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Foreword

This ETSI Technical Report (ETR) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI).

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1 Scope

This ETSI Technical Report (ETR) defines the TETRA Man-Machine Interface (MMI) for the TETRA Mobile Station (MS) which can be a hand portable or mobile (vehicular mounted) station.

The objective of this ETR is to describe the minimum MMI to gain access to, and control of, the TETRA bearer service and teleservice, and TETRA supplementary services, defined in ETS 300 392-2 [1] and ETS 300 396-3 [2].

Additionally it is the purpose of this ETR to aim for a common set of interfaces and interactions that will describe the essential parts of the MMI such that a certain degree of harmonized behaviour amongst the TETRA manufactures can be obtained. It is however not the purpose to mandate a specific implementation of an interface or interaction procedures but rather to establish the common behaviour exposed at the MMI interface and by the MMI interaction procedures.

In general this ETR follows the rules and recommendations laid down by the ETSI Technical Committee for Human Factors (TC-HF) in their specifications referred to in the reference list (see clause 2).

2 References

For the purposes of this ETR, the following references apply:

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

[2]   ETS 300 396-3: "Radio Equipment and Systems (RES); Trans-European Trunked Radio (TETRA); Technical requirements for Direct Mode Operation (DMO); Part 3: Mobile Station to Mobile Station (MS-MS) Air Interface (AI) protocol".

[3]   ETS 300 640: "Human Factors (HF); Assignment of alphabetic letters to digits on standard telephone keypad arrays".

[4]   prETS 300 738: "Human Factors (HF); Minimum man-machine interface (MMI) to public network based supplementary services".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETR the following definitions apply:

bearer service: A type of telecommunication service that provides the capability for the transmission of signals between user-network interfaces.

duplex (full duplex): A mode of operation by which information can be transferred in both directions and where the two directions are independent. See also half duplex.

gateway: A device which will enable the interconnecting of two networks which inherently use different and incompatible protocols.

half duplex (semi duplex): A mode of operation by which information can be transferred in both directions but the transfers are mutually dependent (i.e. up link and down link transfers share same resources). See also duplex.

   NOTE 1:   In a packet switching environment (V+D signalling) protocols can be duplex at one layer and half duplex at another layer.

incoming call: A terminating call which, from the viewpoint of an individual party, is a call that was initiated by another party.

> NOTE 2: See also outgoing call.

Mobile Radio Stack (MRS): A logical grouping that includes all of the air interface protocol element in one MS (the mobile side of the air interface).

Mobile Station (MS): A physical grouping that contains all of the mobile equipment that is used to obtain TETRA services. By definition, a mobile station contains at least one Mobile Radio Stack (MRS).

outgoing call: A call which, from the viewpoint of an individual participant in the call, is initiated by that participant.

> NOTE 3: See also incoming call.

Push-To-Talk (PTT) key: The PTT key on the MMI is activated when the user wants to speak or send data. The PTT key controls the speech and data path in a simplex TETRA system or semi-duplex TETRA system and can be implemented as a manual switch or a Voice Operated Switch (VOX).

simplex: A mode of single or dual frequency working in which information can be transferred in both directions but not at the same time.

supplementary service: A supplementary service modifies or supplements a bearer service or a teleservice. A supplementary service cannot be offered to a customer as a stand alone service. It should be offered in combination with a bearer service or a teleservice.

Switching and Management Infrastructure (SwMI): All of the TETRA equipment for a Voice plus Data (V+D) network except for subscriber terminals. The SwMI enables subscriber terminals to communicate with each other via the SwMI.

> NOTE 4: The SwMI may also make it possible for subscriber equipment to communicate via other transit networks to external applications. Mobile Stations (MS) can access the SwMI using the air interface.

teleservice: A type of telecommunications service that provides the complete capability, including terminal equipment functions, for communication between users according to agreed protocols.

3.2 Abbreviations

AP	Access Priority
AS	Area Selection
CAD	Call Authorised by Dispatcher
CDF	Command Dialogue Format
CMCE	Circuit Mode Control Entity
DGNA	Dynamic Group Number Assignment
DL	Discreet Listening
DMO	Direct Mode Operation
DTMF	Dual Tone Multiple Frequency
ETSI	European Telecommunications Standards Institute
GTSI	Group TETRA Subscriber Identity
ITSI	Individual TETRA Subscriber Identity
LE	Late Entry
MM	Mobility Management
MS	Mobile Station
PC	Priority Call
PPC	Pre-emptive Priority Call
PSTN	Public Switched Telephone Network
PTT	Push To Talk
SS	Supplementary Service
SwMI	Switching and Management Infrastructure
TETRA	Trans-European Trunked RAdio
V+D	Voice Plus Data
VOX	Voice Operated Switch

4 Physical interfaces

4.1 General

In order to facilitate human service interaction with the TETRA system a physical interface needs to be available. It is envisaged that a Mobile Station (MS) can be one of the access points from where a user can interact with the TETRA system. Therefore a MS should provide the necessary keys, buttons, visual and audible indication that support human service interaction.

The following physical interfaces can be provided by a MS:

- keypad for entering alphanumeric numbers signs or codes;

- PTT key for controlling the speech path;

- emergency key for invoking a service with emergency priority;

- on/off key for turning the MS on or off;

- volume key(s) to lower or increase the volume in handsets, loudspeakers etc.;

- visual indications to the user presented in form of icons, or LEDs, or in a display for indications of responses to service invocations, or for indications of service requests to be served;

- audible indications to the user presented in loudspeakers or hand sets for indications of responses to service invocations or for indications of service requests to be served.

Other invocation keys or indications may exist to support other services and functions of the TETRA system. Also other functions and services than those described in this ETR can be supported by the keys, buttons, visible and audible indications described in this ETR. If the latter is the case every care should be taken to maintain the original operational aspects of the keys, buttons, visible and audible indications so that a user is not confused or misled by the operation of the additional services.

In the following each of the physical interfaces as outlined above is described further. It is important to notice that a so called "physical interface" which supports invocation of a particular service does not necessarily have to be implemented in a certain way, e.g. an emergency key can be implemented as a separate key, as an entry in a displayed menu or as a voice activation.

4.2 Keypad

As an option a MS can be equipped with a keypad. When a keypad is provided the layout should be implemented either as a standard keypad or as an enhanced keypad.

4.2.1 Standard keypad

The following keypad in figure 1 is a 4 x 3 array for the numeric keys 0..9 and symbols "star" (*) and "square" (#). The keypad follows the standard telephone keypad array as specified in ETS 300 640 [3].

Figure 1: Standard keypad for a TETRA MS

The keys 0..9, * and # corresponds to the same digits 0..9, * and # in the Circuit Mode Control Entity (CMCE) Dual Tone Multiple Frequency (DTMF) field of the TETRA V+D Air Interface standard (see ETS 300 392-2 [1]).

4.2.2 Enhanced keypad

The keypad may be expanded to a 4 x 4 array covering enhanced radio or telecommunication functionality if applicable. The enhanced keys are "A", "B", "C" and "D" and the coupling with the standard keypad is shown in figure 2.

Figure 2: Expanded keypad for a TETRA MS

The enhanced keys in the expanded keypad shown in figure 2 corresponds to the same digits "A", "B", "C" and "D" in the CMCE DTMF field of the TETRA V+D Air Interface protocol (see ETS 300 392-2 [1]).

> NOTE: The "Register Recall" key often used in connection with supplementary services can be one of enhanced keys, e.g. key "B".

4.3 Other keys

There may be other keys used at the air interface, however there should be no requirement to implement the keys described below and therefore the subclauses are provided for information only.

4.3.1 Push-To-Talk (PTT) key

The PTT key plays a significant role in the request-grant transmission process which is part of the basic operation in a TETRA V+D simplex or semi-duplex system.

When PTT key is used it should at a minimum operate as follows:

- when the PTT is pushed it means that the speech direction is from the MS to the TETRA infrastructure (SwMI);

- when the PTT is released it means that the speech direction is to the MS, i.e. the MS receives voice.

There can exist additional functionality connected to the PTT key, e.g. control of data messages, but that should not affect the normal operation of the PTT.

> NOTE: The implementation of the PTT key is not restricted to a physical push button. It is envisaged that other implementations, e.g. VOX (Voice Operated Switch), is a possibility as long as the PTT functionality for the user is the same.

4.3.2 Emergency key usage

An emergency key can exist as a separate key, as menu driven function or as a separate accessory outside the MS. Whatever the implementation is, the invocation of an emergency situation using the emergency key should lead to mapping of the emergency priority onto the TETRA Air Interface signalling. For example one or more of the following cases are possible:

- activating the emergency key invokes Short Data Service (SDS) precoded emergency message;

- activating the emergency key invokes a TETRA teleservice, e.g. a group call or individual call, with emergency priority connected to the service request;

- activating the emergency key invokes a TETRA bearer service, e.g. a data call, with emergency priority connected to the service request.

4.3.3 On/off key usage

An on/off key may be present in a MS. The on/off key can be implemented e.g. as an integrated part of a vehicular installation, as a separate key or keys or as soft-keys. Whatever the implementation is the behaviour of the on/off key should be as follows:

- when a MS is in a power off state, the activation of the on/off key should power the MS up. At power up the MS may apply for service from the TETRA infrastructure (SwMI) according to the TETRA V+D standard (see ETS 300 392-2 [1]);

- when a MS is in a power on state, the activation of the on/off key should force the MS to power off while at the same time detach its services from the TETRA infrastructure (SwMI).

    NOTE: Applying for service at power up is not necessarily bound to the on/off key. There could exist other functionality in connection with the activation of the on/off key, e.g. choosing network, choosing mode such as trunk mode or direct mode.

4.3.4 Volume key usage

The volume key or volume keys may be present in an implementation as e.g. a rotary switch, an up/down key or as part of a menu driven functionality. Whatever the implementation is it should be unambiguous to the user how the operation works, e.g. if the volume is indicated by numbers either on the display or on a rotary switch increasing the numbers should lead to the volume also increasing.

4.4 Visual and audible indications

As part of the guidance to the user after a service invocation some visual indications, e.g. text display or icons, and/or audible tones in the handset or loudspeaker may be presented to the user. How these are presented to the user is a matter of manufacturers implementations. In the following subclauses the options are described.

4.4.1 Text display indications

The MS can be equipped with a display. If present the following simple guidance rules should be employed:

- the display should reflect the current operational state of the MS;

- the display should adopt the normal presentation rules for displays, e.g. text should be written from left to right.

4.4.2 Icon indications

Icon indications are either implemented as separate LEDs or as part of the display. Their purpose is to serve as an announcement together with possible audible indications. If implemented it should be clear to the user what is notified and the notification should be consistent amongst the same types of invoked services, e.g. all types of incoming calls should preferably use the same indication. The exact implementation, i.e. which symbols or icons are used to announce a particular service should be left to the implementation of the individual applications. The following indications are proposed:

- battery power level (for battery operated MSs only);
- in-service indication (not for DMO);
- transmit indication;
- mode indication (direct mode / trunked mode);
- duplex or simplex mode (if the MS supports both modes).

4.4.3 Audible indications

Audible indications should, in a way similar to visual indications serve as an announcement to the user during MS operation. It is envisaged that the following tones could serve as audible indications during service operation:

- called number busy tone:

    - the purpose is to indicate to the user that the called user is busy;

- call queuing tone:

    - the purpose is to indicate to the user that the network is busy and the call might have been queued;

- network busy tone:

    - the purpose is to indicate to the user that the network is busy and that call request has not or cannot be accepted;

- acceptance tone:

    - the purpose is to indicate to the user that a transaction has been accepted, e.g. a group call is set-up or a registration attempt is accepted;

- rejection tone:

    - the purpose is to indicate to the user that a transaction has been rejected, e.g. a group call has been rejected or a registration attempt is rejected;

- ringing tone:

    - the purpose is to indicate to the user that the called user is alerting;

- alerting tone:

    - the purpose is to indicate to the user that he is being "called";

- call progressing tone:

    - the purpose is to indicate to the user that the call is progressing through the network;

- DTMF tones:

    - the purpose is to indicate DTMF tones when he user activates the keypad as they are sent as digits on the air interface.

The audible tones described above are generated in the MS. Those tones which are generated by the network, either the TETRA network or the Public Switched network are conveyed via the voice channel and are not covered in this ETR.

5   Control of teleservices and bearer services

In order to control and gain access to the TETRA teleservices and bearer services it is envisaged that the user employs the Command Dialogue Format (CDF) as described in ETS 300 738 [4]. The format takes one or more of four forms where the Alphanumeric Command should be used.

The syntax of the Alphanumeric Command is:

START   NNNNNN (SI) FINISH

- START could be a key or menu entry selecting the specific teleservice or bearer service, e.g. an individual call;

- NNNNNN is a numerical string composed of digits 0..9 or an alphanumeric string if supported by the MS. It specifies the called or dialled address and can either be the full address or part of the address or a short form of the address;

- SI is Supplementary Information which is an optional part of the command and may be omitted and deduced from the operation mode of the MS. When included it could be e.g. priority, area selection, encryption or duplex/simplex. It could be a combination of all and in that case a separator (SR) is needed. Normally the "*" symbol will imply separation between supplementary information;

- FINISH marks the end of the command and could be a send key, e.g. the PTT key or a separate key.

NOTE 1:   The Alphanumeric Command syntax string need not contain all of the syntax elements, e.g. START and NNNNNN can be omitted if it is obvious to the user that when activating the FINISH (send) it is a group call to NNNNNN address.

NOTE 2:   The syntax for the Alphanumeric Command is also suitable for invoking Mobility Management services as invoking Short Data Services. The Mobility Management service invocation could be e.g. MS ITSI registration or GTSI group attachment as defined in ETS 300 392-2 [1].

NOTE 3:   The employment of the Alphanumeric Command implies that the user always uses invocation and/or disabling when controlling TETRA teleservices and bearer services. The nature of the invocation shows that it is not necessary to specify any prefix to start the command because it is clear from the context of the service invocation.

6 Control of supplementary services

In order to control and gain access to the TETRA supplementary services it is envisaged that the user employs the Service Code Command Format as described in ETS 300 738 [4]. If supplementary services are invoked by entering digits from the keypad then the star-hash combination of table 1 and the codes of table 2 should be used. Alternative methods such as the use of mnemonics or menu selections are also acceptable.

The syntax of the Service Code Command is:

START PX SC (SR SI) FINISH

- START could be a key or a menu entry selecting that it is a Supplementary service that is addressed;

- PX is the service prefix which indicates the function requested of the service and can either be:

  - activation;
  - disabling;
  - erasure;
  - interrogation;
  - registration.

Table 1 shows the allocation of service prefix.

Table 1: Allocation of service prefix

PX	Function
**	Registration without Activation
*	Activation with Registration, or Activation, or Invocation
# or #	Interrogation, including Data Check Data Request Status Check
#	Deactivation without erasure, or Disabling
##	Deactivation with Erasure, or Erasure

- SC is the service code which is a two or three digit code that is used to identify the supplementary service being access.

Table 2 shows the allocation of TETRA Service Codes.

Table 2: Allocation of service codes

Service code	Supplementary Service
48	Area Selection (AS)
65	Late Entry (LE)
74	Access Priority (AP)
75	Priority Call (PC)
750	Pre-emptive Priority Call (PPC) "Emergency"
751	Pre-emptive Priority Call (PPC) "level 1"
752	Pre-emptive Priority Call (PPC) "level 2"
753	Priority Call (PC) "level 3"
754	Priority Call (PC) "level 4"
755	Priority Call (PC) "level 5"
756	Priority Call (PC) "level 6"
757	Priority Call (PC) "level 7"
758	Priority Call (PC) "level 8"
759	Priority Call (PC) "level 9"
84	Listening
841	Ambience Listening (AL)
842	Discrete Listening (DL)
85	Dynamic Group Number Assignment (DGNA)
86	Call Authorised by Dispatcher (CAD)
99	Over The Air Rekeying (OTAR)

- SR is the separator used for separating the service code and any supplementary information or to separate two items of supplementary information. The separator is a "star" (*);

- SI is Supplementary Information and could be e.g. an alpha string in DGNA describing the textual name of the Group (GTSI);

NOTE 1:   The (SR SI) combination can be repeated a number of times if more information is required to be added to the supplementary service command.

- SX is the service suffix and marks the end of the complete service code string. The suffix is a "square" (#);

NOTE 2:   It is not required to provide the SX command, because there may be other technical solutions that can mark the end of the command string, e.g. a time-out or a predefined SI length.

- FINISH marks the end of the command and could be a send key, e.g. the PTT key or a separate key. The suffix (SX) may be enough to terminate the command string.

7 Information after control actions

Information after control actions is the audible and visual feedback to the user in order to give guidance. This can be provided in all formats and via all media, e.g. auditory tones, recorded or synthetic voice messages, indicator lights, character-based and/or icon based visual display, printed text etc.

The exact format and media are implementation issues, but in order to provide a generic perception to the user the information after control actions should contain a set of minimum steps.

The following control actions are envisaged to be covered:

- activation with registration or activation only; this is the case where a MS applies for service via registration and attachment;

- deactivation without erasure; this is the case where a MS de-registers or detaches and hence is out of service;

- invocation; this is the case where the MS invokes or cancel e.g. either a supplementary service or an individual call.

7.1 Activation and registration of a service

The feedback to the user should contain information on:

- which service has been registered, e.g. when the MS has registered and obtained service from a TETRA infrastructure it should be made clear to the user which type of teleservices and bearer services or supplementary services are available from the network;

- the data registered with the service should be informed to the user, e.g. which GTSI(s) and ITSI have been registered;

- the current status of the service following the activation and registration, e.g. has the MS obtained service or not.

7.2 Deactivation without erasure

The feedback to the user should contain information on

- which service has been de-registered or deactivated, e.g. when the MS de-registers and detaches itself from the TETRA infrastructure (SwMI);

- the current status of the service following the deactivation and de-registration.

7.3 Invocation and disabling of a service

The feedback to the user should contain information on:

- the current status of the invoked service, e.g. when the MS invokes an individual call the user is informed when the called party is alerted, if the call is forwarded to the PSTN Gateway, if the call is forwarded to another network or cancelled due to malfunction;

    NOTE: The current status of the invoked service may also be presenting incoming calls or data as they are considered to be invocation of the service done by another party.

- the service which has been invoked or disabled, e.g. if an individual call is invoked it should be obvious to the user;

- any data that the user has provided to support the service invocation, e.g. the called number in a group call is presented to the user as an acknowledgement.

History

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