ICT Integration of Public Protection and Disaster Relief (PPDR): Mobile Object Bus Interaction (MOBI) Research and Development Project

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Abstract: - In field operations of Public Protection and Disaster Relief (PPDR) services, vehicles are the most important tools. Today, the vehicles are increasingly dependent on ICT systems. PPDR responder's need is to enhance mission critical voice with broadband data. Command and control applications aboard a vehicle are commonplace. There is a need to ease situational awareness and decision making by utilizing sensor information, such as satellite or network based position information, living video images. However, each countries and even every single user organization is developing their own solutions according to their legislation and requirements, because uniform standards are missing. The Mobile Object Bus Interaction (MOBI) research project is a kick off for creating a common international ICT infrastructure for all PPDR vehicles. MOBI researches possibilities to further develop and integrate ICT systems, applications and services of PPDR vehicles. MOBI aims at starting development of standards used by like-minded countries and possibly with the European Commission, the European Law Enforcement Agency EUROPOL and the European Agency for the Management of Operational Cooperation at the External Borders FRONTEX.

Key-Words: - Data communications, ICT**,** Low enforcement, Professional mobile radio, Public safety, Search and rescue, Systems integration

1 Introduction

Public Protection and Disaster Relief (PPDR) services such as law enforcement, fire fighting, emergency medical, and disaster recovery services, bring value to society by creating a stable and secure environment. The protection to be ensured by PPDR responders covers people and the environment and property. It addresses a large number of threats both natural and man-made. One important task of PPDR services is to deal with emergency and surveillance situations on land, sea and air. The most important part of this work is done in the field, so all the tools must match the needs accordingly. When working in the field, vehicles with its devices, systems and services are the most important tools, in which occupational safety, efficiency and ergonomics must be taken into account. Vehicles used and devices installed, must be robust, secure and suitable for very demanding and variable conditions.

The amount of technical devices, applications and services in PPDR vehicles has been increasing during the past few decades. This progression has also increased the volume of different user interfaces and generated new problems, e.g. vehicle airbags have less room to fill. Also technical problems especially with power consumption and cabling have been reported.

Another problem is the poor documentation of applied solutions because there has been no standardization in the field, partially because of the diversity of equipment suppliers. E.g. in fire and rescue service field in Finland, the country is divided into multiple regions, where each and one of those regions have their own fire and rescue departments responsible to deliver fire and rescue services to the public. As the technology develops and becomes more utilized in everyday life, so it does in fire and rescue environment. This will develop services, make them more efficient and especially help the process of the rescue services. Unfortunately so far, there has been no standardization in the equipment and system side of these services. The number of equipment suppliers is large and complex. Yearly delivery volumes have not been helping development of standardization. The aforementioned presents needs for new business models [1], [2].

With an increased number of applications also the amount of transferred data has exploded. In the field, wireless communications' role is to support

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the mobility of first time responders by providing continuous connectivity among responders and with the headquarters. The support includes: maintain voice communication to coordinate the relief efforts for the resolution of the crisis; creation and distribution of a common operational picture among all the responsible parties; collect and distribute data on the operational context or the environment from sensors; retrieve data from central repositories (e.g. building plans, inventory data) to support their activity; support the tracking and tracing of the supply chain of goods and materials needed in the response and recovery phases of a crisis. [3]

In Europe, many dedicated secure network infrastructures have been built and deployed to provide the necessary capabilities for PPDR organizations. These networks, generally realised by TETRA/TETRAPOL are narrowband. Lack of broadband connectivity of wireless communications for existing and future PPDR applications is a real problem [3]. Many new applications require wideband data rates usually provided by commercial operators. For that reason, separate parallel data communication channels are needed. A robust multichannel data communication concept that is independent of single operators, is presented in [4].

The European Commission, the European Law Enforcement Agency EUROPOL and the European Agency for the Management of Operational Cooperation at the External Borders FRONTEX have recognized that lack of interoperability limits the effectiveness of PPDR practitioners in actual operations, and an evident lack of understanding as to whether these limitations arose from technology, operational procedures, gaps in procurement or research [3]. A scientific proven fact is that standardization strongly affects businesses that develop and sell technologies and technology-based products and services; standards are one main enabler for fast growth [5]. For improving interoperability, standardization development with like-minded countries should be started.

Chapter 2 of this paper illustrates the operating environment especially from end-users' perspective. Chapter 3 presents the research, development and innovation programme 'Mobile Object Bus Interaction (MOBI)' being made up of two industrial projects and a research project. Chapter 4 describes the research project in more detailed. Chapter 5 presents the needs for further research and discussions.

2 ICT Systems of PPDR Services

PPDR field operations are increasingly dependent on ICT systems, especially on wireless and mobile communications. In PPDR vehicles, data communication is mission critical. It is necessary to ensure that information and "on-demand" services provided by these technologies are delivered reliably and securely through one or more of the recently developed wireless architectures.

2.1 End-user Perspective

According to [3], the main effort in developing ICT systems of PPDR should be to standardize the interoperability architecture for applications (e.g. command and control) and infrastructure (e.g. interface gateways, mobile unit). Usability is also a main concern as many solutions are not ergonomic or easy to adapt to existing vehicles or infrastructures. The following recommendations are provided [3]: (1) Inter-System Interface (ISI) is an open interface standard used to connect two TETRA networks together. A joint ISI development should be started with roaming as a primary objective. (2) Harmonized frequency bands for PPDR broadband data services should be investigated and identified. (3) There is the need to conduct a feasibility study of TETRA Enhanced Data Service (TEDS) services to confirm if they are able to address the needs of PPDR organizations in Europe. (4) PPDR broadband data network needs standardized and harmonized technologies.

3 MOBI Programme

The target of a Finnish national research, development and innovation programme 'Mobile Object Bus Interaction (MOBI)' is to create a common ICT hardware and software infrastructure for all emergency vehicles. This infrastructure includes devices for voice and data communications, computers, screens, printers, antennas and cablings. Additional, the interlinking with factory-equipped vehicles' ICT systems is research.

The programme consists of two industrial projects and a research project that generates research data for industrial projects by researching and documenting the needs and requirements of the users, power generating and supplying and specifying the existing solutions. One industrial project, led by Cassidian Finland Ltd., develops vehicle installed professional mobile radio concept for law enforcement and fire and rescue operations. Another industrial project, led by Insta DefSec Ltd., develops secure software services. The project utilizes the results of the related research project and aims to develop product concepts which have potential in both domestic and export markets.

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Additionally, Insta DefSec Ltd. will further develop its business model in order to be able utilize growth potential of the product concepts. [5]

This research, development and innovation work starts in Finland, because of Finland has

- evidences of success of developing wireless telecommunications, e.g. 1G - Nordic Mobile Telephone (NMM), 2G – Global System Mobile (GSM), 3G – Universal Mobile Telecommunications System (UMTS) [6]
- the world's first nationwide TErrestrial TRunked RAdio (TETRA) network - the "Viranomaisradioverkko" or VIRVE network - commonly used by Finnish authorities. The VIRVE network is used by the emergency and fire and rescue services, the police, the Finnish Defence Forces, the Frontier Guard, social and health services, the Finnish Maritime Administration and different government departments. Today, the VIRVE network enables the world's best interoperability between different PPDR services.
- extensive experiences in field command systems, e.g. the Police Field Command System POKE has been in operational use since 2006 [7], [8]. From the base of the POKE system, a dedicated system 'PEKE' for fire and rescue work has been developed.
- well operating and organized co-operations between authorities at different levels, e.g. national police – customs – border guard cooperation [9]
- innovation success supporting atmosphere, e.g. Finnish companies are doing R&D with universities and with their competitors, with popular slogan: "Finland is a club, rather than a country" [10].

4 MOBI Research Project

Amount of different technical systems in emergency vehicles has been growing significantly which has caused problems for example in vehicles safety systems and power supply. Documentation of existing solutions varies and there are no standards in the business. Research project generates research data for industrial projects by researching and documenting the needs and requirements of the users, power generating and supplying and specifying the existing solutions. Based on the research a demo vehicle with working ICT-integration will be made. A commercial product including commercializing plans, to be offered in European market is going to be the final outcome of the project. This three-year project started in September 2010.

4.1 Consortium and Founding

The project consortium, led by Laurea University of Applied Sciences, consists of three research institutes, two industrial partners, three small and medium size enterprises (SMEs), several end-user organizations and a public financier; Tekes – the Finnish Funding Agency for Technology and Innovation. The budget of MOBI research projects is 800 000 € and Table 1 shows funding shares.

Table 1 Funding of MOBI Research Project

Participant	€	%
Tekes	480 000	60
Research institutes	108 000	13
Industrial partners	110 000	14
SMEs	63 000	8
End-users	39 000	5
TOTAL	800 000	100

4.2 Work Packages

Fig. 1 shows MOBI's Work Packages (WPs). The project starts by researching user requirements (WP2). The common ICT infrastructure is composed of four layers and their standardised interfaces: vehicle ICT infrastructure and power generation (WP3), data communications (WP4), common software infrastructure (WP5), and ICT services for PPDR practitioners (WP6). Also, a demonstration vehicle is equipped (WP7), new business models studied (WP8) and coordination taken care of (WP1).

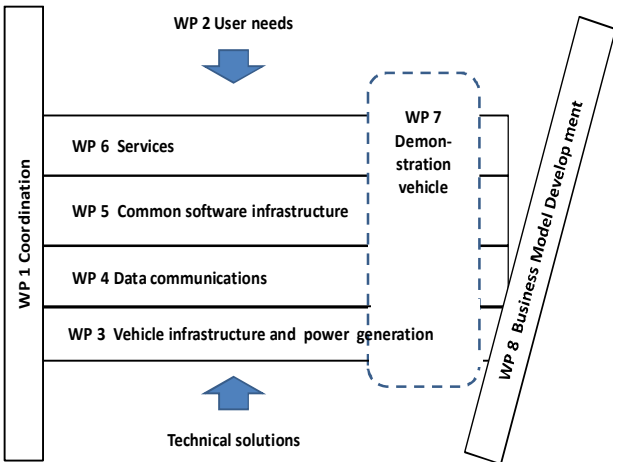

Fig. 1 Work Packages of MOBI Project

4.2.1 Coordination

WP1 includes tasks considering project management, which main objective is to ensure that MOBI research project generates research data for the parallel corporate projects. This work package includes cooperation and exchange of information with other relevant projects, such as MOBI-projects parallel corporate projects, EU FP7/SEC Project

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AIRBorne information for Emergency situation Awareness and Monitoring (AIRBEAM), EU FP7/SEC Project Policy-oriented marine Environmental Research in the Southern EUropean Seas (PERSEUS) and SCientific innOvation Product concept (SCOPE) .

Work package 1 uses Wise Guys-panels that are also common sessions for all the work packages to present what has been done and to plan the future actions. Results from other work packages will be brought to the Wise Guys-panels to be presented. Wise Guys-panels will be scheduled so that they can be arranged before the deadlines of other work packages.

4.2.2 User requirements

In this work package the present electrical- and ICT-systems are being surveyed (for example in case of police vehicles: power supply technologies, radio equipment, video equipment, radars and other speed monitoring devices, IT-workstations, printers, biometric devices, navigation and tracking devices). User and authority requirements for these systems and devices are also being surveyed. Former studies will be used as a source for information.

In this work package administrative and operative systems will be identified and priority and manageability requirements for these systems will be defined. Different authority adoptions (e-adoption, RTTE- and EMC-directives) required for different systems will also be researched. This work package delivers an updated description of the IT-solutions of Finnish emergency vehicles. In this description the requirements are being organized to be used by the companies involved in this research project.

4.2.3 Vehicles infrastructure and power supply

Power consumption is one of the biggest challenges of emergency vehicles and their ICT-systems. Number of computers needed will be optimized and power consumption of the other electrical devices in different operational modes will be researched in this work package. Different kinds of power generating possibilities, such as fuel cells, will also be researched. How could ensuring power supply, power control and sleep-mode control be done in a consistent manner will be researched in this work package.

4.2.4 Data communications

The capability of exchanging information (e.g. voice or data) is essential to improve the coordination of PPDR officers during their operations; especially, wireless communications are important in the response and mitigation of emergency crisis to support the mobility of first responders [3].

Data communications of PPDR vehicles can be divided into three levels. The first level is represented by long distance communications e.g. between vehicles and command and control rooms often realized by narrow band TETRA or TETRAPOL systems, but also e.g. @450, 2G, 3G, 4G and WiMAX are used. Also, FM radio and GPS systems could be referred to, as long distance communications. Normally, the media used depends on the application or is selected manually by the user.

The second level is represented by local network data communication including e.g. CAN, LAN, WLAN and wide band ad-hoc –communications between vehicles. The third level is the accessory communications of different data systems used in vehicles.

The ICT-solutions of PPDR must be robust and easy to install. Misinterpretations or connectivity failures can cause loss of life or delay the resolution of the crisis. Information security and reliability must be properly considered and taken care of. Different encryption methods of different systems cause their own challenges. In addition, different organizations have their own requirements for arranging the information security of their vehicles' systems.

Research of the requirements to be set for data bus and the planning of on-line systems' basic and back-up connections and connections used in off-line systems synchronizing will be carried out in this work package. Different antennas and cabling solutions will also be researched, considering placement, possibilities of interference and possibility of joint cabling.

4.2.5 Common software infrastructure

In this work package the IT-integration of emergency vehicle will be planned. Overview of the vehicle's IT-architecture both in online and off-line situations will be created. In this matter the security of the data in local storing and classified data that can be replicated must be taken into consideration. When planning the vehicle, safety matters must also be considered (such as functioning of vehicles safety devices), which will be one of the major improvements that the integration of systems will bring. Results of the work package 2 will be used as a base for planning of architecture and user interfaces.

The objective of this work package is a description of the architecture which includes description of which components the system

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consists of and how it is being placed. This description consists of application architecture, IT-architecture, technical architecture and layout diagram –levels. There will also be a interface definition which describes applications' connectivity to the system. Light-control systems available in present markets will also be studied.

4.2.6 Services

The main applications and the services they offer for each end-user group (e.g. video surveillance and speed radars for police) will be chosen for further research. The objective of this work package is to define the emergency vehicles' main applications' functionality and to plan the technical planning of these main applications.

4.2.7 Equipping of demonstration vehicle

Industrial participants and end-user organizations are able to test chosen solutions in research environment. Test vehicle built by industrial participants of the project will act as testing environment for the representatives of end-user organizations. A demo-vehicle will be made as cooperation between different participants. Demo-vehicle will be made according to one user-group's requirements meaning that the vehicle will not be a combination of for example police vehicle and rescue service's vehicle. This vehicle will be made for one authority only.

Field testing for the demo-vehicle will be carried out either in Police College of Finland or in Rescue College of Finland.

4.2.8 Business models

Development of ICT-concept is significantly expensive so access to the international markets is desirable. There are good chances to develop the industry in Finland because cooperation between different authorities is efficient and highly developed. The problems mentioned above are similar in all countries: new IT-equipment must be added to authorities' vehicles. A much needed standardization has not happened in the industry. The purpose is to create an international standard Industry's de facto and/or de jure) to the industry, which makes cooperation between authorities easier and more efficient. Objective is to make the final result suitable also for others than just authorities. For example some industry companies, private security services and fleet management-services could have the need for a moving office-type of vehicle solution. These kinds of needs will be considered especially when developing commercial solutions.

Solutions for question: how a developed solution or part of it could be sold as compatible set, will be studied in the work package of business models. Industry's market and volumes, international and national and Public-Private partnerships' regulation will be studied in this work pack-age. One of the main tasks is to monitor the development of markets in this industry in the EU-area. There is an attempt to create scenarios from the business models which will help one to find out who should be responsible for integration work and further equipment acquisition and administration. A Finnish model to act as a base for creating RFQ-documents will be developed and documented in this work package. Development in EU-area (for example EUROSUR) as well as markets' and regulation's (for example outer borders' exit-entry-system which creates new challenges for identification of persons and which is currently being processed by the Parliament of EU) development will be monitored in this work package. Laurea has become a member of Centre for Identification Research, CITeR, as a partner of the University of Arizona and any development in the field of CITeR will be monitored also.

This work package produces new business models for security and safety industry to be used, new concepts, business plan and possibly an FP7-application. User requirement definition will be done in Finland and market research internationally.

4.3 Requirement Analysis

This phase determines and defines what the system should do. Requirement Analysis will be create from results of requirement research. The goal is to recognize requirements and to do functional specification for the system. Requirements will be divided in two groups: Functional Requirements and Non-functional Requirements. These requirements define operations, functions and constraints of the system. [11]-[13]

Functional Requirements define the expectations of its behavior or functions. It describes how it works, how it will communicate with other systems, what kind of stakeholders or users there are, how stakeholders and users can use it and how do they work with it. Generally these are the actions that this system must be able to perform. Non-functional requirements also known as quality requirements define features and constraints of the system. The requirements define nonfunctional quality attributes for the system like usability, reliability, performance and supportability. [11]-[13]

The purpose of this work package processes is to assure that the project outcome meets the expectations of the customers and other (internal or

external) stakeholders. After Requirement Analysis process there will be naturally design process. The purpose of these two processes is to translate the requirements into a specification that describes how to implement the system. [11]-[13]

5 Discussions

Regulations and standardization play an important role in applying the results of research to the market and to PPDR end-users. The on-going planning of European external border surveillance system (EUROSUR) [14] and EU´s enhanced powers in the field of internal security by the Treaty of Lisboa pace the way for further standardization efforts. Finland has one nation-wide TETRA network used by various PPDR organizations. As a consequence, there is full domestic interoperability. Finland has evidences of developing wireless communications standards and well operating and organized co-operations between authorities at different levels. Here, a prototyping environment with de facto standards could be made.

To implement and manage a prototyping environment that can develop and prove standards for interoperability for the 'meaning' of data that enable information to be shared between security providers, both within and between nations. The prototyping environment should provide for candidate operational scenarios to be synthesised (for example a trans-border incident) emulating the data flows between systems and operators, and so show that information exchange retains consistent meaning as well as timeliness when portrayed in different systems. The aim would be to provide a focus for researchers, system designers, information system operators and security front line operators to develop and validate semantics, syntax and meta-data so that such standards can be rolled out by security providers with confidence.

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