRA ISI channel mapping

A.1 TETRA ISI channel mapping for E1 B-channels

When using E1 as transmission line, scenario agreement defines TETRA ISI channel mapping to the transmission media. The TETRA ISI channels are statically configured and each TETRA ISI channel will use a specific E1 B-channel.

TETRA ISI channels are assigned PVC DLCIs and E1 B-channels according to table A.1.

NOTE 1: As the channels are assign so that there is only a single packet data channel per 64 kbit/s channel, then the HDLC DLCI values are redundant.

NOTE 2: As the TETRA ISI channels are permanently mapped on the E1 slots the Call reference information element is also redundant and may or may not be used, refer to clause 5.3.5.

Table A.1: TETRA ISI channel addressing

TETRA ISI Channel	HDLC DLCI (Decimal)	E1 Slot B-Channel
1	21	1
2	22	2
3	23	3
4	24	4
5	25	5
6	26	6
7	27	7
8	28	8
9	29	9
10	30	10
11	31	11
12	32	12
13	33	13
14	34	14
15	35	15
CC	36	PSS1
16	37	17
17	38	18
18	39	19
19	40	20
20	41	21
21	42	22
22	43	23
23	44	24
24	45	25
25	46	26
26	47	27
27	48	28
28	49	29
29	50	30
30	51	31

Annex B (normative): User information transport over E1

B.1 General

When the PSS1/E1 is used as for the transport of the ISI signalling, the transport mechanism for ISI traffic user information (TETRA ISI payload) shall be a subset of LAPF as defined in ETSI ETS 300 402-3 [4] or in annex A.1 of Recommendation ITU-T Q.922 [i.5]. The details are presented in clauses B.2 and B.3.

NOTE 1: For the purposes of the present document ETSI ETS 300 402-3 [4] and Recommendation ITU-T Q.922 [i.5], annex A.1 can be used interchangeably.

NOTE 2: Recommendation ITU-T I.233.1 [i.4] provides further information on the ISDN frame relaying bearer service.

NOTE 3: Frame mode bearer service preserves the order of the frames, but may drop frames, refer to Recommendation ITU-T I.233.1 [i.4].

B.2 LAPF Usage

The format of the HDLC frame used in LAPF is presented in figure B.1, refer to ETSI ETS 300 402-3 [4]. The address field shall be the default two octet address field.

The bit number 8 is the most significant bit. The bit number 1 is the least significant bit and shall be sent first (standard for HDLC protocols).

NOTE: The bits of an octet are numbered from 1 to 8 in the present document.

Table B.1: HDLC Frame in ETSI ETS 300 402-3 [4]

	8	7	6	5	4	3	2	1
Start Flag	$7E_H$							
Address 1	Upper DLCI						C/R	EA0
Address 2	Lower DLCI				FECN	BECN	DE	EA1
Payload	Payload							
FCS 1	FCS							
FCS 2	FCS							
Stop flag	$7E_H$							

A subset of LAPF shall be used as defined in ETSI ETS 300 402-3 [4], however congestion control shall not be used on the B-channels. As a result the LAPF frame relay control bits are set to predefined values:

- C/R is not used in the frame relay transport i.e. is conveyed transparently, refer clause 5.3.2 of ETSI ETS 300 402-3 [4], the value shall be set in TETRA to "1" = 1;
- EA0 = 0 = One more address byte follows;
- EA1 = 1 = Last address byte;
- FECN = 0 = Forward Explicit Congestion Notification (no congestion);
- BECN = 0 = Backward Explicit Congestion Notification (no congestion);
- DE = 0 = Discard eligibility indicator (no discard).

The HDLC frame used to transport TETRA payload shall be as defined in table B.2.

Table B.2: HDLC Frame for TETRA user information transport

	8	7	6	5	4	3	2	1
Start Flag	$7E_H$							
Address 1	Upper DLCI						1	0
Address 2	Lower DLCI				0	0	0	1
Payload	TETRA Payload							
FCS 1	FCS							
FCS 2	FCS							
Stop flag	$7E_H$							

Information elements in the table B.2 are:

Start Flag: $7E_H$;

DLCI: Defined by scenario agreement, refer to annex A;

TETRA Payload: see clause 5.2;

FCS: Frame Check Sequence (Cyclic redundancy check);

FCS1: most significant 8 bits of FCS;

FCS2: least significant 8 bits of FCS;

Stop Flag: $7E_H$.

Cyclic redundancy check

Cyclic redundancy check shall be calculated with generation polynomial: $X^{16} + X^{12} + X^5 + 1$. The cyclic redundancy check calculation shall cover all bytes between and including address 1 and TETRA payload.

Zero Bit Insertion

Since $7E_H$ is used as a packet delimiter it is vital that this pattern does not appear within the packet itself causing the receiver of the packet to falsely detect an end of packet condition. Zero bit insertion shall therefore be used by the sending device so that after every 5 consecutive "1"s an additional "0" is inserted into the bit stream, i.e.:

0 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1 0 1 1 1 1 1 1 0 1

becomes after zero insertion:

0 1 1 1 1 1 0 1 1 1 1 1 0 0 1 1 1 1 1 0 0 1 1 1 1 1 0 1 0 1

The receiving entity shall discard the inserted "0" bits.

B.3 HDLC usage

The E.1 channels use 64 kbit/s physical channels that are unrestricted digital connections. The idle 64 kbit/s E.1 channels transmit continuous stream of "1" bits and the HDLC frames start flag first "0" indicates the beginning of a frame.

NOTE 1: Recommendation ITU-T I.431 [i.3], clause 5.8.1 defines that the "1" density should be at least three "1"s in each octet on idle B-channels.

NOTE 2: Recommendation ITU-T Q.922 [i.5], clause 2.2 identifies as option that the idle basic rate channel should use continuous flag sequence instead of a continuous stream of "1".

The E.1 B-channels are considered to be available as managed by call control, refer to ETSI EN 300 392-3-10 [7], clause 4.4 and there shall be no set-up or other maintenance signalling on the E.1 B-channels, refer clause B.2. The transport of the HDLC frames shall use LAPF frame relay protocol that is unconfirmed i.e. no frame numbering or acknowledgements are used at the link layer, refer clause B.2.

NOTE 3: The frame numbers in the TETRA payload are not visible at the link layer.

Physical layer error situations may be detected and used locally to control availability of E.1 B-channels for calls without any error signalling at the link layer.

Annex C (informative): Physical layer and mapping

C.1 Physical layer

The physical media may be a copper cable carrying 2 Mbit/s signal according to Recommendation ITU-T G.703 [i.1] and having 64 kbit/s framing according to Recommendation ITU-T G.704 [i.2].

C.2 Mapping structure

For TETRA ISI Phase 1 figure C.1 illustrates the mapping structure between the TETRA ISI traffic frames and the TETRA ISI E1 media between two SwMIs.

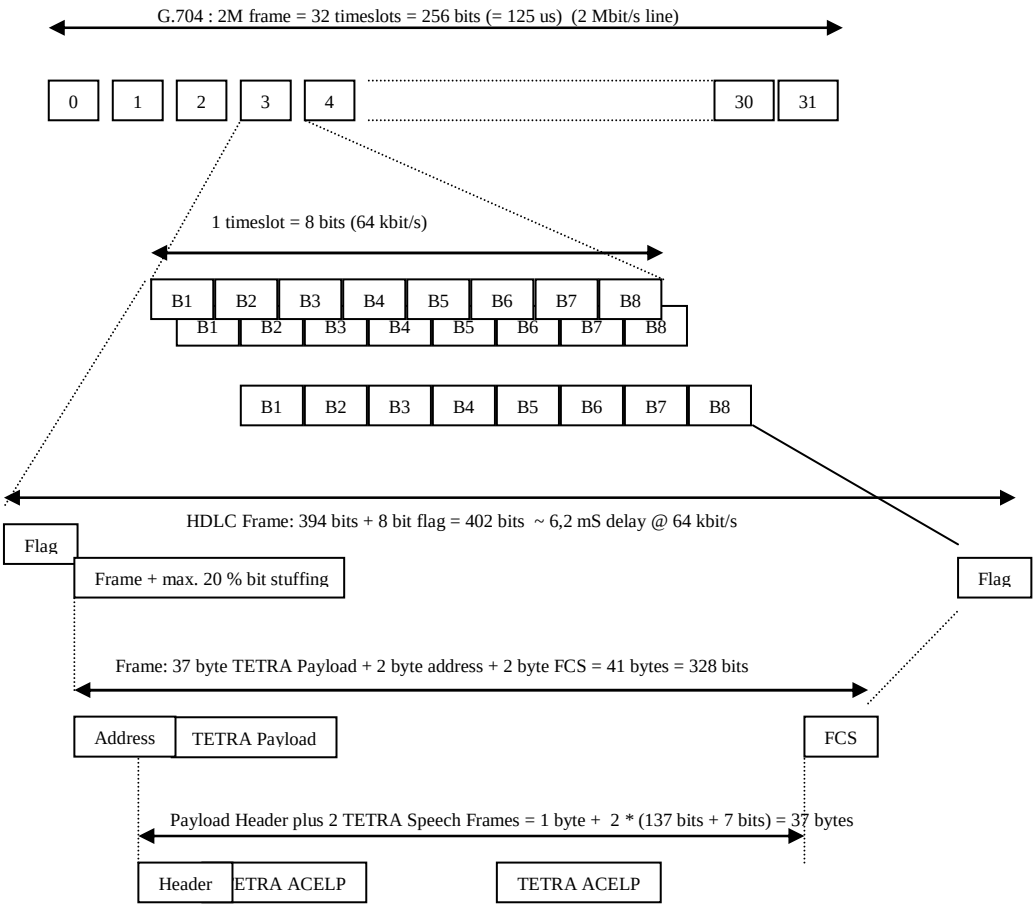

Figure C.1: Mapping Structure

Figure C.1 indicates how a typical TETRA voice call will be carried over TETRA ISI using industry standards:

- Recommendations ITU-T G.703 [i.1] and G.704 [i.2] framing are ITU-T standards for the physical layer;
- Recommendation ITU-T Q.922 [i.5] defines the HDLC structure.

Annex D (normative): User information transport in RTP session

D.1 General

When the SIP/IP is used as for the transport of the ISI signalling, the ISI traffic user information (TETRA ISI payload) related to a call shall be carried in one RTP session as defined in IETF RFC 3550 [5].

The procedures for the transport of TETRA user information over the ISI shall not rely on RTCP packet reception. RTCP protocol use is not specified in the present document, however received RTCP packets may be discarded by the ISI gateway.

D.2 RTP usage

The ISI traffic user information are transported as RTP payload in a generic RTP packet, to be carried over a standard UDP/IP envelope.

The format of the RTP packet to be used for the transmission of the ISI traffic user information is shown in table D.1. The table is re-arranged with respect to the IETF RFC 3550 [5] for coherence with the rest of the present document; however, the expected transmission order of the bits is still the same. Many fields shall assume the fixed values shown in table D.1.

Table D.1: RTP Packet for ISI traffic

Information element	Length	Value	Remarks
Version	2	2	RTP version 2.
Padding	1	0	padding not used (ISI payload always octet-aligned).
Extension	1	0	Header extension not used.
CSRC count	4	0	Number of Contributing sources always 0.
Marker	1		Not used, could be any.
Payload Type	7		TETRA ISI Generic Speech Format. See note 4.
Sequence number	16		Incremented by one at each transmitted packet. See note 2.
Timestamp	32		Sequential time. See note 1.
SSRC	32		Synchronization source. See note 2.
Traffic PDU	variable		See clause 5.2.2. See note 3.

NOTE 1: According the IETF RFC 3550 [5] "for fixed-rate audio the timestamp clock would likely increment by one for each sampling period", therefore, because the sample period for speech in the TETRA codec is 0,125 ms and there are 60 ms of coded speech for each RTP packet, the timestamp will be incremented by 480 units between two consecutive packets.

NOTE 2: The SSRC is a initially random number produced by the transmitted entity within the SwMI generating the traffic. A restarted value in the sequence number, with or without a change of SSRC, may occur every time the talker party changes during a call.

NOTE 3: The relationship between a call and RTP packets flow is defined during call establishment in the ISI signalling and is associated to the destination IP address and UDP port.

NOTE 4: Payload type value could be any dynamic payload type value IETF RFC 4566 [6] and it is negotiated by the gateways during call establishment.

The use of header compression (e.g. RoHC) is not relevant for user traffic on the ISI link.

Annex E (informative): Change requests

The present document includes change requests as presented in table E.1.

Table E.1: Change requests

No	CR vers.	Standard Version	Clauses affected	Title	CR Status
001	11	V1.1.1	2, 2.1, 2.2, 3.2, A.1, Annex B	Use of HDLC for speech frames transport	WG3 approved 090401
002	02	V1.3.2	2.1, 2.2, 5.3.5, B.3	References to ISI TSs must be changed to ENs.	WG3 approved 190327

History

Document history		
V1.1.1	April 2008	Publication as ETSI TS 100 392-3-8
V1.2.1	March 2010	Publication as ETSI TS 100 392-3-8
V1.3.1	May 2018	Publication as ETSI TS 100 392-3-8
V1.4.0	August 2019	EN Approval Procedure AP 20191113: 2019-08-15 to 2019-11-13