Inter System Interoperability
D5.1.1 DRAFT ENHANCED TERMINAL REQUIREMENTS

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REVISION TABLE

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V0.0	12/12/2014	All	All	Template issued
V1.0	22/04/2014	All	All	First draft
V1.1	15/05/2014	All	All	Draft with comments
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Publishable extended abstract

This deliverable (D5.1.1) is the first deliverable issued by WP5.1.

It reports on the advances in Task 5.1.1 until M06.

In particular, the following points are covered:

- the analysis of PPDR user needs;
- the analysis of existing PPDR terminals;
- the definition of requirements for "application enabled" bi-technology terminals;
- the requirements for interoperability functions;
- the requirements for PPDR cloud added value functions and applications.

CONTENTS

1 INTRODUCTION

The aim of WP 5.1 is the definition of the requirements and the architecture of vehicular/hand-held enhanced terminals based on the TETRA/TETRAPOL technology. Such terminals will rely on the use of programmable devices such as smartphones and tablets.

The outcome of this WP is the definition of the architecture of the new terminal and of its services. This WP is strategic because its outputs will be used for the definition of the Adaptation/Communication Manager (WP 5.2), the Security Manager (WP 5.3), the Workflow Manager (WP5.4), the Semantic/Syntactic Translator (WP 5.5) and the User Interface and Business Logic Manager (WP 5.6).

2 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

This section is intended to capture the definitions of some key terms used in the document for the purpose of increased consistency. Most of the definitions are obtained from official 3GPP and ETSI documents:

Access control: the prevention of unauthorized use of resources, including the use of a resource in an unauthorized manner.

Authentication: the act of positively verifying that the true identity of an entity (network, user) is the same as the claimed identity.

Confidentiality: the property that information may not be available or disclosed to unauthorized individuals, entities or processes.

Data integrity: the property that data has not been altered or destroyed in an unauthorized manner.

Encryption: the conversion of plaintext to ciphertext.

Key: a sequence of symbols that controls the operations of encipherment and decipherment.

Key management: the generation, selection, storage, distribution, deletion, archiving and application of keys in accordance with a security policy.

Migration: act of changing to a location area in another network (either with different Mobile Network Code and/or Mobile Country Code) where the user does not have subscription (e.g. ITSI in TETRA) for that network. In this document, migration is used as a synonym of roaming.

Profile: the capability of a particular equipment. This is defined separately for individual subscriber terminals and individual infrastructures.

Provision: the act of supplying a given service (Note: A communication system may be capable of supporting a service. However, it may not supply the service to certain subscriber terminals for which the service is not subscribed.)

Roaming: utilization of a mobile terminal in a network other than the one where the mobile is subscribed but on which the mobile can still be located and operated by agreement between the respective network operators.

2.2 Abbreviations

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

Acronym	Definition
3GPP	3rd Generation Partnership Project
ACM	Adaptation and Communication Manager
AI	Air Interface
AIE	Air Interface Encryption
AuC	Authentication Center
CCK	Common Cipher Key
DCK	Derived Cipher Key
DMO	Direct Mode Operation
E2EE	End to End Encryption

ESI	Encrypted Short Identity
GMO	Gateway Mode Operation
GNSS	Global Navigation Satellite System
GTSI	Group TETRA Subscriber Identity
HMI	Human Machine Interface
IOP	Interoperability Profile
IP	Internet Protocol
ISI	Inter System Interface
ISSI	Individual Short Subscriber Identity
ITSI	Individual TETRA Subscriber Identity
KMC	Key Management Center
KSS	Key Stream Segment
MCC	Mobile Country Code
MNC	Mobile Network Code
MoU	Memorandum of Understanding
MNI	Mobile Network Identity
MS	Mobile Station
MT	Mobile Terminal
NGN	Next Generation Network
OTAR	Over The Air Rekeying
PC	Professional Computer
PDA	Personal Digital Assistant
PEI	Peripheral Equipment Interface
PMR	Professional/Private Mobile Radio
PPDR	Public Protection and Disaster Relief
PS	Public Safety
PSTN	Public Switched Telecommunications Network
RMO	Repeater Mode Operation
RS	Random Seed
RSSI	Received Signal Strength Indication
SCK	Static Cipher Key
SDS	Short Data Service
SFPG	Security and Fraud Prevention Group
SIM	Subscriber Identity Module
SM	Security Manager
SST	Semantic and Syntactic Translator
SwMI	Switching and Management Infrastructure
TAA1	TETRA Authentication and key management Algorithm suite 1
TE	Terminal Equipment
TEAx	TETRA Encryption Algorithm number x
TEDS	TETRA Enhanced Data Services
TEI	Terminal Equipment Identity
TETRA	TErrestrial Trunked Radio
TMO	Trunked Mode Operation
UI&BL	User Interface Adaptor & Business Logic
VoIP	Voice over IP
VPN	Virtual Private Network
WM	Workflow manager
WS	Work station

3 ENHANCED TERMINAL REQUIREMENTS DEVELOPMENT FRAMEWORK

3.1 System Overview

Two different deployments of the enhanced ISITEP terminal are required: the vehicular one and only as proof of concept the hand-held one. Both versions are based on the use of a smart device running the Android Operating System, a tablet PC for the vehicular solution while smarthphone device for the hand-held one.

TETRA and TETRAPOL air interface are provided by legacy TETRA and TETRAPOL modems even if the right approach for the development of a new advanced bi-technology device would be the use of the Software Defined Radio (SDR) technology. Unfortunately the SDR approach would require the development of specific TETRA and TETRAPOL waveform, which is unfeasible with the timeframe of the ISITEP project.

In order to realize a bi-technology terminal the smart device shall be able to manage the legacy TETRA and TETRAPOL modems, indeed in both solutions the smart device shall host the MMI of the enhanced ISITEP terminal, an adaptation layer for the communication with the legacy TETRA and TETRAPOL modem and all the ISITEP applications.

TETRA and TETRAPOL modems shall be physically connected to the smart device in order to allow the communication between the smart device and the TETRA and TETRAPOL modems.

In the ISITEP hand-held at least one of the TETRA/TETRAPOL modem shall be integrated inside the smart device in order to avoid having three terminals, currently end-users, that have to participate to those cross-border PPDR operations where both TETRA and TETRAPOL are used, are equipped with only two terminals: a TETRA one and a TETRAPOL one.

On the other hand in the vehicular solution the legacy modems are installed inside a car and they may be external to the smart device.

Legacy TETRA and TETRAPOL modems provide the following signalling and audio interface:

- TETRA provides a standard signalling to interface the terminal equipment that is the TETRA Peripheral Equipment Interface (PEI) for the TETRAPOL an equivalent TETRAPOL PEI interface has been defined.
- Analogue audio interface

From the security point of view the basic assumption is that both signalling and audio are transported on a wired connection to a trusted termination.

Currently smart devices provide a set of standard physical wireless interfaces while wired interfaces are less used. Moreover for increasing enhanced ISITEP terminal usability a wireless connectivity between the external modems and the smart device shall be preferred.

The use of wireless connectivity between the smart device and the legacy TETRA/TETRAPOL modems open the enhanced ISITEP terminal to two security threats:

- Unauthorised access to TETRA or TETRAPOL modem
- Eavesdropping of conversations related to the attacked terminal

In order to overcome these threats the establishment of wireless connection shall be provided only after authentication and authorization phase and the wireless link shall be encrypted.

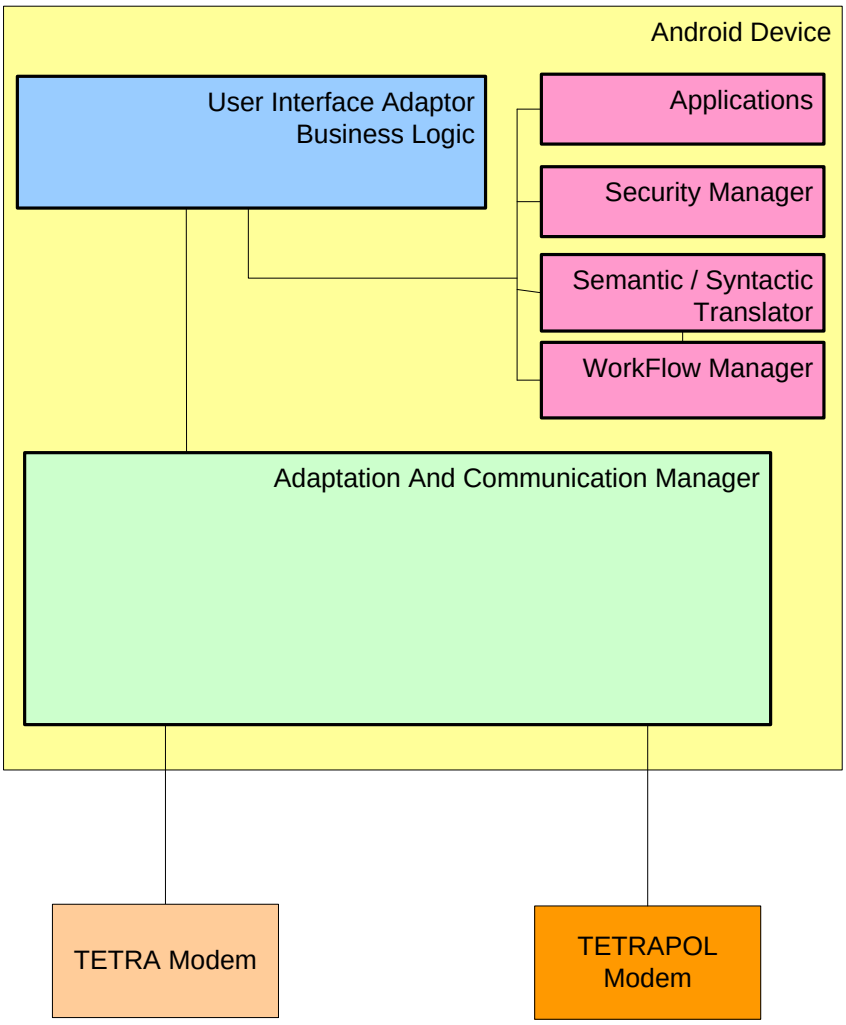

Figure 1: Proposed terminal architecture.

In Figure 1 the high-level block diagram, describing the main features of the proposed terminal architecture is reported. In the following the main features of the system will be listed:

- Physical layer: Bi-technology terminal equipped with a TETRA/TETRAPOL modem and a programmable platform. The programmable device shall be a Smartphone as well as a Tablet computer running the Android Operating System. The first one is suitable for vehicular-based applications while the latter is devised as user equipment.

- Adaptation Communication Manager is the interface decoupling the higher stack levels from the physical layer. In particular:
  - it implements the functionalities (commands, controls and messages) required to allow the communication between the TETRA-TETRAPOL modems and the User Interface Adaptor & Business Logic.
  - it exploits a terminal control interface (PEI for TETRA and PEI-equivalent for TETRAPOL), independent from the specific modem employed;

- it implements a location-assisted roaming service that provides an automatic vertical handover between TETRA and TETRAPOL technologies, when mobile terminals are moving across different countries/networks.

- User Interface Adaptor & Business Logic: the User Interface Adaptor & Business Logic is the set of functionalities devoted to the personalization of human-machine interface according to specific user and operational needs, available network coverage etc. Such functions are designed over an application-oriented architecture. It will integrate the security layers for guaranteeing the security level requested by the application.

- Workflow Manager has the task of enabling proper handling of location-based and PPDR event-aware workflows making use of a standardized representation (e.g. workflow charts). The workflow manager is used for assuring the use of common procedures for PPDR resources. The system shall support browsing of preloaded workflow charts through the User Interface.

- Semantic Syntactic Translator allows reducing language barriers; in particular it has the task of defining and implementing a minimal technology necessary to semantically and syntactically translate the human interface on ISITEP terminals. In more details:
  - It will be based on a database of the most common corpus defined by the end users.
  - The corpus will be translated in several European languages. This database will constitute the reference corpus for the system.
  - It will provide services as the ‘translate option’ exploiting a search algorithm for quickly finding the most likely translation among multiple choices.

- Security Manager is responsible to handle security issue related to the enhanced ISITEP terminal. TETRA and TETRAPOL security are mainly provided through Air Interface Encryption and End to End Encryption, sensible data (encryption keys) used to provide these features are stored inside legacy TETRA/TETRAPOL modems and for security reason no external access is provided to this material. Security Manager responsibility is then linked to the Security aspects related to the smart device and to the communication between the smart device and the legacy TETRA/TETRAPOL modems.

4 ANALYSIS OF PPDR NEEDS

In this section it is reported the analysis performed on ISITEP Security Requirements [1], ISITEP End-User Requirements [2], and the status of the current PPDR terminals. The output of the analysis and of discussions is then formalized into requirements for the terminal and reported in section 5 of the current document.

4.1 Analysis of Security Requirements

In the Security Requirements document two different types of threats to the terminal security have been identified:

- Threats from mismatching security requirements between roaming terminals and visited networks.
- Threats from exposed interfaces within ISITEP terminals.

If the migrating terminal is not security certified to the national requirements of the foreign network, the migrating terminal may expose the visited network to a security risk. Usually the PPDR terminal is security certified in its home network; it is not always possible to certify the terminal to all possible visited networks, because each country has its own security certification process and some countries have a most demanding and heavy one. As a general requirement, in order to limit consequences of potential breaches, roaming terminal user rights shall be restricted to the minimal necessary. This is an issue in charge to PPDR network operators and to the PPDR end-users.

In case the ISITEP terminal is IP connected to the PPDR network, there is also the security risk connected to viruses, malware, trojans, etc. For the ISITEP project, IP connectivity (Packet Data) is not provided in the foreign network, so that the ISITEP terminal is IP connected just to the home network.

The second type of threats can occur if the implementation of the new enhanced ISITEP terminal makes use of a wireless connection between the smart device and the TETRA/TETRAPOL modems.

In this case the wireless connectivity is a weakness in the ISITEP terminal and it shall be secured in order to avoid eavesdropping and unauthorized access to the TETRA/ TETRAPOL modem.

4.2 Analysis of End-User Requirements

In the current paragraph the analysis and discussion of the End-User Requirements document [2], is reported. In particular, the following aspects are analysed:

- Migration
- Talk group
- Applications
- Existing national workflow
- Semantic and syntactic translation

4.2.1 Migration

The radio user in its home network has access to all services provided by the home PPDR network; when the radio user migrates in the visited network:

- Only those services supported by ISI shall be available (in the ISITEP project it is foreseen to provide all the services expected for the ISI phase 3.)

- Group management in the visited network may be restricted to the groups defined in the static link group table.

Along the border the radio is usually able to catch both home and visited network; when the radio user is working along the border of its country, it is sometimes preferable to avoid migration to the visited network while in hot pursuit scenario it would be preferable that the migration from home network to the visited network is performed automatically and radio user cannot carry out any setting modification when crossing the border.

The terminal shall support manual migration procedure. Automatic is considered optional. For terminal supporting both manual and automatic migration procedures, the radio user should be able to set his preference for migration before starting the mission.

The radio terminal HMI shall display the network name/code with which the terminal is currently attached. This functionality is particularly useful in case of automatic migration, where no selection is required to the radio user.

4.2.2 Talk Group

Group call is the most used service in PPDR Networks and in order to manage cross border operations, new talk groups have been defined in the «End-User Requirements» document. The use of new international talk groups is preferred in order to decouple the numbering scheme adopted currently in each country from the new talk groups demanded for international cooperation.

When radio terminal migrates in a visited network, the talk groups used in its home network are no longer valid and the end-user shall select the international talk group that allows him to communicate with the control room in the home network.

The end-user shall be able to understand which groups are available; the radio terminal shall display in grey the group names that are not available within the SwMI where the subscriber is currently registered.

The end-users of PPDR Networks shall focus their attention in their professional core missions and tasks (security, rescue, fight against crime…) while they have to spend the minimum effort in terms of time and capacity in radio transmission. Therefore, radio settings and radio management must be kept as simple as possible. In particular:

- Terminal manipulations (like talk group selection) shall be strictly restricted.
- The intelligence of the radio communication functional model will be basically limited to the ability of selecting the talk group that is requested.

4.2.3 Applications

From the End-user point of view, it is important that the applications used in the home country are still available in the visited country. For example the following applications shall be at least considered:

- Localization service
- Access to remote databases
- Transfer of a picture

Hence, when a terminal moves in a visited network:

- the control room located in the home network shall be able to locate the terminal in the visited network

- the user shall be able to access to databases located in the home network,
- the user shall be able to send/receive picture to/from the proper control room in the home network.

Another requirement on Localization service is that when a radio moves into a visited network it shall be localized also in the visited network in the control room responsible for the PPDR operations in that area.

Localization service is standard TETRA feature while access to remote data bases and picture transfer are not standard TETRA services even if they rely on standard TETRA Short Data Service (SDS) or TETRA Packet Data Service (PD).

The scope of the document is to face only with standard applications foreseen in ISI phase 3 and with the new applications foreseen by ISITEP project. For this reason access on remote databases and picture transfer are not analysed in the present document.

ISITEP specific applications are:

- Workflow manager: this is an application that allows keeping trace of activities performed during PPDR operations; see end-user requirements analysis for the workflow in par. 4.2.4.
- Semantic and Syntactic translator: see end-user requirements analysis in par. 4.2.5.
- Location Assisted Numbering: no indication from end-user requirements
- Dynamic Functional Numbering: no indication from end-user requirements
- Enhanced Message Exchange Application: no indication from end-user requirements

4.2.4 Existing national workflows

A workflow consists in a sequence of actions that shall be performed by first responders participating to a PPDR operation; there are three kinds of first responders:

- Intervention teams,
- Leader of the intervention team,
- Dispatcher operators.

In cross-border PPDR operations, first responders belong to different countries and the responsibility for the overall coordination of the PPDR operations is in charge to the country where the incident occurred; hence, each intervention team has a national reference control room that coordinate its intervention team according to the orders received by the control room responsible for the overall coordination.

Different kinds of PPDR operations are foreseen and different workflows have been specified for each one of them. Each country has defined its own national workflows; ISITEP project is working on standardization of workflows in order to improve international cooperation between PPDR forces.

Detailed analysis on the existing national workflows is provided as output of SP3. In this paragraph a summary focused on terminal-side operations is reported.

There are different actions that can belong to a Workflow:

- Group selection
- Execute orders sent by the leader or by the dispatcher operator using short data messages or pre-defined status messages

- Localization management
- Control and monitoring of both direct-supplied and third-party-supplied services,
- etc.

The workflow functionalities that ISITEP will standardize will then include features like definition of the activities to be carried out, definition of the entities that will be in charge of the tasks, monitoring and update of the temporal evolution of processes; in general the user will be ordered to follow instructions or will directly have the chance to plan, manage, monitor and control all the activities to be carried out adding, if needed, additional information that can result to be useful while checking the temporal evolution of the processes.

4.2.5 Semantic and syntactic translation

International cooperation requires breaking down the language barrier: indeed for a radio user that wants to send status messages, it would be useful to have access to a predefined text messages library that has a translated corresponding message version at the destination party (if the destination party speaks a different language); if the translation process was completely transparent for both entities, a successful interoperability and cooperation could be guaranteed.

ISITEP will define and implement a syntactic and semantic translator so that a PPDR user accustomed to operate with a TETRA national device shall be able to operate in the same way (same language, same procedures) with an ISITEP smart device even under foreign TETRA/TETRAPOL networks.

The semantic and syntactic translator will be used in two scenarios:

- In case of status messages or SDS exchange and in particular when officers on the field, in emergency situations, have to receive specific orders from the leaders or from the dispatcher: in this case a predefined translation table that maps messages and simple phrases in different languages will be used by the off line dictionary that will automatically translate the message into the destination language. When dealing with SDS, the off line dictionary will translate blocks of words/prefixed expression available on the translation table while considering the elements not available (names, etc…) on the translation table as free-text. The translation process is completely transparent both for sending and receiving parties.
- In case of more complex sentences or less common-unusual commands exchanged by users: statistical machine translation (SMT) systems will be used. This approach allows to automatically train translation models for any language pair, still keeping the translation process completely transparent for the entities.

Definition of useful predefined text messages should be extracted from the analysis of workflows specified in SP3.

4.2.6 Data transport used between a network application and the relevant terminal application

In the ISITEP project there are different applications that require interaction between a network-side and terminal-side applications, these are:

- Workflow manager
- Localization service
- Dynamic Functional Numbering
- Extended Message Exchange Application

TETRA and TETRAPOL standards offer two options to transport data: SDS and Packet Data. TETRA provides also enhanced data service TEDS, not available in TETRAPOL.

SDS is provided in ISI phase 3 and also by ISITEP project, but in order to develop new added-value applications for the ISITEP project the use of SDS would require the capability of the added-value application on the network side to be able to send and receive SDS, and no standard interface is available for the application on network side. Moreover using SDS for data application would consume bandwidth on the ISI link.

Packet Data is not available in ISI phase 3, for this reason the packet data theoretically is out of the scope of the ISITEP project, but the use of Packet Data would provide a standard IP interface toward the new added-value applications. The different PPDR networks should be interconnected using an additional IP link, and the application data traffic would not consume the bandwidth of the ISI link reserved for the other TETRA services (speech calls and SDS).

Both SDS and Packet Data provide narrow band access so only narrow band application can be provided in ISITEP project.

Enhanced data service TEDS has been standardized only for TETRA, but we cannot assume to use it because it is not available in TETRAPOL network and because there are few commercial terminals available; in any case the transition form Packet Data to TEDS would not afford changes on those added value applications developed for using Packet Data as transport.

Even if 3G access network is accessible to the smart device, it is not possible to foresee that 3G access network is integrated with all PPDR networks, ISITEP scope are PPDR networks TETRA and TETRAPOL, applications shall be developed considering narrow band transport offered by TETRA and TETRAPOL. 3G access can be adopted for off-line update of the smart device and not for real time use in PPDR operation.

Localization service by standard is provided over SDS transport and there is no reason to change this because ISI link will allow transporting SDSs from the visited network to the home network and AVL Servers provides LIP over SDS interface and are already able to manage localization information.

The ISITEP applications listed above are composed by a network-side and a terminal-side, in order to deploy network-side applications on PPDR networks of different manufacturers a standard framework for developing applications shall be realized. The IP framework is the most generic and standard one to be used, but the availability of Packet Data is required on the TETRA/TETRAPOL air interface.

4.3 Analysis of existing PPDR terminals and smart device

In the following subparagraphs the existing PPDR terminals are analysed: for each one the supported features are reported and, in addition, there is a list of the new requirements that shall be applied in order to support ISITEP scenarios.

The smart device is a general purpose terminal; then, the requirements that characterize the smart device to be used in the ISITEP enhanced terminal are reported.

4.3.1 TETRA terminal

The TETRA terminal requirements needed for TETRA functionality over the air interface and relevant for ISI migrating terminals are listed in TCCA TIP (TETRA Interoperability Profiles).

TETRA IOP V+D:

Part 1: Core

Part 2: Short data Service

Part 4: Authentication

Part 6: Air Interface migration

Part 11: Air Interface Encryption

TETRA IOP ISI:

Part 1: Mobility Management

Part 2: Individual Call

Part 3: Short Data Service

Part 4: ISI Lower layers

Part 5-1: Circuit mode voice transfer (*)

Part 5-2: Packet mode speech format (*)

Part 5-3: Generic speech format

Part 6: ISI Group Call

Some additional terminal requirements not specified in IOP, but relevant for operative use, are listed below:

1. Automatic/manual roaming between TETRA networks

TETRA networks' coverage overlap in border areas. For joint cross-border operations, a terminal may remain in its home network even when in border areas of a visiting country. Hence, it may be relevant to manually force the terminal migration to a visiting network or alternatively to stay in home network as long as possible. In maritime use cases, it may be beneficial to migrate automatically to the visiting network, when it is available. Indeed open sea areas may be uncovered by PMR networks and a terminal may be out of service; then, migration to the first available TETRA network should be automatic. Visiting networks, towards which a terminal is authorised to migrate, should be pre-programmed into the terminal. Triggers for roaming (manual/automatic) should be set on a network basis. Hysteresis (of migration) is needed to prevent oscillation of migration between networks.

2. Displaying the home or visiting network in use on terminal screen

The terminal should show the mnemonic name of the network in use. Indication of migration in progress has to be shown: blinking network name etc. The selected network mnemonic name has to be shown on the UI of the terminal when service is available. Non-availability of any TETRA network should also be displayed.

3. Phone book of visited network users, updates

Phone book should support full ITSI numbers of the entries in phone book to enable calls over ISI, initiated from phone book. Phone book directories for visiting network users and groups by organisation should be supported.

4. Parameterization of terminal services and rights for visited network

In visited networks, visiting terminal user and service rights are typically limited due to security and privacy reasons. In addition to the list of visiting networks, visiting network parameters are also to be pre-programmed for each visiting network. Default parameter values have to be used in case of

missing parameterization. The meaning of TETRA status values may vary between networks: the parameter profile could also convert TETRA status values to those used in visited network, when status is sent to visiting network users or dispatchers.

5. End-to-end encryption (e2ee) services in visited networks.

Some PMR networks use e2ee for all group and individual voice communications. This raises problems in connecting to other PMR networks that use different e2ee or do not use it in voice communications. When making a phone call to a network, where e2ee is not used as default, the call should be initiated in clear mode. When receiving a call, the terminal should automatically adapt its settings to the received call encryption mode. The same applies to group calls. Typically, automatic use of non-encrypted groups should be applied in visiting network, where members can join from both encrypted and non-encrypted networks.

It would be helpful to have automatic fall-back to unencrypted groups in case of joining visiting users whose TETRA terminals do not support the e2ee in use.

4.3.2 TETRAPOL terminal

TETRAPOL is an open standard defined through a set of Publicly Available Specifications (PAS) available to the members of the TETRAPOL forum.

The requirements that a TETRAPOL radio terminal shall comply with for being compatible with TETRAPOL Standard, are defined in a subset of the Publicly Available Specifications (PAS).

PAS 0001 – Part 1General Network Design

PAS 0001 – Part 2 Radio Air interface

PAS 0001 – Part 3 Air Interface Protocol

PAS 0001 – Part 7 Codec

PAS 0001 – Part 8 Radio conformance tests

PAS 0001 – Part 9 Air interface Protocol conformance tests

PAS 0001 – Part 10 Inter System Interface

PAS 0001 – Part 13 User Data Terminal to System Terminal interface

PAS 0001 – Part 16 Security

The interface of the Smart Device with TETRAPOL modem shall comply with

- Control interface: PAS 0001-Part 19-2 System Terminal Control Protocol
- Data interface: PAS 0001-Part 13-6: Specifications UDT and ST interface; MPAP and DTAP protocols

The main supported services are:

- VOICE SERVICES IN NETWORK CONNECTED MODE
    - Group communications: Multisite Open Channel, Talkgroup, Broadcast MOCH, Group call, Late Entry, Scanning, Do not Disturb
    - Private communications: Individual Call, Multiparty Call, Interconnect Call,

    - Emergency communications: Emergency Call, crisis open channel, Emergency Open Channel
- VOICE SERVICES IN DIRECT MODE AND IN REPEATER MODE
    - Direct Mode Call
    - Direct Mode with Network Monitoring (Dual Watch)
    - Repeater Mode Call
    - Direct Mode Emergency Call
    - Response to Direct Mode Emergency Call
- DATA SERVICES
    - Messaging Services: Inter-Personal Messaging Service, External Application Messaging Service
    - Status Messaging Service
    - Note: In TETRAPOL standard specification, the equivalence of SDS is named SUMS.

In TETRAPOL system all Tetrapol communications are always E2E Encrypted. Clear mode is possible only through TETRAPOL network decision and configuration and limited to fallback situations. As E2EE is always requested, there is no request for AIE.

So far there is either, no current available interconnection of TETRAPOL networks from different customers, nor the interconnection of a TETRAPOL network with a TETRA network as specified in TETRAPOL PAS 0001-Part 10 Inter System Interface. However specific solutions have been developed based on dedicated Gateways, which manage set of couples of terminals. Each terminal of the couple is belonging to one of the networks to be interconnected. The limitation of such solutions are a voice interconnection through an analogue and not cyphered interface (in the gateway), plus a reduced Group communications interconnection capability equal to the available number of terminals couples in the Gateway.

It could be possible to develop within ISITEP a new version of TETRAPOL modem which would embedd as many sets of {system configuration (including security), terminal configuration} parameters that the expected number of TETRAPOL networks where ISITEP terminal should roam. The switch from one network to the other would be controled by the user through a User Interface command. Considering the countries where TETRAPOL networks have been deployed it looks like that each country will have at the maximum one neighbouring country where another TETRAPOL system has been deployed. So it should be possible to limit at 2, the set of configurations to embedd. Note that this only possible if the TETRAPOL networks share the same E2EE family algorithm (ie Schengen) and request dedicated budget.

4.3.3 Smart Device

ISITEP smart device will have the primary goal of enabling interoperability and guaranteeing full integration between TETRA and TETRAPOL technologies in such a way that the instruction translation process between the ISITEP UI and TETRA/TETRAPOL modems is completely transparent to the user. TETRA and TETRAPOL features listed in the above paragraphs will have to be guaranteed on a unique, simple and well-designed UI.

In order to enable interoperability and guarantee full integration between TETRA and TETRAPOL technologies, ISITEP will define a novel terminal architecture based on Android Open Source Project (AOSP). The user interface design will make the user's interaction as simple and efficient as possible,

balancing technical functionality and visual elements to create a system that is not only operational but also usable and adaptable to changing user needs.

Considering the constraints of mobile devices and that a smart UI provides the framework on top of which apps are built, a well-designed interface has to be usable, where the usability is intended as a high-level quality objective: “The extent to which, a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (IS0 9241-11 standard). The usability concept nowadays widely accepted is specified in ISO/IEC 9126-1 (2001), according to which it is defined as ‘the capability of the software product to be understood, learned, used and be attractive to the user, when used under specified conditions’.

Hence, the following principles will be taken into account:

- Learnability: how easy is to accomplish basic tasks from the first time the user interacts with the UI. The functionalities presented to the user should be limited to exactly what the user requires to get to their goal.
- Efficiency: Number of steps it takes for a user to complete a task, i.e. resources expended in relation to the accuracy and completeness with which the user achieves a goal. Key tasks should be made as efficient as possible. In few words, how much effort (often in terms of time) do users require to do what they require?
- Effectiveness: The degree of accuracy and completeness with which the user achieves a specified task in a certain context. In few words, do user what they want to do? At this aim, it is extremely crucial in the UI design to early focus on users, analyse what tasks they will perform, which are most important, and what decisions the users will make while using the device.
- Memorability: UI should be easier to use each time the user interacts with it. Obviously a key factor is the frequency of use.
- Safety and Error Recovery: Users should never be allowed to make a mistake. In any case mistakes in the input data have to be easy to correct. It should be possible to undo actions or if this is not possible (for example deleting data) the user should be warned and should need to confirm it.
- Simplicity: Simple tasks never require complex procedures, and complex tasks are tailored to the human hand and mind. Hence, most used tasks should be easy and less common tasks should be possible. The app shall be designed so that all its features and tasks are intuitive and easily discoverable. Unnecessary functionality should be avoided and the visual design and layout should be kept uncluttered. In a simple-designed UI users won’t have to supply any additional settings, because the app is already set up to behave the way they expect.
- Mapping: What the user expects to happen when they interact with the interface is exactly what should happen.
- Visibility: Important information should be the most visible and less important information should be less visible. For example interactive element have to be given ample spacing, text should always be legible, appropriate colours should be used. At this aim, understanding the users goals is critical.
- Feedback: User should always be in control of the interface and not the other way around. People’s actions shall be acknowledged, the action results should be clearly shown, and users should be constantly updated on the progress of their task. Vocal interaction could be also considered.
- Satisfaction: How much the user enjoys or dislikes using the software.
- Consistency: Like-items should always be displayed and the user should have the chance to act the same way across the entire application and between applications. A consistent app isn’t a copy of other apps and it isn’t stylistically stagnant; rather, it pays attention to the standards and paradigms people are comfortable with and it provides an internally consistent

experience. To achieve this goal the UI design has to answer to questions as: does text use uniform terminology and style or the same icons always mean the same thing; can people feel confident and predict what will happen when they perform the same action in different places; do custom UI elements look and behave the same throughout the app; is the app consistent with its earlier versions. Only by respecting these requirements the app will be considered as consistent.

- International-ability and Multilanguage requirements: The degree to which software can be used for the global marketplace, taking into account variations in regions, population stereotypes, languages, and cultures. Automatic translation when user log in (aliasing) in its own native language or in the language chosen on the device.
- Accessibility: the measure of how successfully a product can be used comfortably by a wide variety of people, including users who have visual, physical or age-related limitations that prevent them from fully seeing or using a touchscreen, and users with hearing loss who may not be able to perceive audible information and alerts. Android design patterns were created in accordance with universal design principles, and ISISTEP smart device will follow them to meet basic usability standards. Enable Android's accessibility tools (TalkBack, Explore by Touch and Accessibility settings) and provide vocal and visual feedback will make the implemented app as accessible as possible.
- Portability: in an Android UI, size bucket as handset or tablet, and density bucket as low density dots per inch LDPI, medium density dots per inch MDPI, high density dots per inch HDPI, extra high density dots per inch XHDPI, extra extra high density dots per inch XXHDPI, and extra extra extra high density dots per inch XXXHDPI will be taken into account. This implies for example providing each icon in multiple sizes.

The guidelines followed by main mobile UI suppliers suggest that usability is not an intrinsic characteristic of the product itself but it refers to interaction process between users, product and goals to be achieved. It will then be evaluated not with direct measurement but quantified by means of indirect measures or attributes. The above criteria will be considered in the bi-technology device UI design and evaluated by users.

Crucial characteristics to be considered in the device design will be the multi-language environment, the portability of the system (to make it independent on the used tabled or smartphone) and the safety, both in terms of physical link between the device and the network and in terms of encrypted communication.

On top of the system, a cloud system will be available to users in order to supply additional advanced functions and applications like remote access to database or automatic update of phonebook and talkgroup depending for example on the user position (geo-referenced app).

5 TERMINAL REQUIREMENTS

This section reports on the initial outcomes of Task 5.1.1 “Terminal Requirements”.

The requirements for the enhanced terminal are univocally identified by a code, according to the following tree:

I-ETR-TTT-N.a

Where:

- I is a fixed string standing for “ISITEP”;
- ETR is a fixed string standing for “Enhanced Terminal Requirement”;
- TTT is a three letters specification type code, as listed in the following Table 1– codes are compliant with ECSS Standards (see [RD1]);
- N is the sequential number of the requirement, with respect to TTT:
- a is a progressive letter used in case of more than one specification belonging to the same N-level.

Code	Type	Description
FUN	Functional	Requirements that define what the product shall perform, in order to conform to the needs / mission statement or requirements of the user.
MIS	Mission	Requirements related to a task, a function, a constraint, or an action induced by the mission scenario.
INT	Interface	Requirements related to the interconnection or relationship characteristics between the product and other items.
OPE	Operational	Requirements related to the system operations and maintenance.
HUM	Human Factor	Requirements related to a product or a process adapted to human capabilities considering basic human characteristics.
CNF	Configuration	Requirements related to the composition of the product or its organization.
DES	Design	Requirements related to the imposed design and construction standards such as design standards, selection list of components or materials, interchangeability, safety or margins.

Table 1: possible values for TTT in the requirements code

The ISITEP Terminal is composed by different sub-elements, each requirement may impact one or more of these sub-elements; in the following table, all the sub-elements are listed:

Sub-Element	Abbreviation
Smart Device	SDev
TETRA Modem	TETRA
TETRAPOL Modem	TETRAPOL
Adaptation and Communication Manager	ACM

User Interface and Business Logic	UI&BL
Security Manager	SM
Workflow Manager	WM
Semantic and Syntactic Translator	SST
Dynamic Functional Numbering Application	
Location Assisted Numbering Application	
Enhanced Message Exchange Application	

Table 2: ISITEP enhanced terminal sub-elements

The requirements shall be formalized according the following format.

ID	**Description**
I-ETR-TTT-N.a	*This field contains the requirement.*
Pre-Requisite	
This field is used to identify if the requirement satisfaction is based on some pre-requisite.	
Rationale	
This field is used to justify the requirement.	
Applicable To	
This field is used to specify the impacted sub-elements.	
Discussion/Open issues	
1.	*This field can be used for discussion on requirement.*

5.1 General Requirements

TETRA and TETRAPOL modems shall provide a set of standard capabilities needed to provide those TETRA and TETRAPOL services required by end-user requirements for non-ISI and ISI context. It has been required to be aligned at least to ISI phase 3 contents.

The general requirements are pre-requisites to participate to the ISITEP project and are reported in summary.

ID	**Description**
I-ETR-FUN-1.a	TETRA Modem shall be compliant with TETRA IOP V+D: Part 1: Core Part 2: Short data Service Part 4: Authentication Part 6: Air Interface migration Part 11: Air Interface Encryption
Rationale	

These are prerequisites for the TETRA modem. The requirement is expressed in order to agree with the set of features that shall be available in the ISITEP framework.	
Applicable To	
TETRA	
Discussion/Open issues	
1.	

ID	**Description**
I-ETR-FUN-1.b	TETRA Modem shall be compliant with TETRA IOP ISI: Part 1: Mobility Management Part 2: Individual Call Part 3: Short Data Service Part 4: ISI Lower layers Part 5-1: Circuit mode voice transfer (*) Part 5-2: Packet mode speech format (*) Part 5-3: Generic speech format Part 6: ISI Group Call
Rationale	
These are prerequisites for the TETRA modem that shall operate in ISI framework. The requirement is expressed in order to agree with the set of features that shall be available in the ISITEP framework.	
Applicable To	
TETRA	
Discussion/Open issues	
1.	

ID	**Description**
I-ETR-FUN-1.c	TETRAPOL Modem shall be compliant with TETRAPOL PAS : PAS 0001 – Part 1General Network Design PAS 0001 – Part 2 Radio Air interface PAS 0001 – Part 3 Air Interface Protocol PAS 0001 – Part 7 Codec PAS 0001 – Part 8 Radio conformance tests

	PAS 0001 – Part 9 Air interface Protocol conformance tests PAS 0001 – Part 10 Inter System Interface PAS 0001 – Part 13 User Data Terminal to System Terminal interface PAS 0001 – Part 16 Security PAS 0001 - Part 19-2 System Terminal Control Protocol
Rationale	
These are prerequisites for the TETRAPOL modem to operate within TETRAPOL networks. The requirement is expressed in order to agree with the set of features that shall be available in the ISITEP framework.	
Applicable To	
TETRAPOL	
Discussion/Open issues	
1.	Limitation to a subset of features could be an option. eg Focusing on some of the different types of Group communications

5.2 Interface Requirements

ID	Description
I-ETR-INT-1.a	The TETRA modem shall be integrated inside the smart phone of the hand-held ISITEP terminal solution.
Rationale	
If feasible, a full integrated solution would be an added value content for the ISITEP terminal. Moreover wireless connectivity between radio modems and smart device would expose the ISITEP terminal to security threats.	
Applicable To	
TETRA, TETRAPOL, SDev	
Discussion/Open issues	
1.	

5.3 Requirements for bi-technology terminals “application enabled”

The enhanced ISITEP terminal is a bi-technology terminal provided at the same time with two different radio interfaces: TETRA and TETRAPOL. The end-user equipped with the ISITEP terminal should not perceive the difference between TETRA and TETRAPOL technologies; in order to achieve this goal the ISITEP terminal is equipped with two sw components, i.e. the *Adaptation and Communication Manager* and the *User Interface adaptor & Business Logic*.

The *Adaptation and Communication Manager* abstracts the interface between the radios and the sw components and the applications deployed inside the ISITEP terminal.

The *User Interface Adaptor & Business Logic* abstracts the TETRA / TETRAPOL capabilities to the end-user.

5.3.1 Adaptation and Communication Manager

Adaptation and Communication Manager (ACM) is responsible to manage communication between the upper layer of the ISITEP terminal and the PPDR radios. The following services provided by the PPDR radios shall be exported to the upper layers of the ISITEP terminal:

- Transmission and reception of SDS.
- Transmission and reception of pre-defined status messages
- Speech Call Set up
- Hung Up Speech Call
- Group Management
- General information on the networks
- General information on the radios equipment.

The ACM is also responsible for network selection. According to end-user requirements it shall be possible to perform network selection either manually or automatically. Manual network selection requires that the end-user performs some manual operation on the ISITEP terminal to select the network, while automatic network selection does not require the participation of the end-user to the network selection procedure.

Manual network selection may be required for specific cross-border missions where PPDR services are offered by both home and foreign networks, and the end-user may prefer to stay hooked to its own home network.

Network selection may be automatized following different criteria such as:

- Operator established policies used to guide network discovery and selection. This turns the network selection functionality in a dynamic but operator-controlled mechanism. Operator policies may be dynamically provisioned over the air or be pre-programmed in terminals. Network selection policies could be adjusted to the needs of specific PPDR operations (e.g. incident-based network selection policies).
- User information (e.g. user subscription profile with network access rights, user preferences, user's role in an incident, analytics with historical data, etc.)
- Application/service specific requirements (e.g., encryption, service continuity, application type, voice/data connection, etc.). In addition, the use of applications in terminals may be subject to prioritisation that could also impact on network selection (for example, upon the initiation of a responder emergency function, an agency-defined list of applications shall be given the highest priority and may pre-empt, if necessary, other resources to be admitted in a given network). The priority and quality of service (QoS) settings of applications may be dynamically modifiable based on the incident and locally defined needs.
- Device location and time of day. Terminals should include the capability to collect and convey terminal location data in near real time. Terminals may support ancillary (hybrid) means to augment and enhance location determination (e.g., compass or accelerometer, RF pattern matching, Wi-Fi, altimeter, secondary satellite constellation (A-GNSS), etc.)

- Local operational environment of the terminal. Terminals may implement device intelligence features regarding the computation and use of real-time conditions that influence the network selection and traffic routing decisions. Potential context information to obtain and leverage is:
    - Mobility conditions. Motion of the terminal relative to one or more base stations or access points (e.g., terminal speed with respect to one or more access points that may be estimated by the device according to implementation dependent mechanisms).
    - Power conditions (e.g., battery levels and usage)
- Radio network characteristics (e.g. technology, supported features/capabilities, venue-specific information). Terminals should be able to discover in an efficient manner (resource consumption and responsiveness) which access networks are available in the vicinity of the terminal, including radio access network identifiers and technology specific information.
- Radio network conditions (e.g. signal strength/quality, network load, barring criteria).

Network discovery and selection functionality should not be limited to TETRA and TETRAPOL networks but designed to support access through additional radio interfaces such as Wi-Fi and 3GPP if implemented in terminals

The scope of the ISITEP project is to realize a unique trans-European PPDR network that is able to provide communication services to all European PPDR forces. The trans-European PPDR network will be realized interconnecting the PPDR networks already available in different countries; in most cases different network operators manage PPDR networks belonging to different countries.

It can be assumed that there will be only small areas where more PPDR networks provided by different operators overlap, precisely along the boundaries of the countries. In this context, the main requirement is that communication service is always guaranteed, i.e. in case an intervention team crosses the border, communication services shall continue to be available without requiring any user manipulation on the terminal.

Another point to be considered is that the interconnection between PPDR networks will be realized using ISI interface, but not all the PPDR services and features will be available across ISI interface for the ISITEP project; then, each PPDR terminal will have access to the entire set of PPDR services only when it is located under its home PPDR network. As a consequence, the automatic network selection criteria shall consider signal strength and terminal settings related to network preferences. Optionally, the automatic network selection may also consider other criteria such as that described above (e.g., operator policies for network selection, location of the terminal, radio network conditions, etc.).

Finally, in ISITEP project the radio access is limited to TETRA and TETRAPOL networks, while broadband radio access (WiFi and 3GPP) is reserved for future evolution of PPDR networks; hence, network selection capabilities to be implemented in the ISITEP enhanced terminal are strictly limited to TETRA and TETRAPOL radio access.

5.3.2 User Interface Adaptor & Business Logic

User Interface Adaptor & Business Logic (UI&BL) is responsible to provide a unified user interface for TETRA and TETRAPOL end-users. TETRA end-user shall be able to manage the ISITEP terminal even when it is located under the TETRAPOL network and the TETRAPOL end-user shall be able to manage the ISITEP terminal when it is located under the TETRA network.

ISITEP bi-technology device, whose architecture will be based on Android Open Source Project (AOSP), will make the user's interaction as simple and efficient as possible to create a system that is not only operational but also usable and adaptable to changing user needs.

In order to make transparent to the user the instruction translation process between the ISITEP UI and TETRA/TETRAPOL modems, the usable smart Android terminal will include the following basic elements:

- PIN handling to access the terminal
- Login: a username and password to access as chief officer/minister body guard/team officer leader, ecc…
- Home screen: it houses app shortcuts, folders and widgets. Favourites Tray at the bottom always keep the user's most important shortcuts and folders in view regardless of which panel is currently showing. In this section it will be available a shortcut to access to the UI&BL of the enhanced ISITEP terminal. On the UI&BL of the ISITEP terminal fast access buttons will be available to have direct and easy access to PPDR services like a dedicated emergency button, a dedicated PTT button, talkgroup selection, phonebook to access to speech call services and status messages and all the PPDR services foreseen.
- All App screen: the user can easily access this screen by pressing the All Apps button at the center of the Favourites Tray. Users can drag an app or widget icon from the All Apps screen and place it in any empty location on any Home screen
- Recents screen: the user can easily access this screen by pressing the button at the right side of the navigation bar. This screen is used to switch between recently used applications and provides a clear navigation path between multiple ongoing tasks.
- System Bars: screen areas dedicated to the display of notifications, communication of device status, and device navigation: in particular on the Android status bar there will be symbols that indicate the radio/network status, call encrypted/not encrypted, the battery level etc. On the bottom (navigation bar) as in every Android device the user can find Back, Home, Recents.
- There will be a main radio Settings section where the user can set its account, audio settings (volume control and accessories settings) and the most important TETRA/TETRAPOL settings
- Notifications as recent events accessible at any time from the status bar: missed call, unread messages, etc.

In order to provide the full set of PPDR capabilities it is required an analysis of TETRA and TETRAPOL capabilities and usage. This point is necessary to understand which are the common points and the different ones in order to provide a common interface to TETRA and TETRAPOL users. It can be assumed that the following PPDR services represent the minimum requirements for both technologies:

- TALKGROUP control: group may be preloaded in the device or network can be provided with a dynamic group provisioning. Different set of talkgroups may be defined for each PPDR network where the device may migrate. The user will be able to change the selected talkgroup
- Phonebook used to make individual calls.
- Call management:
    - Emergency call: to whom (individual or group, both home and visited dispatcher)/send position/live mic how many secs and how many cycles
    - Half duplex individual settings (timestamp, etc…)
    - Full duplex individual settings (timestamp, etc…)
    - Priority call to be requested to the network (customizable for each call or default value)
- GNSS management:
    - Check position of the smart device on a preloaded map with GNSS coordinates
    - Give direction (optional)
    - Set up LIP settings/ interval report (time/space, etc…), to whom the report has to be sent (for example to both home network and visited network)

- Messages (two different icons for SDS and status):
  - Status (preloaded in the device)
  - SDS
  - Settings: default destination address for status/ default destination address for SDS (group or a specific entity) /preferred destination addresses (set up for example 5-10)/send position and timestamp, etc. Could be included in main radio Settings section.
  - History as a mobile phone

On top of the system, an ISITEP cloud system will be available to users in order to supply additional advanced functions and applications like remote access to database or again automatic update of phonebook and talkgroups depending for example on the user position (geo-referenced app). For reference see par. 5.5.

5.3.3 Requirements

ID	Description
I-ETR-FUN-2.a	Adaptation and Communication Manager shall translate instructions from user interface and business logic into commands toward TETRA and TETRAPOL modem and vice-versa. The following commands shall be supported at least : - Switch-on/off the TETRA/TETRAPOL Modem(s) - Group selection - Individual call - Group call - Short data messages - ….
Rationale	
Adaptation and Communication manager is the abstraction layer between the TETRA/TETRAPOL modems and the radio user interface.	
Applicable To	
ACM	
Discussion/Open issues	
1.	

ID	Description
I-ETR-FUN-2.b	Adaptation and Communication Manager shall be able to monitor TETRA and TETRAPOL access network. At least the following information shall be provided: - RSSI

	- MCC and MNC - Security class (1, 1+3, 2, 3) - Networked or FallBack - Etc…
Rationale	
- RSSI can be used to manage migration - MCC and MNC can be used to notify to the radio user information on the available SwiMi - Security Class, security can be reached in different ways in each PPDR network, it is useful for the radio user to know the security class provided by the SwiMi.	
Applicable To	
ACM, TETRA, TETRAPOL	
Discussion/Open issues	
1.	

ID	**Description**
I-ETR-MIS-1.a	User Interface shall provide the radio user the possibility to select automatic or manual migration.
Rationale	
According to the PPDR scenario the radio user may be more interested in keeping active the connection with its home network than moving to a foreign network.	
Applicable To	
UI&BL	
Discussion/Open issues	
1.	

ID	**Description**
I-ETR-MIS-1.b	In case migration is performed manually, the user interface shall provide the radio user the possibility to select the serving network.
Rationale	
The radio user is able to perform manual selection of the discovered PPDR network.	
Applicable To	
UI&BL	
Discussion/Open issues	

1.	

ID	**Description**
I-ETR-MIS-1.c	If migration is performed automatically, the Adaptation and Communication Manager shall consider: • Whether candidate networks are home/visited networks • The security level of candidate networks • The services available in the candidate networks If there are multiple candidates that satisfy minimum required security levels and service availability, the Adaptation and Communication Manager shall consider the signal strength and terminal settings related to network preferences. Optionally, the ACM may also consider criteria such as (see section 6.3.1): Operator established policies; User information; Application/service specific requirements; Device location and time of day; Local operational environment of the terminal; Network characteristics; and Radio network conditions. In case the foreign network does not provide the same service and the same security level, then the migration shall be performed only when the currently selected network is no longer available. If more than one foreign network is available, the Adaptation and Communication Manager shall prefer the one that grants the better security level and the better service.
Rationale	
The radio shall use its home network that has higher security level and more services as long as it is possible; however, as soon as no signal strength is available, the migration shall be performed automatically towards the new network without any user manipulation.	
Applicable To	
ACM	
Discussion/Open issues	
1.	

ID	**Description**
I-ETR-FUN-3.a	User Interface shall display on the screen the network name/code with which the terminal is currently attached.
Rationale	

The radio user shall know which is the SwiMi the radio is attached to.
Applicable To
UI&BL
Discussion/Open issues

1.	

ID	**Description**
I-ETR-FUN-4.a	User Interface should display only the available talkgroups, or at least it shall display the available talk groups differently from the not available ones.
Rationale	
The radio user shall know which are the talk groups available in the serving SwiMi.	
Applicable To	
UI&BL	
Discussion/Open issues	
1.	

ID	**Description**
I-ETR-FUN-5.a	The migrating radio shall be able to automatically select the group used in the visited network.
Rationale	
When the radio migrates to a visited network, it could be possible that the group in the visited network that is statically linked to the group in the home network have a different GSSI. In order to avoid any user manipulation on the migrating radio, the group selection shall be made automatically by the terminal.	
Applicable To	
UI&BL	
Discussion/Open issues	
1.	

ID	**Description**
I-ETR-FUN-6.a	User Interface shall display if the speech call is ciphered or clear.
Rationale	

The radio user shall be aware of the security of his communications. SM should not be impacted because encryption information shall be provided by the ACM to the UI&BL in order to be shown on the terminal display.
Applicable To
UI&BL
Discussion/Open issues
1.

ID	**Description**
I-ETR-FUN-7.a	User Interface shall provide the capability to select if the communication is ciphered or not.
Rationale	
The radio user shall be able to select the E2EE and AIE security level of the communication.	
Applicable To	
UI&BL	
Discussion/Open issues	
1.	

5.4 Requirement for interoperability functions

According to end-user some extra functions are required for feasible interoperability on the field:

- Security manager (SM)
- Workflow manager (WM)
- Semantic and syntactic translator (SST)

5.4.1 Security Manager

The enhanced ISITEP device is provided with two modems (TETRA and TETRAPOL), and each of them is equipped with internal secure storage device where sensible data (used to manage TETRA and TETRAPOL security) are stored.

For security reason, each radio modem does not provide external access to the internal secure storage device and, consequently, the security manager in the enhanced terminal should not be allowed to access to TETRA and TETRAPOL security data material.

The main Security Manager task is to manage the security inside the smart device; the main following aspects shall be analysed:

- Protect the access to smart device and to the UI&BL.
- Protect the smart device from malware, viruses etc.

- Secure the Android-based kernel. The problem of realizing a secure sandbox for applications running on Android is still an open issue despite some opening towards the use of this OS also in secure environments (US).

- If the radio modems are wireless connected to the smart device, the SM shall protect the wireless connectivity.

ID	Description
I-ETR-FUN-8.a	Security Manager shall provide the smart device with authentication and authorization services. The radio user shall be allowed to use the smart device only after successful user authentication.
Pre-Requisite	
Rationale	
Applicable To	
Security Manager	
Discussion/Open issues	
1.	

ID	Description
I-ETR-INT-2.a	The Wireless connectivity between the smart device and the TETRA / TETRAPOL modems shall be encrypted.
Rationale	
Applicable To	
Security Manager, TETRA Modem, TETRAPOL Modem	
Discussion/Open issues	
1.	

ID	Description
I-ETR-FUN-9.a	A secure fence for applications running on Android shall be realized on the smart device.
Rationale	
The smart device shall be provided with a security mechanism that protect the device from viruses, malware, Trojans etc.	

Applicable To	
SM	
Discussion/Open issues	
1.	

5.4.2 Workflow Manager

For each PPDR operation, each country has defined its own workflow; in order to improve the international cooperation, ISITEP project is going to define standard workflows to be used for international PPDR operations (SP3).

Workflow Manager (WM) on the ISITEP terminal shall help the leader of PPDR forces and dispatcher operator to coordinate the PPDR intervention team in the PPDR operations. Intervention team may be composed by PPDR forces belonging to different countries and then WM should interact with SST in order to provide instructions to the end-user in its native language.

The features associated with the workflow activity management and control will be divided in three subsystems:

- Features aimed at the activity execution (workflow),
- Features aimed at the control and monitoring of both direct-supplied and third-party-supplied services,
- Features aimed at planning, control and monitoring of the economic-financial trend of contracts.

The Workflow Manager will have to assist officer/manager with planning, management, monitoring, control and supervision of all the activities to be carried out, with rapid access to Information System (IS) functions that support the activities and with checking the correct and prompt execution of the fulfilments for each procedural iter both from internal operational unit and external subject.

Therefore, it will have to allow to:

- Define the entities subject to control,
- Attribute the entity subject to control to an “Operating procedure”, which consists of a series of simple (“task”) or complex (“subprocess”) tasks that have to be carried out by internal operational unit or external subjects («Resources» in the following),
- Define the temporal evolution of the status of all entities subject to control,
- Manage the timers activated by the events connected to the operating procedures
- Monitor the activity status by generating alerts and alarm warnings
- Complete both synoptic and analytic informative files to support:
  - Task execution for each operational unit (task list and work-in-progress status monitoring),
  - Monitoring and supervision of the correct activity execution
  - Monitoring and supervision of the organizational structure efficiency level.

To this aim the Workflow Manager shall support:

- Definition and updating of the organizational structure including composition and consistency of the operational units and functions and duties assigned to them
- Tasks, processes and events definition
- Entity status automatic update when executing specific tasks and/or processes
- Manual data entry for additional information concerning carried out actions
- Workflow evolution monitoring

- Workflow dashboard, as synoptic and analytic informative files that form the resource dashboard both with the aim of to-be-carried-out activity planning and monitoring and control. The dashboard must show the fixed deadlines, activity workflow working progress and the assigned priorities
- Priorities management and supervision of the tasks assigned to each resource with possible reassignment depending on current and expected payload
- Fast access to forms supporting execution of the assigned tasks.

User interactions will be organized in two subsystems:

- WF assistant: web component which allows access to activity workflow control panel that include operational task for the user,
- WF Supervisor: web component which allows access to monitoring and activity workflow supervision panels.

More in detail, WF assistant will include the features to:

- Display user's tasks,
- Display non assigned tasks that could eventually be assigned to the user,
- Take responsibility of a task of an existing activity workflow,
- Create a new activity workflow,
- Carry out a task with I.S. support,
- Notify that a manual task has been completed,
- Reassign a task to another use,
- Display the iter associated with an activity workflow and the involved internal/external operational units,
- Create a subtask and assignment to the corresponding operational units.

WF supervisor will include the features to:

- Display both in-progress and completed user's activity workflow,
- Process and display user's activity workflow statistics (subordinates included),
- Process and display subordinates' payload and activity workflow,
- Display non assigned tasks,
- Assign or reassign a task of an existing activity workflow,
- Create a new activity workflow,
- Display the iter associated with an activity workflow and the involved internal/external operational units,
- Process and display operational units Key Performance Indicators.

5.4.3 Semantic and Syntactic Translator

ISITEP will define and implement a syntactic and semantic on line translator to overcome language barriers, which are a main obstacle for a successful interoperability. When using the ISITEP smart device, a PPDR user accustomed to operate with a TETRA national device shall be able to operate in the same way (same language, same procedures) even under a foreign TETRA/TETRAPOL networks.

Two approaches can be considered:

- Off line fixed-terms & sentences dictionary: a predefined lexicon accepted by all countries in their native languages for status messages and simple phrases. In this way the user can select a status message in his desired language (the language chosen on the Android tablet)

and the off line dictionary will automatically translate the message into the destination language by checking the status message translation table; the user can also write a SDS that the off line dictionary will convert into the destination language by translating the blocks of words/prefixed expression available on the translation table while considering the elements not available (names, etc…) on the translation table as free-text.

- "best effort" mode based on statistical machine translation (SMT) systems that allow to automatically train translation models for any language pair. Due to problems of compound words, idioms, morphology, different word orders, alignment and syntax, these systems are trained on large quantities of parallel data, i.e. bitext (collection of sentences in two different languages, which is sentence-aligned, in that each sentence in one language is matched with its corresponding translated sentence in the other language) from which the systems learn how to translate small segments, as well as even larger quantities of monolingual data, from which the systems learn what the target language should look like. Once the model has been trained, an efficient search algorithm quickly finds the highest probability translation among the exponential number of choices and the decoder finds the highest scoring sentence in the target language corresponding to a given source sentence hence translating the source sentence into the target language.
  SMT systems can be based on several types of translation models as for example:
  - Word-based: translated elements are words; these models can cope with translation where a single native word produces many foreign words, but not the other way, due to compound words, morphology and idioms. This system is not widely used today.
  - Phrase-based: the co-occurrences of words and segments (phrases) are used to infer translation correspondences between continuous sequences of words in the two languages of interest.
  - Syntax-based, based on the idea of translating syntactic units, rather than single words or strings of words.
  - Hierarchical phrase-based, which combines the strengths of phrase-based and syntax-based translation. This system uses phrases (segments or blocks of words) as units for translation and uses synchronous context-free grammars as rules (syntax-based translation).

  The more data is used or in general the closer the data used is to the type of data to be translated, the more accurate the translation system is.

  In general the benefits of statistical machine translation over other approaches as rule-based systems are:
  - Better use of resources, that can be explained with the use of natural language, with the flexibility (SMT systems are generally not tailored to any specific pair of languages) and with the automatic training model of the systems (rule-based translation systems require the manual development of linguistic rules, which can be costly, and which often do not generalize to other languages)
  - More natural translations even if using statistical matching to translate rather than a dictionary/grammar rules approach can often result in text that include apparently nonsensical and obvious errors.

ISITEP syntactic and semantic translator will explore all available state-of-the-art SMT systems to find the solution the best suits with TETRA/TETRAPOL users' needs and requirements.

5.5 Requirements for PPDR cloud added value functions and applications.

ISITEP project's scope is to realize a unique European digital professional network in order to provide all the PPDR agencies with communication services and improve international mono-agency and multi-agency cooperation.

In order to improve cooperation, ISITEP project provides the following added value functions and applications:

- Location Assisted Numbering
- Dynamic Functional Numbering
- Enhanced Message Exchange Application

Such services are based on data exchange between applications developed at terminal and network levels; this means that terminals shall be compatible with the considered applications. In a cross-border scenario, where there is unlikely compatibility between different national radio systems and mobile applications, the first aspect to be considered is to guarantee that such services are still available for the migrating radios in the home network across the ISI link.

A common framework for application development shall be defined in order to deploy the same application developed by different manufacturers in PPDR networks.

Even if these requirements are the input for WP 6.4 and WP 6.5, they have been collected in this document because the implementation of these applications may impact on ISITEP terminal sub-elements. In this paragraph the requirements that can be addressed at both network and terminal side are collected.

5.5.1 Location Assisted Numbering

Each PPDR agency has typically more control rooms; each of them is responsible for a specific border country zone. The Location Assisted Numbering allows to specify one special number for each PPDR agency; in this way the radio user can call the same special number independently of its position and the PPDR network automatically routes this particular speech call to the nearest control room related with that special number.

ID	**Description**
I-ETR-FUN-10.a	For each kind of service, the radio user shall be able to always select the same name in its address book independently of its location, and the call shall be automatically routed.
Rationale	
The radio user should not know the service number to be used for each area; when the radio user moves towards a visited network, the service numbers shall be automatically updated in his address book by the PPDR Network.	
Applicable To	
Network	
Discussion/Open issues	
1.	

5.5.2 Dynamic Functional Numbering

Each country may define special numbers for different functions. According the End User Requirements [2], special numbers may be for example the numbers used to call the nearest international coordination group for each agency:

- Fire brigade
- ciVilian protection
- Rescue (emergency health care).
- Police
- Border guards
- Multi-agency

Dynamic Functional Numbering (DFN) is the feature that links these special numbers to specific roles/entities (like the ones listed above) in such a way that, when a radio user moves to a different country, the special numbers present in his phonebook are automatically updated in the terminal according to the foreign country number definition without any user manual operation.

The functions required in international joint PPDR operations have to be defined for each area of interest in the workflows and in the shared standard procedures.

.ID	Description
I-ETR-FUN-11.a	DFN application (on the network-side) shall associate, for each country, the agencies defined in the workflow to some special numbers. Every time a subscriber belonging to the home network migrates to a foreign network, the DFN terminal-side application shall ask to the DFN network-side application to provide the list of special numbers available in the foreign country. The DFN network-side application should send the list of special numbers available in the foreign country to the DFN terminal-side application. The DFN terminal-side application shall then update the terminal address book and the emergency button with the special numbers received by the DFN network-side application, linking each special number to the proper agency name.
Pre-requisite	
In each PPDR Network it shall be possible to define the association between a special number and the number used to contact each agency in each area (at least based on Location Area).	
Rationale	
Applicable To	
Network / Terminal	
Discussion/Open issues	
1.	

5.5.3 Enhanced Message Exchange Application

One of the main obstacles in the coordination of international joint PPDR operations is the different languages used by the intervention teams. The Enhanced Message Exchange (EME) Application is the feature that provides the transport of orders by using short messages; order are provided by the coordinator in his language and are received by the resources belonging to that function in their native language. A set of pre-defined and pre-configured orders shall be defined in the workflow and in standard procedure. In case an order has not been pre-defined, a real-time translation should be performed.

This capability is also useful in PPDR operations where PPDR resources use the same language because it is often difficult to properly understand speech-orders due to the high background noise.

ID	Description
I-ETR-FUN-12.a	The sending EME terminal-side application shall provide the end-user with the list of available pre-defined orders, and shall allow the user to define new orders. The list of pre-defined orders shall be presented in the user native language. Only the functional leader shall be enabled to provide orders to the PPDR resources assigned to its functional group.
Rationale	
Applicable To	
Network/Terminal	
Discussion/Open issues	
1.	

ID	Description
I-ETR-FUN-13.a	Short data messages containing pre-defined orders shall be translated at terminal side and kept translated in the history.
Rationale	
Applicable To	
Network/Terminal	
Discussion/Open issues	
1.	

ID	Description
I-ETR-FUN-14.a	Short data messages containing new orders, not present in the pre-defined

	order list, shall be translated at network-side. The EME network-side application shall provide real-time translation between the language used by the sender and the receiver. The receiving EME terminal-side application is in charge to ask for real time translation service to the EME network-side application.
Rationale	
Real-time translation requires interaction with an up-to-date professional language translator that would map any language to any language. Considering that new orders not considered in standard procedures should be rare, it is feasible that the real-time translation is provided by a network-side application.	
Applicable To	
Network/Terminal	
Discussion/Open issues	
1.	

6 CONCLUSIONS

This document has presented an analysis of the following points:

- PPDR user needs, focusing on both security and end-user requirements;
- Existing PPDR terminals belonging to both TETRA and TETRAPOL technologies;
- The definition of requirements for "application enabled" bi-technology terminal; in particular, both features and interfaces for the physical layer, the Adaptation and Communication Manager and the User Interface Adaptor & Business Logic have been included;
- Interoperability requirements presenting how the Workflow Manager, the Semantic Syntactic Translator and the Security Manager will manage the constraints in terms of required features and technology;
- The requirements for PPDR cloud added value functions and applications, which would provide all the PPDR agencies with communication services and improve international mono-agency and multi-agency cooperation.

The document will be used as a starting point for the definition of the Adaptation/Communication Manager (WP 5.2), the Security Manager (WP 5.3), the Workflow Manager (WP5.4), the Semantic/Syntactic Translator (WP 5.5) and the User Interface and Business Logic Manager (WP 5.6).

7 REFERENCES

[1] D 2.2.2 Security Requirements
[2] D 2.3.1 End User Requirements Specification
[3] D 2.4.x System architecture and Network Requirements