Inter System Interoperability

D2.4.1 - SYSTEM SUBSYSTEM DESIGN DESCRIPTION (SSDD) CANDIDATE RELEASE

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REVISION TABLE

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V0.2	20/02/14	All	All	Consolidated ToC

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V0.3	16/05/14	All	All	Integrated contributions from partners
V0.4	18/07/14	All	All	Integrated contributions from partners
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Publishable extended abstract

ISITEP project pursues the achievement of operational interoperability among European first responders, addressing in a comprehensive manner the regulative, organizational, operational and technical level.

This deliverable documents the system-subsystem design description of the global ISITEP architectural framework. To that end, the document first develops a high-level view of the ISITEP global system architecture and then conducts the system-subsystem decomposition, delineating the scope of each of the subsystem elements and describing the interaction among them.

On this basis, the document then covers the specification of the four subsystems, namely: the “Mission-oriented framework” subsystem, the “ISITEP cloud network” subsystem, the “ISITEP terminal” subsystem, and the “Interoperability tools” subsystem.

The specifications reported in this document are primarily aimed at guaranteeing a coherent development of the four components of the ISITEP framework within SP3, SP4, SP5 and SP6. The specifications are a candidate release version produced at M12. The final version of the specifications will be reported in a subsequent deliverable due by M30.

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CONTENTS

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1 INTRODUCTION

A European network where forces share communications, processes and a legal framework would greatly enforce response to disaster recovery and security against crime. Until now, uncertainty on costs, timescale and functionalities has slowed down integration of national Public Protection & Disaster Relief (PPDR) networks. The lack of interoperable communication systems has impeded the cooperation of PPDR forces, although a strong European commitment has been established through Schengen and Lisbon treaties.

ISITEP project pursues the vision of allowing first responders of European ISITEP federated countries to seamlessly interoperate by overcoming current operational and technological barriers [1]. New European entrants will be easily federated into the ISITEP European network to achieve seamless interoperability.

To achieve ISITEP's vision, the project will develop a framework encompassing procedures, technology and legal agreements to achieve a cost effective solution for PPDR interoperability.

Through the proposed framework, PPDR agencies may achieve in the short term a cross-national interoperability that leverages existing technologies and is open to the benefits offered by emerging technologies in the long term. The framework is expected to offer an economically sustainable solution compliant with service procedures and regulatory frameworks.

In this context, Task 2.4.1 within WP2.4 "System architecture and network requirements" is aimed at defining the system-subsystem design description of the ISITEP system, covering:

- Description of the global system architecture
- System- subsystem decomposition
- Subsystems specifications from end-user system requirements (WP2.3) and security system requirements (WP2.2).

Through this description, Task 2.4.1 will guarantee a coherent development of the four components of the ISITEP framework within SP3, SP4, SP5 and SP6. The task will also seek to ensure that the architectural model specified for the ISITEP system is able to support the functional model (SP3) specified for the demo (SP7).

Work conducted in Task 2.4.1 is to be reported through the following deliverables:

- D24.1 "System subsystem design description (SSDD) candidate Release" (M12)
- D24.2 "System subsystem design description final release" (M30)

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2 DOCUMENT SCOPE

This deliverable (D24.1) reports on the advances in Task 2.4.1 until M12. In particular, the following points are covered:

- Section 5 describes the global system architecture of the ISITEP framework and addresses the system-subsystem decomposition.
- Section 6 covers the specification of the “Mission-oriented framework” subsystem.
- Section 7 covers the specification of the “European Inter-System Interface (ISI) cloud network” subsystem.
- Section 8 covers the specification of the “Enhanced user terminal” subsystem.
- Section 9 covers the specification of the “Interoperability-enabling tools” subsystem.

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3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

This section is intended to capture the definitions of some key terms used in the document for the purpose of increased consistency:

ISI over IP: IP-based implementation of the ETSI TETRA Inter-System Interface (ISI).

Network operator: the person or company that runs the TETRA/TETRAPOL network and who has people or organisations as customers.

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.

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.

Transport or transit services carrier: an intermediate entity that provides interconnection in different levels (Service, Transport).

3.2 Abbreviations

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

Acronym	Definition
3GPP	3rd Generation Partnership Project
ANF	Additional Network Feature
API	Application Programming Interface
AVL	Automatic Vehicle Location
CC	Call Control
EU	European Union
GIS	Geographical Information System
GPS	Global Positioning System
GW	Gateway
IP	Internet Protocol
ISI	Inter System Interface
ISSI	Individual Short Subscriber Identity
ITSI	Individual TETRA Subscriber Identity
HMI	Human Machine Interface
MNI	Mobile Network Identity
MS	Mobile Station
MT	Mobile Terminal
NGN	Next Generation Network
LIP	Location Information Protocol
PAS	Public Available Specifications
PD	Packet Data
PDH	Plesiochronous Digital Hierarchy
PDU	Protocol Data Unit
PMR	Professional/Private Mobile Radio

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PPDR	Public Protection and Disaster Relief
PS	Public Safety
PSTN	Public Switched Telecommunications Network
QoS	Quality of Service
RTP	Real-Time Transport Protocol
SDH	Synchronous Digital Hierarchy
SDP	Session Description Protocol
SDR	Software Defined Radio
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SSI	Short Subscriber Identity
SwMI	Switching and Management Infrastructure
TCS	TETRA Connectivity Server
TEDS	TETRA Enhanced Data Services
TEI	Terminal Equipment Identity
TETRA	TErrestrial Trunked RAdio
VoIP	Voice over IP
VPN	Virtual Private Network
WS	Work station

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4 GLOBAL SYSTEM ARCHITECTURE AND SUBSYSTEM INTERACTION

4.1 Global System Architecture and Subsystem Elements

The ISITEP proposed framework aims to assess and achieve operational interoperability among transnational PPDR operators jointly addressing the regulative, organizational, operational, and technical levels. To that end, ISITEP will address all the legal-technical “layers” involved in PPDR operational interoperability [2] in a specific framework, as illustrated in Figure 1, consisting of four components [1]:

- **A mission-oriented framework**, containing a standardized model of operational procedures and template agreements, together with its associated functional radio model.
- **A European Inter-System Interface (ISI) cloud network**, integrating the PPDR national infrastructures to allow transnational roaming services within secure protocols.
- **Enhanced user terminals,** integrating communication technologies (e.g., TETRA, TETRAPOL) into a novel terminal architecture based on smart devices (tablets and smartphones).
- **Interoperability-enabling tools**, including tools for infrastructures dimensioning, training, business model assessment, and applications for PPDR operations.

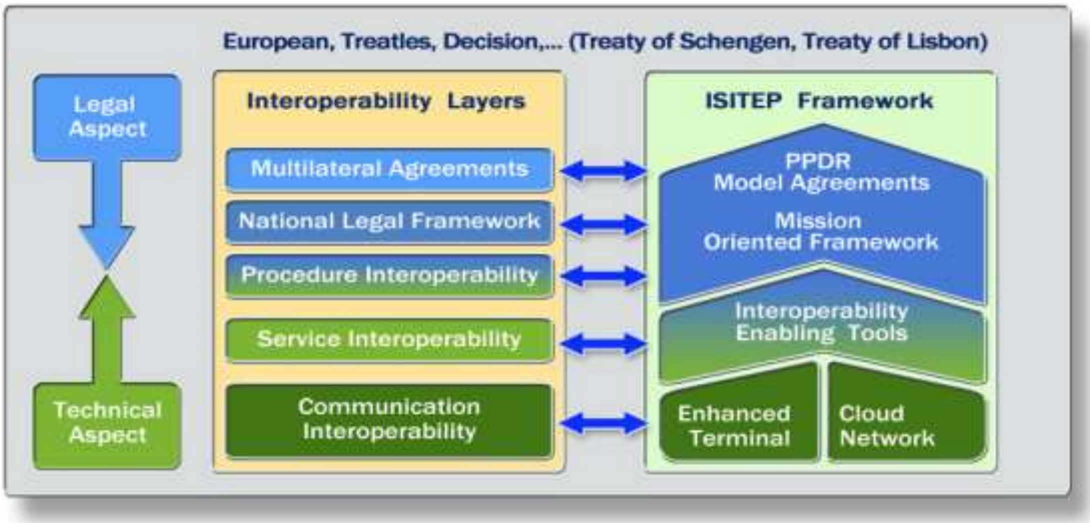

Figure 1. ISITEP model for transnational PPDR operational interoperability

As depicted in Figure 1, the bottom interoperability layer is to be achieved by the capability to communicate among teams from different countries. This implies technical interoperability at the radio and network levels. This aspect is solved in the ISITEP framework by the enhanced user terminals and the European ISI cloud network components. The next interoperability level on top of the communication layer implies interoperability of the services that are necessary for PPDR operations. For example, teams should be able to share services related to management of geographical resources. According to PPDR end users, there is a set of essential services that enable interoperability; i.e., without these services, interoperability is not effective in international operations. In ISITEP, the development of a set of interoperability-enabling tools and applications will address such minimal set of services and functions to enable service interoperability.

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Moving upwards to the top layers of the interoperability model, the procedure interoperability level includes technical, organizational, and legal aspects. Procedures shall specify the essential rules of communications. A functional model has to be defined to specify group interactions, and, therefore, a defined set of operational procedures has to be provided to allow cooperation in any PPDR scenario. Since a national legal framework has to guarantee rights and obligations for visiting teams in foreign areas, operational procedures have to be supported by multilateral agreements (treaties) among countries. Such agreements have to be in line with international legislation (treaties, decisions, etc.). These top level interoperability layers are addressed through the development of the ISITEP mission-oriented framework.

Based on above framework, a high-level view of the ISITEP global system architecture and its subsystem elements is provided in Figure 2. Further details for each of the components are provided in the following subsections.

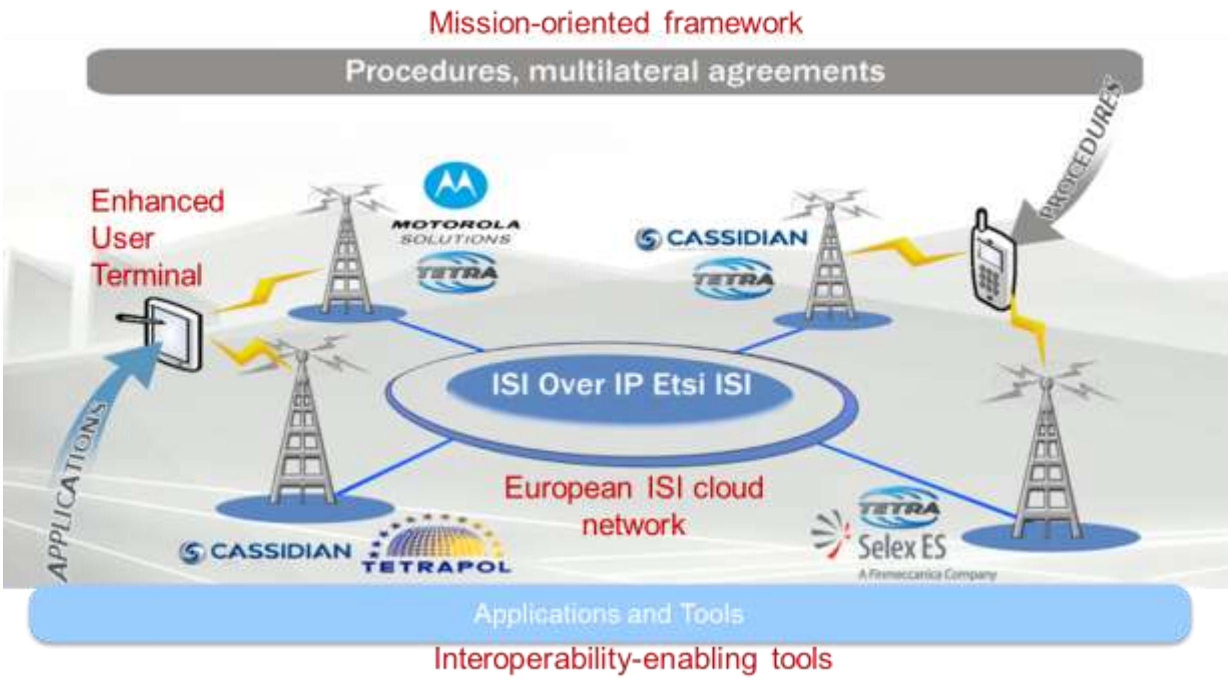

Figure 2. ISITEP global system architecture and subsystem elements

4.1.1 Mission oriented framework

Cross-border cooperation is a European priority for improving citizens' security [3][4]. Sharing resources at European level for Disaster Relief improves effectiveness of firefighting, civilian protection, medical and rescue operations. To enable cross-border operations, involved countries have to define multilateral agreements with terms, conditions, and operational procedures [5]. Current agreements are region specific (e.g., Norway–Sweden, Italy– France, Benelux, etc.) and limited to particular scenarios (e.g., the Senningen Treaty enables police services of Benelux countries to carry out joint operations abroad). A description of the current regulatory and legal frameworks, together with existing solutions and operational procedures for cross-border operation at European level is reported in ISITEP deliverable D21.1 [6].

Together with the need to achieve and improve radio communication / service interoperability among national PPDR networks, the development of a multilateral agreement draft template for PPDR

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cooperation, so that each country may use its template as a basis for its multilateral treaty, is seen as a cornerstone for fostering and improving cross-border PPDR cooperation. A similar strategy has been proven to be effective for increasing the level of cooperation among INTERPOL's member states.

Norway and Sweden are defining a model of PPDR cooperation that may be used as a draft template for bilateral agreements. In the end, a standardized operational model, with the associated functional radio model and common set of procedures, has to be defined by PPDR end users. Common international working methods covered in the operational model have to be prerequisite for efficient cross-border cooperation. Common talk groups, common language, and radio communication rules have to be specified. Following [7], regarding functional models and procedures, the template agreement has to identify the need of order routines, connection routines, guidelines, and procedures for fleet model in PPDR networks, and parameter settings for subscribers and talk groups. The experience from end users has confirmed that such an approach is correct [7][8].

Based on above considerations, the mission-oriented framework consists of a standardized model for the business processes and workflows required in main PPDR interoperability events harmonizing organizations, procedures and technology and taking into account organizations, procedures and legal agreements.

The model will be based on the inventory from the European working groups that study the best cooperation standards and practices to carry out these missions, and will use as main reference the Norway-Sweden current agreement. Preliminary user requirements have being reported in [9].

The following elements will form part of the mission-oriented framework:

- Standard model for PPDR missions (business processes and workflows), templates that single Member States may adapt to obtain multilateral agreements and the specific and the Norway-Sweden bilateral agreement.
- Functional model, encompassing the definition of the fleet map, numbering plan, security and rights set up to be applied to support the operational processes and procedures.
- Common procedures in operations, resulting in a handbook of PPDR procedures in operations will a focus on first responder on the field and/or the control rooms operators.
- Procedures for new entrants to the ISITEP network, enabling connecting new countries to the ISITEP network.
- Procedures for roaming activation, in order to support roaming services between countries where the interworking between their PPDR networks is not operational.

4.1.2 European Inter System Interface (ISI) cloud network

In the past decade, the European Council has been stressing the need for interoperability among PPDR technologies in Europe, e.g., TETRA and TETRAPOL [5].

Currently, TETRA is the dominant technology used in public safety organizations, either replacing the traditional professional mobile radio (PMR) technologies to become the unifying technology (e.g., in Portugal) or being considered for future adoption (e.g., in Poland). Indeed, TETRA technology is an ETSI standard that was defined with the scope to have a unique trans-European digital professional communication standard.

TETRAPOL is the other prevalent technology in Europe. Although a proprietary technology (compared with the ETSI standard TETRA), it is a publicly available standard and has achieved a

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significant share in the European market, mainly boosted by the French market and other countries in its area of influence.

The introduction of TETRA and TETRAPOL about 10 to 15 years back increased substantially the possibility to talk cross agency internally in a country but still cross border communication for the public safety forces is not well solved as of today. Indeed, the need for more international cooperation and the related need for international communications have fostered the emergence of several solutions to overcome the lack of roaming (i.e., migration) capability between the existing national PPDR radio networks. Among these alternative solutions, the use of (radio) gateways is the most common approach nowadays. Current gateways basically allow for the interconnection of networks at the analogue audio signal level or at digital voice & data signal level. Their main advantage is that the first responders can use their own usual terminals to perform group calls over two or more interconnected countries. However, first responders cannot use their terminals on another network abroad (no “roaming” capability): everybody has to remain under the coverage of its own national radio network. An overview of existing gateway interconnections between the European countries is reported in ISITEP deliverable D21.1 [6].

Also in the 1990s, the ETSI started the standardization process for the TETRA ISI interface to interconnect independent TETRA networks. The ETSI TETRA ISI standard relies on QSIG/PSS1 (i.e., an ISDN-based private signalling standard) to provide a bearer for the transfer of ISI traffic between the switching and management infrastructures of two TETRA networks. Today, such a standard is employed only by a few TETRA vendors for limited functionalities (i.e., basic registration scenarios, individual call, short data, and telephone). In the case of TETRAPOL, specifications for a network-to-network interface between two TETRAPOL systems, or between a TETRAPOL system and another digital PMR system, have also been produced (TETRAPOL PAS 0001-Part 10 Inter System Interface). However, 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.

Based on above considerations, the European ISI cloud network is intended to integrate the PPDR national/regional infrastructures to allow migration and communication services and associated applications within a secure framework. Hence, ISITEP system will interconnect a number of TETRA/TETRAPOL networks by means of ISI gateways, which will be interconnected through international links. A number of different gateways are to be developed to cover the use of TETRA and TETRAPOL technologies as well as the use of legacy TETRA ISI E1 by some networks.

The ISITEP project will use the ETSI TETRA ISI standard as input for creating an ISI over IP for internetwork. The extension of ISI to TETRA–TETRAPOL and TETRAPOL–TETRAPOL interconnections to assure the whole range of interconnecting capabilities is an element to be added to achieve full interoperability. Such a solution implies additional security challenges that may be addressed through conventional IP security systems (i.e., firewalls, intrusion detection systems, etc.) and potential security-assessment certifications.

The adoption of IP as the basis for the evolution of an ISI protocol stack will also enable easy integration of current narrowband PPDR networks with broadband IP access technologies such as Wi-Fi and LTE. This integration will add high data rate capability to the PPDR systems.

The following elements will form part European ISI cloud network:

- ISI over IP protocol specifications.
- ISI Gateways. Elements that provide ISI functionalities between the interconnected TETRA /TETRAPOL networks. A number of different ISI Gateways are to be defined to support the different combinations of radio technology (TETRA, TETRAPOL) and interconnection technology (E1 circuits, IP transport).

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- Security Gateway. Element that provides enhanced protection to traffic and signalling information running on the interfaces that cross PPDR network operator boundaries.
- Transport network. External network(s) used for the E1/IP interconnection (international links) of the national PPDR networks.

4.1.3 Enhanced User Terminals

In general, the proposed transnational intersystem interface IP network will allow migrating an existing TETRA or TETRAPOL national terminal abroad. This means that on the specific TETRA/TETRAPOL terminal, no activity is required to achieve the roaming capability. On the other side, since TETRA and TETRAPOL are incompatible radio technologies, an enhanced bi-technology terminal is required to operate between TETRA and TETRAPOL countries.

Capabilities supported by end-user terminals have been boosted in recent years, particularly in the commercial domain with the massive adoption of the so-called smartphone terminals. Owing to their powerful operating systems and related software-development kits, modern smartphones are becoming a versatile platform for the development of new services and applications, with their computing and communication capabilities improving continuously. In this context, some initiatives are underway to support multi-mode/multi-standard capabilities and related features such as seamless mobility across networks (e.g., 3GPP and Wi-Fi networks) and intelligent network selection [10][11].

Complementary to the use of commercial domain technologies, a potential implementation technology for advanced mobile terminals is software-defined radio (SDR) [5][3]. Unfortunately, this requires the development of specific PPDR (TETRA–TETRAPOL) waveforms, which may be critical in the short–medium term due to business sustainability. Current standard SDR platforms are designed for military use and, therefore, hardly suited for the PPDR market in terms of performance and cost.

Thus, in the short to medium term, the most promising approach is to use open programmable telecommunication devices such as Linux/Android-powered tablets or smartphones embedding a TETRA–TETRAPOL modem over a programmable platform. This approach enables a cost-effective bi-technology terminal to be obtained and can be easily extended to other PPDR communication technologies, e.g., the broadband ones (i.e., LTE).

The ISITEP enhanced user terminal will consist of a programmable platform (a smartphone or a Tablet PC) with a TETRA/TETRAPOL modem. The following elements will form part of the enhanced user terminal:

- Adaptation Communication Manager, which decouples the higher stack levels in the programmable platform from the TETRA-TETRAPOL modems.
- User Interface Adaptor Business Logic, comprising a set of functionalities devoted to the personalization of human-machine interface according to a specific user.
- Workflow Manager, which 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).
- Semantic Syntactic Translator, which allows reducing language barriers through the minimal technology necessary to semantically and syntactically translate the human interface on ISITEP terminals.
- Security Manager, which handles various security configurations to allow communications among different national teams.

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4.1.4 Interoperability-enabling tools

ISITEP addresses some specific tools that are necessary to enable cross border joint PPDR operations, to make existing network interoperable, and to demonstrate economic sustainability as required by the topic. Such tools are related to applications for interoperability, training, infrastructure dimensioning and business evaluation.

In particular, the interoperability-enabling tool package consists of the following elements:

- Supporting Tools:
    - Infrastructure dimensioning tool, which will support the deployment of the ISI developed solution by assisting the stakeholders' decision makers through provision of an estimation of the network elements and associated costs required for the realization of the anticipated interoperability functionalities.
    - Terminal and operations training tools, which will be used (1) to assist end-users on the operation and management of TETRA/TETRAPOL terminals, that are different (different manufacturer, model) from those used in their own organization, and (2) to educate and train the end users on the organizational structure, methods and procedures that foreign PPDR forces employ in particular crisis situations.
    - Operations cost estimation tool for business analysis. This tool will allow estimating savings from cooperation through ISITEP interoperability framework.
- Applications for the enhanced user terminal:
    - Dynamic functional numbering, application to communicate with PPDR resources in charge in a specific operational area.
    - Location assisted numbering, application to call PPDR resources of a specific type in a specific area.
    - Enhanced message exchange, application to allow exchange of orders through short messages.

4.2 Interaction of Subsystem Elements

All ISITEP framework components (depicted in Figure 3) are strictly correlated. Technological means (ISI cloud network, Enhanced user terminals, Interoperability-enabling tools) provide the basis for the development of improved cooperation procedures and multilateral treaties. Conversely, multilateral agreements provide the reference framework in which interoperability enabling technologies can be exploited.

With reference to the technological means of the ISITEP framework, the European ISI cloud network is intended to integrate the PPDR national/regional infrastructures at network level to allow migration and communication services and associated applications within a secure framework. With ISI in place, migration within a single technology (either TETRA or TETRAPOL) can be transparently managed at terminal level. The Enhanced User Terminal thus addresses the need for roaming across incompatible radio technologies, TETRA and TETRAPOL. Nevertheless a bi-technology terminal is only capable to provide basic roaming capability; in order to fully exploit technical interoperability and enable effective cross border joint PPDR operations a set of value added applications (Dynamic functional numbering, Location assisted numbering, Enhanced message exchange application) is developed as part of the interoperability enabling tools. All these technological means will be adopted by end-users only if their economic sustainability is demonstrated and end-user can promptly use them. At this aim within the Interoperability-enabling tools, the Infrastructure dimensioning tool, the Operations cost estimation tool and Terminal and operations training tools are developed to provide

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an estimation of the costs associated with ISI deployment and interoperability enforcement, as well as to educate and train the end users on the organizational structure, methods and procedures adopted to manage cross border joint operations.

With reference to multilateral agreements in order to obtain a successful cooperation between intervention teams of different nature belonging to different countries it is necessary that neighbouring countries share clear procedures that specify for each scenario how PPDR forces shall interact, identifying roles and responsibilities. To enable cross-border operations, involved countries have to define multilateral agreements with terms, conditions, and operational procedures, that leverage on the technological means developed.

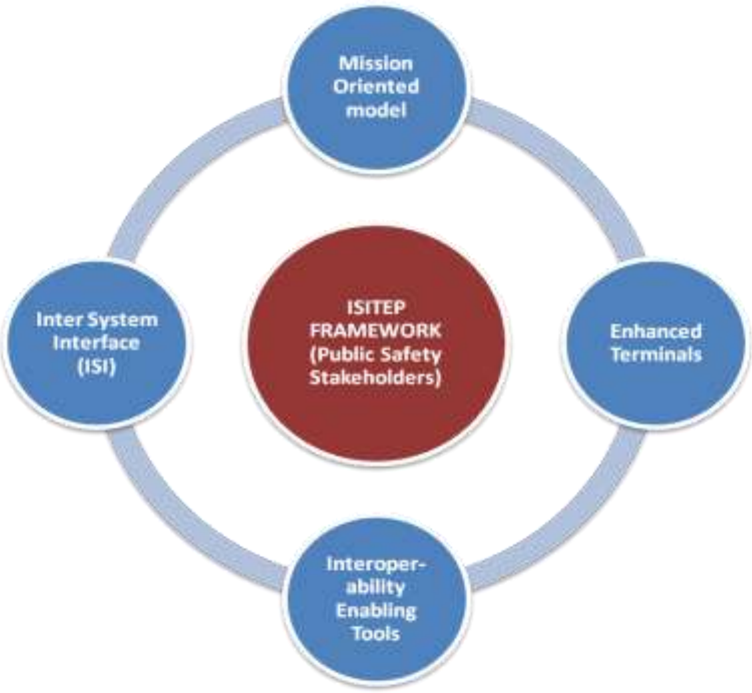

Figure 3. ISITEP Framework components

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5 MISSION-ORIENTED FRAMEWORK SPECIFICATION

One of the goals of the ISITEP project is to set-up a Mission-Oriented framework that improves cooperation between PPDR forces belonging to different countries in the international PPDR missions. The Mission-Oriented framework helps to overcome legal, procedural, linguistic and technological differences between the involved countries, allowing PPDR forces to be focused on the success of the PPDR mission.

The Mission-Oriented framework deals with the following aspects:

- Bilateral agreements
- Standard procedures for international mission
- Common language
- PPDR terminal user interface

Once the Mission-Oriented framework has been defined, it becomes a powerful means to integrate new countries in the European PPDR Network.

5.1 Bilateral agreements

With Schengen and Lisbon treaties citizens belonging to more than 20 different European countries are able to travel freely without passports across the border of the countries concerned. When border controls have been abolished, new scenarios and opportunities for the public safety have been configured. Mainly the following new PPDR scenarios can be envisaged:

- Multi-agency cooperation
- Cross-border surveillance
- Hot pursuit
- Joint operations: Disaster relief

To grant security inside the Schengen area cooperation and coordination between police services and judicial authorities have been stepped up, but today a policeman does only have police competencies in his country; while cooperation between fire brigades and rescue services belonging to different countries is allowed by local agreements made by responsible authorities in the border regions [12].

International cooperation is possible only if the PPDR communication networks provide a unified PPDR communication service allowing police, fire brigades and rescues services to access to PPDR services provided in the foreign country. In order to achieve this goal there are issues of different natures to overcome:

- Technical
- Administrative
- Economic

Technical issues are discussed in chapters 6 and 7, while the other issues are discussed in the current chapter.

In order to avoid that a migrating terminal exposes the visited network to a security risk [13], the migrating terminal should be security certified also in the visited network. Usually each country has its own security certification process and the PPDR terminal is security certified only in its home network. Security certification can be heavy (costly) and time consuming. It would then be useful to define a

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more light security certification process for international cooperation taking into account some restrictions on the use of PPDR services for the migrating users. Security certification process shall clearly define TETRA/TETRAPOL security features to be used in the international cooperation and eventually the mode of sharing encryption keys between PPDR forces.

In the same way in which service providers of national cellular networks (GSM/UMTS) had signed economic agreements in order to allow international roaming for their subscribers, PPDR service providers shall sign bilateral economic agreements in order to allow migrating users to access to PPDR services in the foreign PPDR network.

In the border regions, different PPDR access networks may overlap because each neighbouring country reaches the border with its national PPDR network. In order to avoid frequency conflicts neighbouring countries shall share a frequency plan for the coverage of the border regions [6][12].

In short, in order to improve international cooperation between PPDR forces bilateral agreements shall be signed between European neighbouring countries in order to define responsibilities and operational action limits for European PPDR forces when they move in a foreign country inside the Schengen area. Bilateral agreements shall define:

- Policeman competencies outside of its country in the border region.
- Fire brigades and rescue services shall be allowed to provide cross-border help.
- A shared security policy for international PPDR communications.
- Services that shall be provided to the migrating users.
- Economic agreements regarding the use of PPDR network infrastructure by the migrating users.
- A shared frequency plan for the coverage of the border regions.

The bilateral agreements described above involve many and different entities that could even change from EU country to EU country. It would be useful to have a single European Register where for each country and for each type of agreement is defined the entities to be contacted.

5.2 Standard procedures

In the ISITEP project for each country there are mainly the following types of PPDR forces that may interact:

- Police
- Fire brigades
- Health
- Civil protection

Each PPDR force has its own operating procedures and four types of PPDR forces per 10 countries (looking just to the countries in the ISITEP consortium) means many combinations of different operating procedures.

In order to obtain a successful cooperation between intervention teams of different nature belonging to different countries it is necessary that neighbouring countries share clear procedures that specify for each scenario how PPDR forces shall interact identifying roles and responsibilities. Periodic trials shall be foreseen in order to train intervention teams for the joint operations.

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The nature of the intervention teams involved in each country for each scenario under consideration in ISITEP is illustrated in Figure 4.

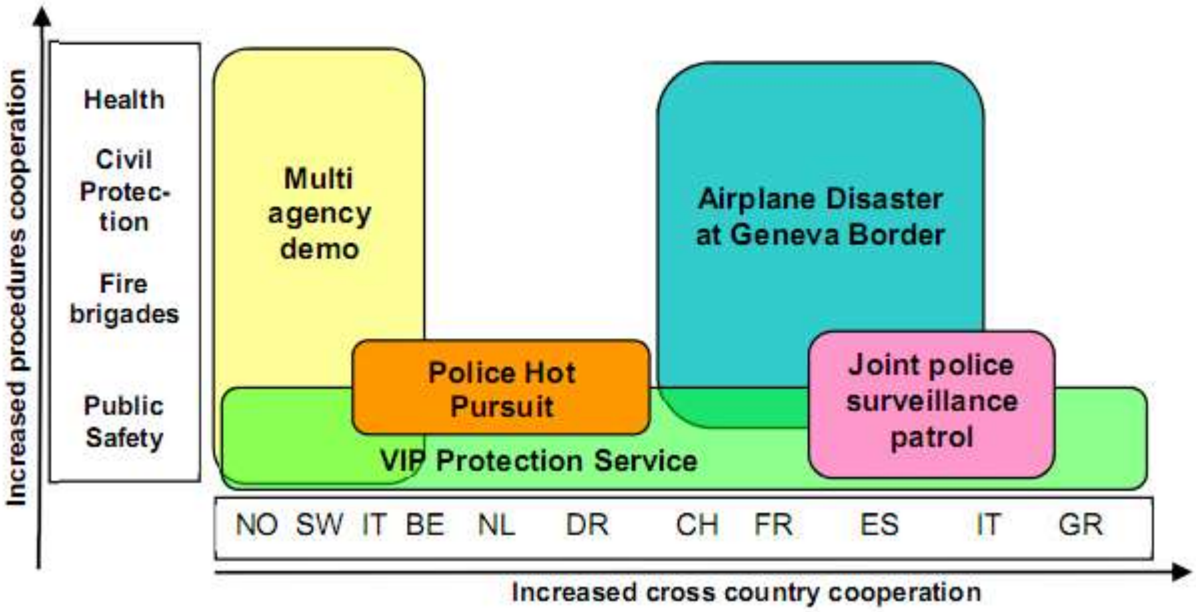

Figure 4. PPDR European cooperation scenarios considered in ISITEP

Usually the overall coordination of PPDR operations is in charge to the country where the incident occurred, but in hot pursuit scenario the incident area is not fixed, standard procedures shall define rules to coordinate also this use case.

For each scenario, standard procedures shall identify players, defining roles and responsibilities. Fleet map definition for international cooperation is required. Standard procedures shall provide naming convention for simple identification of the players:

- Intervention team leader
- Intervention team
- Dispatcher

Standard procedure shall specify the use of the PPDR terminal in order to simplify the use of PPDR services to the migrating users, for example according the 3 Country Pilot Final Report [12]:

- Common telephone dialling procedure
- Agreements on basic use of radio communication

Standard procedure shall provide a pre-defined and standardized list of orders commonly used in each scenario.

Standard procedure shall foresee a common speech language for the communications between control rooms belonging to different countries.

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5.3 Common Language

The language barrier is one of the main obstacles to international cooperation. In the standard procedures, neighbouring countries shall agree on a common language and dispatcher operators shall attend periodically to language courses in order to be able to use the language foreseen by the procedures for international communication.

Even if the same language is selected for international communication, the foreign accent and the high background noise prevent the clear comprehension of the speech, for this reason ISITEP project foresee the implementation of the Enhanced Message Exchange application that shall provide orders translations in the native language of the end-users, see chapter 8 for more details on this application.

5.4 PPDR terminal user interface

A user belonging to an intervention team that is involved in a PPDR operation shall not worry about the communication system. The user shall be able to communicate easily with its group or with the dispatcher. For this reason, one of the main requirements is that the user interface of the PPDR terminal shall be kept as simple as possible in order to limit terminal manipulation.

Currently cross border operations involving different PPDR systems require that intervention team is equipped with two different PPDR terminals (i.e. TETRA and TETRAPOL), and the user shall use one radio or the other according the radio coverage.

TETRA and TETRAPOL technologies are slightly different, especially in resource allocation and a user accustomed to use TETRA may have difficulty in using TETRAPOL, and vice versa.

The ISITEP project addresses the development of an enhanced PPDR terminal that provides a unified Human Machine Interface (HMI) to access both TETRA and TETRAPOL network infrastructure, in this way the end-user will be facilitated to use the communication system also when he moves in neighbouring country that use a PPDR network technology different from that to which he is accustomed. More details on enhanced ISITEP terminal are reported in chapter 7.

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6 EUROPEAN ISI CLOUD NETWORK SPECIFICATION

6.1 Architecture reference model

The architecture reference model for the European ISI cloud network is depicted in Figure 5. The model encompasses a set of functional components involved in the interconnection of two TETRA or TETRAPOL networks and the interfaces/reference points among the functional components.

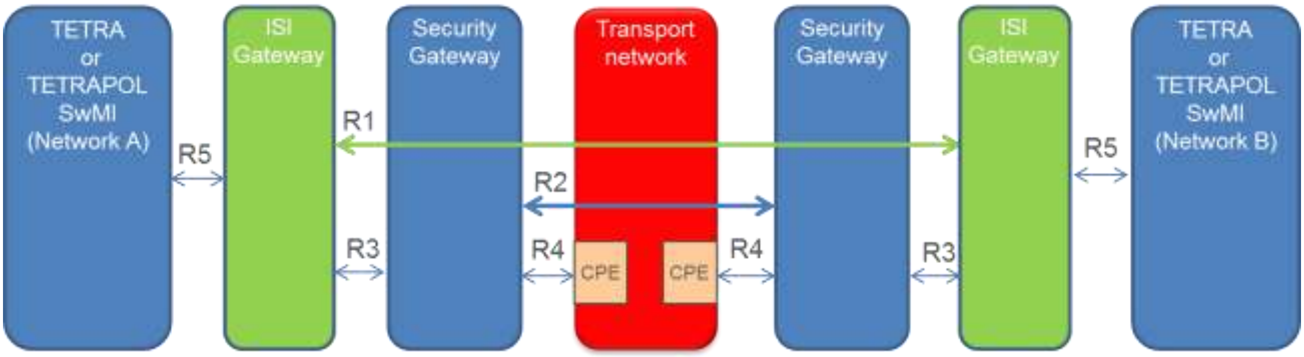

Figure 5. Architecture reference model of the ISI cloud network

The functional components within the architecture reference model are the following:

- ISI Gateway. Element that provides the ISI functionalities for the interconnection of a TETRA or TETRAPOL network. A number of different ISI Gateways are to be defined to support the different combinations of radio technology (TETRA, TETRAPOL) and interconnection technology (E1 circuits, IP transport).
- Security Gateway. Element that provides enhanced protection to traffic and signalling information running on the interfaces that cross PPDR network operator boundaries.
- Transport network. External network for the E1/IP interconnection (international links) of the national PPDR networks.
- TETRA/TETRAPOL switching and management infrastructure (SwMI). This represents the core functionality of existing PMR networks.

The following interfaces/reference points are defined:

- R1: Reference point between two remote ISI gateways. Two protocol stacks are under consideration for the implementation of this reference point: ETSI TETRA ISI and ISITEP ISI over IP. Both protocol solutions are based on a point-to-point service model (i.e., the R1 reference point terminates between two peer ISI gateways). It is considered that SwMIs do not perform transit-switching functions.
- R2: Reference point between two remote Security Gateways. It will enable the support of the essential security requirements needed to interconnect national networks within the interoperability cloud. It could rely on the use of protocols such as the IPsec protocol in tunnel mode in case of IP transport connectivity. A point-to-point service model is also assumed in this interface (i.e. a R2 reference point terminates between two peer Security Gateways).
- R3: Reference point between the ISI Gateway and the Security Gateway. This interface is intended to allow the implementation of the ISI Gateway and the Security Gateway in separate

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physical devices. An internal packet-switched network (e.g. Ethernet) could be used for the interconnection of these two elements.

- R4: Reference point between the Security Gateway and the Customer Premise Equipment (CPE) of the transport network used for international interconnection. The interface to the CPE depends on the transport technology. In the case of IP interconnection, this interface can be e.g. a standard Ethernet interface.
- R5: Interface between the TETRA or TETRAPOL SwMI and the ISI gateway. Its implementation is technology/vendor specific. In the case of TETRA, it could be based on IP or circuit-switched technology. In the case of TETRAPOL, the Call Control (CC) API Server interface could be used.

6.2 Interconnection configurations

This section identifies different interconnection configurations based on the following dimensions:

- Technology used in the radio interface and in the ISI interface of the interconnected networks. This basically is related to the implementation of reference points R1 and R5.
- Number of interconnected networks. This basically depends on the service model used in R1 and R2.

As to the first dimension, five different interconnection configurations (illustrated in Figure 6) are identified when considering the different possible implementations of R1 and R5 reference points:

- **Configuration A**. Two TETRA networks are interconnected using the R1 implementation based on ISI over IP. Internally, these networks can use either IP-based or circuit-switched-based interfaces in the R5 reference point between the SwMI and the ISI Gateway.
- **Configuration B**. Two TETRA networks are interconnected and one of them provides support for the ETSI TETRA ISI interface.
- **Configuration C**. Interconnection of TETRA networks based on the ETSI TETRA ISI interface.
- **Configuration D**. Interconnection of TETRA and TETRAPOL networks. Protocol ISI over IP is used in the R1 reference point. R5 in the TETRA network can be either packet or circuit-switched based. R5 in the TETRAPOL is based on the Call Control (CC) API Server.
- **Configuration E**. Interconnection of TETRAPOL networks. ISI over IP gateways are Protocol ISI over IP is used in the R1 reference point. R5 is based on the TETRAPOL Call Control (CC) API Server.

Interfaces R2, R3 and R4 do not impact on the above classification. However, the implementation of the interface R2 and R3 is directly related to the solution adopted for R1.

As to the dimension considering the number of networks to be interconnected, given that R1 and R2 reference points are both based on a point-to-point service model, the interconnection of PPDR networks shall be done in pairs. Therefore, a full-mesh topology linking all the networks at R1 and R2 reference points is necessary. The case of three interconnected networks is depicted in Figure 7.

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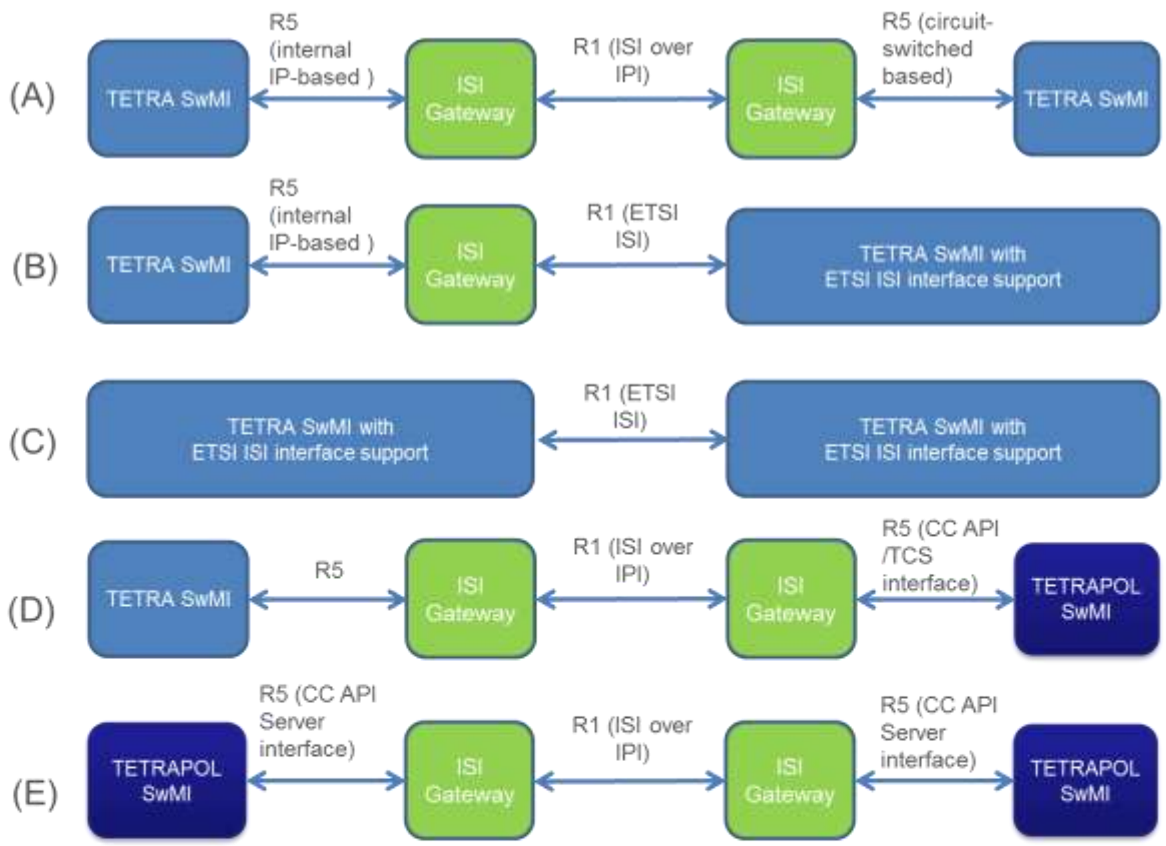

Figure 6. Interconnection configurations based on the different possible implementations of R1 and R5 interfaces

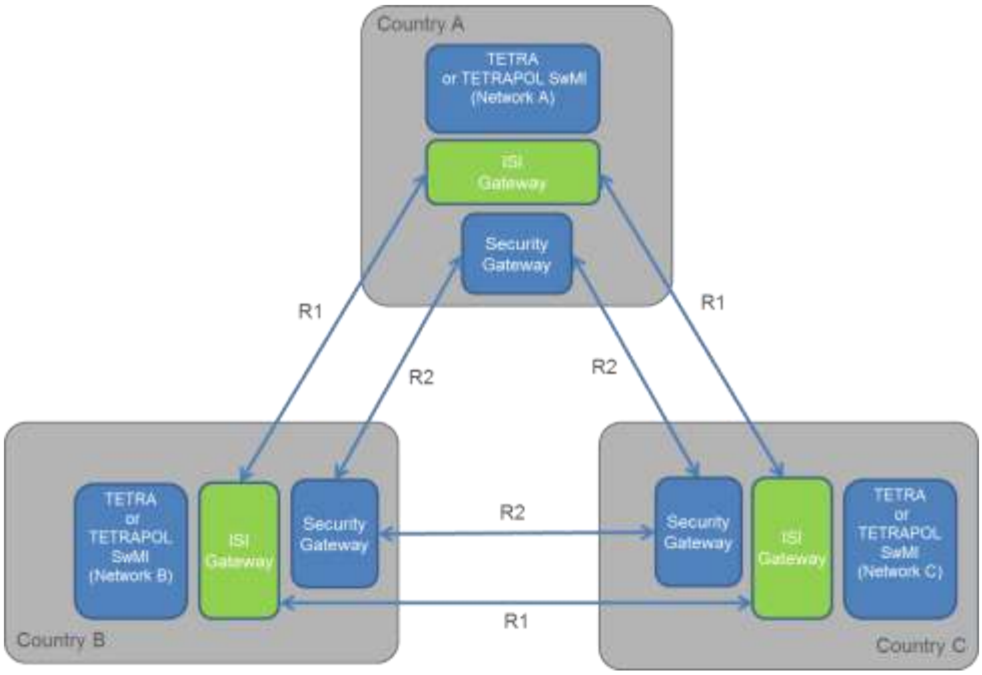

Figure 7. Interconnection configuration with three PPDR networks

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6.3 ISI interface specifications

ETSI started the standardization process for TETRA ISI to support cross-border cooperation between independent TETRA networks in the 1990s. The TETRA ISI application is built on top of the PSS1 protocol stack for interconnecting Private Integrated services Network eXchanges (PINXs) to form Private Integrated Services Network (PISN). PSS1 is the ISO term; the PSS1 protocol is also known, informally, as QSIG, generic term created by the European Computer Manufacturers Association (ECMA), which developed most of the signalling protocols comprised in the PSS1 protocol. A simplified view of the ETSI TETRA ISI protocol stack is depicted in Figure 8. The TETRA ISI functionalities are organised in the following set of so-called Additional Network Features (ANFs):

- Additional Network Feature - ISI Individual Call (ANF-ISIIC);
- Additional Network Feature - ISI Group Call (ANF-ISIGC);
- Additional Network Feature - ISI Short Data service (ANF-ISISDS); and
- Additional Network Feature - ISI Mobility Management (ANF-ISIMM).

Signalling needs for TETRA ISI operation which are not directly supported by PSS1/QSIG protocols are provided by ISI Generic Functional Protocol (GFP). ISI GFP does not by itself control any ANF-ISI Protocol Data Units (PDUs) but rather provides a means to convey them. The Remote Operation Service Element (ROSE) is used to convey ANF-ISI PDUs. For speech transmission, the TETRA coded speech frames are carried in 64 kbit/s E1 channels. The general aspects of the ISI are specified in ETSI EN 300 392-3-1 [14], which provides pointers to a number of specifications covering the individual ANFs. Today, such a standard is employed only by a few TETRA vendors for limited functionalities (i.e., basic registration scenarios, individual call, short data, and telephone).

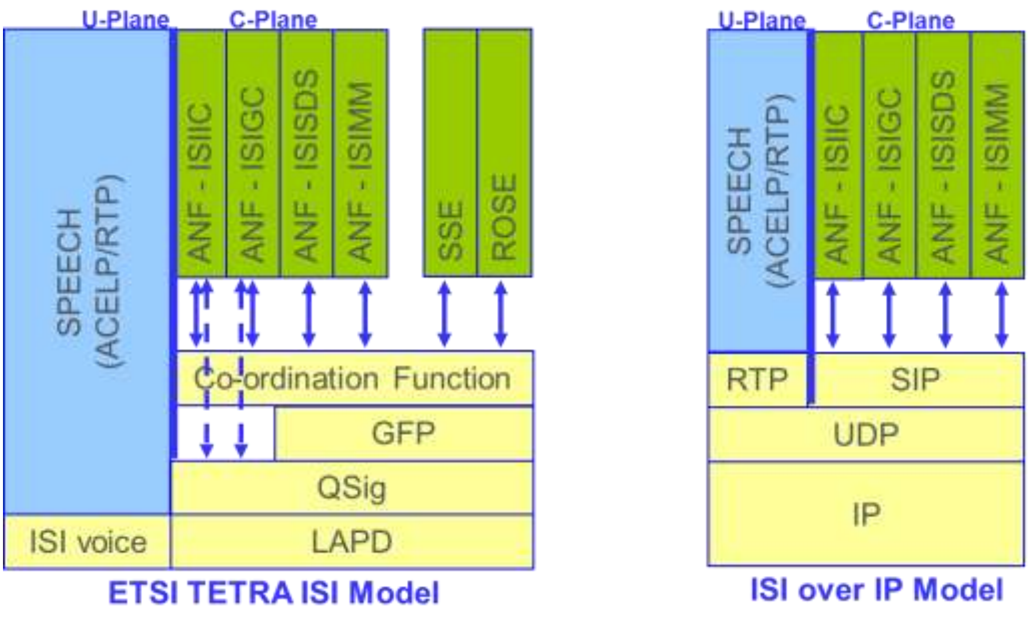

Figure 8. Existing ETSI TETRA ISI and proposed ISI over IP models

The current de facto standard for Voice over IP (VoIP) communications is the Session Initiation Protocol (SIP), which may be conveniently used for the implementation of the proposed new ISI

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interface over IP transport. The approach adopted in ISITEP is to change the ETSI ISI ANFs so that they become bearer protocol independent. In this way, SIP could be used as a bearer protocol instead of QSIG. Hence, the SIP protocol would be used to convey Session Description Protocol (SDP) messages and ISI messages between SwMIs. This approach is illustrated in Figure 8, where it is also shown that voice traffic will be now supported over the Real-time Transport Protocol (RTP). This IP-based implementation of the ISI application is referred to as “ISI over IP”.

ISITEP at this aim will provide, at TETRA-TETRAPOL network level, public specifications to be subdued to the ETSI standard. Such public specifications will be produced by all the European network manufactures with the approval of relevant operators and end users. ETSI standardization cannot be achieved during ISITEP time frame because such process is normally longer than three years on these topics. In any case, since ISITEP public specifications will be demonstrated and approved on the field by end users and operators, the following standardization process will be shortened submitting a Public Available Specification (PAS) to ETSI.

ISI over IP specifications are being developed within WP4.1.

6.4 Gateway specifications

Based on the possible interconnection configurations discussed in section 6.2, three different ISI Gateways have to be developed in ISITEP (depicted in Figure 9):

- GW1: Gateway that allows the interconnection of existing TETRA networks (based on Motorola and SELEX ES equipment) through the ISI over IP protocol.
- GW2: Gateway that provides translation between the QSIG / E1 and SIP / IP in both directions. The objective is to allow TETRA networks that have been implemented on circuit based technology to interoperate with packet switched implementations of TETRA.
- GW3/4: Gateway allowing a TETRAPOL network via Call Control (CC) API to be interconnected with another TETRA or TETRAPOL network through the ISI over IP protocol. GW3 is used to interconnect a TETRA and a TETRAPOL Regional Network, through a CC API / TCS interface for signalling and analog or S0 digital audio signal for voice. GW4 is used to interconnect TETRAPOL to TETRAPOL Regional Networks, via CC API interface for signalling and analog or S0 digital audio signal for voice.

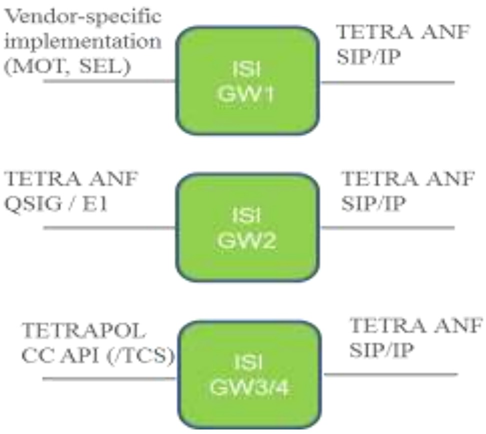

Figure 9. Variants of the ISI Gateways to be developed in ISITEP

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Gateways are being developed in WP4.1 (GW1), WP4.2 (GW2), WP4.3 (GW3) and WP4.4 (GW4). In addition, WP4.5 will develop a solution for ISITEP so that interoperability between TETRA or TETRAPOL networks and ISI over IP networks can be achieved using a mobile gateway. The deployable gateway will be connected through satellite connection to the national networks.

6.5 Security gateway specifications

The security gateway will provide enhanced protection to traffic and signalling information running on the interfaces that cross PPDR network operator boundaries. In particular, ISITEP security framework grounded on security gateways shall solve two main issues:

- Provide confidentiality and integrity of traffic exchanged among networks. The technical solution to provide required security of connections will be defined. This may include use of commercial encryption and Virtual Private Network (VPN) solutions as well as extension of some country specific (high) security connections to the connected network interface. The link security must be ensured not to degrade the capacity and QoS of the interconnections.
- Prevention of intrusions into the national networks. The existing TETRA and TETRAPOL networks have national security requirements, which must be fulfilled at the points of international interconnections. The task will define the technical solutions at the interconnection points to fulfil those requirements. The requirements may vary, depending on using commercial connectivity services versus direct secured links between the two parties, preventing intrusion.

A solution based on proper configuration of off-the-shelf components is envisioned. The security gateway solution is being developed in WP4.6.

6.6 Transport network specification

Two main options exist for the interconnection between PPDR networks deploying IP-based interfaces:

- Direct connections using, e.g., leased lines.
- Indirect connections through a packet-switched intervening network.

A leased line refers to a dedicated connection that allows for communication between two sites (a point-to-point leased line) or between a site and the Internet (an internet leased line). Leased lines typically deliver bandwidth over a leased fibre connection, although copper local tails can sometimes be used as well. Leased line connection speeds can range from 64 kilobits per second (Kb/s) to 10 gigabits per second (Gb/s).

On the other hand, indirect connections can be established by using L2 or L3 virtual private networking services provided by a third party carrier. The 3rd party IP network provider will establish a virtual private network (VPN) between the PPDR' networks and shall provide QoS mechanisms and shall guarantee appropriate Service Level Agreements (SLAs).

At the network layer, IPv4 or IPv6 may be used and at the transmission layer either PDH/SDH transmission system or Ethernet-based systems are possible solutions.

The design of the transport network architecture for PPDR networks interconnection is being addressed in WP2.4.

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7 ENHANCED USER TERMINAL SPECIFICATION

From the nineties the EU Council has been stressing the need to create a single European PPDR network interconnecting all the national PPDR networks requiring also interoperability between TETRA and TETRAPOL technologies.

TETRA terminals may be certified to interoperate with TETRA Networks provided by different manufacturers and they can move in a foreign TETRA network if they have been pre-provisioned in that foreign network. However, there is currently no way that a TETRA terminal can move under a TETRAPOL network. The ISITEP project aims to fill this technology gap addressing a new enhanced bi-technology terminal.

A potential implementation technology for advanced mobile terminals is Software Defined Radio (SDR). SDR is expected to replace legacy Application Specific Integrated Circuit (ASIC).

The new generation of telecommunications devices like tablet PC and smartphones based on open programmable operative systems with a low cost and high computational hardware platforms, could be used to develop SDR specific TETRA-TETRAPOL waveforms realizing the new bi-technology PPDR terminal.

Unfortunately, development of TETRA-TETRAPOL waveforms does not fit with a short-medium term project like ISITEP and currently development costs are not economically justified for PPDR specific market.

The issue of cost and time required for development of new TETRA and TETRAPOL waveforms may be overcome by using already developed TETRA and TETRAPOL modems.

The ISITEP enhanced terminal is a new PPDR terminal that is composed by two radio modems and a smart device. Two configurations of the ISITEP terminal are foreseen: vehicular and hand-held.

In the Vehicular configuration the TETRA and the TETRAPOL modems are external to the smart device, they are installed inside the car. A tablet PC could be used as the smart device.

The Hand-held configuration is a proof of concept version, in order to facilitate the end-user a smart phone is used and at least one radio modem is embedded in the smart phone, the other radio modem will be externally connected to the smart phone.

Figure 10 illustrates the high level architecture of the ISITEP terminal. The detailed architecture is provided in ISITEP SP5 deliverables.

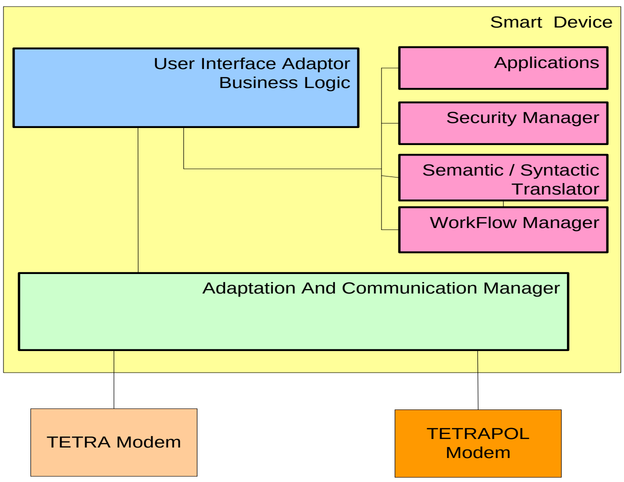

Figure 10. Proposed terminal architecture

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PPDR applications are deployed on the smart device. Three different type of applications have been identified:

- Bi-technology application enabled: these are the PPDR applications that shall address bi-technology interoperability issues:
    - Adaptation and Communication Manager
    - User Interface Adaptor and Business Logic
- Interoperability functions: these are the PPDR applications that shall address human interoperability issues:
    - Security Manager
    - Semantic and Syntactic translator
    - Workflow Manager
- PPDR cloud added value applications: these are the added value applications addressed in SP6. Added value applications foreseen for ISITEP project are described in chapter 8, in the figure are identified generically as applications.

7.1 Bi-technology 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, namely 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 software components and the applications deployed inside the ISITEP terminal. It provides a common interface toward the User Interface Adaptor and Business Logic component and it manages vertical mobility between TETRA and TETRAPOL.

The User Interface Adaptor & Business Logic represents the Human Machine Interface (HMI) of the enhanced ISITEP terminal, it abstracts the TETRA / TETRAPOL capabilities to the end-user, it shall simplify the use of TETRA to TETRAPOL users and vice versa the use of TETRAPOL to TETRA users. Being the User Interface Adaptor & Business Logic the HMI of the PPDR terminal, it is expected some interaction with those applications that shall simplify human interaction during international PPDR operations.

7.2 Interoperability functions

According to ISITEP end-users, there is a minimal set of services and functions that shall be provided in order to make effective interoperability in international operations where PPDR intervention teams belonging to different countries, speaking different languages and used to follow different workflow shall cooperate in the same PPDR operation.

Interoperability functions have been identified in the following applications:

- Security manager: as TETRA and TETRAPOL waveforms are produced by the relevant modems the TETRA and TETRAPOL security is managed inside each radio, for security reason the security manager is not allowed to access to TETRA and TETRAPOL security data material; each radio does not provide external access to its internal secure data storage. Then

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in the ISITEP project, the Security Manager main task is to secure the smart device and communication between the smart device and the radio modems.

- 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). The Work Flow Manager shall help PPDR resource to follow standard workflow defined by ISITEP project.
- Semantic and syntactic translator: one of the main obstacles to the coordination of PPDR operations is the language barrier. Semantic and Syntactic Translator is aimed at helping to overcome the language barrier, for example providing translation workflow instructions. It has been hypothesized an interaction between workflow manager and semantic and syntactic translator.

7.3 General PPDR terminal requirements

Some general requirements have been expressed by ISITEP end-users in order to improve the usability of the PPDR terminal in international PPDR operations where more than one PPDR network is involved in providing communication service. Standard PPDR terminals are out of the scope of the ISITEP project, and then end-users have defined a trade-off between their wishes and the short term available technology. The ISITEP enhanced terminal will full-fill those requirements not addressed by a standard PPDR terminal in order to prove the enhanced usability of a terminal.

First of all the user shall be able to know if it is registered in its home network or in a foreign network, so the PPDR terminal shall show the Mobile Network Code (MNI) where it is registered. The user shall be able to call PPDR users belonging to a different PPDR network so inside the address book of the PPDR terminal it shall be possible to specify not only the SSI but also the MNI.

When the PPDR terminal migrates to a foreign network, the user shall not be required to perform any manipulation on its terminal to be able to communicate with its working group. In order to be able to decouple the numbering plan used in the different country, the PPDR terminal shall be able to attach automatically to the proper working group according to the country where it is migrated. The user shall not perform manual group attach after migration, the working group SSI used in home and foreign country may be different from the one used in the visited network.

Another end-user requirement that affects the PPDR terminal is related to the localization system. When the PPDR terminal is located in its home network, it shall be tracked only by the localization system inside its home network. On the other hand, when the PPDR terminal migrates to a foreign network, it shall be tracked by both location systems in the home and in the foreign network. Therefore, when the PPDR terminal migrates, it shall update the destination of the location tracking system in order to be able to send location information to both home and foreign location tracking system.

Also the Emergency button of the enhanced ISITEP terminal may be customized according the network where it migrates. In this way, it would be possible to manage the emergency following the rules of the network where the enhanced ISITEP terminal is registered.

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8 INTEROPERABILITY ENABLING TOOLS SPECIFICATION

All the PPDR manufacturers have developed as an added value application for their PPDR networks the Automatic Vehicle/person Location service (AVL). The AVL is used to track automatically resources using TETRA/TETRAPOL radios and GPS. Such service integrates the location information inside Geographical Information System (GIS).

As first requirement, ISITEP project shall grant that users migrating in a foreign country are still able to provide their location to the AVL system in its home network. This capability is granted because location information are transported using short data service that is granted across ISI link in ISI phase 3.

An additional requirement is that migrating users shall be tracked also by AVL location system in the foreign network, this requirement can be achieved if all the PPDR terminals use the Location Information Protocol (LIP) to provide location information to the AVL systems.

In order to improve interoperability the ISITEP project addresses the development of the following new interoperability tools:

- Infrastructure dimensioning tool
- Training tools
- Business sustainability tools
- Added value interoperability tools

8.1 Infrastructure dimensioning tool

The infrastructure dimensioning tool will support the deployment of the ISI developed solution by assisting the stakeholders' decision makers through provision of an estimation of the network elements and associated costs required for the realization of the anticipated interoperability functionalities. In particular, the tool is aimed at providing an estimation of the following communications resources:

- Radio access infrastructure: TETRA/TETRAPOL radio access and transmission equipment needed in an intervention area where a number of PPDR forces from different countries are going to be deployed.
- Inter-system Interconnection infrastructure: ISI equipment and associated external links that interconnect the national TETRA/TETRAPOL networks of the countries involved in the joint or cross-border operations.

This estimation will be based on the coverage and capacity needs arisen in the intervention area (the area where common transnational operations are taking place). Information about existing infrastructures will also be accounted so that the tool can estimate the need for additional/temporary equipment to be deployed. As part of the infrastructure dimensioning tool, a logistic tool will also be developed that will provide all infrastructure equipment and related material, as well as the related cost for each simulated scenario.

8.2 Training tools

Advanced systems users today are becoming proficient through advanced technology that is blurring distinctions between live and virtual training.

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TETRA and TETRAPOL HMI simulators shall be provided in order to train PPDR resources to the use of TETRA and TETRAPOL feature.

Simulation is a technique for practice and learning that can be applied to many different disciplines and types of trainees. It is a technique (not a technology) using training tools to replace and amplify real experiences with guided ones, often “immersive” in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion. “Immersive” here implies that participants are immersed in a task or setting as if they were the real world.

The skills requirements that can be enhanced with the use of training tools include:

- Technical and functional expertise training
- Problem-solving and decision-making skills
- Interpersonal and communications skills or team-based competencies

All of these share a common thread in that they require active listening and collaboration besides possession of the basic knowledge and skills. Therefore, every training programme of the tools will create a feedback and debriefing sessions that will follow. Feedback must be linked to learning outcomes and there must be effective debriefing protocols following all simulation exercises.

There will be senior staff used as scenario writers for these simulation/training cases. These writers will customize the scenarios for interoperability team training and role-playing in order to highlight or facilitate certain roles or team interaction. These scenarios should be realistic, practical, and comprehensive. Scenarios would usually also have event triggers, environmental distractors, and supporting events. They should be developed systematically with proficiency-based assessment in place, which can emphasize integrative team performance as well as technical performance. All practice and action should also be validated by data and evidence.

Some common pitfalls that have been observed during team performance include among others:

- The lack of understanding of roles and responsibilities using an advanced system
- The absence of clearly defined specified roles may persist, despite generally acceptable team performance; this may not become obvious until there is a change in team members, which then reveals the role confusion (who is doing what).
- Most communication systems have no or few processes or backup plans when errors occur.
- There is an unspoken assumption by members that everyone will perform at 100% efficiency and effectiveness. However, there is no method to measure this.

The educational benefits of these training tools to our people education will include the following:

- Deliberate practice with feedback
- Exposure to uncommon events
- Reproducibility
- Opportunity for assessment of learners
- The absence of risks

Therefore, special training tools will be developed in ISITEP project in order to train PPDR resources to the international PPDR operation workflows defined in the standard procedures provided by SP3.

Well-trained personnel improve coordination of international PPDR operation increasing performance of PPDR resources.

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8.3 Business sustainability tools

Business sustainability tools help in sizing the PPDR foreign intervention and in improving radio planning definition, increasing interoperability between PPDR resources belonging to different countries.

Improving interoperability between PPDR resources of neighbouring countries lowers the effort that each country has to bear, for example, in maintaining PPDR resources around the border areas.

Business sustainability tools help to evaluate the saving produced by the increased interoperability. In this way, part of the saving could be invested in further improvement of interoperability between PPDR forces.

Scope of ISITEP project is to create a virtuous circle between saving, investment and efficiency of PPDR intervention in international operations.

8.4 Added value interoperability tools

According to ISITEP end-users, there is a minimal set of services and functions that shall be provided in order to make effective interoperability in international operations. These services are addressed in ISTEP SP6 through added value interoperability tools.

The following interoperability services have been required:

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

These services are realized using application based on client-server paradigm. Client application is deployed on the terminal side, while server application is deployed on the network side.

A standard framework for application deployment shall be realized in order to be able to deploy the server application inside PPDR networks of different manufacturers and the client side inside android smart devices. From the point of view of the server application development, the simplest and most general hypothesis is to use an IP framework, both TETRA and TETRAPOL provides narrow band IP packet data connectivity. Moreover, considering the progressive adoption of broadband capabilities in the European PPDR networks, in the future applications developed on a narrow band IP may be used also in broadband IP packet data connectivity, improving service performance.

Unfortunately, ISITEP project scope is the ISI phase 3 features, and Packet Data (PD) functionality is addressed in ISI phase 4. Therefore, PD cannot be used and the only way to allow communication between server and client application is the short data service. The server application can interface the PPDR network exploiting proprietary host API exported by each PPDR network or through the air interface, controlling a radio terminal through the PEI interface.

The identification of the proper framework for developing the abovementioned added value applications is one of the tasks of the ISITEP project SP6.

8.4.1 Dynamic Functional Numbering

Functional numbering is a service that allows identifying a function with a number; the person in charge of the function may change but the number to call is always the same. Functional numbers are used for example in public telephone networks to identify emergency functions (in Europe there is the 112 as unique emergency number).

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In PPDR networks functional numbers may be used to call a special PPDR resource (the leader of fire brigades, the leader of police, the leader of rescue services, etc.) in a certain area.

A functional number may also be linked to the emergency button of the PPDR terminal.

It is possible that functional numbers used in country are different from the ones used in another country. Therefore, the dynamic functional number service would provide the capability to configure in the address book of the PPDR terminal the correct functional numbers for the country.

8.4.2 Location Assisted Numbering

In each country for each PPDR force there are many operational centers, typically each one of them is responsible for a certain geographical area. It would be very difficult for an end-user to address its call to the right centre. Usually PPDR networks provide the network capability to address properly this kind of calls providing special numbers (functional number) mapped to the different operational centre using the Location Area where the calling party is registered. This solution is limited by the relative imprecision bounded with the use of Location Areas, the use of GPS would be better.

The goal of the ISITEP Location Assisted Numbering application is to provide functional numbers to contact the proper PPDR operational centre using the GPS position of the terminal instead of the Location Area position.

The PPDR resource shall select the functional name to call and the network side will route the call toward the person in charge of the function in the area where the calling is located.

Functional numbers may be created by Control Room application or they can be pre-configured in the system. Final destination of the functional number may be updated by a Control Room application or directly by authorized users for example using call forwarding capability, but in this second case a deep interaction between the application on the server side and the Home Location Register (HLR) of the PPDR network would be required.

8.4.3 Enhanced Message Exchange Application

During PPDR operations, unexpected emergency scenarios shall be faced by a lot of resources belonging to different PPDR organizations. Unexpected emergency scenarios may require PPDR joint action outside the pre-established patterns of a standard workflow. Often in this kind of emergency situations, it is not clear how the emergency should be faced and the solution may be clear to some skilled persons but not to the entire PPDR organization. In this context, it would be very helpful if the useful information could be disseminated quickly and efficiently to the involved PPDR forces.

In an international context, the language barrier is an issue for fast and efficient communication. In this regard, one of the ISITEP project goals is to reduce language barriers in PPDR operations by deploying an Enhanced Message Exchange application.

The Enhanced Message Exchange application shall be used to provide written communications (i.e. orders or information) to the PPDR resources, which shall be translated into the proper language of the end-user. This application would help in overcoming the language barriers in international PPDR operations, where intervention teams may be composed by PPDR forces that speak different languages. Moreover, it has been verified that, often in the PPDR operations, there is high background noise that prevents from speech understanding. Therefore, written communications also in this case could help in improving understanding.

Written communications shall be "real-time" translated by a server application after the source and destination language have been detected.

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For security reasons, only authorized end-users in charge for providing communications to a certain PPDR forces shall be allowed to send written communications using the Enhanced Message Exchange application to the relevant PPDR group.

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9 CONCLUSIONS

ISITEP project pursues the achievement of operational interoperability among European first responders, addressing in a comprehensive manner the regulative, organizational, operational and technical level.

To that end, Task 2.4.1 within WP2.4 "System architecture and network requirements" is aimed at defining the system-subsystem design description of the ISITEP system, covering the description of the global system architecture; the system- subsystem decomposition; and the subsystems specifications from end-user system requirements (WP2.3) and security system (WP2.2). Through this description, Task 2.4.1 will guarantee a coherent development of the four components of the ISITEP framework within SP3, SP4, SP5 and SP6. The task will also seek to ensure that the architectural model specified for the ISITEP system is able to support the functional model (SP3) specified for the demo (SP7).

This deliverable (D24.1) reports on the advances in Task 2.4.1 until M12.

The high-level view of the ISITEP global system architecture and the system-subsystem decomposition is reported, delineating the scope of each of the subsystem elements and describing the interaction among them.

In addition, candidate release specifications of the four ISITEP constituent subsystems has been developed, namely: the "Mission-oriented framework" subsystem, the "ISITEP cloud network" subsystem, the "ISITEP terminal" subsystem, and the "Interoperability tools" subsystem.

As follow-up work within Task 2.4.1, further refinements and details might be introduced in the specifications of these four subsystems to account for the set of requirements being produced by WP2.2 and WP2.3 and to keep up consistency with the advances across the different SPs. The final specifications will be reported in a subsequent deliverable (D24.2) associated with Task 2.4.1, due by M30.

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