Action full title:

Universal, mobile-centric and opportunistic communications architecture

Action acronym:

UMOBILE

Deliverable:

D6.6“Standardization Plan”

Project Information:

Project Full Title	Universal, mobile-centric and opportunistic communications architecture
Project Acronym	UMOBILE
Grant agreement number	645124
Call identifier	H2020-ICT-2014-1
Topic	ICT-05-2014 Smart Networks and novel Internet Architectures
Programme	EU Framework Programme for Research and Innovation HORIZON 2020
Project Coordinator	Prof. Vassilis Tsaoussidis, Democritus University of Thrace

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 645124

Deliverable Information:

Deliverable Number-Title	D6.6 Standardization Plan
WP Number	WP6
WP Leader	AFA
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Due date	M12: 31/01/2016
Actual date of submission	31/01/2016

Dissemination Level:

PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	
CI	Classified, as referred to in Commission Decision 2001/844/EC	

Document History:

Version	**Date**	**Description**
Version 0.1	19/11/15	Initial plan for standardization dissemination
Version 0.2	10/01/16	Revised first version, added CCSDS and NetWorld 2020
Version 0.3	22/01/16	Revised second version
Version 0.4	30/01/16	Final version

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Executive Summary

Background: This report is written in the framework of Task 6.3 "Standardization plan" of UMOBILE project. The deliverable envisions UMOBILE's main objectives in terms of standardization activities in the area of contributions and co-operation with various standardization bodies.

Objectives:
The main objectives of Work Package 6 are to cover the contributions of UMOBILE project in terms of dissemination, standardization, and exploitation of results. In the context of standardization, it is foreseen to consider i) standardization bodies; ii) technological platforms; iii) interexchange with other projects.

UMOBILE aims 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 as well as to promote user-centric networking in all its aspects.

The UMOBILE project has identified a set of relevant standardization bodies, mostly focused on the ICN, DTN and global Internet fields, that will be monitored to guarantee the alignment of the UMOBILE solution with the latest standards and to identify potential contributions to the ongoing standardization activities.

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1. Introduction

The main objective of UMOBILE is to develop a mobile-centric service oriented architecture that efficiently delivers contents/services to the end users. The UMOBILE decouples services from their origin locations, shifting the host-centric paradigm to novel incorporated aspects from both information-centric and opportunistic networking with the ultimate purpose of delivering an architecture focused on: i) improving aspects of the existing infrastructure (e.g., keeping traffic local to lower OPEX); ii) improving the social routine of Internet users via technology-mediated approaches.

UMOBILE aims to push network services (e.g., mobility management, intermittent connectivity support) and user services (e.g., pervasive data sharing and content management) as close as possible to the end users. By pushing such services closer to the users, we can optimise, in a scalable way, aspects such as bandwidth utilisation and resource management. We can also improve the service availability in challenged network environments. For example, users in some areas may suffer from intermittent and unstable Internet connectivity when they are trying to access certain online services.

In this context, we envision contributions to relevant standardization bodies as well as contributes to technological platforms, and knowledge/experience exchange with other projects, as described in detail in D1.2.

2. Plan for standardization activities - Monitoring

UMOBILE targets to play an active role in the international standardization bodies related to the area of interest to the project. The standardization activities will focus on contributing to (draft) specifications, and taking initiative in designing system and protocol aspects as applicable. As a general principle, the plan for each standardization initiative will cover the following subsequent activities:

- The project has identified the standardization bodies and specifications that could be interested/impacted by the UMOBILE research activity.
- The project focuses on liaison activities with the targeted standardization bodies in order to qualify and determine the appropriate course of action. UMOBILE partners are already in contact with the involved parties of every relevant group and collaborate towards the maximization of effort gain and exploitation of results, within the Future Internet context.
- The project follows a specific standardization plan for each impact area (i.e., research group, relevant technical area).
- UMOBILE consortium also participates in the review process, including assessment analysis and implementation of recommended outcomes from standardization bodies.
- The relevant UMOBILE standardization activities are to be disseminated through regular meeting of standardization bodies, international conferences and workshops.

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The initial target standardization bodies, contributions and collaboration among partners in the key activities is presented in Table 1.

Entity	Working Group	Expected Activities	UMOBILE Partners Involved
IRTF	ICNRG	UMOBILE development guidelines	COPELABS, TECNALIA, UCL
	DTNRG	To provide interoperable communications with challenged environments where continuous end-to-end connectivity cannot be assumed.	COPELABS, DUTH, TECHNALIA
	GAIA	To develop sustainable solution and standardization for global Internet access	COPELABS, DUTH, UCAM
CCSDS		Dissemination of relevant outcomes on DTN	DUTH
NetWorld2020		Technical discussion platform. Strong contribution platform, in the form of input to white papers addressing different aspects of networking technology.	Senception
WFA		Deployment aspects; specification contributions	Senception

Table 1. UMOBILE initial mapping of the standardization entities and the involved partners.

3. Standard contributions

Several project partners are actively participating in various standardization bodies such as the Consultative Committee for Space Data Systems (CCSDS), NetWorld 2020, WiFi Alliance (WFA) and the Internet Engineering Task Force (IETF) as well as the Internet Research Task Force (IRTF). Within UMOBILE, we focus on novelty of the design architecture involved in many stages of research and development. Therefore, we believe that direct submission of results to IETF will not be fruitful due to the objectives and strategies of the project. However, IETF also maintains research branches such as IRTF, that is more open to innovations in communication architecture. Candidates for focused contributions are current efforts in the IRTF to position DTN and ICN as exploitable technologies. With both communities being somewhat disjoint at this point, the UMOBILE objectives in joining ICN with DTN concepts can directly influence the communities' thinking in both areas. We plan, for instance, to actively contribute to scenario and research challenge definitions, as well as position the UMOBILE functional components as a possible approach for traversing ICN, DTN and traditional IP deployments.

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UMOBILE will focus on influencing research and development activities, which is particularly sensible as the innovative technologies. UMOBILE will incorporate and propose standardization elements to achieve the necessary baseline interoperability across implementations.

3.1. IRTF Information-Centric Networking Research Group (ICNRG)

The Information-Centric Networking Research Group (ICNRG) is a research group within IRTF. Its main objective is to couple ongoing ICN research with solutions that are relevant for evolving the Internet at large. The research challenges for ICN include:

- Naming schemes for ICN, including scalable name resolution for flat names
- Scalable routing schemes
- Congestion control, QoS approaches, and caching strategies
- Metrics that make it possible to evaluate ICN implementations in a consistent manner
- Security and privacy, including scoping of information objects and access control to them
- Application/application-protocol design and APIs
- Business, legal and regulatory frameworks

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3.1.1 UMOBILE Standardization Topics - Contributions

UMOBILE expected outcomes that may be promoted in IRTF are mostly related to the ICN. A preliminary analysis of the possible contributions in ICNRG has identified a list of potential contributions, as detailed in Table 2.

Standardization Element	Type of Contribution	Schedule	Priority	Partner
Solving the congestion problem using ICN	Presentations to ICNRG meetings	ICNRG Meeting, Prague July 2015	High	UCL
Resilience in disrupted Information-Centric Networks	Presentations to ICNRG meetings	ICNRG Meeting, Prague July 2015	High	UCL
Keyword-based naming scheme in ICN networks	Presentations to ICNRG meetings	ICNRG Meeting, Tokyo October 2015	High	UCL
ICN Research Challenges	Internet Draft	In review process	Medium	UCL
Social-aware Opportunistic forwarding based on data interests	Internet Draft	In review process	High	COPELABS, TECNALIA
Data synchronization for named data networking	Internet Draft	In review process	High	COPELABS, UCL

Table 2. Preliminary overview of potential UMOBILE standardization topics in ICNRG

UCL has already participated in the Interim meeting of the ICRNG in Prague, San Francisco and Yokohama Japan (IETF 93). Dr Ioannis Psaras and Dr Vasilis Sourlas have represented UCL, where they discussed the on-going work at UCL related with the UMOBILE project and got feedback from the ICNRG group members, especially on the work related with the WP3 about the UMOBILE ICN specifications of the architecture. In the ICN meeting in Prague (July 15), UCL presented the "Solving the congestion problem using ICN"work, about congestion and flow control, related with the WP4 Task 4.1. UCL also presented the "Resilience in disrupted Information-Centric Networks" work, related with the WP3. In the ICNRG meeting held in Tokyo (October 2015), UCL presented the naming scheme that

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will be used in the UMOBILE architecture (WP3), based on a keyword-based naming scheme.

UCL plans to participate in the next ICNRG meetings, and promote the UMOBILE project within the ICN research community.

Last, but not least, Dr Ioannis Psaras (UCL) participates in the "ICN Research Challenges Internet-Draft", which summarises the group's activities in the area and outlines the priority areas of research value. The Internet Draft (I-D) has now been finalized and has gone through the review process in order to become an Informational RFC. Dr Ioannis Psaras has been actively involved in the preparation of this document both in the initial stages and in the revision process.

3.2. IRTF Delay Tolerant Networking Research Group (DTNRG)

The Delay-Tolerant Networking Research Group (DTNRG) of IRTF is chartered to address the architectural and protocol design principles arising from the need to provide interoperable communications with and among extreme and performance-challenged environments where continuous end-to-end connectivity cannot be assumed. Examples of such environments include spacecraft, military/tactical, some forms of disaster response, underwater, and some forms of ad-hoc sensor/actuator networks.

Among the challenges to be addressed are: large delay for transmissions resulting from either physical link properties or extended periods of network partitioning, routing capable of operating efficiently with frequently-disconnected, pre-scheduled, or opportunistic link availability, high per-link error rates making end-to-end reliability difficult, heterogeneous underlying network technologies (including non-IP-based internets), and application structure and security mechanisms capable of limiting network access prior to data transit in an environment where round-trip-times may be very large.

The group intends to build upon the extended "bundling" architecture created originally for the Interplanetary Internet. This architecture proposes an alternative to the Internet TCP/IP end-to-end model and employs hop-by-hop storage and retransmission as a transport-layer overlay. It provides a messaging service interface conceptually similar to electronic mail, but generalized for application-independence and supported by specialized reliability and routing capabilities.

The intended work products of the DTNRG include architectural descriptions (concept documents), a bundling protocol specification, and a series of one or more network-environment-specific "profile" documents. These profile documents will include descriptions of 'convergence layers' intended to adapt the overlying messaging architecture for use in specialized networking environments (space, water, sensor networks), and are expected to be created by the study teams.

Members of the DTNRG also intend to distribute source code of a reference implementation of the architecture and protocols developed.

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3.2.1. UMOBILE Standardization Topics - Contributions

UMOBILE leverages the delay disruption, and disconnection-tolerance concept of the DTN architecture, in several communication scenarios described in D2.1. Below, we summarize the expected contributions of UMOBILE consortium to the DTNRG.

Standardization Element	Type of Contribution	Schedule	Priority	Partner
ICN-DTN architecture	Closely follow the outcomes of DTNRG meetings, workshops and Internet Drafts.	Regularly	Medium	DUTH
Integration of ICN and DTN	Internet Draft	In review process	High	COPELABS, DUTH, TECNALIA

Table 3. Preliminary overview of potential UMOBILE standardization topics in DTNRG

3.3. IRTF Global Access to the Internet for All (GAIA)

The Global Access to the Internet for All (GAIA) is an IRTF initiative that aims:

- to create increased visibility and interest among the wider community on the challenges and opportunities in enabling global Internet access, in terms of technology as well as the social and economic drivers for its adoption.
- to create a shared vision among practitioners, researchers, corporations, non governmental and governmental organisations on the challenges and opportunities
- to articulate and foster collaboration among them to address the diverse Internet access and architectural challenges (including security, privacy, censorship and energy efficiency).
- to document and share deployment experiences and research results to the wider community through scholarly publications, white papers, presentations, workshops, Informational and Experimental RFCs.
- to document the costs of existing Internet Access, the breakdown of those costs (energy, manpower, licenses, bandwidth, infrastructure, transit, peering), and outline a path to achieve a 10x reduction in Internet Access costs especially in geographies and populations with low penetration.
- to develop a longer term perspective on the impact of GAIA research group findings on the standardization efforts at the IETF. This could include recommendations to protocol designers and architects.

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3.3.1. UMOBILE Standardization Topics - Contributions

The UMOBILE use cases involve a social extension in the access to networking services or the Internet. In this context, the scenarios' output as well as the project outcome can be of particular interest to the GAIA research group.

Standardization Element	Type of Contribution	Schedule	Priority	Partner
System design for universal communication architecture	Dissemination of relevant outcomes on community network at the IRTF GAIA workshop	Regulary	Medium	DUTH, UCAM
System design for universal communication architecture	Informational Internet draft	In review process	High	COPELABS

Table 4. Preliminary overview of potential UMOBILE standardization topics in GAIA

3.4. The Consultative Committee for Space Data Systems (CCSDS)

The Consultative Committee for Space Data Systems (CCSDS) was formed in 1982 by the major space agencies of the world to provide a forum for discussion of common problems in the development and operation of space data systems. It is currently composed of eleven member agencies, twenty-eight observer agencies, and over 140 industrial associates.

Since its establishment, it has been actively developing recommendations for data- and information-systems standards to promote interoperability and cross support among cooperating space agencies, to enable multi-agency spaceflight collaboration (both planned and contingency) and new capabilities for future missions. Additionally, CCSDS standardization reduces the cost burden of spaceflight missions by allowing cost sharing between agencies and cost-effective commercialisation.

During the last decade, CCSDS has been actively involved in the standardization of the Delay Tolerant Networking (DTN) architecture and its corresponding Bundle Protocol (BP) for interoperable space communications.

3.4.1. UMOBILE Standardization Topics - Contributions

The outcomes of UMOBILE, and in particular the impact of the delay-tolerant elements of the UMOBILE architecture, can be of particular interest to CCSDS, since the proposed solutions may fit into the space communications as well.

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Standardization Element	Type of Contribution	Schedule	Priority	Partner
UMOBILE use cases in disconnected environments	Dissemination of relevant outcomes on DTN at the CCSDS regular meetings	Regulary	Low	DUTH

Table 5. Preliminary overview of potential UMOBILE standardization topics within CCSD

3.5. NetWorld 2020

NetWorld2020 is the European Technology Platform for communications networks and services. Communications networks enable interaction between users of various types of equipment, either mobile or fixed. The NetWorld European technology platform gathers more than 700 players of the communications networks sector including industry leaders, innovative SMEs, and leading academic institutions. The mission of NetWorld is to strengthen Europe's leadership in networking technology and services so that it best serves Europe's citizens and the European economy.

UMOBILE expects to contribute to NetWorld2020 white papers, as well as to other efforts under development in the context of ICN and Device-to-device communications.

At this stage, several partners of NetWorld2020 are monitoring the opportunities for disseminating UMOBILE results. This outcome has already been provided on the white paper “Beyond 5G”.

3.5.1.UMOBILE Standardization Topics - Contributions

Standardization Element	Type of Contribution	Schedule	Priority	Partner
Beyond 5G scenarios	Dissemination of aspects concerning taking advantage of proximity, e.g. in the context of device to device communications	In review process	Medium	Senception
Beyond 5G scenarios	Dissemination in the context of Social-based proximity services	In review process	Medium	Senception

Table 6. Preliminary overview of potential UMOBILE standardization topics in NetWorld 2020

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3.6. WiFi Alliance (WFA)

The WiFi Alliance is a non-profit industry association that promotes Wireless LAN technology and certifies products if they conform to certain standards of interoperability. There are several programs launched by WFA.

The relevant standard with UMOBILE is Wi-Fi CERTIFIED Wi-Fi Direct®, a certification mark for devices supporting a technology that enables Wi-Fi devices to connect directly, making it simple and convenient for pervasive communications (i.e., printing, file sharing, data synchronisation and remote display)

UMOBILE relies on Wi-Fi direct to support user-centric networking, and the project expects to provide contributions to Wi-Fi Peer-to-Peer Services technical specifications in particular concerning deployment and validation aspects.

3.6.1. UMOBILE Standardization Topics – Contributions

Standardization Element	Type of Contribution	Schedule	Priority	Partner
Wi-Fi Direct	Monitoring of relevant aspects concerning Wi-Fi direct issues (e.g. issues in authentication)	In review process	High	Senception

Table 7. Preliminary overview of potential UMOBILE standardization topics in WFA

4. Conclusions and Next Steps

This deliverable has described the standardization strategies planned to ensure that UMOBILE research activities are aligned with the existing trends and innovations. The UMOBILE standardization activities target the widest possible impact of project outcomes in various standardization bodies, both European and worldwide.

The involvement in standardization activities in the ICN and DTN technical area (e.g., in ICNRG and DTNRG), led by partners already active in these areas, will be a key point to increase the visibility of the UMOBILE concepts and the impact of the project outcomes. A plan with expected contributions to specific standardization bodies has been already defined and presented in this document.

The consortium will periodically review and revise these initial plans, taking into account the evolution of the research and standardization directions, as well as the maturity of the UMOBILE outcomes at the different stages of the project. The related updates will be reported in the deliverable 6.7 (Standardization report).

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