EUROPEAN TELECOMMUNICATION STANDARD

FINAL DRAFT
pr **ETS 300 392-13**

February 1997

Source: ETSI TC-RES

Reference: DE/RES-06001-13

ICS: 33.020

Key words: TETRA, V+D, protocol, SDL

Radio Equipment and Systems (RES); Trans-European Trunked Radio (TETRA); Voice plus Data (V+D); Part 13: SDL model of Air Interface (AI)

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE
Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE
X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

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

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Foreword

This final draft European Telecommunication Standard (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI), and is now submitted for the Voting phase of the ETSI standards approval procedure.

This ETS is a multi-part standard and will consist of the following parts:

Part 1: "General network design".

Part 2: "Air Interface (AI)".

Part 3: "Inter-working", (DE/RES-06001-3).

Part 4: "Gateways", (DE/RES-06001-4).

Part 5: "Terminal equipment interface", (DE/RES-06001-5).

Part 6: "Line connected stations", (DE/RES-06001-6).

Part 7: "Security".

Part 8: "Management services", (DE/RES-06001-8).

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: "PICS Proforma".

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

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1 Scope

This ETS defines the Specification and Description Language (SDL) model of the TETRA Voice plus Data (V+D) Air Interface (AI).

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ETS 300 392-2: "Radio Equipment and Systems (RES); Trans-European Trunked RAdio (TETRA); Voice plus Data (V+D); Part 2: Air Interface".

[2] ITU-T Recommendation Z.100 (1993): "Specification and Description Language (SDL)".

[3] ISO/IEC 8878: "Use of X.25 to provide the OSI connection mode network service".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the following definitions apply:

acknowledged data transfer: A service provided by the layer below which gives an acknowledgement back over the air interface from the lower layer peer entity. This service is used by the layer 3 entities to acquire a secure transmission including re-transmissions.

Advanced Link (AL): An AL is a bi-directional connection between one Mobile Station (MS) and a Base Station (BS) with provision of acknowledged and unacknowledged services including windowing, segmentation, extended error protection and choice among several throughputs. The data transfer via the AL requires a set-up phase.

announced cell re-selection: Cell re-selection where MS Mobile Link Entity (MLE) informs the Switching and Management Infrastructure (SwMI) both in the serving cell and in the new cell that cell change is performed. There can be three types of announced cell re-selection:

- type 1: The MS-MLE knows the new cell and the traffic channel allocations on the cell before deciding to leave its serving cell;

- type 2: The MS-MLE knows the new cell before changing to it, but does not know the channel allocation on the new cell in advance;

- type 3: The MS-MLE need not to know the new cell before changing to it. The serving cell is only informed by the MS-MLE that it wants to change cell.

TETRA V+D may support all three types of announced cell re-selection.

attached: An MS is said to be attached to a cell when the MS is camped and registered on the cell. The MS may be in idle mode (i.e. not actively processing a transaction) or in traffic mode (i.e. actively processing a transaction in reception and/or in transmission). It is the Mobility Management (MM) which decides when an MS is said to be attached.

Basic Link (BL): A bi-directional connectionless path between one or several MSs and a BS, with a provision of both unacknowledged and acknowledged services on a single message basis.

call transaction: All of the functions associated with a complete unidirectional transmission of information during a call. A call can be made up of one or more call transactions. In a semi-duplex call these call transactions are sequential.

camped: An MS is said to be camped on a cell when the MS is synchronized on the cell BS and has decoded the Broadcast Network CHannel (BNCH) of the cell. The synchronization procedure is performed by the Medium Access Control (MAC) entity and the interpretation of the Network information from the BNCH is performed by a procedure in the MLE. It is the MLE which decides when an MS is said to be camped on a cell.

cell re-selection: The act of changing the serving cell from an old cell to a new cell. The cell re-selection is performed by procedures located in MLE and in the MAC. When the re-selection is made and possible registration is performed, the MS is said to be attached to the cell.

cell-id: Characterized as the channel number of the main carrier on the cell.

confirmed service: A service provided by the layer below which ensures that a message is responded to by the peer entity before new messages are allowed. The service may be used for synchronization of peer entities or for provision of sequential behaviour.

current serving BS: The BS on one of whose channels the MS is currently operating.

direct set-up signalling: A signalling procedure where immediate communication can take place between the calling and the called users without the alerting process and without an explicit response from the called user that he has answered.

initial cell selection: The act of choosing a first serving cell to register in. The initial cell selection is performed by procedures located in MLE and in the MAC. When the cell selection is made and possible registration is performed, the MS is said to be attached to the cell.

migration: The act of changing to a new location area in a network (either with different Mobile Network Code (MNC) and/or Mobile Country Code (MCC)) where the user does not have subscription, an Individual TETRA Subscriber Identity (ITSI) for that network.

monitoring: The act of measuring the power of neighbour cells and calculate the path loss parameter C2 based upon information on neighbour cells broadcasted by the serving cell.

on/off hook signalling: A signalling procedure which includes an alerting process to the called user. The calling user waits for an explicit response from the called user that he has answered before the call can be set-up.

received segment sequence number: The number of the currently received segment.

roaming: The act of changing location area within a network of same MNC/MCC, and for which the user has a valid registration (ITSI).

scanning: The act of measuring the power of neighbour cells and calculate the path loss parameter C1 based upon the information on the neighbour cells broadcasted by the neighbour cells themselves.

segment: A LLC segment is the AL unit of transmission and re-transmission. A segment is the numbered piece of a TL-SDU fitting into one MAC layer Protocol Data Unit (PDU) (MAC block). A segment is a synonym to a PDU.

Service Data Unit (SDU) number: A number on the Logical Link Control (LLC) entity to keep TL-SDUs in order.

serving cell: The cell that is currently providing services to the MS.

subscriber class: A subscriber class has no other defined usage than offering a population subdivision. The operator defines the values and meaning of each class.

surveillance: The process of monitoring the quality of the radio link to the serving cell.

timebase: A device which determines the timing state of signals transmitted by a BS or MS.

timeslot number: The timing of timeslots within a Time Division Multiple Access (TDMA) frame.

TLC-SAP: The management Service Access Point (SAP) is a way of modelling layer-to-layer communication for management and control purpose.

un-acknowledged data transfer: A service which does not give any acknowledgement back to the service user.

unannounced cell re-selection: Cell re-selection where the MS-MLE does not inform the serving cell that it intend to change to a new cell. Only the new cell is informed about the MS-MLE.

unconfirmed service: A service which does not ensure response from peer entities before allowing new messages. This implies that messages to be transported may arrive in different order at the peer entity.

undeclared cell re-selection: Cell re-selection where the MS-MLE does not inform the serving cell nor the new cell that cell change is performed.

validation model: A model for the protocol specified with a formal description technique in this case, SDL.

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

AL	Advanced Link
BL	Basic Link
BNCH	Broadcast Network CHannel
BS	Base Station
CC	Call Control
CMCE	Circuit Mode Control Entity
CONP	Connection Oriented Network Protocol
DL	DownLink
FCS	Frame Check Sequence
ITSI	Individual TETRA Subscriber Identity
LLC	Logical Link Control
MAC	Medium Access Control
MCC	Mobile Country Code
MLE	Mobile Link Entity
MM	Mobility Management
MNC	Mobile Network Code
MS	Mobile Station
PC	Protocol Control
PDU	Protocol Data Unit
PS	PostScript
QoS	Quality of Service
SAP	Service Access Point
SCLNP	Specific Connectionless Network Protocol
SDL	Specification and Description Language
SDU	Service Data Unit
SP	Service Primitive
SS	Supplementary Service
SwMI	Switching and Management Infrastructure
TDMA	Time Division Multiple Access
TETRA	Trans-European Trunked RAdio
TL-SDU	SDU from the service user (i.e. MLE)
TLA	A layer 2 service access point (TLA-SAP)
TLB	A layer 2 service access point (TLB-SAP)
TLC	A layer 2 service access point (TLC-SAP)
TM-SDU	SDU from the layer above MAC (i.e. LLC)
UL	UpLink
V+D	Voice plus Data

4 General

The Specification and Description Language (SDL) model defined in this ETS is the TETRA V+D MS. The model is based on the description given in ETS 300 392-2 [1]. Even though some Line Station (LS) functionality has been given in ETS 300 392-2 [1] they have not been defined in the SDL model. Specification of concurrent services for the TETRA protocol stack is outside the scope of this ETS. In case there are any conflicts between the SDL model and ETS 300 392-2 [1], the textual specification shall be taken as the correct description instead of the SDL model.

Due to the fact that SDL is not suitable for bit exact data description, there is no data description given in this ETS. The names of the signals and the parameters are the same as in ETS 300 392-2 [1] where the use of SDL described in ITU-T Recommendation Z.100 [2] has permitted it.

The SDL model in this ETS is created from the SDL validation model of TETRA V+D leaving out detailed descriptions that were necessary for validation purposes only. Generally only SDL blocks and processes of the TETRA MS validation model have been included. SDL procedures have been included in the model in case there is a non-trivial functionality in a procedure that is not obvious from the naming or use of the procedure.

Generally, each of the SDL protocol entities of the TETRA MS has been built of two main parts:

- the protocol part; and

- the formatter part;

converting PDUs to N - 1 Service Primitives (SPs). The protocol part of the SDL models handles the main functionality of the entity. It contains the handling of SAPs above the protocol entity and PDU interface to the next lower protocol entity. The formatter part of the SDL models handles the conversion between the PDUs of the protocol entity and SPs of the SAPs of the next lower service interface.

NOTE 1: The naming of the formatter part may vary, e.g. in Circuit Mode Control Entity (CMCE) the SDL process defining the formatter part is called Protocol Control (PC).

Due to the number of pages in the SDL specification of the MS the actual SDL specification diagrams are distributed in an electronic version which accompany this ETS.

NOTE 2: The PostScript (PS) files that are referenced in this ETS are packed into an archive named 392d_ev.lzh. Other file formats are available on request.

For each protocol entity there are several PS files. Annex A contains references to the PS files for the stack model, while each of the following annexes (annexes B to H) describes a single protocol entity and their references to the files on the diskette. In addition to references to the SDL diagrams and PS files, the annexes also contain information on the specific protocol model.

Annex A (normative): Protocol stack model

SAPs at the top of TETRA MS protocol stack are the ones that are defined for Mobility Management (MM), CMCE, Specific Connectionless Network Protocol (SCLNP) and Connection Oriented Network Protocol (CONP) entities in ETS 300 392-2 [1].

The Supplementary Services (SS) SAP above CMCE has not been included in the model since it is outside the scope of ETS 300 392-2 [1]. Therefore the SS SAP is not visible in the block structure of the stack model.

The definitions of the SDL signal lists visible in the stack block structure can be found in the protocol entity block structure diagrams of the SDL models, described in the following annexes.

Table A.1 gives the descriptive name and file name of the SDL model.

Table A.1: TETRA MS stack model file

Descriptive name	File name
TETRA MS stack block structure	tetra.ps

Annex B (normative): MM model

The SDL model in this ETS of the textual MM protocol specification as defined in clauses 15 and 16 of ETS 300 392-2 [1], covers all mandatory requirements and some optional features.

For the SDL model it is assumed that the MM service users behave according to the their defined functionality. That means that the SDL of the MM is not robust to operations not required in the textual protocol specification.

The SDL model has been structured in accordance with the architecture defined for the MM functional entities in the textual protocol specification, and it follows the states and signal behaviour in the SDL diagram from ETS 300 392-2 [1], clause 15.

Table B.1 gives the descriptive names and file names of the SDL model.

Table B.1: MM files

Descriptive name	File name
MM block structure	mmblock.ps
MM Protocol	mmproto.ps
MM Formatter	mmform.ps

Annex C (normative): CMCE model

The SDL model in this ETS of the textual CMCE protocol specification as defined in clauses 11, 13 and 14 of ETS 300 392-2 [1], covers all mandatory requirements and some optional features.

The SDL model can only handle one instance of Call Control (CC) even if it is specified in ETS 300 392-2 [1] that there may exist multiple instances of TNCC-SAP running at the same time.

For the SDL model it is assumed that the CMCE service users behave according to the their defined functionality. That means that the SDL of the CMCE is not robust to operations not required in the textual protocol specification.

The interface to PC uses internal signalling for the layer 2 SPs, sent before the actual CMCE PDU.

The SDL model has been structured in accordance with the architecture defined for the CMCE functional entities in the textual protocol specification. The SDL model follows the states and signal behaviour described in the diagrams from ETS 300 392-2 [1], clause 14.

For the handle of colliding calls a COLLIDING_CALL state is added.

Table C.1 gives the descriptive names and file names of the SDL model.

Table C.1: CMCE files

Descriptive name	File name
CMCE block structure	cmceblk.ps
CMCE Call Control	cmcecc.ps
CMCE Short Data Services	cmcesds.ps
CMCE Protocol Control (formatter)	cmceform.ps

Annex D (normative): SCLNP model

This model of SCLNP expects that the service user above SCLNP is conformant to ETS 300 392-2 [1]. This means that the service user shall not use service primitives against the protocol as described in ETS 300 392-2 [1], clauses 26 and 27.

All of the mandatory SCLNP functions which can be applied to MSs given in the ETS 300 392-2 [1], subclause 27.7, are implemented in this SDL model. Priority handling and sub-addressing is limited to copying the values between service primitives and the corresponding PDUs. Mandatory forward PDU function is limited to sending all SCLNP packets to MLE.

The Quality of Service (QoS) information passing from the protocol process to the formatter process is handled using SDL remote variables. All other communication between the two processes is handled via the PDU route in this model.

The optional SCLNP packet re-transmission has been specified in the SDL model. In ETS 300 392-2 [1], subclauses 18.3.4.7.3 to 18.3.4.7.6, it is defined that SCLNP may re-transmit packets which have not yet been successfully transferred to SwMI. In this model of SCLNP the re-transmission covers the latest packet sent to MLE after MLE-CLOSE and MLE-OPEN indication sequence. An SDL Boolean constant called SCLNP_RESENDS_AFTER_CLOSE controls whether to use this functionality or not.

Table D.1 gives the descriptive names and file names of the SDL model.

Table D.1: SCLNP files

Descriptive name	File name
SCLNP block structure	sclnpblk.ps
SCLNP Protocol	sclnppro.ps
SCLNP Formatter	sclnpfor.ps

Annex E (normative): CONP model

The model of CONP expects that the service user above CONP is conformant to ETS 300 392-2 [1]. It means that the service user shall not use service primitives against the protocol as described in ETS 300 392-2 [1], clauses 24 and 25.

The SDL model is only a model of the State/Event table of the X.25 described in ISO/IEC 8878 [3]. It shows the use of the TETRA Air Interface layer 2.

Table E.1 gives the descriptive names and file names of the SDL model.

Table E.1: CONP files

Descriptive name	File name
CONP block structure	conpblk.ps
CONP Protocol	conpprot.ps
CONP Formatter	conpform.ps

Annex F (normative): MLE model

The SDL model in this annex of the textual MLE protocol specification as defined in clauses 17 and 18 of ETS 300 392-2 [1], covers all mandatory requirements and some optional features.

The optional features specified in the SDL model are the type 1 and type 2 cell re-selection procedures. A simple specification of the initial cell selection procedure is also given. This procedure however should not be seen as putting any further requirements on other possible conforming initial cell selection procedures. Furthermore, only a very simple criterion function for initiating any cell re-selection procedure has been specified. Also the QoS negotiation possible during the AL service set-up phase is specified in very little detail.

There is no buffering mechanism specified in the SDL model. So each MLE service user can have only one MLE service request in progress at a time.

For the SDL model it is assumed that the MLE service users behave according to the their defined functionality. This means that the SDL specification of the MLE is not robust to operations not required in the textual protocol specification.

The SDL model has been structured in accordance with the architecture defined for the MLE functional entities in the textual protocol specification. For some of the functional entities in the textual specification more SDL processes have been specified to define their model. This has been done to separate, and hence clarify, the different procedures handled by each functional entity. Because of this, the amount of internal signalling has increased. Also, however, the scope rules of SDL variables adds to the amount of internal signalling. The internal signalling has been implemented through the use of exported variables and remote procedures.

The SDL model of the MLE given in this annex also contains the diagrams for those procedures which include signal exchange.

Table F.1 gives the descriptive names and file names of the SDL model.

Table F.1: MLE files

Descriptive name	File name
MLE block structure	mle.ps
MLE block structure	mleblock.ps
MLE Attachment Management	mle_attm.ps
MLE Cell Surveillance	mle_csur.ps
MLE Data Transfer	mle_data.ps
MLE Management Entity	mle_mng.ps
MLE Monitor Cells	mle_moni.ps
MLE Network Broadcast	mle_nwbc.ps
MLE Scan Cells	mle_scan.ps
MLE TLAB Formatter	mle_tlab.ps
MLE TLC Formatter	mle_tlc.ps

Annex G (normative): LLC model

The scope of the SDL model of the LLC protocol covers the mandatory requirements described in the textual protocol specification (ETS 300 392-2 [1], clauses 19 to 22).

The model is valid for one endpoint identifier, i.e. no more than one instance of each LLC service may exist concurrently.

In addition to the mandatory ones, several optional features are defined in the model.

The optional priority ordering of SDUs has been defined in the SDL model for each LLC service.

The optional cancel operation has been specified throughout the model, however excluding the pre-emptive priority cancellation for readability reasons.

Both optional AL services, i.e. acknowledged and unacknowledged, are defined in the SDL model.

The QoS negotiation in this SDL model is performed outside the acknowledged AL protocol entities, i.e. the negotiation is the service user's responsibility and this LLC model does not have functionality related to the QoS negotiation.

The optional Frame Check Sequence (FCS) calculation and checking are part of the Basic Link (BL) model, comprising both acknowledged and unacknowledged BL services.

The optional buffering functionality for the service user data defined in the LLC model is one possible solution of such a mechanism, and therefore does not set any requirements or restrictions to a conformant LLC protocol implementation. The buffering mechanism can be observed at the procedure call level in the SDL diagrams for the reader to be able to follow, when, in the dynamic behaviour of the protocol, the normal buffer operations may take place. Buffering is described for each LLC service sending service user data.

Optional features in the textual protocol specification are identified in the SDL specification using the SDL option symbol.

NOTE: However, if an optional feature in the protocol functionality is constructed into the SDL model and separating the optional functionality would reduce the readability, the option symbol may be omitted.

Table G.1 gives the descriptive names and file names of the SDL model.

Table G.1: LLC files

Descriptive name	File name
LLC block structure	llcblock.ps
LLC Logical Link Control	llclogic.ps
LLC Basic Link Acknowledged	llcbasa.ps
LLC Basic Link Unacknowledged	llcbasu.ps
LLC TX Acknowledged	llctxa.ps
LLC RX Acknowledged	llcrxa.ps
LLC RX Unacknowledged	llcrxu.ps
LLC Formatter	llcform.ps

Annex H (normative): MAC model

The SDL model in this ETS of the textual MAC protocol specification is as defined in clause 23 of the ETS 300 392-2 [1]. It is limited to the upper MAC and only handles the synchronization and the protocol behaviour.

For the SDL model it is assumed that the MAC service user behaves according to its defined functionality. This means that the SDL specification of the MAC is not robust to operations not required in the textual protocol specification.

The SDL model has been structured in accordance with the architecture defined for the MAC functional entities in the textual protocol specification. The SDL model follows the behaviour described in the diagrams in ETS 300 392-2 [1], clause 23.

Table H.1 gives the descriptive names and file names of the SDL model.

Table H.1: MAC files

Descriptive name	File name
MAC block structure	macblock.ps
MAC Receiver	macrx.ps
MAC Transmitter	mactx.ps

History

Document history			
July 1996	Public Enquiry	PE 110:	1996-07-22 to 1996-11-15
February 1997	Vote	V 9717:	1997–02–25 to 1997–04–25