Action full title:

Universal, mobile-centric and opportunistic communications architecture

Action acronym:

UMOBILE

Deliverable:

D6.9 “Final plan for the Use and Dissemination of Foreground ”

Project Information:

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Project Acronym	UMOBILE
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Project Coordinator	Prof. Vassilis Tsaoussidis

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After D6.4 that includes information about the exploitation roadmap defined by UMOBILE consortium in month 18, this D6.9 updates this roadmap and identifies the exploitation actions for UMOBILE.

Deliverable Number-Title	D6.9 Exploitation Report
WP Number	WP6
WP Leader	AFA
Task Leader (s)	Alberto Pineda (FON)
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1. Executive Summary

Background: This Report is written in the framework of Task 6.2 "Exploitation" of UMOBILE project.

The ultimate objective of UMOBILE is to advance networking technologies and architectures towards the conception and realization of Future Internet. In particular, UMOBILE extends Internet (i) functionally – by combining ICN and DTN technologies within a new architecture -, (ii) geographically – by allowing for internetworking on demand over remote and isolated areas – and (iii) socially – by allowing low-cost access to users but also free user-to-user networking.

Objectives: This document is aimed at updating D6.4, a previous exploitation plan provided by the consortium in month 18. D6.9 updates the exploitation plan and also identifies the exploitation actions for UMOBILE.

The document starts in Section 2 with an overview of the current situation and an analysis of the UMOBILE solution within the market in terms of strengths, weaknesses, threats and opportunities. The rest of the document is organized as follows. Section 3 gives a comprehensive overview of the adopted exploitation strategy. Section 4 provides a summary of the main results of the project that will be used to open new markets, business applications, products and services. The business case analysis performed in task T6.2 is presented in Section 5. The detailed exploitation plan of each industrial and academic partner is elaborated in more detail in Section 6. The conclusions are drawn in Section 7.

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2. Overview

This Section provides an overview of the current mobile sector and emerging trends from a business perspective. The positioning of UMOBILE within the market of the new paradigm of opportunistic networks via internet centric networking and delay tolerant networks is also provided by means of a SWOT analysis (strengths, weaknesses, threats and opportunities).

2.1. Current mobile sector and emerging trends

Current Internet bases on host-centric access, which hosts the traffic exchange of billions of devices reaching up to exabyte of data per year. However, nowadays more and more users want to get Internet access everywhere, anytime, content-based and only when required. In addition, users' connectivity patterns have greatly evolved moving from very static scenarios to scenarios where mobility is the main actor and users are mainly interested in accessing big chunks of information, irrespective of its physical location. User demand is increasing through the use of mobile devices that present multiple connectivity options. Cisco VNI reports that Global mobile data traffic will increase nearly eightfold between 2015 and 2020 [1]. Mobile data traffic will grow at a compound annual growth rate (CAGR) of 53 percent from 2015 to 2020, depicted in Figure 1, reaching 30.6 exabytes per month by 2020.

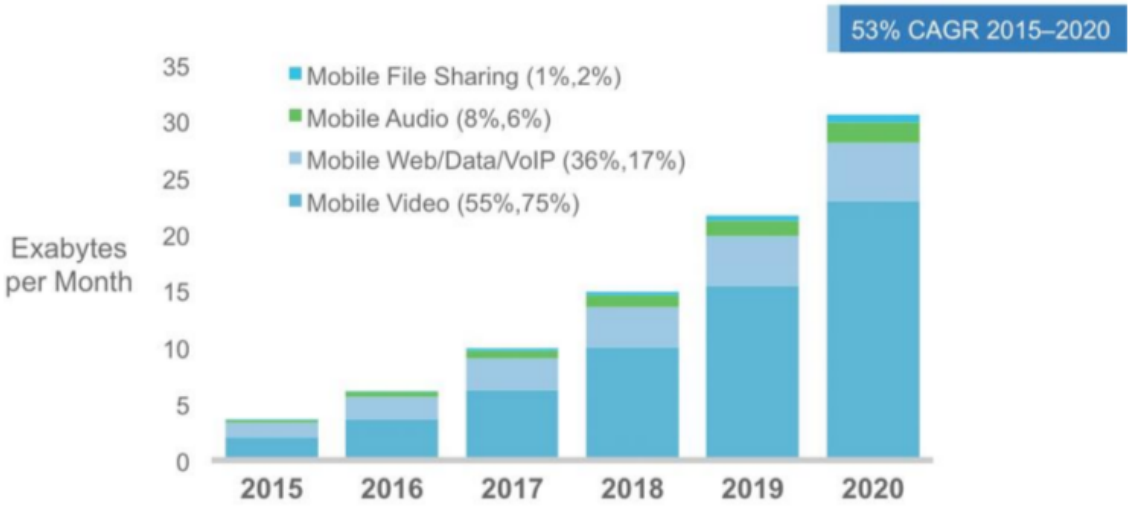

Figure 1: Mobile Data Traffic prediction. Source Cisco VNI Mobile 2016.

The number of mobile-connected devices per capita will reach 1.5 by 2020 [1]. There will be 11.6 billion mobile-connected devices by 2020, including M2M modules – exceeding the world's projected population at that time (7.8 billion). This will translate into an environment of fully connected devices that require an Internet connection, making the Internet of Things (IoT) a reality.

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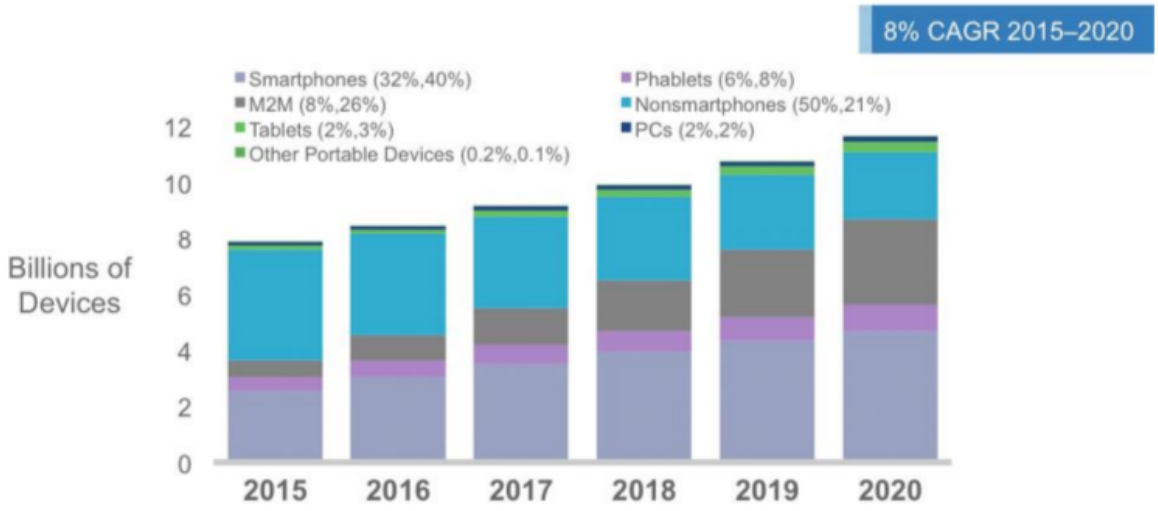

Figure 2: Global Mobile Devices and Connections Growth. Source Cisco VNI Mobile 2016.

This increased demand in content boosts Information Centric Networking (ICN) to emerge as a revolutionary solution introducing more flexibility and efficiency in the mechanisms for content dissemination among users.

In addition, as aforementioned, at this time there is a trend that users want to access to contents anywhere, only when required, and sometimes in isolated dynamic situations that will create opportunistic networks. Leveraging Delay Tolerant Networking (DTN) principles, founded on a store-and-forward model with persistent storage, and jointly integrated with ICN, will support seamlessly mobility for extreme disruptions and also remove the need of end-to-end connectivity between the user and the location context server.

The Gartner Hype Cycle [2], which allows identifying the maturity and adoption of specific technologies, finds Named Data Networking (NDN) at a very early stage with still more than 10 years foreseen to reach a plateau level. NDN, key component within the UMOBILE framework, represents a specific architecture design for the ICN solution. Figure 3 presents the Networking and Communications Hype Cycle 2015 where NDN is identified as a promising technology. This clearly states the importance of the UMOBILE project, which does not only approaches the definition of a unified ICN and DTN communication platform but also opens opportunities for new services and applications.

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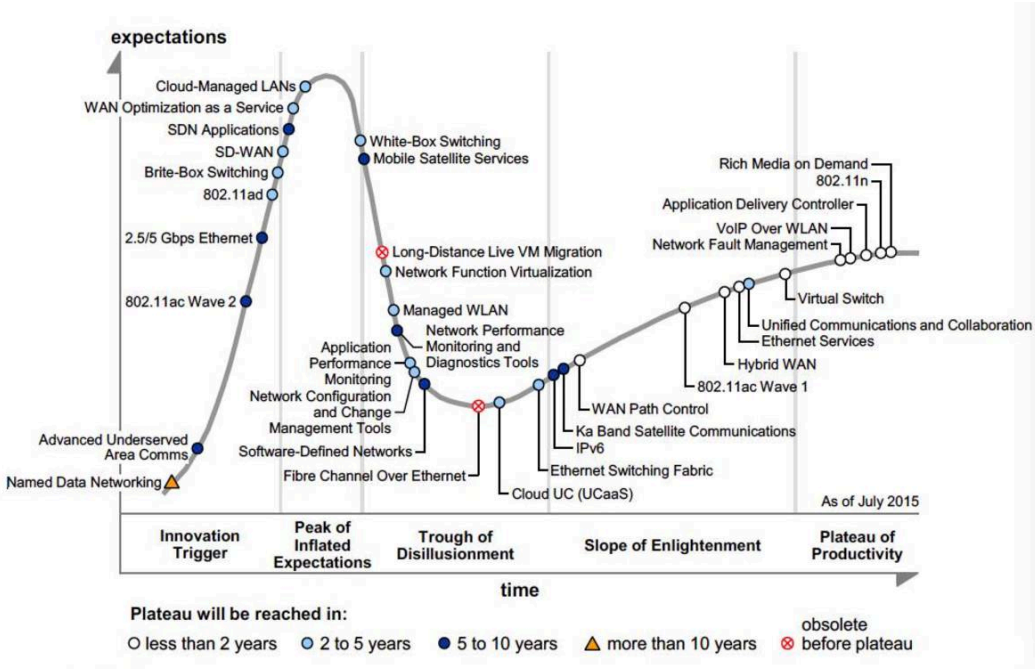

Figure 3: Gartner Hype Cycle for Networking and Communications 2015. Source Gartner July 2015.

2.2. SWOT Analysis

In this section, the proposed UMOBILE solution will be assessed within current mobile dissemination schemes and market. The objective of this comparison is to point out the benefits regarding the use of UMOBILE by mobile operators or other entities, and therefore, the exploitation opportunities for the partners.

Table 1: SWOT of UMOBILE solution

	Strengths	**Weaknesses**
Internal	• Increases network coverage and enables communication of users in unconnected and remote areas. • Saving costs in extending network infrastructure to reach rural and remote areas. • Applicable to V2V communications and, similarly, to other "things". • Approaches lack of WAN coverage scenarios. • Use in disruptive networking environments to give Internet connectivity. • Reinforcement of innovative use cases. • Enable the wide-spread adoption of content-centric networking solutions	• Shows dependencies on end-user terminals. These dependencies may require the collaboration with OS providers (e.g. Google, Apple, etc.). • May entail higher battery consumption on terminals. • May require standardization, mainly at the integration of DTN with ICN. • Service guarantees depend on the UMOBILE penetration and adoption. • Trust issues when the user becomes both consumer and producer of content. • Limit adaption by service providers in the short term.

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External	**Opportunities**	**Threats**
	• Enables the development of new and innovative services and applications based on ICN and DTN paradigms (e.g., based on media sharing). • Increased use of mobile devices: smartphones will reach percent of mobile data traffic by 2018. • Increase access to traffic content as more areas will be covered. • Popularization and boosting the well-known concept of smart cities. • Increase social interaction. • Guarantee connection service in emergency situations.	• UAV WiFi connectivity range may limit the Internet connection when used for emergency purposes. • Government and public administrations may exclude themselves of adopting this new architecture. • Legal issues regarding the UAVs flight that may limit UMOBILE operation. • User may not perceive opportunistic communications as secure and stop using UMOBILE framework due to trust issues. • Low adoption.

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3. Exploitation strategy

For being effective and successful, an exploitation strategy has to be considered from the very beginning of the project and has to be embedded in all its significant steps. This is the reason why the exploitation process depicted in Figure 4 has been applied to the consortium activities.

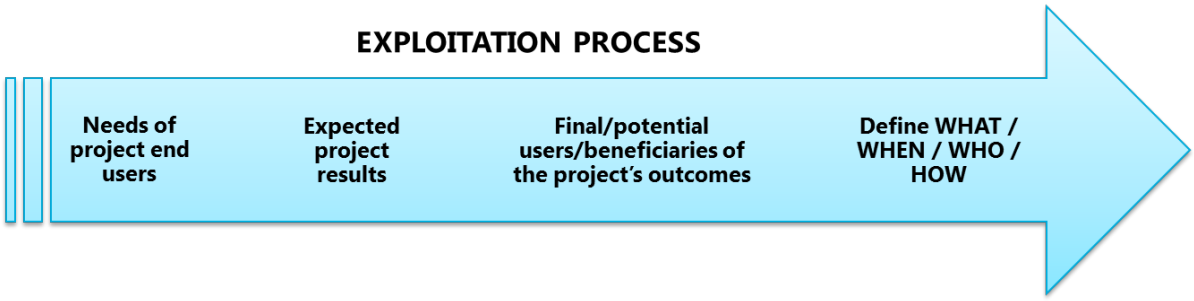

Figure 4: Exploitation process considered throughout the UMOBILE project

This exploitation process covers the whole project timeline and strives for being as proactive as possible by integrating participatory processes in each step. It is worth to be noted that the starting point of the whole process does not coincide with the beginning of the project activities. In fact, the consortium partners need to have clear in mind which the possible usages of the produced outcomes are during the design phase of the proposal. This is the reason why a clear exploitation plan for each involved partner has been already provided in the Description of Work, based on the expected project results also described in the same document. These results have to be focused on satisfying specific needs of identified end users.

The aforementioned two first steps characterize the design phase of the project and its first activities (i.e., all the phases in which the direction to be taken and the potential outcomes are still not steadily defined). Once it has been started and its first activities have been completed, the potential users and beneficiaries of the project's outcomes can be identified with much more confidence, up to arrive to their final definition when going deeper into the timeline and approaching the ending date.

After having clearly in mind which the final or at least potential end users of the project's outcomes are, it is necessary to identify all the details related to the exploitation activities. First of all it has to be decided which are the obtained results that can be exploited (i.e., WHAT). In fact, it is possible that not all the results obtained throughout the project are ready to be used directly or indirectly towards or after its end.

After that, each partner has to select the exploitable results of its interest and to identify which are the target users in their business (i.e., WHO). It has to be then decided how they can be addressed and which are the mechanisms and strategies to be used for each type of outcome (i.e., HOW). Also the time dimension has to be carefully planned, in order to cover the period of time before and after the end of the project (i.e., WHEN).

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The last two steps depicted in Figure 4 can be iterated several times up to the end of the project in order to refine and to better detail each component.

4. Exploitable results

In this section we describe the results of the project which could be used directly or indirectly for further research activities other than those covered by itself, for developing, creating and marketing a product or process, or for creating and providing a service. Each partner can freely use all or a part of them, according to its exploitation plan later described into the document.

In general, the typical outcomes of a project can fall into one or more of the following categories, such as: process/process technology, method, models, algorithms, recommendations for standards, service/service technology, prototypes/pilots for a product, software codes, and intellectual property right (i.e., patent).

UMOBILE outcomes can be exploited as a technology solution or as a solution as a service. Each of them has specific features that are analysed in the following sub-sections.

4.1. UMOBILE as a technology solution

UMOBILE proposes an innovative architecture implemented using disruptive paradigms and technologies that is able to offer new enhanced services to the end user. This architecture merges information-centric networking with delay-tolerant networking in order to efficiently operate in different network situations, reaching disconnected environments and users and providing new types of services.

To assist in technology adoption, UMOBILE includes an end-user driver product, the UMOBILE End-User Service (UES), which can be downloaded via captive portals and assist in bootstrapping UMOBILE.

This product encompasses the complete UMOBILE solution as a package, developed during the project execution. The commercialization of such product is exploited as a complete technology solution that can be sold (B2C as well as B2B, by a company providing this solution) to any entity that wants to deploy UMOBILE related services.

The UMOBILE solution can be also used to build services on top of it. In this case, a company can buy the UMOBILE solution in order to develop one or several services on top of the designed architecture.

4.2. UMOBILE solution as a service

Other potential utilization of the UMOBILE solution is the enablement of exploitation licenses for other entities to provide UMOBILE services as a product. This way, the complete solution can be provided to a client and this client can afterwards offer UMOBILE services to its clients. Therefore, UMOBILE solution is exploited as service. For

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instance, a "UMOBILE service provider" (e.g., an operator with UMOBILE technology solution) offers UMOBILE services to other entities willing to use UMOBILE.

The provided services by UMOBILE solution can be the ones developed during the project or can be new services built on top of the architecture.

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5. Business models

5.1. UMOBILE Value Chain

The following figure depicts the value chain for a UMOBILE business ecosystem.

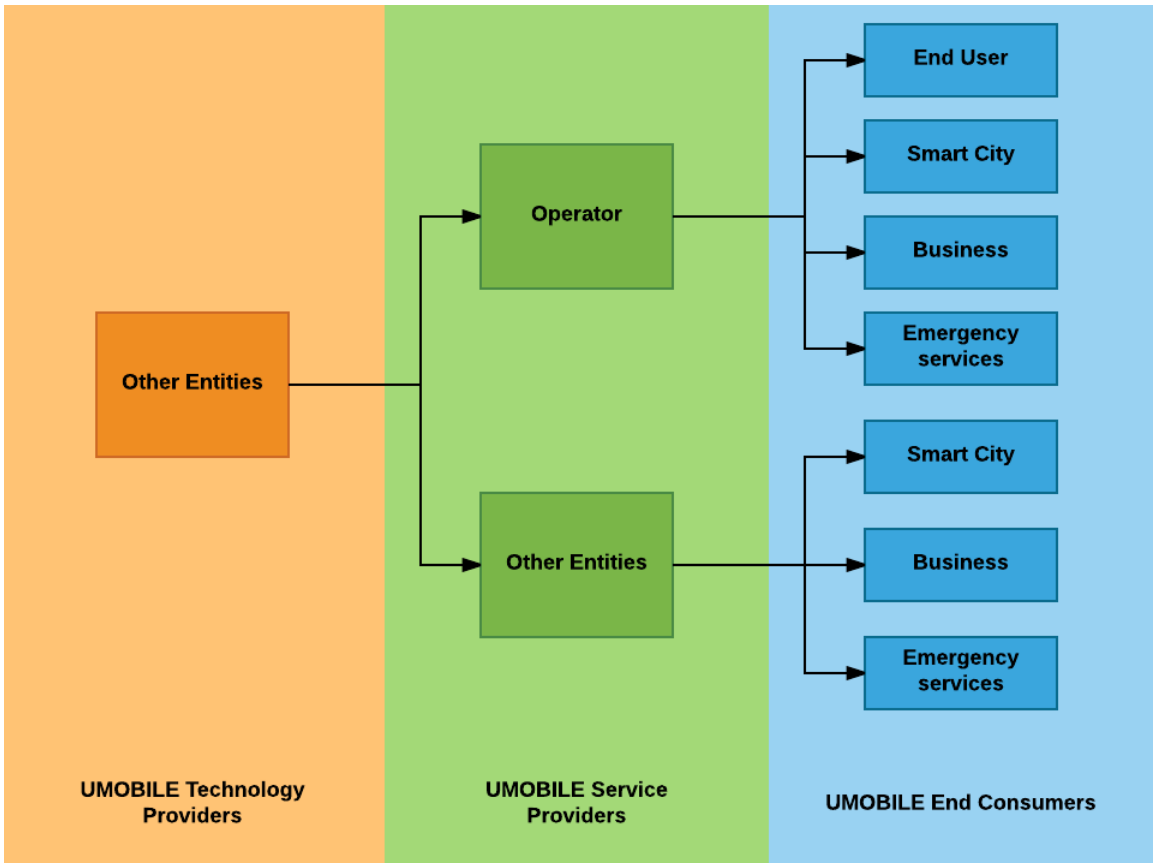

Figure 5: UMOBILE Value Chain

In the value chain, three main levels have been defined:

- *Technology providers:* these entities develop and offer UMOBILE technology. They can offer the technology developed during the project or they can build services on top of the platform developed during the project.
- *Service providers:* these entities offer services thanks to the technology provided by UMOBILE Technology Providers. Operators can take advantage of this technology in order to improve their networks and provide innovative services. On the other hand, other entities can provide services and build new business models.
- *End customers:* these entities consume UMOBILE services provided by UMOBILE service providers.

Within each level, several entities have been represented. Some entities can fit into different levels. For example, an entity can be a technology provider that develops the technology and can be, at the same time, a service provider as it provides services to end customers.

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The next sections describe the business canvases for the main entities in the value chain.

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5.2. Business Canvas for UMOBILE Technology Providers

A UMOBILE technology provider is an entity that develops UMOBILE technology for UMOBILE architecture and services. This entity sells this technology to UMOBILE service providers. It can also sell support, licensing, deployment of the network, maintenance or operation.

These entities can be existing companies or new ones that decide to build new business models thanks to UMOBILE technology.

Table 2: Business Canvas for UMOBILE Technology Providers

<table>
<tr>
<td rowspan="2">Key Partners

UMOBILE Technology Providers.

They develop and offer UMOBILE technology including the architecture, the UAVs, the deployment and the associated apps.</td>
<td>Key Activities

Development, deployment, support, maintenance of UMOBILE Technology.

Technology provider sells the technology to UMOBILE service providers.

Technology Providers can also offer support, integration, operation and maintenance services on top of their technology.</td>
<td rowspan="2">Value Propositions

Providing UMOBILE technology

Selling, licensing and authorizing the use of UMOBILE technology (software, architecture).

Deployment, maintenance and support services

Providing support services for the technology/architecture.</td>
<td>Customer Relationships

UMOBILE Service Providers

These entities purchase UMOBILE technology in order to provide services to other entities or to end customers. There are two groups:

Operators: they can improve their networks and provide innovative services.

Other entities: such as local authorities or municipalities. They can build new business models around this technology.</td>
<td rowspan="2">Customer Segments

Operators

Telecommunications operators

Other entities

Entities that can build a new business models around UMOBILE technology buying it in order to provide innovative services.</td>
</tr>
<tr>
<td>Key Resources

UMOBILE Technology

UMOBILE architecture, software and apps.

Support services

Support and maintenance of the architecture, software or deployment.</td>
<td>Channels

Direct Marketing-B2B

Targeting customer segments (e.g. on line advertisement, workshops, etc.)</td>
</tr>
</table>

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Cost Structure	Revenue Streams
Fixed Costs -Personnel costs: developers of UMOBILE technology, personnel for deployment, maintenance and support services, etc. -Fixed cost of Hardware and software cost for development of platform. -Other general expenses such as renting and related infrastructure, financial, etc. Variable Costs - Variable Costs depend on number of customers, level (frequency and coverage) of maintenance and support needed. - Other general expenses like supplies	Fixed Revenue from selling/ licensing/ renting/ fixing and supporting UMOBILE technology Variable -Revenue sharing with operators, content providers and other entities respect to their sale growth. -Variable revenue related to support and maintenance services of UMOBILE technology.

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5.3. Business Canvas for UMOBILE Service Providers

A UMOBILE service provider is an entity that provides services developed on top of UMOBILE technology. It buys UMOBILE technology to a UMOBILE technology provider.

Table 3: Business Canvas for UMOBILE Service Providers

<table>
<tr>
<td rowspan="2">Key Partners

UMOBILE Service Providers.

They provide services that are built on top of UMOBILE technology. They can be operators that thanks to the technology purchased to UMOBILE technology providers improve their network. They can also be entities that acquire UMOBILE technology and build a new business case in order to provide services.</td>
<td>Key Activities

UMOBILE service providers buy UMOBILE technology to UMOBILE technology providers in order to provide services. They can provide the services to end customers or to other different entities.

UMOBILE service providers can, also, build new services on top of UMOBILE architecture and provide them.

UMOBILE service providers can provide the service and support.</td>
<td rowspan="2">Value Propositions

Providing UMOBILE services

UMOBILE service providers provide UMOBILE related services exploiting UMOBILE technology.

Deployment, maintenance and support services

Providing support services for the technology/architecture.

Enhancing UMOBILE technology

Building new services on top of UMOBILE technology.</td>
<td>Customer Relationships

Emergency Services

UMOBILE architecture is able to provide services to emergency services.

Smart cities

Smart cities can receive services in order to provide access in some parts of the city where there is not coverage or where the macro-cells are not enough.

Business

Business of all kinds such as restaurants or shops can be interested in the information generated by UMOBILE.</td>
<td rowspan="2">Customer Segments

End users

Emergency Services

Public administrations that manage this kind of services.

Smart cities

City councils

Business

Any kind of business</td>
</tr>
<tr>
<td>Key Resources

UMOBILE Technology

UMOBILE architecture, software and apps.

Support services

Support and maintenance of the architecture, software or deployment.</td>
<td>Channels

Direct Marketing-B2B

Targeting customer segments (e.g. on-line advertisement, workshops, etc.)</td>
</tr>
</table>

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	UMOBILE Services Services built on top of UMOBILE architecture and technology. They can be developed during the project or after it for a specific application.			

Cost Structure	**Revenue Streams**
Fixed Costs -Personnel costs: developers of UMOBILE technology, personnel for deployment, maintenance and support services, etc. -Fixed cost of Hardware and software cost for development of platform. -Other general expenses such as renting and related infrastructure, financial, etc. Variable Costs - Variable Costs depend on number of customers, level (frequency and coverage) of maintenance and support needed. - Other general expenses like supplies	Fixed Revenue from selling/ licensing/ renting/ fixing and supporting UMOBILE services Variable -Revenue obtained from the new services developed. -Variable revenue related to support and maintenance services. - Variable revenue that operators obtain thanks to the improvement of their networks.

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6. Exploitation plans per partner

In this section each partner provides its own exploitation plan in terms of products and/or services which can be provided by using the outcomes of the project. Each plan is structured as follows: a brief description of each company and an overview of the identified products and/or services are provided. After that, the exploitation plan and the already performed activities are described, together with the expected benefits of each identified solution.

6.1. ATHENA Research and Innovation Center

Company profile

The "Athena" Research and Innovation Center was founded in 2003 as the "IRIS – Integrated Research for the Information Society", in order to consolidate and further expand the Greek R&D activities and initiatives in the area of ICT.

The Unit of Environmental and Networking Technologies and Applications (ENTA), is located in Xanthi and is dedicated to promoting fundamental and applied research in all aspects of contemporary environmental and networking problems.

Research and Development

The research group under the supervision of Prof. V. Tsaoussidis has extensive experience in the area of Delay-Tolerant Networking, design and evaluation of protocols for challenging environments, such as near and deep-space, or opportunistic terrestrial networks.

Exploitation plans

Athena RC will advertise the UMOBILE platform and its results to interested parties, including local Civil Protection Authorities. To this end, video from the large-scale demo event, held in Umbria, will be used, as it is contextually relevant. Collaboration with national and international partners, including research groups, will be sought, with the objective to advance the UMOBILE platform via its deployment in other projects. To this end, internal funding will be used to organise meetings and short lectures, both in Athena RC premises and remotely.

Athena RC researchers, with their capacities as university professor and teaching assistants in Democritus University of Thrace, will add lectures related to opportunistic communications and the UMOBILE project in the "Compute Networks" syllabus. Similarly, opportunities will be provided to students in order for the latter to acquire hands-on-experience with the modules developed in the course of the project.

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6.2. UCL

Company profile

University College London (UCL) is one of the premier universities in the UK and has been consistently ranked in the top 20 universities in the world. In the area of communications research, the Electronic Engineering department's activities span areas across all the layers of the communication protocol stack, ranging from radio, optical coding and transmission through routing, resource control and traffic engineering up to content-centric and peer-to-peer networking, multimedia applications and network/service management.

The Communications and Information Systems Group (CISG) within UCL EE department has a long history and expertise in the networking area, which has been obtained through its participation in a number of research projects in the areas of QoS, network/service management, content-centric networking content distribution, virtualization and future Internet, in which it has had a leading role. UCL's relevance expertise is also testified through numerous prestigious publications and the high standing in the networking research community of the relevant academics who will be involved in the project. Examples of recent related projects are TEQUILA, MESCAL, CONTEXT, AMBIENT, MCDN, AGAVE, EMANICS, AUTOI, ENVISION, COMET and GreenICN. COMET together with GreenICN has been some of the most successful projects in the area of content-networking and ICN. CISG at UCL is currently running a UK-funded EPSRC project on "Active Content Management at Internet Scale" (COMIT), which focuses on a smooth migration path towards the shift to Information-Centric Networking. Dr. Ioannis Psaras has a personal EPSRC Early Career Fellowship, one of the most prestigious awards in the UK, to investigate the shift towards Information-Centric Networks and edge-/fog-computing.

Research and Development

UCL will bring into the project its expertise in content resolution and delivery in ICN environments, naming systems and architectures and optimal server placement for content distribution to remote regions. More in particular, UCL will work on naming, content resolution and replication/caching of content close to the users in an environment, where direct access to the origin server is not possible. This will be achieved through smart content naming that allows for sophisticated and efficient replication based on content names. UCL will also participate in the design of energy efficient algorithms for disaster-tolerant scenarios, where battery-limited mobile devices are the main carrier of content.

Exploitation plans

UCL is reforming its MSc modules to include Information-Centric Networking principles and related topics. We have allocated a dedicated slot on in-network caching, which we will update to include naming and addressing in Information-Centric Networks, as well as routing based on names.

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In terms of software, we are continuing the development of our *Icarus* simulator, initially developed for the GreenICN project. Icarus has received wide interest and attention from the community and we are therefore, continuing the extension of the simulation tool to include more functionality. We will soon be announcing a mailing list dedicated to issues related to the code, to attract further interest. We also plan to release the KEBAPP Android library. The KEBAPP library will offer an open API that any application will be able to use to enable shared computing between Android using NDN and WiFi Direct.

Expected benefits

We expect to produce high-impact publications in the area of Information-Centric Networks with a specific focus to mobile, opportunistic environments. We are already publishing high-quality papers, including papers in IFIP Networking 2016 and IEEE LANMAN 2016, where we also received the Best Paper Award. We hope that these papers will make an impact to the community and through our dissemination channels we will make the results of the UMOBILE project visible to the wider community. Recently, we also published papers in the ACM ICN 2017, creating impact with new contributions in the field of edge computing using ICN technology.

6.3. UCAM

Company profile

In this project, UCAM is a short name for University of Cambridge which is represented by the Networks and Operating Systems (NetOS) research group of its Computer Laboratory (Computer Lab, https://www.cl.cam.ac.uk).

NetOS is responsible for conducting teaching and research in topics including computer architecture, operating systems design, functional programming languages, network monitoring and protocol design, practical distributed systems and mobile communications. NetOS works closely with other groups of the Computer Lab and the University, as well as industrial partners such as Microsoft Research. The Computer Lab has an outstanding track record of start-ups and spinout companies. Likewise, it has motivated many large companies (for example Microsoft, ARM, Intel, Nokia, Broadcom) to base some of their main research laboratories and actual design teams in the area.

Directly involved in UMOBILE are members of the Networking for Development (N4D) research subgroup (https://www.cl.cam.ac.uk/~as2330/n4d/) which is included within NetOS and led by Dr. Arjuna Sathiaseelan.

In the N4D Lab we conduct research on understanding the fundamental challenges of providing universal Internet access and explore technological solutions to solve some of the challenges. One of our research threads is the development of technology that can be deployed ad-hoc in emergency situations such as those affected by natural disasters and social instability. As such we have gained a substantial body of knowledge and expertise in related topics including Information Centric Networking, Mobile Opportunistic Networking and Satellite Networking. Our focus is on the development of innovative, experimental technology that we deploy in realistic scenarios for further debugging and

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evaluation. Our aim is to produce open source technology for the benefit of the society, as opposed to exploitation by means of direct commercialization. We will observe this principle in the exploitation of our UMOBILE results.

Technology Development

UCAM will contribute to the UMOBILE architecture the following two technologies: **QoS mechanisms** based on monitoring and service migration and developing a low cost drone for delivering services in challenged environments. UCAM is currently developing the service migration functionality over the NDN platform with support for both push and pull services. This development will be one of the core services in UMOBILE architecture.

The drone prototype called the Cloudrone involves a lightweight micro cloud infrastructure deployed in the sky using indigenously built low cost drones, single board computers and lightweight Operating System virtualization technologies. Cloudrone will benefit from Information Centric Networking (NDN, specifically) to decouple the service from the location thus removing the need for the current end-to-end client server model such that the service and/or content can be served directly by any host that currently has the service/content. The integration of service migration with NDN will assist Cloudrone to perform such operations.

Regarding QoS mechanisms, UCAM is developing a service placement algorithm, called BASP (Bandwidth-aware Service Placement) that helps migrating services to enhance the QoS in challenged decentralized community networks. UCAM has carried out preliminary evaluations based on a small scale deployment in Guifi.net (which is the world's largest community network).

Exploitation plans

UCAM will firstly integrate the service level QoS mechanisms based on migration/edge computing and Cloudrone platform with the scenarios to be developed by the UMOBILE consortium as envisioned and documented in D2.1. This will serve as a preliminary test and an opportunity to measure and evaluate their basic features such as performance and scalability.

UCAM is currently trying to secure additional research funding to further develop, test, evaluate and exploit the QoS mechanisms and Cloudrone platform independently from outcomes produced by other UMOBILE partners and beyond the expectations of the UMOBILE project. At UCAM, we are already using the preliminary results of our QoS mechanisms and Cloudrone platform to apply for additional research funding to exploit our outcomes in situations where such technologies are needed to address actual problems. We have already submitted some funding applications and are preparing others.

In this order, we have a long record of research collaboration with Thailand (a developing country liable to flooding). For instance, we have helped them to build TakNet

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(http://interlab.ait.asia/TakNet/assets/player/KeynoteDHTMLPlayer.html), the first community network in Thailand and located in a rural village of the Northern region of the country. At the N4D Lab, we regard Thailand as an ideal deployment scenario to test, evaluate and exploit the outcomes of the UMOBILE projects, namely, the Cloudrone platform and QoS mechanisms. We are already discussing this possibility with the Asian Institute of Technology (AIT).

For instance and depending on the availability of additional funding, we will deploy the Cloudrone platform in rural areas of Thailand to perform regular environmental monitoring, build early warning systems and ad-hoc systems to support rescue operations. We have already made some progress in this direction. We have discussed with the AIT our interest in exploiting the Cloudrone in the emergency crisis such as landslide, tsunami. At the time of writing this D6.4 deliverable, discussions are ongoing with AIT team about using the Cloudrone and/or UAVs in the emergency scenarios.

In July 2016, Dr. Arjuna Sathiaseelan was invited to give a talk about Cloudrone technology at the Techfugees Cambridge conference. Following this workshop, we have been contacted by some organisations who work as volunteers in refugee camps including the camp in Calais (France - UK border) to discuss the potential deployment of the Cloudrone platform in refugee camps to provide Internet services to refugees.

For instance and subject to additional funding availability, we will help Actionaid organisation (https://www.actionaid.org.uk/blog/news/2015/12/14/on-the-front-line-of-the-refugee-crisis) to deploy the Cloudrone platform in one of the refugee camps in Greece like Kara Tepe, Moria, Sisto and Skaramanga or the Calais jungle in France (about 5 000 people, including 500 children) to provide Internet services to refugees. The idea is to use drones with embedded services that can fly between nearby cities and refugee camps carrying services from nearby cities to refugee camps and download them in local servers. We will provide these services with service migration facilities to re-locate them optimally to enhance QoE experienced by their users. The Cloudrone platform instrumented with service migration mechanisms will support crucial services such as education contents, healthcare, social media, etc.

Likewise, drones will carry data (content) in both directions, such as news, films and educational material.

Depending on additional funding availability, we will deploy the QoS mechanisms in actual network such as the Guifi.net (https://guifi.net) community network to test them in actual working environment and to enhance the QoE (Quality of Experience) of guifi.net users. Guifi.net is currently the largest community network in the world and includes approximately 31 000 nodes.

In addition to producing research technology, the mission of UCAM is to train students and new researchers. In pursuit of this goal, we are already using the drone based application and QoS mechanisms mentioned above to train students from India (a developing country) who are currently visiting the N4D Lab for internships to collaborate with us in the building of the drones and the drone application

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(https://www.youtube.com/watch?v=cJjrxbB3mV4&feature=youtu.be) and QoS mechanisms such as service migration.

In the same order, in March 2016, UCAM and T/ICT4D Lab, The Abdus Salam International Centre for Theoretical Physics (ICTP) organized the Workshop on new Frontiers in Internet of Things at the International Centre for Theoretical Physics in Trieste, Italy. In this workshop, we already use our expertise in Information Centric Network technologies (e.g., NDN, PURSUIT), light weight virtualization technology (e.g., Docker), service migration, community network as well as the suitable platform for IoT (e.g., raspberry Pi) to train practitioners, researchers, engineers and regulators from several developing countries including Africa, Asian and South America. Figure 1 shows our activities during the trading session. The goal of the workshop was to transfer both our technologies and knowledge to the participants in the hope that they will deploy our or similar technologies in their countries. After the workshop, we have been working closely with some of the participants. For example, we have advised the Tunapanda Institute (http://www.tunapanda.org) in the deployment of a community network in Kibera, Kenya, to provide people living in slums with internet connectivity to gain access to educational content from their neglected houses. Another outcome of the workshop is the establishment of a collaboration link with regulators from Mozambique: they have expressed interest in using edge computing based applications to be deployed on their TV white space. In particular, we have been discussing the potential implementation of a micro data centre using a swarm of Raspberry Pi and Docker to create the regional database of TV whitespace. We emphasize that, these technologies are the same as those used in the Cloudrone platform; consequently, we will re-use and exploit them in a different scenario.


Figure 6: The training sessions lead by UCAM during the Workshop on new Frontiers in Internet of Things at the International Centre for Theoretical Physics in Trieste, Italy

To make our research results widely available, we publish and present them in international leading venues such as ACM ICN and AINTEC where we have won best paper awards. We hope that our findings will motivate the industry and research communities to exploit our results directly, that is, using the same solutions or inspire the development of new ones.

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Expected benefits

The deployment of the drone application would benefit a large section of the population of Thailand that regularly suffers from natural disasters. For instance, in 2011 alone, floods and landslide affected more than 2 million people. Similarly, the deployment of the QoS mechanisms in the community networks of Thailand would benefit 300 people. We clarify that Thailand is an attractive scenario for the deployment of our technology because it is a developing country with a population of 67 million where 50% of the population do not have Internet access. We expect that collaboration with the Asian Institute of Technology (AIT) not only accelerates the testing and experimentation capabilities of the UMOBILE project but also opens up opportunities for stakeholder engagement, specifically with local councils concerned with benefits and impacts of technologies developing under UMOBILE's project.

The deployment of the QoS mechanisms in Guifi.net would benefit community network of approximately 31000 nodes. We intend to use service migration platform to migrate the service like video streaming and disk storage in the real community network while extensive experiments and evaluations will be carried out. The outcome of this evaluation will provide the better quality of service to the users in the community network and create a new business model for Guifi.net.

A potential deployment of the Cloudrone platform in refugee camps will benefit thousands of refugees. For example, it is known that at its peak, the refugee camps in Greece were home to thousands of migrants. Similarly, the Calais jungle in France is home to 5 000 people, including 500 children. We show these figures only as examples to support our arguments, sadly there are other refugee camps with larger populations and similar needs.

6.4. COPELABS

Company profile

COPELABS is a research unit of University Lusófona, Lisbon, Portugal, focused on the interdisciplinary study of cognitive functioning, social interaction and behaviour inference, to assist the study of networking and information science technology, as well as to support a better use of technology towards society. The ultimate goal of this dual approach is to promote societal well-being.

Our mission is to design, develop, and validate pervasive, low-cost, and user-friendly technological solutions that are both useful in the context of psychological and cognitive intervention as well as capable of placing the citizen in the heart of the social structure that today encompasses the Internet. Overall, COPELABS comprises 27 researchers, 16 of each hold a PhD and have wide experience on project management and European initiatives. COPELABS integrates UMOBILE with the SITI group that is dedicated to

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informatics systems and technology; focus on pervasive wireless systems and social Internet design.

As research unit, COPELABS has a vast experience both in project development as well as in European project coordination, having been the most recently example of a coordinated project the FP7 IST ULOOP (gr 75148. Projects where COPELABS have previously been involved are: WiNeMo Cost; FP6 Ambient Networks; FP6 NOBEL II; FP6 6NET. COPELABS is an affiliate of the network of excellence on Internet Science, and actively engages in several technological platforms, such as the Future Internet Assembly, Net!Works.

Our list of results is openly available at: http://copelabs.ulusofona.pt/scicommons/.

Product overview (value proposition)

The outcome of the UMOBILE project will consolidate the international position of the SITI group of COPELABS, in the research field of opportunistic networks and data-centric networking. At the end of the UMOBILE project, COPELABS will be able to enforce its international position by providing scientific solutions based on social trust computation and social-based and interest-based communication approaches.

Exploitation plans

COPELABS aims to extend its expertise on opportunistic networking as well as information centric networking by actively contributing for the adaptation of ICN paradigms, such as the Named-Data Networking (NDN) to operate in challenges networks, where data is exchanged by exploiting the communication opportunities created by wireless contacts among mobile devices.

COPELABS aims to benefit from the lack of contributions by the international scientific community to extend NDN operation over challenged networks, leading to several research topics to be investigated and creating significant collaboration opportunities among European institutions. Within COPELABS exploitation plan we may highlight the goal of strengthening the scientific ties between Europe and the United States of America, where a big investment on the Named-Data Networking architecture is being made.

In particular, COPELABS plans to exploit UMOBILE solutions in three ways:

- Develop new European collaborations aiming to exploit the integration of NDN and opportunistic networks to develop new solutions in the area of Internet-of-things.
- Contribute to the international scientific community by developing open-source tools and applications able of boosting the communication among people without relying on the presence of network infrastructure.
- Exploit UMOBILE architecture as a starting point to participate in more research proposals and projects at European level that are not focused only on ICN.

As a research unit associated with University Lusófona, we aim to make an UMOBILE prototype and test-bed available as a research lab to support practical courses of the

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informatics department. Moreover, our expertise in the UMOBILE project will be used to update the pedagogical content of some courses of the NEMPS PhD program on New Media and Pervasive Systems.

COPELABS started already the execution of the proposed exploitation plan based on the following activities:

- Inclusion of the developed prototype and open-source code related to NDN-OPP (NDN for opportunistic wireless networks) and the associated applications Oi! for short messages and Now@ for data sharing in the NEMPS PhD program at University Lusófona, namely at the curricular unit of Pervasive Communication Systems. The mentioned prototypes will be integrated, starting in the 2018/2019 academic year in other courses of the Master program in Computer Engineering and Information Systems.
- The developed prototype is also made already available to all PhD students that are developing their PhD thesis proposals in the current academic year.
- The developed prototypes (NDN-OPP, Oi! and Now@) were already open to the international scientific community via Google Play and GitHub. These prototypes were already presented in major international events such as ACM ICN 2017 in Berlin, and IETF meeting 101 in London. They will still be presented this year in the ACM Mobisys 2018 conference in Munich. After what the plan is to intensify the dissemination of the developed prototypes in other events such as IETF 102 in Montreal, other international conference (to be selected) and near COPELABS industrial partners.
- COPELABS is already developing a plan to submit a new European project proposal in which the outcome of the UMOBILE project will be used. Such proposal will be submitted until April 2019.
- In scientific terms, COPELABS is starting to exploit the outcome of the UMOBILE project in other areas, such as to support the development of solutions for distributed Edge Computing systems. A first presentation was already done in the meeting of the Decentralized Internet Infrastructure research group (DINRG) of IRTF in the IETF 101 meeting in London.

Expected benefits

We aim to expand the outcomes of UMOBILE project to the society with various partners, namely in the field of mHealth. This will be done in the context of a new COPELABS laboratory called Proxemics Data Lab. Within this laboratory we are working on behaviour correlation/inference via pervasive, non-intrusive technology as the one being developed within the UMOBILE project. The outcome of the UMOBILE project will support COPELABS work in two main areas: community/group dynamics and early detection of

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neuro/psychological disorders. One example is the usage of opportunistic networking solutions to study the proxemics effect in social cohesion and support.

6.5. TECNALIA

Company profile

Fundación TECNALIA Research & Innovation (Tecnalia) is a private, independent, non-profit applied research centre of international excellence. Legally a Foundation, Tecnalia is the leading private and independent research and technology organisation in Spain and one of the largest in Europe, employing 1,378 people (164 PhDs). TECNALIA is committed to generate major impacts in economic terms, by means of innovation and technological development, addressed by 7 business divisions, covering economic sectors of Energy, Industry, Transportation, Construction, Health and ICT. TECNALIA has been granted over 250 patents and promoted more than 30 spin-off companies.

The Industry and Transport Division of TECNALIA participates in this project. This division is focused on the design, manufacturing, maintenance and end-of-life of industrial products and services, for the improvement of its clients' competitiveness in the following strategic sectors: foundry and steelmaking, machine-tool, automotive, aerospace, aeronautics, railway, construction, and de-manufacturing and food industry. Actually, the business area participating in the project is the Smart Systems area, which focuses its activity on:

- Data analytics smart solutions development as support for decision-making systems
- Indoor location and tracking systems for people and assets, based on hybrid wireless technologies and protocols
- Instrumentation and data acquisition systems for industrial machinery and goods
- Condition-based monitoring solutions for maintenance and products lifecycle management
- Digital factory: production monitoring, optimization and optimal process control
- Industrial safety and risk management systems
- Energy efficiency solutions focused on consumption prediction models and decision making support tools

TECNALIA participates in the High Level Group of European Technological Platform for Researching in Manufacturing (ManuFuture), coordinating the multi-annual work plan for the "Factories of the Future" JTI/PPP (Dr. Rikardo Bueno); and is represented in the executive board of the European Technological Platform for Researching in Robotics (EUROP), in the board of the European Robotics Research Network (EURON) and in the Advanced Research & Technology for Embedded Systems (ARTEMIS). Tecnalia participates also in the following Platforms: European Technological Platform for materials (EUMAT), European Association of Automotive Centres (EARPA), Intelligent

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Transport Systems Platform (ERTICO) and European Association for Sustainable Process Industry through Resource and Energy Efficiency (A. SPIRE Aisbl). TECNALIA is member of the European Association of Research and Technology Organisations (EARTO) and its Special Interest Group EUROTECH.

Product overview (value proposition)

TECNALIA performs Technology transfer to companies either via public funded projects (e.g. more than 264 participated European projects) or via private contracts. Additionally, TECNALIA has an organizational structure called VENTURES, to support the creation of Start-ups, entrepreneurship, business angels' networks, etc., and an instrument called Inspiring Business Forum (IBF) with associated organizations to promote innovation.

TECNALIA's main outcome from the work developed within the UMOBILE project has been the implementation of a modified Android daemon, which allows DTN based communications by establishing a bridge between NDN and IBR on the same Smartphone. This enables each personal device (i.e. individual Smartphone) to act as a comprehensive node hybridising both environments: the information centric and the disruption tolerance awareness. TECNALIA is expected to exploit this UMOBILE outcome, by organizing, analysing and reusing all derived knowledge and experience within the context of next generation smart systems and solutions for several domains. It is envisioned that the work developed can be applied in diverse forms to some assets within the Smart Systems business unit.

As an applied research centre, TECNALIA can use different approaches in order to exploit the results derived from the work performed in the UMOBILE project:

- Royalties and licenses: being one of the missions of TECNALIA to transfer knowledge and innovation to companies, the results could be exploited by the creation of patents that can be licensed to third part companies.
- Services portfolio: the results and knowledge that TECNALIA acquires through the project UMOBILE will be included into the services that TECNALIA offers to advanced engineering companies, mainly in the regional scope but also at European level.
- Creation of spin-off companies: TECNALIA expects that a technology-based spin-off company can be created in order to exploit and further develop the product family of location and tracking solutions under development, and improved by knowledge originated within the project.

Technical developments will be integrated quickly into its research agenda giving to TECNALIA a competitive edge compared to other research institutions.

Exploitation plans

TECNALIA is the first leading private and independent research and technology organization in Spain. Tecnalia, performs Technology transfer to companies either via public funded projects (e.g. more than 264 participated European projects) or via private

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contracts. Additionally, TECNALIA has an organizational structure called VENTURES, to support the creation of Start-ups, entrepreneurship, business angels' networks, etc., and an instrument called Inspiring Business Forum (IBF) with associated organizations to promote innovation.

TECNALIA is expected to exploit the UMOBILE smart routing techniques, organizing and analysing all existing knowledge and experience within the context of next generation smart systems and solutions for several domains.

As an applied research centre, Tecnalia can use the different approaches in order to exploit the results derived from the work performed in the UMOBILE project:

- Royalties and licenses: being one of the missions of Tecnalia to transfer knowledge and innovation to companies, the results could be exploited by the creation of patents that can be licensed to third part companies.
- Services portfolio: the results and knowledge that Tecnalia acquires through the project UMOBILE will be included into the services that Tecnalia offers to advanced engineering companies, mainly in the regional scope but also at European level.
- Creation of spin-off companies: Tecnalia expects that a technology-based spin-off company can be created in order to exploit and further develop the product family of location and tracking solutions under development and improved by knowledge originated within the project.

Expected benefits

The main outcome that TECNALIA obtained from the UMOBILE project is the development and implementation of a hybridization framework to provide a personal end-device (i.e. Smartphone) with the capability of creating and exposing DTN based communications from an ICN-aware daemon. This allows multiple application fields, from identifying offloading mechanisms in certain strategic services, to extend the device-to-device opportunistic capabilities already being explored within the digitalization process of industrial sectors. This valuable outcome can be further evolved and incorporated into a former research area within the Smart Systems Business Unit. Obtaining a system at TRL 6 by the end of the UMOBILE project, has positioned TECNALIA in an optimal situation to gain and retain its relevant role as innovation partner for many client and partner companies in the Basque Country eco-system. This position will foster TECNALIA's importance among its partnerships at European and international levels.

With the aim of transferring value to the society through innovation and technology, the Telecom and Electronics team shows a high degree of specialization and focus on: ad-hoc embedded hardware design and prototyping, multicore computing, advanced FPGA-based design, indoor location solutions based on hybrid wireless technologies, sensor and actuator networks, Radio Frequency (RF) design and GNSS RF-Frontends among others. The Telecom and Electronics team provides a response to market and research demands in terms of capacity and velocity, competence, critical mass, qualified professionals,

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equipment and anticipation to technological changes. The expected benefits for this team within TECNALIA could be summarized as:

- Integration of results into localization and tracking product line
- Expertise in social interactions applied to user safety and quality of experience
- Interworking with companies to trigger innovative products via knowledge transfer
- Digitalization of industrial processes and activities

6.6. TEKEVER

Company profile

TEKEVER Autonomous is an SME, Original Equipment Manufacturer and provider of unmanned systems, in air, land and sea, tailored for the security, aerospace, civilian and commercial markets. TEKEVER Autonomous System was founded in 2007 as a spin-off of the TEKEVER Group activities in the robotic market and, as part of TEKEVER Group; it jointly explores and benefits from the group implementation worldwide. TEKEVER activities are product-driven and significant investment is dedicated to research activities leading to innovative technologies, in different fields, from flight control, payload exploitation, automatic planning to image processing, analysis and image features tracking. TEKEVER targets its markets in close collaboration with customers and establishing important partnerships to bring technology to a mature operating level and promote technological readiness driven by the market needs.

With subsidiaries in Europe, Asia, the United States and South America, TEKEVER leverages innovation technology, ensuring an unprecedented advantage to its clients and partners throughout the World, being based out of Portugal. TEKEVER has significant experience in collaborative research (FP6, FP7, ESA, EDA) having coordinated eight FP7 projects and one H2020, and participated in numerous other European projects.

TEKEVER Autonomous Systems personnel are involved in several civil organization networks addressing the problematic of UAV's integration in the market, contributing to the development of standards, like EUROCAE. TEKEVER Autonomous Systems is also member and leading company of the R&D work group of the Portuguese FEEM organization, a hypercluster organization for the Economical Sustainable Sea Exploitation that aggregates industry, research centres, universities and governmental institutions acting in different sectors, from fishing to production, security, energy, biology and naval domains.

In UMOBILE, TEKEVER AS is mainly involved in the validation and testing of UMOBILE prototypes, especially through the demonstration of their possible operation in Unmanned Aerial Vehicles (UAV). In addition to defining the validation exercises and associated KPI to be measured, TEKEVER AS will be integrating UMOBILE enabled

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communication systems on unmanned aerial platforms, providing, operating and deploying these platforms in validation exercises as backhaul add-ons and data mules.

Product overview (value proposition)

The Air Ray Systems are the main products of TEKEVER Autonomous Systems. Air Ray Systems have been extensively and successfully field tested and battle proven by multiple Armed and Security Forces. From 4.000m+ mountains to active volcanos, Air Ray systems have been through the hardest operational conditions, assuring resilience and readiness for any type of situation.

TEKEVER Air Ray systems are designed to be simple to operate while delivering the highest performance. Simplicity lowers the amount of training required, with operators typically trained in less than one week, and helps delivers the best results in under pressure conditions. The Air Ray systems offer a wide array of payload types, including multiple types of EO, IR and thermal sensors, LiDAR, Radar or SAR. Additionally, and to provide the best operational support, all systems provide multi-platform support for system control and payload exploitation.

Communication relay is considered one of the core missions for TEKEVER systems: connectivity is provided for ground forces, support operations "over the hill" and support local forces (Foot soldiers and vehicles) with a local connections link or satellite link. Delay Tolerant Networking technologies have also been implemented in TEKEVER systems. However, current communication relay capabilities are focused on security and military scenarios. UMOBILE is an opportunity to extend the Air Ray system capabilities to missions with harsher requirements from the communications point of view, such as civil protection, emergency or social networking, enablement of connectivity to crowds, etc. Hence, UMOBILE will contribute to extend the set of Air Ray possible missions, opening the doors to other markets besides defence and security, such as civil, entertainment or the Internet of Things.

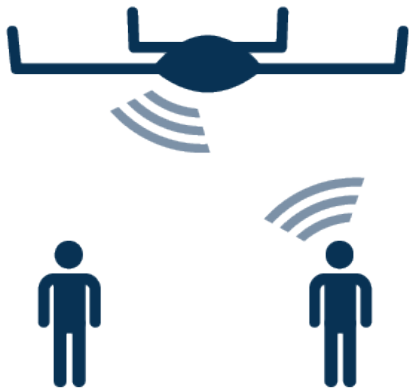

Figure 7: Air Ray Communication Relay

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Exploitation plans

The Air Ray Systems are fully developed in house by TEKEVER, from radios and flight controllers to structures. Hence, TEKEVER possesses the know-how to fully exploit the capabilities developed in UMOBILE, designing a path to market, through their integration in the current line of products, adding new capabilities and consequently opening new market opportunities. For that purpose, TEKEVER expects to:

1. Mature the developed technology in the short term, improving it with knowledge that arises from the test campaigns, and ensuring the best adaptation to the company's line of products;
2. Test, validate and demonstrate the technology with different devices, in the short/medium term, in operational environments to be defined as strategic for the Air Ray Systems;
3. Transfer the knowledge from the research teams into the delivery teams, integrating, implementing and qualifying the developed capabilities into TEKEVER's systems;
4. Operation of various UAVs flights in order to analyse the performance of the systems and the functioning of its implementations, which was accomplished with the planning of the UAV demo and instructing respective participants;
5. Demonstrate and commercialize the results, elaborating technical documentation and include the development of a marketing-business case plan.

Expected benefits

TEKEVER Autonomous Systems expects to benefit from the UMOBILE results through the addition of value to the company's Air Ray line of UAVs. This incorporation of innovation will expectedly increase revenues via:

- Current and new customers in markets, such as military and security entities, that could find value in increased Delay Tolerant Networking capabilities and Communication Relaying using UAVs;
- New customers in markets such as entertainment and media, civil protection, Internet of Things, commerce, industry and services, where UMOBILE related capabilities will possibly enable the successful introduction of TEKEVER products.

6.7. SENCEPTION

Company profile

Senception is a Portuguese SME focused on the development of a software-based core engine to stimulate communication and interaction between people, PerSense™.

We cherish the vision of improving the daily routine of citizens via the development of user-friendly telecommunications and interaction technology. We build such vision via

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the application of our core engine PerSense in different vertical markets. Currently Senception is addressing 2 different vertical markets: family and schools, and local commerce.

Senception's products have as value-add non-intrusive behaviour tracking and inference of user preferences as well as of social roaming habits. Our solutions are software-based, and available in the most used operating systems.

Senception incorporates a team that is strongly based on industrial research, being currently involved in several industrial research activities.

Product overview (value proposition)

PerSense™, currently in Technology Readiness Level 7 (TRL 7), is a software-based communication and interaction platform with three main features: i) **stimulation of interaction** via learning and inference of daily routine context ("How was your day?"); ii**) contextual notifications/data exchange** within trusted circles ("let's share this memento!"); iii) **secure communication** anywhere, anytime (instant messaging, video calls). We do this with low cost technology that can be easily installed in personal clouds, smartphones, and embedded technology (with the capability to use Wi-Fi). The key concept applicability is protected by an IPR licensed with exclusivity (IPR EP 13186562.9).

PerSense aims at creating a new market trend based on services concerning not only communication, but also interaction. Technically, PerSense is based on two main software components: the manager, and a mobile application, tailored to different vertical markets. As software modules, both components can run on the same device or on different devices.

Our three core value propositions are: **price**; **usability**; **pervasiveness**. Customers are expected to buy a low-cost and yet innovative technological solution, derived from the most recent scientific and technological advances in next generation internet communication, and yet pragmatic enough to be accessible by a non-technical enabled user, without the need to have particular service support. PerSense low cost as well as its flexibility are key aspects which make it a pervasive technology. A third key aspect of PerSense is the capability to perform estimation of future doing based on learning of activities recognized. The third key aspect is the adaptability to future scenarios, derived from the software modularity it integrates. Being a strong believer in research and innovation, Senception offers to specific partners, in the context of industrial research, the possibility to explore light versions of its products, in the context of research.

Exploitation plans

Senception is currently integrating (2018) aspects derived from learning concerning contextualization and direct communication between people, derived from the work and learning performed in UMOBILE into its product PerSense. Context-awareness, learning from roaming habits, similarity in interests, as well as device availability over time and space are relevant aspects that shall be integrated into PerSense T-Kiddo Premium

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(vertical market for families and schools, B2C), as well as into PerSense Ddicas Premium (vertical market for local commerce, B2C and B2B). Both these products are expected to be launched still in 2018.

The learning derived in the course of UMOBILE, in the tools PerSense Mobile Light as well as in the open-source Contextual Manager module, have assisted Senception in improving several operational aspects of its products, ranging from security aspects, to better communication models.

Senception is also exploring, for 2019, the use of the information-centric routing paradigm (DABBER) and direct communications. The integration of these features is expected to start in 2018 and to be concluded in 2019. Such features assist Senception in reaching new markets (e.g., tourism).

Expected benefits

The work developed in UMOBILE is relevant from an exploitation perspective, as it assisted Senception in evaluating other types of vertical markets (e.g., tourism), while at the same time improving the product to serve the current selected markets.

The project findings are also relevant from an exploitation perspective, as they assisted Senception in expanding potential partnerships, where Senception's products can be seen as a differentiating service, for instance, for WISPs.

UMOBILE has already assisted Senception in reaching a quicker time-to-market as well as in understanding limitations derived from the operational, realistic nature of the proposed technical solution (e.g., battery limitations; intermittent connectivity; security and privacy). These are aspects that are crucial to better understand the potential of the core engine in our selected markets, and to explore new ones.

We are already working to explore the findings into strategic partnerships (e.g. with WISPs, with shopping malls, with municipalities).

6.8. FON

Company profile

FON is a company founded in 2006 by entrepreneur and Internet pioneer Martin Varsavsky with the goal of blanketing the world with WiFi that is free for everyone. Even though it is an SME, it has more than 21 million hotspots across the globe and partnerships with leading operators. This currently makes FON the world's largest WiFi network. In addition to operate its WiFi networks, FON develops its own technology, which includes among others: WiFi access points, service platforms and mobile apps.

After several years operating WiFi networks and developing its own technology, FON decided to sell also its technology to other entities and operators apart from its community WiFi partners. In 2018 FON has launched two commercial brands in order to exploit these two business models.

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Fontech, the technology arm of Fon and leader in WiFi software, makes managing and operating WiFi smart and simple for operators and enterprises. Our software-based solutions and team of experts empower our clients to deliver carrier-grade WiFi services in a secure, scalable, and uniquely flexible way, enabling an exceptional WiFi experience for their customers. We are the trusted WiFi software provider to top-tier global telcos and enterprises such as the Deutsche Telekom Group, SoftBank, Telstra, and Vodafone Group.

Fon is the global WiFi network. We pioneered residential WiFi sharing over a decade ago and, together with leading telcos, we've built the world's largest WiFi community of over 21 million hotspots. We are experts in keeping people seamlessly connected by aggregating residential and prime public WiFi footprints, as well as facilitating interconnection between WiFi networks. Our global clients include AT&T, British Telecom, Eurona, KPN, Proximus, Travel Club, and Virgin Mobile.

In UMOBILE, FON provides expertise as WiFi network operator. In particular, FON participates in the definition of user requirements, system and network requirements and system deployability design in order to ensure an appropriate integration of the UMOBILE platform into the FON WiFi network. Moreover, FON leads the definition of the validation setup of UMOBILE and deployment trial activities. Furthermore, FON contributes in the preparation of the proof of concept used during the validation tasks of this project. Finally, FON also leads the exploitation task as a representative of the industrial partners.

Product overview (value proposition)

One of the FON's main products and, maybe, the most famous one, is the community WiFi. FON signs agreements with operators so they can provide community WiFi service to their subscribers including FON's functionality in the CPE (Customer Premise Equipment) that they install in users' premises. This way, users are able to connect to any of the access points that propagates FON's signal all over the world without regard to the operator. The main value proposition that FON offers to mobile operators with this product is offloading between cellular network and WiFi network. Users receive an added value service as they are able to have Internet connectivity all around the globe.

However, this traditional offloading (i.e. from cellular to WiFi networks) is no longer sufficient to cover current and future scenarios. For example, it has been also unable to cope with crowded scenarios (e.g. stadiums) since Wi-Fi networks end up suffering from similar congestion symptoms than cellular networks.

UMOBILE has identified those scenarios and proposed a solution that solves the connectivity problems by combining different technologies. UMOBILE is an opportunity for FON to improve the community WiFi product, i.e. the offloading value proposition, that the company currently offers with an innovative complement for certain scenarios that cannot be properly covered by current solutions.

During the project, FON is working on the integration of UMOBILE platform into its network. FON may opt to convert access points to UMOBILE access points in order to offer

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a more complete offloading value proposition to operators. Regarding the app for the users, FON may offer UMOBILE's app in a first step and may integrate the functionality in its app if the operator wants a more complete user experience.

On the one hand, FON will keep on targeting telecom operators by offering a more complete offloading method applicable to previously uncovered scenarios. On the other hand, new markets may be opened for FON by offering UMOBILE related services to specific venues (e.g., stadiums) or municipalities.

During the project, as mentioned before, FON has launched a new commercial brand to start providing also WiFi technology to third parties. This is a good opportunity for UMOBILE solution and for FON as it can include some of the technology developed in the project in some of the products that it is providing currently. Device to device communications and service migration are, probably, two of the most interesting technologies for FON products currently.

Exploitation plans

FON develops its own technology, which includes access points, mobile apps and frontend and backend systems. Moreover, apart from operate WiFi networks thanks to this own technology, FON takes advantage of it to create products and services that are provided to third parties. Thereby, FON currently has the capabilities of "productising" a UMOBILE solution, taking as a starting point what is being developed during the project.

FON plans to go for the following phases to ensure proper project exploitation:

1. *Knowledge transfer from R&D unit to development units and business / marketing departments*: FON R&D unit will arrange and lead internal meetings to share UMOBILE concepts, project results and potential opportunities. Several presentations have been already arranged during the project.
2. *Identification of functionalities and value propositions*: Jointly with business and marketing units, features and value propositions derived from UMOBILE and subject to be integrated into FON services will be identified. Business case simulations covering the main value proposition have been performed. Those are also related to FON's current offering.
3. *Operator partners and other potential customers' feedback collection*: after value propositions identification, a process of feedback collection will be initiated to ensure that current FON operator partners perceive value on UMOBILE derived features. This feedback collection may also include new potential customers like venues or municipalities. Initial value propositions will be shaped by considering the collected feedback.
4. *Development and productisation*: reaching this phase means that a bundle of UMOBILE functionalities have been chosen for development, implementation and productisation into FON existing technology. An engagement with device vendors or OS providers may be required in this phase.

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5. *Pilots and commercial launch*: final phase before commercial launch will cover a bundle of pilots with the aim of debugging pre-commercial versions of the solution and collect additional feedback.

Expected benefits

UMOBILE opens opportunities in terms of new products and services. These new products and services could potentially provide new revenue streams by:

- Targeting current customers (i.e. operators) with an extended offer regarding offloading. Alternatively, UMOBILE service could be also incorporated into current business model as a value-added service with no additional cost for the operator in order to improve customer retention and satisfaction.
- Targeting new potential customers (e.g. venues, municipalities). Business models can be implemented into offers that include UMOBILE platform use, UMOBILE platform integration services or UMOBILE terminal functionality licensing.

6.9. AFA

Company profile

AFA Systems SRL is an ICT SME, specialized in network solutions and advanced IP communications, based in Termoli (IT), with branch offices in Italy. The permanent staff has high qualifications and skills (master degrees and PhD) in information engineering, software engineering, computer science, economics, marketing, with different backgrounds ranging from network solutions to video-surveillance applications, biometrics systems and multimedia security. The company applies a comprehensive Quality Management System based on ISO 9001:2008 standard, in full compliance with international standards, using the most advanced equipment.

With its talented team, AFA Systems develop highly innovative projects in two interrelated and completing business units:

- AFA Industrial (production of a range of integrated IP platforms, for unified communication, IP security and VoIP, called MajorNet®).
- AFA Engineering (networking projects and system integration).

The Industrial business unit produces the MajorNet platform, a range of systems providing a complete set of IP services, from unified communication to local web-storage, demanded by business users, SMEs, public entities, schools, etc. The MajorNet platform aims at catching the massive market opportunity created by low cost broadband Internet access that generates demand for sophisticated, reliable, integrated and easy-to use IP services. MajorNet is distributed through a network of channel partners; there are currently thousands of MajorNet users, growing rapidly.

The Engineering business unit designs and installs large-scale wireless networks, telecommunication systems, video-surveillance systems and advanced IP networks, integrating the company's own infrastructures with the Telcos' infrastructures; over

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those heterogeneous IP networks, a general result is to grant a high "end to end quality". The company currently operates many wide area networks (mainly wireless), from its dedicated NOC (Network Operations Center).

Product overview (value proposition)

The current key points of the MajorNet platforms are the capability to cover a wide number of use cases and users' needs on the basis of a defined set of network models, in cost-effective way and with user-friendly configuration procedures.

The UMOBILE outcomes will directly increase the value of the MajorNet platforms. Whereas at the moment the MajorNet platforms are inherently a network element at the customer premises, the application of the UMOBILE logical modules from ICN and DTN will make the MajorNet platforms an element of the network infrastructure itself. A similar result will be produced by the adoption of the service migration paradigm, defined and studied during the UMOBILE project.

The MajorNet platforms will gain the role of smart UMOBILE-sed WiFi access points and in-networks smart service execution gateways (SEG), which run services pushed at the network edges. New applications will be covered where the MajorNet platforms will act as in-network-caching elements, dynamically hosting contents and services on the basis of the users' interests.

Exploitation plans

To pave the way and then support real deployments, AFA Systems has designed the UMOBILE Lab as a complete testbed for both the network devices and user devices (e.g. smartphones). With a remote access to the UMOBILE Lab, each partner of the Consortium is now able to upload new software modules and test functional architectures; the AFA Systems personnel will assist and operate if a physical connection needs to be modified.

AFA Systems plans then consist of starting to convert some of its wireless networks, based on the MajorNet platforms to the UMOBILE architecture. This is a way to exploit the UMOBILE components (AP, SEG, apps) as well as the UMOBILE architecture, as agreed during the early stages of the project (for naming, forwarding, routing storing).

The ultimate target of such transformation, will be aimed at:

- deploying of new networks, from private and public greenfield environments, based on the AFA MajorNet platforms exploiting the UMOBILE architecture;
- upgrading of such existing MajorNet networks, in accordance with the UMOBILE concepts, where needed;

Different categories of users have then been identified to be addressed by the UMOBILE applications:

- Very large groups of users, gathered in the same areas for specific, ‘opportunistic’ reasons, (e.g. sports events and music concerts, airports and train stations), where the UMOBILE communications peculiarities will allow people to overcome

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congestion and overload issues and exchange live information (text, pictures, videos) with other neighbouring users in the same area;

- Communities of people, belonging to the same organization (e.g. schools, universities, hospitals, hotels and resorts), where both the huge number of concurrent users and the type and size of running applications (e.g. video lessons) create a strong demand of connectivity and where the UMOBILE protocols can be effectively applied;
- Teams of people with the same mission and tasks, such as Fire Brigades, Rescue Teams, Army Organizations, etc., where communication has to be assured even in extreme contexts such as, for instance, after catastrophic events.

One of the most significant examples of exploitation of this latter concept covers the Civil Protection needs, specifically in those countries and areas where people have been mostly affected by such kind of disasters (earthquakes, fires, flooding, …).

To this aim, AFA has then taken the lead within the UMOBILE Partners, to address some of the Italian Civil Protection Agencies, to design and deploy applications of the UMOBILE outcomes for rescue and recovery purposes.

The UMOBILE Final Demo, held in Foligno (Umbria, Italy) for CRPC (Civil Protection Agency in Umbria), one of more seriously affected areas by the latest earthquake in 2016), on 17th, 18th April, 2018, represents not only the first relevant and tangible exploitation of the UMOBILE concepts to the Civil Protection context, but also the first event which will be replicated over several other Regional Agencies in Italy and, possibly, the other Countries of the UMOBILE Partners.

Expected benefits

At the end of the UMOBILE project, we have achieved to demonstrate a system prototype in operational environment during the Final Demo.

Next challenges will then consist of:

- Consolidating and Upgrading the Civil Protection case, by migrating the UMOBILE applications over the MajorNet platforms;
- Extending the UMOBILE concepts to other 'verticals', such as Public Administration and Large Private Organizations.

This is a promising starting point to extend the current application domain of the MajorNet; the platforms have started gaining unique characteristics improving the competitive position of both the product and the AFA Industrial business unit.

With the UMOBILE experience, the AFA Engineering business unit has innovated its principles of the network design, renewing its technological leading position. On the basis of both the UMOBILE systems and architecture, the company has started enriching and upgrading its portfolio of solutions offered to both private and public organizations.

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7. Conclusions

D6.4 provided in month 18 a draft version of the exploitation plan. This exploitation plan is updated in this report, D6.9. Some of the information included in this document is an update of the information included in D6.4.

We have clearly described the current situation of the sector together with the identification of the emergent trends. In addition, this information has been revised since D6.4 and updated in this document.

Same approach has been followed for Sections 3, 4 and 5. They have been revised in detail for this document updating, if necessary, the information provided in D6.4.

Section 6 is the section with more substantial changes. All the partners have better specified and addressed their exploitation plans considering the final definition of the UMOBILE solution.

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8. References

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[2] Gartner Networking and Communications Hype Cycle 2015

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