Designing emergency vehicle ICT integration solution

Jyri Rajamäki and Timo Villemson

***Abstract*—**E.g. Finnish police cars have about 40 different user interfaces (radio, navigation, command and control systems, radar, alarm lights etc.) on the deck beyond cars' user interfaces. In cold weather conditions, all police vehicles are not creating enough electricity for intensive operations. Also, wiring and ergonomics are problematic. However, the annual delivery amount of emergency vehicles is so low that traditional business models being made up of selling of devices and systems do not inveigle suppliers into doing remarkable developing work. So, other business models, such as digital service concepts, are needed also for security services. In this paper, the concept vehicle is a Volkswagen transporter used by the Finnish police, but the possibility of extensibility to other emergency vehicles is also discussed. A new mobile platform for police cars is proposed and the digital service design parameters of the ICT integration solution are defined. Further research subjects are also presented.

***Keywords*—**Digital service design, Emergency vehicle, Emergency vehicle ICT systems, Police ICT systems.

I. Introduction

EMERGENCY vehicles used by police, customs, frontier guards as well as fire and rescue services are increasingly dependent on ICT systems and wireless and mobile communications. In the past decade, more and more new technical devices and systems have been installed in these vehicles and it is necessary to secure a reliable and dependable technology support for "on-demand" services through any of the wireless architectures that have been in development recently.

However, there are serious challenges to overcome. By the same token of increased ICT system, the user interfaces of emergency vehicles have increased considerably. This has inflicted on occasional problems on functionality, for example the space of airbag to function has decreased. Also, technical problems with regard to electric supply and cabling arrangements have occurred. In addition, the documentation of applied solutions has been fluctuating, and the longed-for standardization in the field has not taken place because of the large variety of equipment suppliers. The annual delivery amount of emergency vehicles is so low that the standardization has not developed.

In global communications, service providers are moving from a network-centric to service-centric environment to meet consumer and enterprise demand for innovative multimedia applications and services. Increasing focus on the end user and meeting this demand requires advanced network deployment but in the current cash strapped environment how can this be accomplished while at the same time achieve reduction in total cost of ownership. Through creative partnering and innovative risk sharing options, new managed services and outsourcing business model options provide the framework for creating a next generation enabled portfolio of services for consumers and enterprises without compromising network performance, service quality and security.

In this situation, the integration of infrastructure-based communications and ad hoc networks, on-demand service and business models and their provision in a highly-volatile interconnection environment; and smooth interoperability of architectures with regard to emergency vehicles should be studied. The content of this paper is that Chapter II illustrates the operating environment; communication networks of public authorities, emergency vehicles as well as the ongoing change towards service business. Chapter III describes the main ICT systems of an emergency vehicle with emphasis on the police car. Chapter IV presents the research method applied in this study; the digital design service approach. Chapter V presents the findings of this study, i.e. a new mobile platform for a police car is proposed as well as the digital services and the design parameters of the ICT integration solution. Chapter VI presents the needs for further research and conclusions in Chapter VII presents the scalability of the solution, and the scalability to other emergency vehicles

II. Environment

A. Security Networks

In any society characterised as an information society, the different network and information system services available must be optimised for the purpose in question and must complement each other. According to [1] it was necessary to take a view concerning the protection of advanced critical infrastructure under exceptional circumstances and also during serious disruptive situations in normal circumstances, on account of the following factors: society has become more information-intensive; foreign ownership has increased;

Manuscript received December 2, 2009.

J. Rajamäki is with Laurea University of Applied Sciences, Vanha maantie 9, FI-02650 Espoo, Finland (phone: +358-40-7642750; e-mail: jyri.rajamaki@ laurea.fi).

T. Villemson is with Laurea University of Applied Sciences, Vanha maantie 9, FI-02650 Espoo, Finland (phone: +358-50-3814922; e-mail: timo.villemson@laurea.fi).

functions are outsourced; ICT systems are more integrated and interdependent; usage of freely accessible information networks; and the greater dependence on electricity.

According to [1], it should be ensured that the state always has sufficient ownership and control authority concerning at least those elements of the fixed telecommunications networks most critical to the functioning of society. This objective should be implemented in such a way that, to guarantee security, the amount of the state's capital tied up in the ownership of telecommunications companies is as little as possible, and that the actions needed are targeted in such a way that there is no justified cause to assume that they will hinder the pursuit of a communications policy that is independent of state ownership. The Government should set up a standing committee of public servants, composed of representatives of the main ministries and other authorities, for the purpose of supporting and coordinating official tasks concerning the regulation of communications markets, the availability of electronic networks for public authorities, and the ownership policy with regard to communications companies. Also, the high security national information infrastructure produced by the security network project for the government sector should be utilised wherever possible.

Fig. 1 shows the interrelationships of different Finnish critical communication networks. The world's first nationwide TETRA network - the VIRVE network - is commonly used by Finnish authorities. The VIRVE network is used by the emergency and fire and rescue services, the police, the Finnish Defense Forces, the Frontier Guard, social and health services, the Finnish Maritime Administration and different government departments.

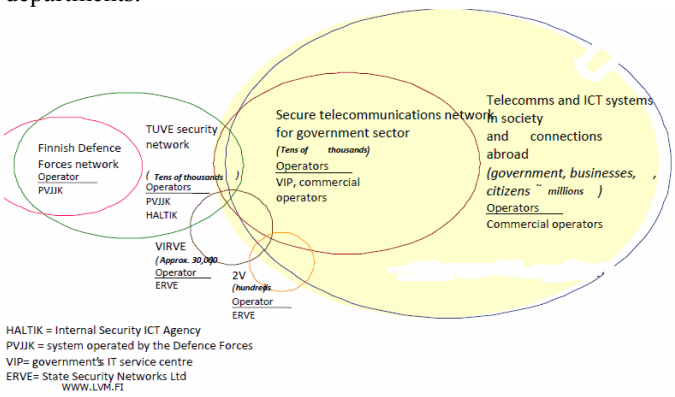

Fig. 1 Finnish critical communication networks [1]

B. Emergency Vehicles in Finland

The authorities have to operate in a variety of different conditions in Finland. They must be able to get about in narrow city streets, country roads, fells, coastal and inland waters etc. Great seasonal differences increase the demands on police vehicles. The means of transport used by the police are passenger car, van, bicycle, boat, Jet Ski, motorcycle, motor scooter, snowmobile and horseback. In Finland, the police have approximately 1,500 cars and vans. VW Transporter is the most common vehicle, and at present, they account for almost a third of all the vehicle stock. Police vehicles are used for an average of 7 years, after which they are sold at Police Technical Centre auctions.

The interior of the VW Transporter can be converted into, for example, an office, a dog-handling vehicle or a vehicle weighing unit. The police identifiers and other equipment for the cars are fitted at the Police Technical Centre, which is a support services unit that acquires, maintains and develops equipment and supplies for the Finnish Police.

The responsibilities of the Police Technical Centre include the supply of police vehicles and uniforms, care of service weapons, and the acquisition, storage and sale of the material needed by the police. The purpose of the development work is to ensure that police receive equipment and supplies that are thoroughly tested and suited to Nordic conditions.

In addition to the Finnish Police, the customers of the Police Technical Centre include other security and emergency bodies of the central and local government.

C. Digital Services

The annual delivery amount of emergency vehicles is very low in Finland. Therefore, a traditional product based economy being made up of selling of devices and systems do not inveigle suppliers into doing remarkable developing work. So, other business models, such as digital service concepts, are needed also for security services.

A service is defined as 'any activity or benefit that one party can give to another that is, essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical product' [2]. According to [3], 'digital services' means services, which are obtained and/or arranged through a digital transaction (information, software modules, or consumer goods) over Internet Protocol (IP). A difference between digital and non-digital services is the idea of ownership, which indicates possession. For a digital artefact, the physical possession might not be the same as having full control and often digital rights and ownership rights have non-specific, which makes it difficult to know who owns what and where the rights of one party stops and the others begin. 'Digital rights' is an area where the provider of a digital service might represent a large number of digital owners in their interactions with other parties. [3]

Another difference between digital and non-digital services is the sense of tangible versus intangible. Also, consideration of the net benefit in the digital service (i.e. quality of execution) is more important than the personal nature of the relationship [4].

III. ICT Solutions of Emergency Vehicles

The operations of the Internal Security ICT Agency (HALTIK) were initiated in 2008. HALTIK produces information and communication technological services to the administrative branches of the Ministry of the Interior relating to home safety and immigration. The Internal Security ICT Agency is responsible for providing basic information technology services, expert services related to information

technology, as well as the implementation of security cluster services on the basis of a service contract that adheres to the orderer-producer principle. HALTIK has about 320 employees. HALTIK services are used by approximately 18,000 customers from the various public branches of the Ministry of the Interior. About a half of these customers are police officers.

A. Police Data Systems and Information Services

1) POKE Field Command Systems

Today, the most important data system of Finnish police cars is the POKE Field Command System, whose real-time data communication such as text and status message services are enabled by the VIRVE network. VPN tunneling techniques in IP enables Security; also TETRA-IP low bandwidth is available; and public mobile operator networks are in use for high bandwidths. GPS module enables low price position data; GPS is attached to all police mobile radio, which in Finland means 1500 handheld radios with GPS. POKE system dispatches 2 million AVL message per day. [5], [6]

Fig. 2 Vehicle installations of the POKE system [6]

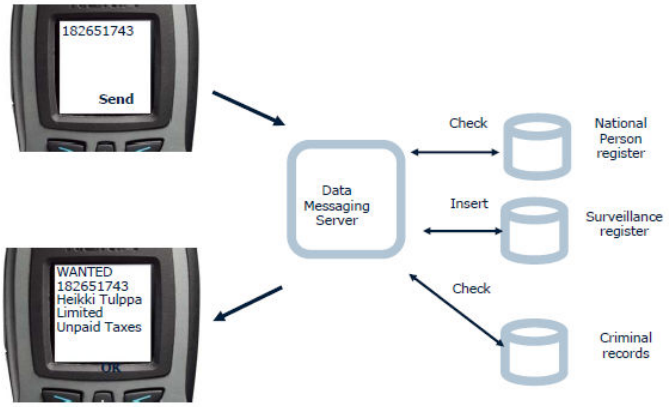

Fig. 3 POKE system text services [6]

Vehicle installations of the POKE system are shown in Fig. 2; van installation on the left and passenger car on the right. Fig. 3 represents POKE's text services. POKE Field Commander (Fig. 4) includes a touch screen, a TETRA modem and a huge map and chart material.

2) PATJA

The police affairs information system a.k.a PATJA is a nationwide police information system in Finland, which stores the practical work related information of the police. The different parts of PATJA are: 1) crime report index, 2) investigation and post-assistance system, 3) investigation and post-assistance system archive records, 4) the warrant register, 5) identification registry, 6) the property register, 7), arrest registry, 8) characteristic registry, 9) crime execution way registry, 10) the registry of sought after motor vehicles, and 11) message dispatch registry. It is allowed to collect information to the PATJA database about individuals for joint use according to the Finnish police law.0

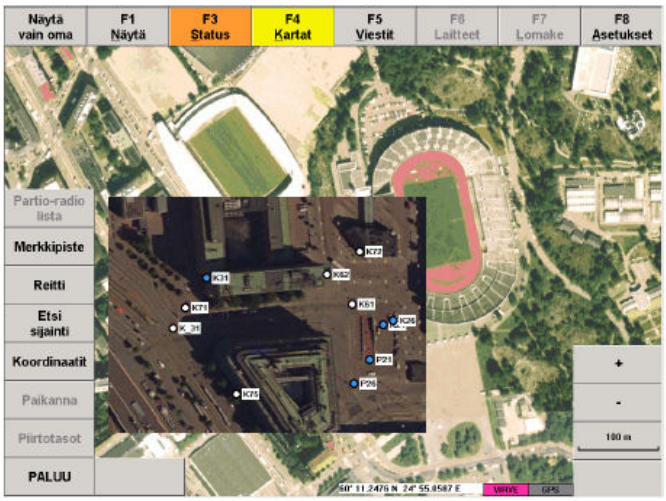

Fig. 4 POKE Field Commander [6]

3) Schengen Information System

The Schengen Information System (SIS) is a secure governmental database used by several European countries to maintain and distribute information on individuals and pieces of property of interest. The intended uses of this system is for national security, border control and law enforcement purposes. Information in the SIS is shared among institutions of the 27 participating countries in the Schengen Agreement Application Convention (SAAC). Although Ireland and the United Kingdom have not signed the SAAC, they take part in Schengen co-operation and use the SIS for law enforcement purposes.

4) HALTI

HALTI is the Finnish police gun permit register. The information system stores the information of all the gun permit owners in Finland. All the queries made to the database are logged and the legality of the register is frequently checked by the police information management center.

5) Workstations

The Workstations service offered by HALTIK includes equipment procurement, installation and commissioning, maintenance and servicing arrangements and the safe disposal of information. Operating systems and application programs for the service includes the installation and maintenance, and necessary updates. The service also includes a customer-specific IT support in problem situations as well as expert advice for IT and IT-security matters.

6) Telecommunications

HALTIK manages Interior Ministry's core network and communication links and also takes care of malware protection. HALTIK began operations in 2008. Administration's Information Technology Center a.k.a HALTIK produces services for the Ministry of Interior of Homeland Security and immigrations information and communication technology services. The service center is responsible for technical knowledge in basic services, information technology-related professional services and security services for the cluster service contracts based on the purchaser-provider basis.

7) HelpDesk

HALTIK implements a centralized helpdesk for the entire police administration staff 24 / 7. The support service aims to provide the police administration staff one contact point through which all service requests are received and directed to appropriate specialists. Support services are received trough telephone, e-mail and web-site.

8) Special Systems in Vehicles

The emergency vehicles supplied by the Police Technical Centre of Finland have many electrical, electronic and ICT devices and system, such as intelligent electric supply systems, radio, video and radar equipment, average speed measurement system, alarm devices, pc, printer, weighing appliance, biometric systems, automated recognition systems for registration plates, GPS and Alco meter. Mobile communication equipment includes devices for both TETRA networks and public mobile operator networks, such as GPRS, Edge, 3G, @450, WLAN and WiMAX.

IV. Digital Service Design Research

A gigantic shift from a product based economy to one based on services, specifically digital services is ongoing. The subject of this study is to design new digital services for public security services. Today, digital services are being designed for and offered to users. However, very little is known about the design process that goes behind these developments; is there a science behind designing digital services? [3] The framework of this study is designing of emerging digital services applying guidelines described in [3], [4].

It has been argued that innovation is more a result of iterative emergence than design [7]. According to [3], there are some important differences between digital services, existing software products, and non-digital services. While these differences vary from service to service, there are similarities that are useful to the field of design science [3].

The party that gives the service or activity is the digital service provider; and the party receiving the activity or benefit is the digital service user. A single transaction is sufficient to provide a digital service, however, these transactions are usually provided in groups or continuous transactions. Two organizations with exactly the same digital artifacts can behave totally differently in the market. [3]

Two dimensions that emerged from [4] included 1) fundamental design dimensions; and 2) fundamental service provider objectives. The fundamental design dimensions included the ideas of service delivery, service maturity, malleability, and pricing, but are not necessarily exhaustive. The fundamental service provider objectives include how the digital service is designed to meet the objectives of business success, technological success, and success of interactions. [4]

A. Fundamental Design Dimensions

According to [3], four fundamental design dimensions distinguish one service from the other: 1) Service delivery, 2) Service maturity, 3) Malleability (provider and user), and 4) Pricing and funding.

The service delivery describes how the service is provided and the range of requirements for the consumer of the service to participate at different levels [3]. Table I shows service delivery requirements - what is required to use the digital service?

TABLE I
SERVICE DELIVERY REQUIREMENTS [3]

Level	Description
High	Specialized hardware or software required (latest version or certified hardware/software)
Medium	Standard computers with late (past 2 or 3 years) operating system sufficient
Low	Older computers (3+ years) and operating systems work fine, but specified
None	Minimum hardware/software requirements not specified

The four digital service maturity levels used in this study and described in Table 2 are as follows: 1) Enthusiast - designers available to assist; 2) Professional - professional customer service; 3) Consumer phase - help accessible within product; and 4) Embedded - automatic, help not required [3].

TABLE II
STAGES OF DIGITAL SERVICE MATURITY [3]

Development Phase	When Problem Arise	Technical skills requires by system users:	Overriding Goals of Phase
Enthusiast	Technical users solve the problems themselves or check with other technical experts or with the system designers	High	Innovation and creativity
Professional / Business	Formal customer service delivery system with occasional interaction with the systems designer	Medium	Value and reliability
Consumer	Eliminated need for interaction with systems designers and best practices are built into the system and the customer service delivery systems	Low	Simplicity and trust
Embedded Systems	Eliminated the need for interactions with customer service delivery systems. System failures are handled as artefacts of failures of related systems	None	Automation and dependence

According to [3], a most desirable quality of digital services is the ability to be malleable or to be able to adapt to changing market needs or requirements. Digital services have an advantage if they can be dynamically and incrementally changed without the need for the users to upgrade their software, since the functionality of the latest code is deployed from the service provider upon use. Tables 3 and 4 shows service malleability levels with regard to providers' and users' point of view.

TABLE III
DIMENSIONS OF SERVICE PROVIDER MALLEABILITY [4]

Malleability Level	Description
High	Changes are easily made to the digital service offerings by the service provider and require no testing
Medium	Changes require changes to more than a few parts of the service and limited testing
Low	Changes are difficult or expensive to implement and require extensive scenario testing
None	Changes require a complete re-write or complete new implementation

TABLE IV
DIMENSIONS OF SERVICE USER MALLEABILITY [4]

Malleability Level	Description
High	The service user is either not impacted by the changes or is positive towards them
Medium	The service user is impacted in their use of the digital service and must make some changes to their user behavior.
Low	Changes are difficult or expensive for the service user to consume and may interfere with their continued use of the product unless there are other incentives to remain as a service user.
None	The digital service is like a completely new offering and could have been provided by another service provider.

The value proposition is an important component in digital services, where users pay for the perceived value. Generic approaches to revenue logic in the open source software business are identified as follows [8]:

- *Licensing*, that is, license sales and royalties as the main source of revenue.
- *Revenue sharing* with distribution partners or profit sharing with users.
- *Loss-leader pricing*, meaning giving something for less than its value. This is done, for example, in order to increase the customer base for later revenue, or, to support sales of some other part of the product/service offering.
- *Media model*, where the revenue is based on advertisement sales either through advertisement in the user interfaces of software or by selling user information for advertisers.
- *Effort-, cost- or value-based pricing*, which is a common approach in customized or tailor-made software solutions and made to order software projects.
- *Hybrid models* as various combinations of the above.

B. Fundamental Service Provider Objectives

Digital services are offered to users for the benefit of the users, but the service provider is doing so to achieve certain objectives. Three service provider objectives described in [3] are: 1) Business objectives, 2) Technological objectives, and 3) Interaction objectives.

Business objectives are not just about making money, but also about building a successful business which includes brand establishment, customer loyalty and offering superior customer service. Business objectives are answering in the following questions: Can design impact customer acquisition and retention and if so how? How does the provider of the system make money to keep their service online? How important are service enhancements to their growth and sustenance as a going concern? How does the provider of the system differentiate their service from that of competitors? [4]

Technological objectives describe the level of importance of the choice of technological solutions. They are studying e.g. questions: How much control does the service provider exercise over all components of their technology? Where is the product in the lifecycle? [4]

In this context, interaction means the human-computer interaction and the experience a user gets while using the service. Interaction objectives review: How is loyalty encouraged? Can customers distinguish between one brand and another? Is the digital service easy to learn? How does the service provider meet the custom or individual needs of their customers? [4]

While all of these objectives are important, often there is a ranking that executes a controlling effect on the design of digital services [3].

C. Fundamental Digital Service Design Taxonomy

Fig. 5 shows the four design dimensions, which dictates how best to improve the service; and three service provider objectives. There are dependencies between design objectives and design dimensions, e.g. business objectives are likely going to impact choices of service delivery and pricing functions. Similarly technological objectives could stipulate how malleable a service is.

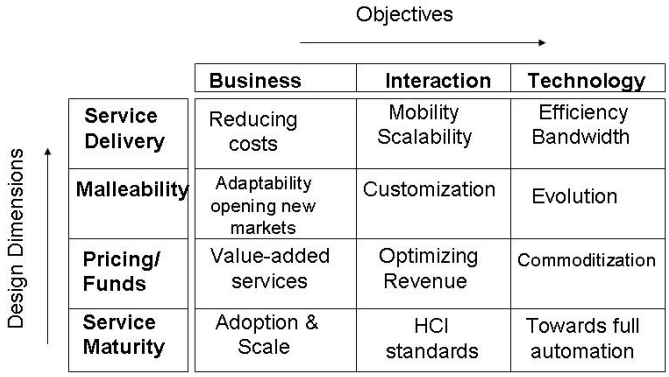

Fig. 5 Digital service design taxonomy [4]

The taxonomy can be applied for digital service design to think about non-functional and functional aspects of design. It provides a holistic framework for developing new methods and forces one to think about non-technical aspects of the services. [4]

V. Design Taxonomy of Police Car ICT Systems

The design of large and complex ICT integration solutions is a difficult task. ICT system integration could be seen as a journey that an organization undertakes to interconnect its siloed business functions and work practices to streamline organizational processes. It can require solutions that are unique because of constraints from the current set of legacy applications. Enterprise integration, sometimes referred to as systems integration, is an example of ICT integration which is widely researched. However, design knowledge for enterprise integration solutions is difficult to articulate and reuse [9]. The solutions often take the form of connecting stovepipe legacy applications (referred to as EAI – enterprise application integration [10]) or imposing and customizing enterprise systems packages (referred to as ERP – enterprise resource planning software [11]). Regardless of the solution chosen, bottom-up EAI or top-down ERP, the integrated solutions are intended to support and facilitate cross-functional business processes [12]. Because of the unique nature of each ICT integration project and the significant organizational change burden associated with the deployment of integration solutions, much research related to the design of integration solutions is dominated by either 1) a technology perspective, e.g. devising more efficient middleware implementations, or 2) investigation of organizational concerns such as transformation and change management. [9]

A. Design Dimensions

Table V examines some of the current devices, systems and protocols used in a police car with regard to the different aspects of the digital service design dimensions. When considering the devices, the main perspective is in the malleability of the system. Is it closed or open for changes and in what level; hardware, software or both? When studying the systems, we must consider the platform where the system is run on as well as the level of input the user is allowed to the system. E.g., the PATJA system is solely a helpdesk system that is concentrated on output. When examining the protocols we must consider how the value is added there, because with some protocols a simple software update at the service provider's end is sufficient and in the worst case scenario the service provider has to renew a massive amount of hardware and software and also include an extensive amount of testing. The same aspects apply for the service's user. E.g. the newest WLAN devices have a hardware level support for the coming n-class, and when the standard is finalized the new service can be taken into use with a simple software patch.

TABLE V
DESIGN DIMENSIONS OF POLICE CAR ICT SYSTEMS

	Service delivery requirements	Stages of digital service maturity	Dimensions of service provider malleability	Dimensions of service user malleability
Device				
PC	Medium	Low	Medium	Medium
Printer	Low	Low	None	High
GPS	High	None	Medium	Trust
Alco meter	None	None	None	None
HC SCALE	None	None	None	None
Laser speed gun	None	None	None	None
ANPR	Medium	None	None	Medium
System				
POKE	Medium	Low	Medium	High
VIRVE	High	Low	Low	Medium
PATJA	None	Medium	High	High
RANKKURI PRO	Low	Low	Low	Medium
Protocol				
2G	Low	Low	Low	Medium
3G	Medium	Low	Medium	Medium
FM	Low	None	High	High
WLAN	Medium	Medium	Medium	Medium
@450	Medium	Low	Medium	Medium
WiMAX	Medium	Low	Medium	Medium
GPS	Medium	Low	Medium	Medium
TETRA	Medium	Medium	Medium	Medium

When further examining the design dimensions of police car ICT systems, some basic presumptions could be made. With regard to service delivery requirements, all of the classifications are made by considering the platforms where the device, system or protocol can be used, e.g., is it a closed system or a system that is run from a browser windows and is the protocol moved through a tower, cable or perhaps ad hoc? With regard to the stages of digital service maturity, we look at the freedoms a user is given with the service and also the skills required interacting with the system. With regard to the dimensions of service provider and user malleability, we look at services in point where the service is updated or given added functionality.

Table V is a preliminary one as we have not yet received or produced an extensive list of devices, systems and protocols used in the different police vehicles. Also, the values given in the tables are estimates based on the scarce and scattered information collected from varied sources. However, there are a lot of similarities in the services that are viewed in Table V. The services are mostly based on technologies that are closed; they have extensively been researched and, also, wield a wide variety of support. This is a good sign because people working in the field of public security or emergency services should not operate as beta testers, and should only use services that are well tested and preferably standardized. Another good notice is that the services needed in police cars are services that can and mostly are used in all kinds of emergency vehicles, like ambulances and fire trucks. Our digital service design goal is that most of the services can be applied in different emergency vehicles. That calls for modularity in the designs for the core services. Also, the use of level 'medium' and level 'none' systems should be increased, because level 'high' services might prove too hard to use in the field and in some situations level 'low' systems could be too rigid.

B. Digital Service Design Taxonomy

As [3] levels, platforms that offer digital services are emerging to be an important area of research and study. Fig. 6 shows our way of thinking what kind of a new integrated mobile platform for digital services of a police car should be. When studying how the digital service design taxonomy

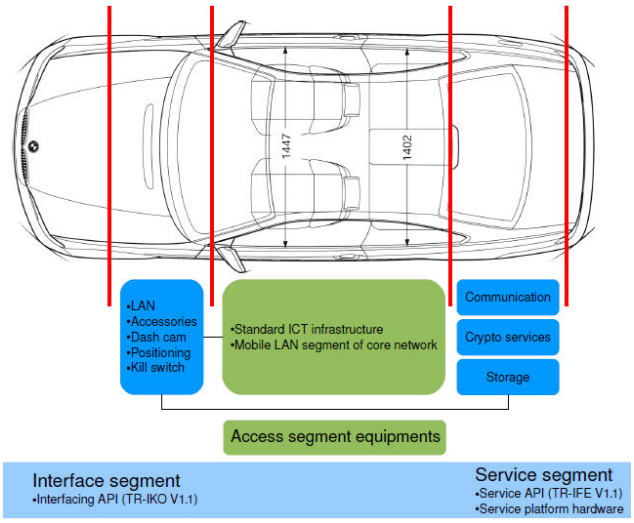

Fig. 6 New mobile platform for police car

(shown in Fig. 5) can be applied with regard to emergency vehicle ICT integration solution, Fig. 7 summarizes the current state of services used in police cars. On the other hand, Fig. 8 lists the goals of our integration project and how we are planning on refining the taxonomy in it.

	Business	Interaction	Technology
Service Delivery	Mostly savings are earned through competitive tendering.	Systems are built straight into the car. For that reason, most of the services are unmovable.	Systems operate mostly in a low bandwidth, high latency networks.
Malleability	Different services are constructed through multiple providers. System integrator is missing.	Customization is acquired through added hardware and is usually rigid and hard.	Systems are delivered by different providers using different interfaces giving minimal interaction with other systems.
Pricing / Funds	Service providers are too scattered to achieve new service designs.	Optimization through competitive tendering.	At its current state commoditization is not a realistic option.
Service Maturity	The scattered nature of the services makes it impossible to evaluate their adoption rate.	The provided interfaces are intended for a larger market so they are mostly standardizes.	Most of the systems have a high level of automation and do not require a lot of user interaction.

Fig. 7 Current state of police car's ICT services

	Business	Interaction	Technology
Service Delivery	Savings are acquired through modular packages and more efficient processes.	The amount of devices has decreased and most of the interfaces and services are integrated into more easily movable ensemble.	Most of the data link interfaces are made into a bigger whole with enough intelligence to switch modes on the fly.
Malleability	All services are acquired through a single provider who takes care of all the aspects of the service.	Customization is acquired through easily manageable modules.	The R&D is acquired through the service provider, universities and the service user.
Pricing / Funds	The adding of value is more easily done as the whole package is handled by a single provider.	New and improved funding models can be implemented more easily because of the nature of the service.	Commoditization can be acquired when the service is taken into the global markets.
Service Maturity	The modular design of the service makes it easily adaptable into different environments.	The core design will be made according to the HCI standards but the modular design will also allow redesigning.	The automation level will be made modular and adjustable for different modules, situations and users.

Fig. 8 Designing goals emergency vehicle ICT integration

VI. Discussions and Conclusions

In the public safety and security field, applied business models are needed with regard to promote *de facto* and *de jure* standardization for systems and services. The market in the field has to be studied and the minimum volumes of needed services should be defined. In addition to this, the interrelationship between national and international regulations as well as public private partnership legislation should be detected. The nature of the service design solution is generic; the user requirements of the police, border guards and customs have great similarities, and the new services should serve them all. An example of these services is a gateway that provides all of the essential data services; authenticates the user to the service, manages the protocol versions, acts as a server for key services, providing a gateway to external servers. Also, an essential question is the synergy with the fire and rescue department; should the service also be usable to this user segment, and if, how to treat common services.

Design is moving towards incremental and prototyping

based approaches. Experience and service flow design gain importance as we develop for customers even with regard to public security services. In this paper, we apply the taxonomy approach proposed in [3] and [4]. We illustrate essential design features that apply to digital services for public security authorities. This is the first such study as per our knowledge. In this preliminary attempt, we have identified several key design dimensions and service provider objectives that play an important role in both the success of the mobile service platform for emergency vehicles as well as the business models in the safety and security field.

REFERENCE

[1] M. Lehti, H. Pursiainen, J. Ristola and R. Parmes, *Promoting the availability of secure telecommunications networks*, Publications of the Ministry of Transport and Communications 26/2009, Helsinki, Finland.

[2] P. Kotler, G. Armstrong, V. Wong, and J. Saunders, *Principles of marketing*. *Fifth european edition*, Essex: Pearson Education Limited, 2008.

[3] Williams, K., Chatterjee, S. and Rossi, M., "Design of emerging digital services: A Taxonomy," in *European Journal of Information Systems*, vol. 17, no 5, pp. 505-517, 2008.

[4] Rossi, M., "Design of digital services", presented at the INFORTE Seminar Digital Service Design, Nov. 12th – 13th 2009, Espoo, Finland.

[5] Vilppunen, H., "TETRA data services & applications", presented at the TETRA Congress, June 13th -14th 2006, Warsaw, Poland.

[6] Nurhonen, P., "POKE – GIS-based field command system for police", presented at the Nordic Seminar of the Use of Geographic Information in Crises Management, May 19th – 20th 2008, Bergen, Norway.

[7] G. van Alstyne and R. K. Logan, "Designing for emergence and innovation: redesigning design", in *Artifact,* vol. 1, issue 2, pp. 120–129, 2007.

[8] R. Rajala, J. Nissilä and M. Westerlund, "Revenue models in the open source software business" in *Handbook of Research on Open Source Software: Technological, Economic, and Social Perspectives,* edited by K. St. Amant and B. Still, New York: Information Science Reference, pp. 541-554, 2006.

[9] K. Umapathy, S. Purao and R. R. Barton, "Designing enterprise integration solutions: effectively", in European Journal of Information Systems, vol. 17, no 5, pp. 518–527, 2008.

[10] M. L. Markus and C. Tanis, "The enterprise systems experience – from adoption to success" inn Framing the domains of IT management research: Glimpsing the future through the past, edited by R. W. Zmud, pp 173–207, Pinnaflex Educational Resources, Cincinnati, OH, 2000.

[11] J. Lee, K. Siau and S. Hong, "Enterprise integration with ERP and EAI" in *Communications of the ACM,* vol. 46, no. 2, pp. 54–60, 2003.

[12] A. M. Sharif, Z. Irani and P. Love, "Integrating ERP using EAI: a model for post hoc evaluation", in *European Journal of Information Systems*, vol. 14, no. 2, pp. 162–174, 2005.