Towards an Open, Secure, Decentralized and Coordinated Fog-to-Cloud Management Ecosystem

D6.2 mF2C annual report on dissemination and standardization (Year 1)

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Executive Summary

The mF2C project is focused on delivering a management framework for the challenging fog-to-cloud domain. This deliverable provides a report of all the dissemination and standardization activities that were performed during the first year of the project. This corresponds to activities tracked under *Task 6.1 Dissemination* and *Task 6.2 Standards*. It includes the details of the different events (scientific, EU related, Industrial, standardization, open source) that partners have participated at as speakers presenting the mF2C project, or research related to the project. A number of papers have been written which have been published or still under review for 2018 and these are also documented. The deliverable reports its first year results on standardization initiatives that it has been monitoring across a variety of communities, industry, and at regional and international levels. This deliverable also provides initial plans for both dissemination and standardization activities for the second year of the project identifying opportunities to engage with the key stakeholders that have now been identified, therefore increasing the potential for successful dissemination of project results.

1. Introduction

1.1 Introduction

This deliverable describes all the dissemination and standardization actions carried out from M01, January 2017, to M12, December 2017, and corresponding to activities developed in Task 6.1 (M01-M36) Dissemination and Task 6.2 (M01-M36) Standards.

The activities developed during this first year can be divided into two phases. In the first phase, from M01 to M06, the focus was more on creating awareness about the project and to prepare a dissemination and standardization plan, collected in the case of dissemination in deliverable *D6.1 Dissemination strategy and plan* (M06). The second phase, from M06 to M12 the focus has been the consolidation of these activities, although the awareness phase has not ended on month M06, but it will continue providing feedback during all the project life.

In the case of dissemination activities, in the first phase, some of the main activities have been: website creation, social network accounts creation, posters, flyer, mailing list for receive newsletter creation, etc. We also identified and reported in D6.1 the potential target groups and the means of communication with each of them.

During the second half of the year, second phase, the activity in the mF2C website, as well as in the social networks has growth exponentially, with an increase in the number of followers, the creation of the mF2C blog, the acceptation of different research papers, etc.

Regarding standardization activities, the mF2C project is still in this first phase of ramping up. The main standardization activities during this first year have been to approach the relevant standardization bodies related to fog, cloud, IoT, etc. To this end, mF2C is monitoring standards initiatives across a variety of communities, by industry, and at regional and international levels. We think that the second phase of standardization activities, that is, to participate in the evolution of standards to advocate the results of mF2C innovations, will come easily along with the results of the project, after iteration IT-1 (M18).

It is worth mentioned that from the mF2C point of view, the target of the dissemination is not only the scientific and research community but also dissemination activities should help the achievement of exploitation and standardization goals. For this reason, this deliverable is complementary to deliverable *D6.5 mF2C annual exploitation plans and market analysis (Year 1)*.

1.2 Purpose

The objective of this deliverable is to provide an overview of the dissemination and standardization activities carried during the first year project, starting on January 2017 to December 2017 (M01 to M12). It also provides the trends for the dissemination and standardization activities planned for the second year of the project.

This deliverable is organized as follows; Section 2 is a report of the dissemination activities developed during this first year, as well as the planned for the second year. Section 3 describes all the activities developed during the first year in standardization and the plans for next year. Both sections are divided into subsections to according to different categories of activities.

1.3 Glossary of Acronyms

Acronym	Definition
AI	Artificial Intelligence
BSD	Berkeley Software Distribution
F2C-DP	Fog to Cloud Distributed processing
IoT	Internet of Things
KPI	Key Performance factors

QoE	Quality of Experience
R&I	Research and Innovation
SLA	Service Level Agreement

Table 1. Acronyms

2. Dissemination of mF2C Results

2.1 Report of dissemination activities

The objective of this section is to provide an overview of the dissemination activities carried out by mF2C during the first year of the project, starting on Jan 1st 2017 to December 31st 2017 (from M1 to M12), classified according to different categories.

2.1.1 Liaison and collaboration with related projects/groups

In this subsection, we review the related projects that we have established collaboration with during the first year's project. Besides this, we will show what the strategy of collaboration with these related projects is.

The goals established in deliverable D6.1 Dissemination strategy and plan, related to mF2C liaison and collaboration, are:

- Share information about aims, plans and results with related projects.
- Follow the evolution of other projects and provide feedback (when possible).
- Add value to mF2C results.
- Before collaborating or proposing collaboration, clearly identify mF2C objectives and expected results (message).

These initiatives can increase mF2C impact and results from active projects may be incorporated to the project results. Furthermore, despite not having any direct KPI related to the number of established liaisons, we have a KPI related to the number of workshops organized during the project lifecycle: 3 workshops organized through the project lifecycle, including co-organized with similar projects or initiatives.

The consortium established a strategy, proposed in deliverable D6.1, for collaborating with related projects. The main points of this strategy are:

- Participate in EC conferences, workshops, information days, etc. related to Cloud computing topics in general, especially Fog Computing.
- Support dissemination actions coming from other projects (following in social networks, including in Newsletters, retweet, etc.)
- Create an article in our website. We have created a tab in our website with information about the projects we have set collaboration [1]
- Organize meetings and workshops and invite related projects.
- Participate in meetings and workshops organized by related projects.
- Promote standardization work.

Basically, during this year, we established collaboration with the projects listed in Table 2, for supporting the dissemination actions coming from these projects, as well as participating in workshops and events organized by related projects.

Project	Contact Partner	Collaboration
CloudWATCH2	Ana Juan Ferrer, Lara López (ATOS)	mF2C has been included in its Service Offer catalogue and participated in its Concertation Meeting, held in conjunction with NetFutures 2017. mF2C is also deciding the best way to participate in the standards map initiated by CloudWatch2.
RECAP	Alec Leckey (INTEL) Xavi Masip (UPC)	mF2C and RECAP project will complement each other because RECAP optimizes the application

		placement from the edge to the cloud. Xavi Masip (UPC) is advisory board member of RECAP.
CIPSEC	Xavi Masip (UPC)	The expertise acquired in CIPSEC will help to address the security challenges when designing the mF2C architecture.

Table 2. Established collaboration with mF2C related projects during the first year

In the specific case of CloudWatch2, this project helps R&I initiatives to overcome challenging issues like standards and pricing to maximise the socio-economic impact of this new cloud ecosystem. mF2C has been included in its Service Offer Catalogue, making it available to any potential stakeholder. With this collaboration, mF2C will increase the widespread of its results with different stakeholders aiming to reduce the time for reaching potential end users or early adopters that can benefit of the proposed novelties. Apart from the direct collaboration with CloudWatch2 led by ATOS, ATOS on behalf of mF2C is leading the Future Cloud cluster of the EC.

Intel Labs Europe is participating in the RECAP project [2] which is focusing on optimizing application placement and infrastructure provisioning from the network edge to the data-center. There are areas of complementarity between both projects which INTEL is seeking to synchronize. The Scientific and Technical Manager of mF2C (Xavi Masip, UPC) is one of the external advisory board of RECAP.

UPC participates in a H2020 related project, CIPSEC [3], which is an innovation action. The main objective of this project is to create a unified framework that orchestrates different security products to offer high levels to Critical Infrastructures (CI). The expertise acquired in CIPSEC will help to address the security challenges when designing the mF2C architecture; and also, in the opposite way, CIPSEC will benefit from the knowledge, acquired in mF2C by common partners, about hierarchical architectures. One of the consequences of this synergy could be the proposal of hierarchical and distributed security architecture for fog to cloud systems. Xavi Masip presented the mF2C project to the CIPSEC consortium during the 4th plenary meeting in Vilanova i la Geltrú, June 2017.

Other partners, despite not having an established collaboration, are/have been collaborating in related project. One of these partnesr is XLAB who currently collaborates on InterIoT project [4] that focuses on bridging the gaps the world of heterogeneous IoT devices. XLAB also has worked on an IoT project called APRICOT [5] where the global scale sensing reasoning and searching infrastructure was the main topic. This is related to mF2C because it has some similar network structure as FOG in mF2C. They have been also working in many other IoT project containing functionality ranging from distributed systems, security in the distributed systems and zero knowledge protocols, where one is able to authenticate and at the same time hide their identity.

Engineering is not currently engaged in other related research Projects, but in the past Tiscali has been participating in several H2020 Projects, for example FAR-EDGE - Factory Automation EdgeComputing Operating System Reference Implementation, 5G-MEDIA - Programmable edge-to-cloud virtualization fabric for the 5G Media industry, CloudPerfect - Enabling CLoud Orchestration, Performance and Cost Efficiency Tools for QoE Enhancement, Engineering participate also in the AIOTI Alliance for Internet of Things Innovation.

On the other hand, in Table 3, we present the list of projects which we plan to establish collaboration with during the second year.

Project	Collaboration	Owner
BigStorage	The part from BigStorage most related to mF2C is the storage platform that is being developed to support big	BSC will keep in contact regarding

	data applications in a homogeneous environment. The mF2C system will be able to offer access to data in a very heterogeneous environment.	the creation of a working group for Smart Cities.
CYCLONE	mF2C can take advantage of CYCLONE development in SlipStream for its orchestration and brokerage functions, including cloud interoperability, application deployment automation and scaling.	SixSq, developers of SlipStream, will monitor for collaboration opportunities
WITDOM	The security mechanisms developed during the WITDOM project could be exploited in the mF2C project to safely operate with the private data collected from the IoT devices.	TBD
WISER	The security assessment of the mF2C products could be evaluated and tested with the cybersecurity assessment platform developed in WISER.	TBD
TIMON	The TIMON project collects the data from IoT devices integrated in vehicles or roadside units. From mF2C perspective, the TIMON's architecture can serve as an example of how the current IoT technology is integrated in the closed proprietary cloud.	TBD

Table 3. Target project for second year

Apart from reaching these related projects during the second year, some of the partners have individual plans for new activities with projects with an ongoing collaboration, such as UPC, who is preparing new papers about security in mF2C systems in collaboration with the H2020 CIPSEC project, or STFC, who will establish a collaboration with Hartree IoT staff at a more formal level [6].

Moreover mF2C will participate in the poster session in H2020 project clustering event on January 31st, in Athens, organized by the ReCRED project, aiming at establishing tight connections with relative H2020 projects in the field of Privacy and Security. The event will have the participation of about 20 H2020 running Projects.

2.1.2 Scientific Venues

In this subsection, we detail the scientific events that mF2C partners have participated as speakers presenting the mF2C project, or research related to the mF2C project. This list of events attended is in Table 4.

Summarizing the activities during this period: ATOS, BSC, Engineering and UPC collaborates in the organization of the F2C-DP Workshop co-located in EuroPar 2017 [7], August 28, Santiago de Compostela, Spain; and some of the partners attended the workshop and the conference. Apart of the consortium members attending the F2C-DP Workshop, 13 external people attended this workshop (such as people from IBM and Inria), which gave a high visibility to the ongoing research papers presented in this workshop.

STFC presented the mF2C project both internally (based on the prototype) and at a couple of UK-based events for scientific software developers. UPC presented the mF2C project to H2020 CIPSEC consortium during the 4th plenary meeting, as well as, prepared a stand with the mF2C poster and flyers to the attendants of the IWQoS 2017 ([8]held in Vilanova i la Geltrú in June 2017). Finally, UPC (Zeineb Rejiba) also presented an ongoing research work related to Discovery in a workshop organized by the Spanish thematic network Elastic [9], on October 18, 2017.

Date	Event	Partners	Contribution
August 28, 2017	EuroPar 2017	Rosa Badia (BSC), John Kennedy, Matic Cankar (XLAB), Antonio Salis (ENG), Breogan Costa (WOS), Alejandro Gomez (UPC), Francesc Lordan (BSC)	Attended and some of them paper presenters (see Table 15)
June 13, 2017	4th CIPSEC plenary meeting	Xavi Masip (UPC)	mF2C project presentation
June 14-16	IWQoS 2017	UPC	Stand with mF2C poster and flyers
October 18, 2017	Workshop organized by the Spanish thematic network: Elastic Networks co-located with Wireless World Research Forum meeting 39	Zeineb Rejiba (UPC)	Research presentation without associated paper.
Dec 2017	UK-based events	STFC	mF2C presentation for scientific software developers

Table 4. Scientific venues presented at in year 1

Figure 1 mF2C presence in the IWQoS 2017 conference

Table 5 presents some of the scientific venues proposed by the partners to be attended in the second year of the mF2C project. Basically, partners propose to attend workshops related to mF2C co-located with main conferences in the area, to attend scientific venues organized by related

projects with an established collaboration, as well as to present the mF2C project in plenary meetings of projects with an established collaboration, or to be established.

Event	Partners	Contribution	Target
Conferences organized by or co-located with related projects	ATOS	Attendance, project presentation and chairing.	NetFutures CloudForward Concertation meetings
National UK events	STFC	Attendance and project presentation	CIUK, SIG-Cloud, etc
Workshop co-located in conferences of the area	UPC and all	Attendance, project presentation and paper presentation	11th IEEE/ACM International Conference on Utility and Cloud Computing (UCC)

Table 5. Scientific venues for second year

2.1.3 EU-related Venues

In the dissemination plan proposed in deliverable D6.1, we considered as one of the main dissemination strategies to carefully follow several events organised by the European Commission, especially those linked to the topics addressed by mF2C, such as cloud and fog computing, IoT, etc. The objective of these events is support the dissemination of EU-funded projects and to bring them near to potential stakeholders. These meetings will help the establishment of actions in collaboration with related projects, because although there is not a specific KPI related to EU related venues, it exists a KPI related to: Number of significant actions in collaboration. The attended EU events during the first year of the mF2C project are listed in Table 6, and plans for second year are proposed in Table 7.

Date	Place	Event	Partners	Contribution
June 28-29, 2017	Brussels (Belgium)	Net Futures 2017	Ana Juan (ATOS)	Ana Juan-Ferrer - Inter-cloud Challenges, Expectations and Issues
June 28, 2017	Brussels (Belgium)	Concertation meetings organized by CloudWATCH2	Ana Juan (ATOS)	Ana Juan-Ferrer - Session: Achievements and New Directions for the EC Clusters: Inter-cloud Challenges, Expectations and Issues Ana Juan Ferrer- EC Cluster break-out sessions, chair.
November 9-10, 2017	Budapest (Hungary)	ICT proposers' day	Matija Cankar (XLAB)	Attendant with participation to Networking and Information sessions
November 29-30, 2017	Madrid (Spain)	EC NEM Summit,	P. Andriani (ENG)	Attendant, speech: "Media industry meets 5G: the 5G-MEDIA project in 5G-PPP phase 2"

Table 6. EU related venues

Ana Juan from ATOS is leading the Future Cloud cluster of the EU on behalf of mF2C. The results of this leading is the participation in different EU events, such as NetFutures 2017 and the concertation meeting organized by Cloud WATCH2. Net Futures (www.netfutures.eu) aims to improve

competitiveness of the European technology industry, bringing together interconnected community involving companies, organizations and people belonging to research, innovation, business development, and entrepreneurship. On the other hand, as mentioned before, CloudWATCH2 helps R&I project to increase their impact on the market, bringing together highly specialised experts in standardisation, security and legal aspects. Moreover, CloudWATCH2 has regular concertation meetings co-located with the Net Futures Conference and Exhibition, which gives the opportunity to reach a wide audience of EU researchers from different EU projects. The detail of the participation in these meetings is:

- Presentation in Net Futures 2017, in the Inter-Cloud Cluster Concertation event. Ana Juan from ATOS presented "Inter-cloud Challenges, Expectations and Issues", as well as lead the cluster and chaired different sessions.
- In Concertation meetings organized by CloudWATCH2, Ana Juan presented the session "Achievements and New Directions for the EC Clusters", presented the cluster: "Cluster on Inter-Cloud. Challenges, Expectations and Issues"; and chaired the EC Cluster break-out session.

On the other hand, Matija Cankar from XLAB attended the ICT proposers' day in Budapest, with participation to Networking and Information sessions, held on November 9-10, 2017.

Table 7 presents some of the target EU venues planned for the second year of the project. Ana Juan from ATOS will continue leading the Future Cloud cluster of the EC, which will give to the mF2C project new opportunities to attend EU venues related to this cluster.

Event	Contribution
Future Cloud cluster events [10]	Presentations, workshops, chairing, etc.
Net Futures 2018	Presentations, workshops, chairing, etc.
Concertation meetings organized by CloudWATCH	Presentations, workshops, chairing, etc.
Participation to international industrial and EU events	Presentations, workshops, chairing, etc.

Table 7. EU related venues plans for second year

2.1.4 IETF and Standardization Venues

During the past year, some participation to Standardization events have been done, particularly by ATOS and INTEL, as detailed in the following table, while XLAB participated in discussions to OASIS standardisation group, particularly in TOSCA (Topology and Orchestration Specification for Cloud Applications), and in several Security and Privacy Technical Committees.

Worldsensing has been engaged with LoRa Alliance working group, monitoring the evolution of the protocol.

Date	Event	Partners	Contribution
17 Jan 2017, Brussels	Workshop to promote practical collaboration between Cloud Open Source and Standardization [11]	Ana Juan Ferrer (ATOS), John Kennedy (INTEL)	Actively contributed an industrial perspective to EC driven activities
18 Jan 2017, Brussels	Cloud - Select Industry Group on cloud standards: ICT Standardisation Priorities for the Digital Single Market [12]	Ana Juan Ferrer (ATOS), John Kennedy	Actively contributed an industrial

		(INTEL)	perspective to EC driven activities

Table 8. IETF & Standardization venues for first year

For the coming year the following table summarises the events and working groups various partners are interested in joining.

Event	Partners	Contribution
Standard oriented EC main events or workshops	ATOS	Presentations, workshops, chairing, etc.
Main events on CIMI	SIXSQ, BSC	Presentations, workshops, chairing, etc.
OpenFog Consortium, ISO/IEC JTC1 and OCCI working groups, Standard oriented EC main events or workshops	INTEL	Presentations, workshops, chairing, etc.
EIT Digital (Trento node of the European Institute of Innovation and Technology), Alliance for the Internet of Things (AIOTI PPP), NESSI (Networked European Software and Service Initiative), European Organisation for Security EOS	ENG	Presentations, workshops, chairing, etc.
OGC, OGF, W3C relevant standards	STFC	Presentations, workshops, chairing, etc.

Table 9. IETF & Standardization venues planned for second year

2.1.5 Industrial Venues

During the past year INTEL, SIXSQ and Engineering participated in some major industrial events and fair trades; SiXSQ has been selected as outstanding innovation company in the field of Edge, fog and Cloud Computing technologies and Smart Cities solutions.

Intel participated in a number of industrial events organized by *NESSI* and *Big Data Value Association*.

Date	Event	Partners	Contribution
12-15 March 2017	DC Transformation Manchester 2017	INTEL	Keynote presentation by Intel in which they introduced the mF2C project http://dtmanchester.com/
March 2017	CeBIT trade fair in Hamburg	SIXSQ	Attendant, with participation in European Commission's EU Village which showcased EU-funded innovators and their products
21-22 November 2017	IOTHINGS Rome 2017	ENG	Attendee
6-8 November 2017	WSO2Con Europe 2017	ENG	Presented the case study: *"WHO CARES? A WSO2 Cloud Oriented Reference Architecture for Patients Home Caring"*
21-23 November 2017	European Big Data Value Forum 2017, Versailles	ENG	Attendee
November 2017	EIT Digital Italian Innovation Day 2017, Trento	ENG	Participated in the opening panel *"Big Data as Smart Cities Enabler"* and

			discussed mF2C project

Table 10. Industrial venues for first year

The following table presents some of the target international industrial and EU venues planned for the second year of the project.

Event	Partners	Contribution
Participation to international industrial and EU events	INTEL	Presentations, workshops, chairing, etc.
Participation to international industrial and EU events	SIXSQ	Fair Trades, Presentations, workshops, chairing, etc.
Participation to international industrial and EU events	ENG	Presentations, workshops, chairing, etc.

Table 11. Industrial venues for first year planned for second year

Ongoing overall mF2C achievements will be presented externally, at local, national and international outreach events as the opportunities arise. Such events include the regular site visits from industry, academia and government that the Intel Leixlip site hosts, national research conferences, and Intel exhibits at regional and international events such as Research@Intel Europe, Intel Developer Forum, and Mobile World Congress.

2.1.6 Open Source Venues

mF2C partners have a strong experience in promoting and developing open source software, believing that this software license contributes to the development and sustainment of business in startups, SMEs and Large industry. Also, the mF2C management framework is designed as open source. For this reason, particular attention has been taken to the engagement with Open Source communities.

During the first year, some partners have contributed to the Open Source communities, particularly XLAB with OASIS TOSCA, major contribution to Emmy (XLABs Zero-Knowledge proofs library) and other Security and Privacy Technical Committees.

Also STFC collaborated with OpenWRT, OpenSSL, Mosquitto and OpenVirtualBox communities.

Also ATOS worked actively with the communities, and is willing to release all project results under an Open Source scheme. Table 12 lists the Open Source events attended by mF2C partners during the first year's project.

Date	Event	Partners	Contribution
28-29 November 2017	FIWARE Tech Summit, Malaga	ENG, ATOS	Attendant & presentation. Deep discussion on Open Source and Smart Cities

Table 12. OpenSource venues for first year

For the coming year the following table summarises the events and working groups various partners are interested in joining.

Event	Partners	Contribution
Open Source oriented main events or workshops	INTEL	Presentations, workshops, chairing, etc.
Events related to OpenWRT, OpenVirtualBox, Mosquitto, OpenSSL	STFC	Presentations, workshops, chairing, etc.
Events related to OASIS TOSCA, ManageIQ, Emmy, OpenStack, Security and Privacy	XLAB	Presentations, workshops, chairing, etc.

Technical Committees		

Table 13. OpenSource venues planned for second year

2.1.7 Scientific Papers

Publishing in different scientific and industrial journals or participating in relevant conferences, workshops and market exhibitions is a very proficient way to promote mF2C development and transferring knowledge. This can be performed by the consortium, but also by the individual partners.

According with the dissemination plan proposed in deliverable D6.1, some KPIs (Key Performance Indicators) has been defined to evaluate the effectiveness of the work done.

Action	KPI	Measure
Scientific publications	Number of publications (articles, papers, etc.) in conferences and events	20 during the project: at least 3 the first year, 7 the second year and 10 the third one
General publications	Number of publications in journals or other peer reviewed publications	At least **3** per year
Participation in events and conferences	Number of events assisted with a relevant paper	50 during the whole project: 10, 15, 25 during the first, second and third year

Table 14. KPIs associated to scientific publications

During the first year a remarkable number of papers have been produced, reaching and exceeding the defined target KPIs.

The following table summarises the list of papers produced:

Date	Event	Partners	Publication
Aug 28, 2017	mF2C-DP workshop, EUROPAR 2017	ENG	A. Salis, G. Mancini – "Making use of a Smart Fog Hub to develop new services in airports"
Aug 28, 2017	mF2C-DP workshop, EUROPAR 2017	BSC	Francesc Lordan, Daniele Lezzi, Jorge Ejarque, Rosa M. Badia – "An architecture for programming distributed applications on Fog to Cloud systems", to be published in Lecture Notes, Springer.
Aug 28, 2017	mF2C-DP workshop, EUROPAR 2017	XLAB, UPV	M.Cankar, E.Olivares, M.Markovic, F.Fuart – "Fog and Cloud in the Transportation, Marine and eHealth domains", to be published in Lecture Notes, Springer.
Aug 28, 2017	mF2C-DP workshop, EUROPAR 2017	UPC	A.Gomez, X.Masip, E.Marin, S.Kahvazadeh – "A Hash-Based Naming Strategy for the Fog-to-Cloud Computing Paradigm", to be published in Lecture Notes, Springer.
Aug 28, 2017	mF2C-DP workshop, EUROPAR 2017	WOS, UPC, ATOS, TUBS	Andrea Bartoli, Francisco Hernandez, Laura Val, Jose Gorchs, Xavi Masip, Eva Marin, Jordi Garcia, Ana Juan and Admela Jukan – "Benefits of coordinated Fog-to-Cloud resources management strategy on a Smart City Scenario", to be published

			in Lecture Notes, Springer.
Jun, 2017	IEEE/ACM IWQoS	UPC	V. Barbosa, A. Gómez, X. Masip, E. Marín, J. Garcia – "Towards a Fog-to-Cloud Control Topology for QoS-Aware End-To-End Communication" [13]
Jun, 2017	IEEE CAMAD	UPC	V. Barbosa, W. Ramirez, X. Masip, E. Marín, S. Sánchez – "Proactive vs Reactive Failure Recoverty Assessment in Combined Fog-to-Cloud (F2C) Systems" [14]
Nov, 2017	IEEE FTC	UPC, IBM	V. Barbosa, W. Ramirez, X. Masip, E. Marín, S. Sánchez, G.J. Ren – "Towards Service Protection in Fog-to-Cloud (F2C) Computing Systems" [15]
Submitted Nov 16, 2017	IEEE Wireless Communications Magazine	UPC, TUBS, ATOS, IBM	Xavi Masip-Bruin, Sergi Sánchez-López Alejandro Jurnet, Eva Marín-Tordera, Admela Jukan, Guang-Jie Ren and Ana Juan - "Towards a Resilient Management Solution for Combined Fog-to-Cloud (F2C) Systems"
Submitted Nov 9, 2017	IEEE Wireless Communications Magazine	UPC, IBM	Zeineb Rejiba, Xavi Masip-Bruin, Alejandro Jurnet, Eva Marín-Tordera, Guang-Jie Ren - "F2C-Aware: Enabling discovery in Wi-Fi-powered Fog-to-Cloud (F2C) systems"

Table 15. Papers accepted, published or submitted during first year

Regarding the KPI of Participation conferences, the expected target has been reached; we expect more papers and participations next year, according to the KPI.

For the coming period the main scientific research findings and outcomes will be published and/or talked about at scientific international conferences and in scientific journals, not only for dissemination and knowledge transfer, but also to stimulate to test implementations.

Particular attention will be paid to scientific conferences/journals focusing on Fog and Edge Computing, but also on broader conferences and journals related to parallel and distributed computing.

The first target is traditional top level and good reputation international journals, magazines and conferences, targeting works in the areas of distributed systems, data management, security and privacy, networking and computing. The type of audience of this class of targets is research and, to a minor extent, industry. Traditional and good reputation conferences will be selected for the improvement of the visibility of the project and raise awareness of the innovative aspects of the mF2C Framework.

Also events on Cloud Computing and Internet of Things (IoT) will be selected, since they would help in raising awareness of the project within the cloud computing and IoT community and enable the project to participate in the building process of the reference community.

Key scientific results will be documented in formal papers and submitted to targeted academic conferences and workshops. The following table summarizes some interesting coming events that could fit the mF2C dissemination strategy:

Date, Location	Event	Audience
1-3 May 2018, Washington DC, USA	IEEE International Conference on Fog and Edge Computing [16]	research
25-30 June 2018, Seattle, USA	IEEE International Conference on Edge Computing, [17]	research
2-7 July 2018, San	IEEE International Congress on Internet of Things, [18]	research

Francisco, CA, USA		

Table 16. Events addressable for paper submission in second year

2.1.8 Workshops and training sessions

Knowledge sharing and enforcing within the partners is another relevant activity to pursue. According with the dissemination plan proposed in deliverable D6.1, some KPIs (Key Performance Indicators) has been defined to evaluate the effectiveness of the work done.

Action	KPI	Measure
Assistance to events and conferences	Number of events assisted with a relevant paper	At least **2** per year
Organization of workshops (in collaboration or not)	Number or workshops organized with significant present	**3** workshops organized through the project lifecycle, including co-organized with similar projects or initiatives

Table 17. KPIs associated with workshops and training sessions

During the first year a remarkable number of training and workshops organized and/or attended have been performed, reaching (or exceeded in the case of events with presented papers) the defined target KPIs.

In particular the F2C-DP workshop has been organized, collocated with the EuroPar 2017 in Santiago de Compostela. Eight papers have been received and six have been accepted and presented.

The workshop has been structured with:

- Keynote presentation, by John Kennedy (Intel Labs) "The emerging edge – drivers, technologies and challenges – an industry perspective"
- Two paper sessions
  - Architecture and technologies for Fog to Cloud
  - Fog to Cloud Use Cases
- Final Technical Panel: *"Technology challenges towards a Fog to Cloud architecture and its impact in business models"*, chaired by Rosa M. Badia (BSC), and participation of Christian Perez (INRIA), Antonio Salis (ENG), John Kennedy (Intel)

The following table summarizes the list of training and workshops attended:

Date	Event	Event	Partners	Participants	Contribution
4-5 April 2017	Nuvla & SlipStream Training day, **Geneva**	training	XLAB, UPC, BSC, ATOS, TUBS, ENG, SIXSQ	12 + 6 external participants from industry	2 day training delivered by SixSQ
18 Sept 2017	COMPS and DataClay Workshop, **Vilanova I la Geltrù**	training	XLAB, UPC, BSC, ATOS, TUBS, ENG, SIXSQ, INTEL, STFC	20	Training delivered by BSC
13-14 Nov 2017	Security Workshop, **Abingdon**	training	STFC, TUBS, BSC, Engineering Sardegna, Intel, UPC, SixSq	4 + 11 (remotely)	Training delivered by STFC
28 Aug	F2C-DP Workshop in Europar 2017,	Workshop	Antonio Salis (Engineering)	20	Paper presentation

2017	**Santiago de Compostela**		Alejandro Gomez (UPC) Matjia Cankar (XLAB) Francesc Lordan (BSC) Breogan Costa (Worldsense)		

Table 18. Training and workshops attended in first year

For the coming period, the mF2C consortium is committed to organize at least one workshop, which could be co-located within EuroPar 2018, or another major event (e.g. IEEE ICFEC - International Conference on Fog and Edge Computing). The objective is to showcase project results and outcomes to relevant audience, in an international event that could help us in maximizing our promotion and impact.

The Summer Camp is another major event that has been planned for month 22. It will be hosted in Barcelona, at BSC premises. The objective is to perform deep training to the selected audience (mostly PhD students, to be defined the number of attendees) in the relevant research themes linked to cloud, fog, IoT and Security areas. In the same event the External Advisory Board meeting will be hosted as well.

2.1.9 Website and Social Media

One of the most effective parts of dissemination and communication activities is the online presence with a showcase in the web for our business.

The first pillar is represented by the Project website, used as major contact point for our audience and central information hub for all relevant information, available documents or deliverables, all major milestones and breaking news regarding the project.

It includes a Google Analytics code that has been implemented in April, and helps in collecting statistics about website usage and visitors.

The Home page of the mF2C website contains a menu with eight tabs:

- Home
- Project Overview: with a brief description of the project and the uses cases
- Press room: with the publications of the project, including deliverables, newsletters and open code.
- Consortium: This page shows the logos of all the partners with links to individual pages with the introduction of the partner and its role in the project.
- News & Events: showing a list of all the news of project as well as all the events where mF2C partners participate.
- Related Projects: will show a brief description of the related project with an established connection with mF2C.
- Blog: page contains articles of related topics to mF2C addressed to a wide audience
- Contact us: it allows visitors to send a message to mF2C.

This home page also contains a connection to mF2C Twitter account the latest published tweets. Below the Twitter connection it also has a form to be registered in the website and receive the periodical mF2C newsletters. Finally it also contains the latest news and publications of the project.

Figure 2 mF2C website

Second pillar is represented by Social media, a key element for the effectiveness of dissemination and communication activities. The consortium decided to focus on:

- LinkedIn [19]
- Twitter [20] both for general communication and engagement.
- ResearchGate for academic dissemination [21]
- and setting up a YouTube channel [22] for videos, tutorials and animations.

According with the dissemination plan proposed in deliverable D6.1, some KPIs (Key Performance Indicators) has been defined to evaluate the effectiveness of the work done.

Action	KPI	Measure
Project website	Number of visitors	At least **1.500** visits per year
Social Media channels	Number of followers in Twitter	At least **250** from outside the project
	Number of tweets	At least **100** tweets per year (unique and retweeted)
	Number of YouTube videos	At least **2** videos per year

Table 19. KPIs associated with website and social media channels

During the first quarter the logo has been created, and then the website has been designed and implemented, with addition of google analytics code in April. Due to some feedback collected in EC CloudWatch event in Brussels, reporting a difficulty in recognising the project name, a new logo has been created and website and document templates updated. New contents have been added in sync

with major achievements and deliverable release. In September a new Blog section has been added, and blog posts published regularly on a monthly basis.

In terms of visitors, collected metrics from April report that the number of sessions at end of November (8 months history) is about 1600 (see Figure 3), thus reaching the defined target KPIs.

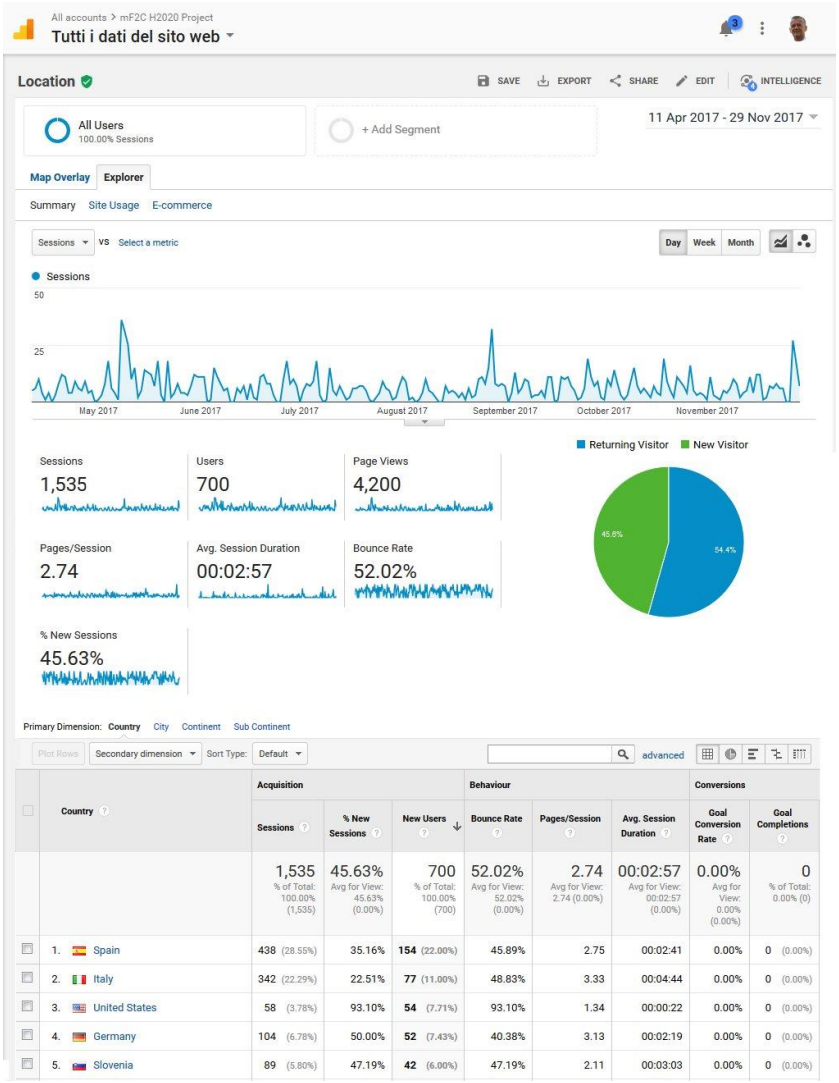


Figure 3 Website statistics on November 29, 2017

In Figure 3 we can see some statistics from the mF2C website. The total number of sessions is 1535 from 700 different users and with 4200 page views. The average number of visited pages in each session is 2.74 and the average duration of a session is 2 minutes 74 seconds. An important observation from this data is that almost a half of the visitors (45.8%) are returning visitors. Another important observation is the origin country of the visitors, most of them are from Spain and Italy, which are countries with different partners in the project, but in third position we have United States, showing the interest in the project from people not related to the project, or even from outside Europe.

Social Media has been leveraged to widen visibility and engagement for the project, even taking advantage of the extensive social networks already existent within the consortium.

Different efforts have been put in place both from the official account and from some partners, even for boosting the impact. We got good numbers in terms of views and likes, thus widening the visibility.

As of end of November we collected the following:

Social media	tweets/posts	Tweets target	Followers	Followers target	Views
Twitter	117	100	80	250	47200
LinkedIn	75		78		480
ResearchGate	18		10		102

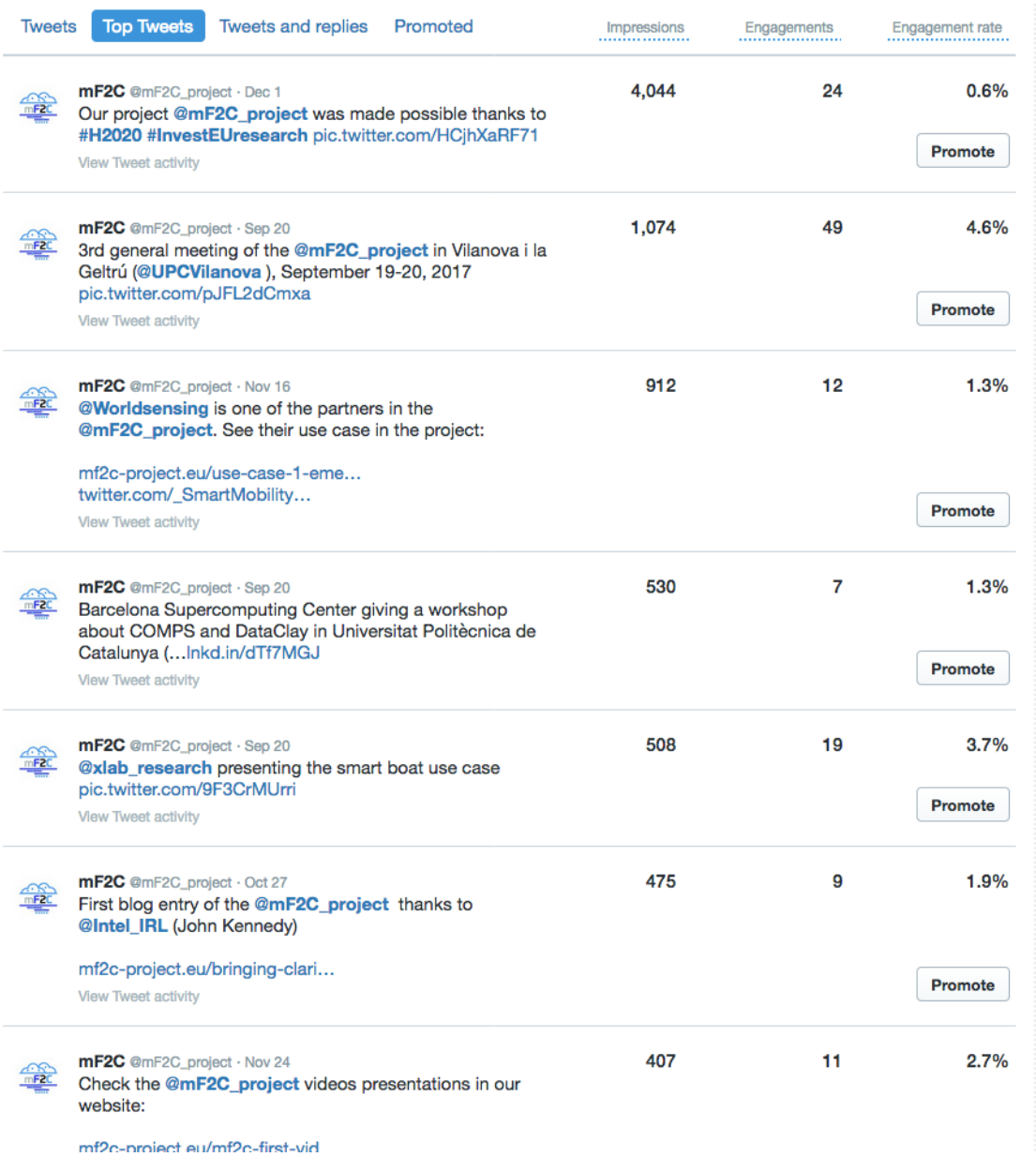
Table 20. KPIs associated with social networks

Summing up number of tweets/posts of the different social media we reach easily the target, while the same for followers give numbers bit below the threshold.

But all partners in the consortium have an active position on both Twitter and LinkedIn, so if we consider the efforts form the mF2C project coming from partners, particularly in the LinkedIn feed, we can end up that the real impact of the dissemination has been more than expected.

In fact, even considering social media activity of the Exploitation and Dissemination Manager (EDM) with its own account in LinkedIn, we can add 618 more followers, 32 articles/posts with about 3000 views.

In the next figures, we show some of the tweets and posts in LinkedIn with higher impact both, in the number of impressions and/or in the rate of interaction. From Figure 4 and Figure 5 we can observe that the Tweets with more impact are usually related to announcements of plenary meetings, workshops, training, etc. such as the case of Figure 5.



Tweets	Top Tweets	Tweets and replies	Promoted	Impressions	Engagements	Engagement rate	
mF2C @mF2C_project · Dec 1 Our project **@mF2C_project** was made possible thanks to **#H2020 #InvestEUresearch** pic.twitter.com/HCjhXaRF71 View Tweet activity				4,044	24	0.6%	Promote
mF2C @mF2C_project · Sep 20 3rd general meeting of the **@mF2C_project** in Vilanova i la Geltrú (**@UPCVilanova**), September 19-20, 2017 pic.twitter.com/pJFL2dCmxa View Tweet activity				1,074	49	4.6%	Promote
mF2C @mF2C_project · Nov 16 **@Worldsensing** is one of the partners in the **@mF2C_project**. See their use case in the project: mf2c-project.eu/use-case-1-eme… twitter.com/_SmartMobility… View Tweet activity				912	12	1.3%	Promote
mF2C @mF2C_project · Sep 20 Barcelona Supercomputing Center giving a workshop about COMPS and DataClay in Universitat Politècnica de Catalunya (…lnkd.in/dTf7MGJ View Tweet activity				530	7	1.3%	Promote
mF2C @mF2C_project · Sep 20 **@xlab_research** presenting the smart boat use case pic.twitter.com/9F3CrMUrri View Tweet activity				508	19	3.7%	Promote
mF2C @mF2C_project · Oct 27 First blog entry of the **@mF2C_project** thanks to **@Intel_IRL** (John Kennedy) mf2c-project.eu/bringing-clari… View Tweet activity				475	9	1.9%	Promote
mF2C @mF2C_project · Nov 24 Check the **@mF2C_project** videos presentations in our website: mf2c-project.eu/mf2c-first-vid				407	11	2.7%	

Figure 4 Some tweets with relevant number of views

Figure 5 Tweet for the 3rd general assembly

Figure 6 shows some of the LinkedIn posts with more views, and as well as in Twitter these are usually related to mF2C events. Only as an example, the left picture in Figure 6 corresponds to a demo made during the 3rd plenary meeting mentioned in the tweet of Figure 5.

Apart of the tweets and posts of the mF2C official account, some of the partners, both individually or/and as institution have been very active disseminating the results of the project and helping in its promotion. Examples of this are shown in Figure 7 and Figure 8, with some of the more viewed posts in LinkedIn from Antonio Salis (ENG), with for instance 1212 views of the post about the Nuvla Training Day held in Geneva.

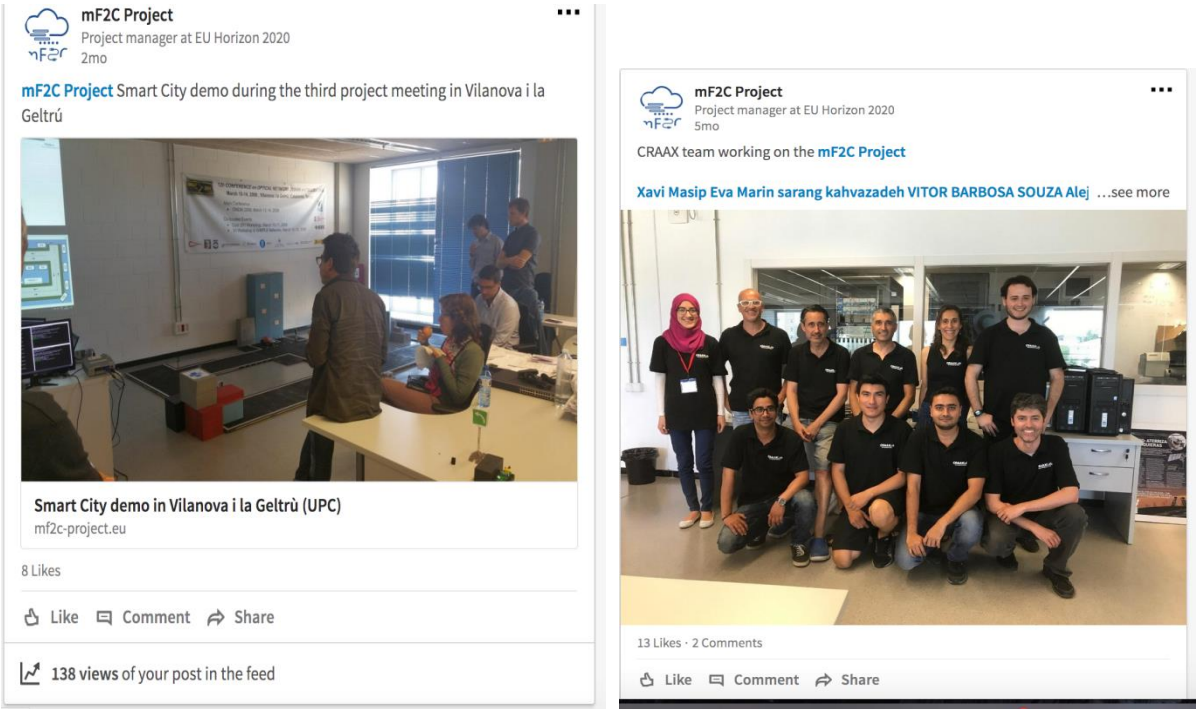


Figure 6 Some LinkedIn posts

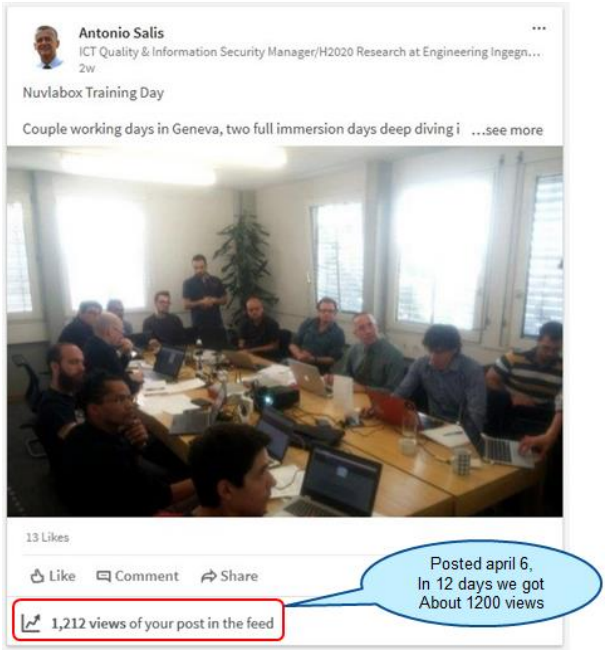


Figure 7 LinkedIn Post about Nuvla Training Day held in Geneva

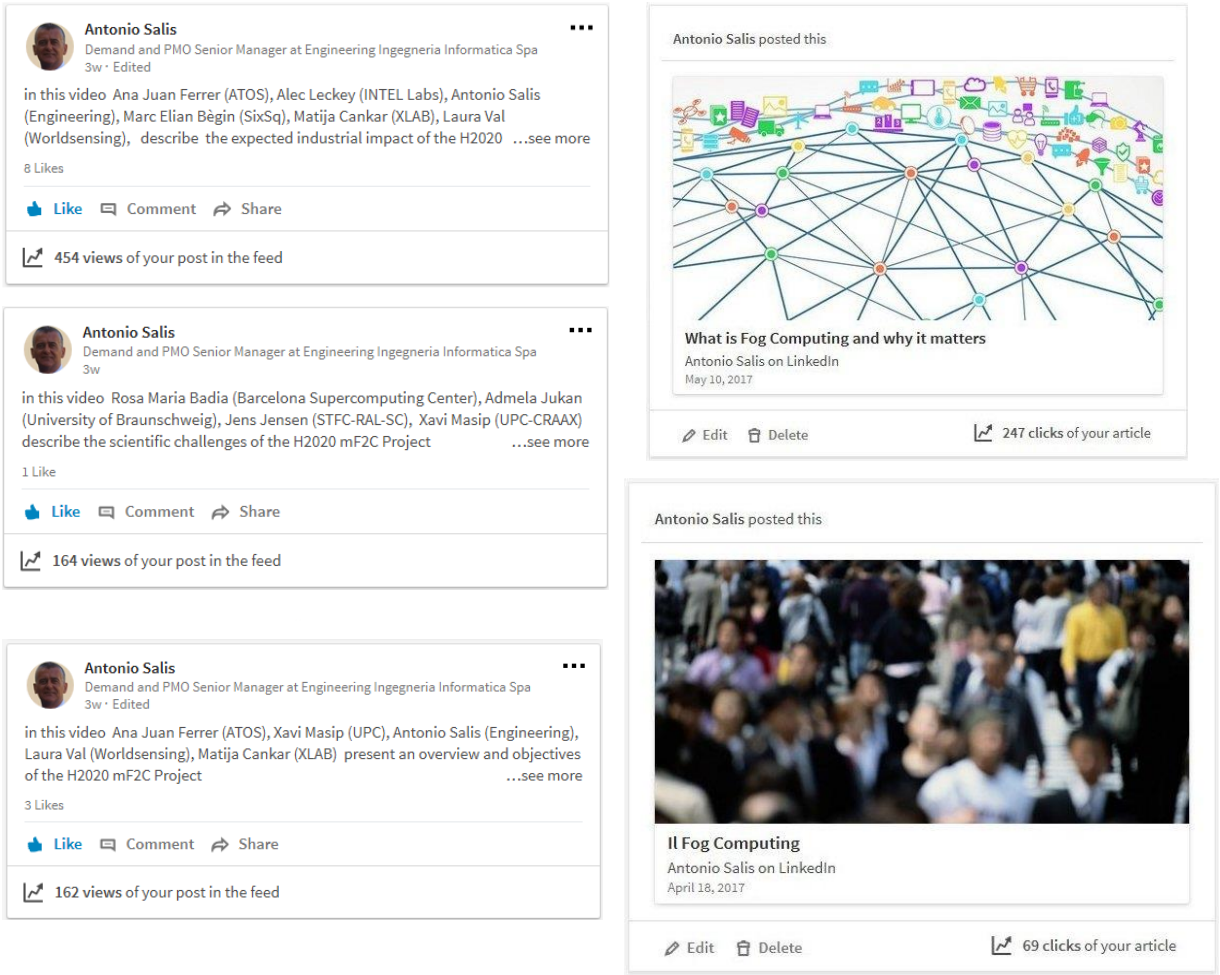


Figure 8 LinkedIn Posts about videos published Fog Computing

In Table 21 we show the different media support from mF2C partners, taking into account the social network activity as well as the online presence in partner's websites mentioning/promoting the project. This online presence includes also partners' official portals that promote the Research and innovation activities broadly; EU funded running projects and participation in major events.

Partner	Portal	Twitter	LinkedIn
SIXSQ	Dedicated entry for mF2C on the SixSq website [23] with cross-reference to the project website. There are also 2 blog entries about edge/fog computing referencing the project.	Tweets are actively re-tweeted and in addition tweets regarding the project are posted via the SixSq account	LinkedIn Posts by the project are actively shared
WOS	Links to the project in corporate portal and press release	Tweets support	LinkedIn posts
TUBS	no	Tweets support	LinkedIn posts
ATOS	Both on official website and Planetic website	Tweets support	LinkedIn posts
ENG/TISC	yes	Tweets support	Various posts

			and articles
INTEL	Not yet. Intel Labs Europe is just exiting a restructuring and online media presence will be refreshed to align with new direction, reflecting engagements including mF2C.	Not yet	Not yet
XLAB	Dedicated entry for mF2C on the XLAB website [24] and [25]	Tweets are actively re-tweeted and in addition tweets regarding the project are posted	LinkedIn Posts by the project are actively shared
STFC	An entry in the STFC will be added soon	Tweets support	LinkedIn posts
BSC	Mf2c listed in the projects page of BSC website	Tweets support	LinkedIn posts
UPC	UPC has a specific entry in the research group web (CRAAX) [26] H2020 mF2C project was mentioned in the EPSEVG web (Escola Politècnica Superior d'Enginyeria de Vilanova i la Geltrú) [27]	Tweets support by different people	LinkedIn posts by different people

Table 21. Social media support by partners

For the coming period the website will be continuously updated with posts of all relevant information, available documents, deliverables or software codes, all major milestones and breaking news regarding the project. Most of the partners have mentions to the project in their web pages, but other such as STFC, have the intention of creating news or press releases in their corporative websites.
The use of social media will be increased, as we are getting some major achievements, so the need to disseminate these results, with the objective to increase the number of visits to the webpage as well as the number of followers in the different social networks.
The Online media channel will be focused on communicating what we are producing, which solutions we are going to provide, so messages will be more oriented to technical IT industrial stakeholders and communities, highlighting availability of source code, promoting videos, presentations, whitepapers, speeches.

Finally, the KPI for videos publishing on YouTube has been reached, since three videos have been recorded:

1. video about project overview and objectives
2. video about the expected industrial impact
3. video about the scientific challenges of this project

All videos have been published and made available on both

- mF2C YouTube Channel [22]
- UPCommons Research Portal [28]

Several posts have been published to promote all videos, on mF2C website, LinkedIn and Twitter with about 1000 view after the first two weeks.

2.1.10 Promotional Materials

One of the means to help getting engaged with relevant stakeholders is the preparation of marketing materials, with the purpose of raising awareness about the project and also to support the partners in the different events they may attend.

For this reason the necessary marketing materials has been produced in order to give an overview of the project, its objectives, challenges and expected results, and support partners in the participation to international events, fairs and exhibitions.

According with the dissemination plan proposed in deliverable D6.1, some KPIs (Key Performance Indicators) has have been defined to evaluate the effectiveness of the work done.

Action	KPI	Measure
Whitepapers (business and/or scientific)	Number of whitepapers published	**At least one** business oriented whitepaper and **one** technical/scientific whitepaper
Marketing collateral materials	Number of flyers	At least **1** per year
	Number of posters	**2** (one technical and one business oriented)
	Number of project videos	At least **1** per year

Table 22. KPIs associated with whitepapers and marketing collateral material

Regarding whitepapers from January 2018 the technical whitepaper will be approached with a detailed description of the system architecture defined for IT-1, with system components, data management and security/privacy features and policies to be completed and published by M18, while a more business oriented version will be approached later, and completed by M30. From first whitepaper some video animations will be produced and published as well.

The target for year 1 for flyers has been reached: from May a first flyer has been completed and made available for supporting partners in international events.

Figure 9 First mF2C flyer (front)

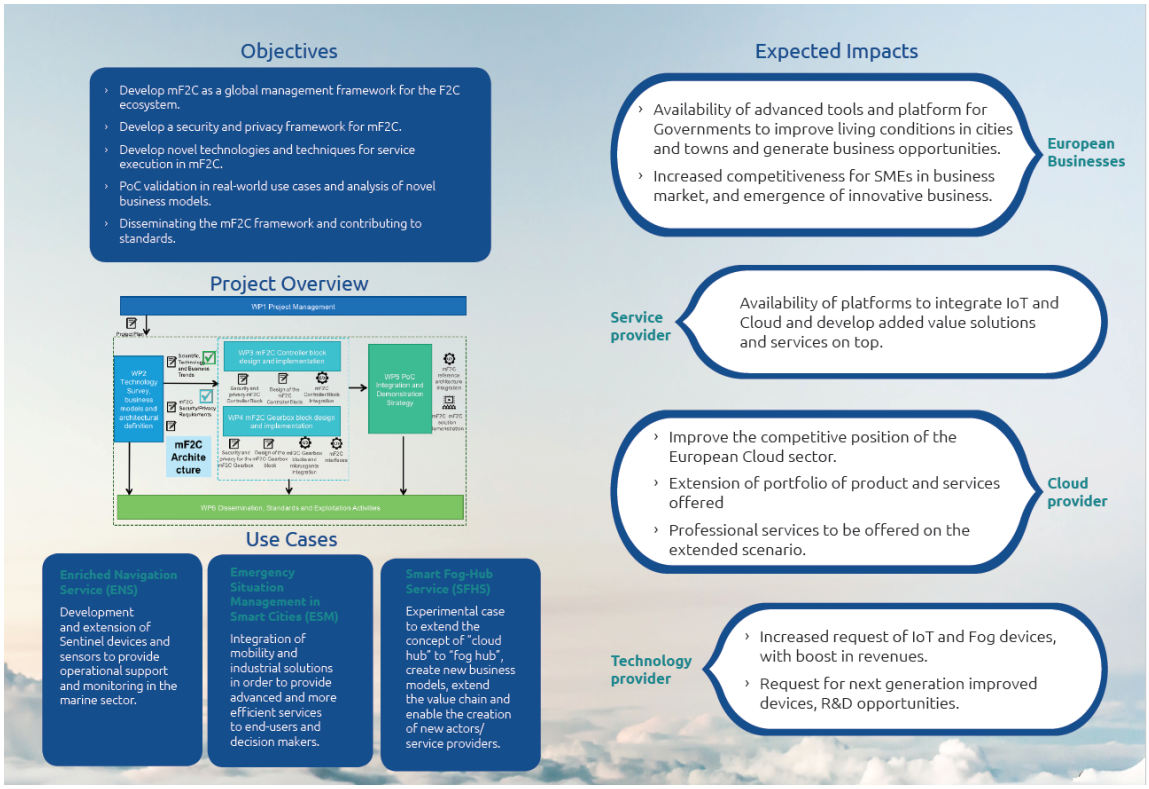


Figure 10 First mF2C flyer (back)

Also for posters the target has been reached: two different posters have been produced and made available, the first one, from UPC is the official one and available since May 2017. It has been used during the IWQoS 2017 conference held in Vilanova i la Geltrú on June 16-18, 2017.

The second has been designed by TUBS and used within the TU Braunschweig premises for internal dissemination purposes.

Figure 11 First mF2C poster

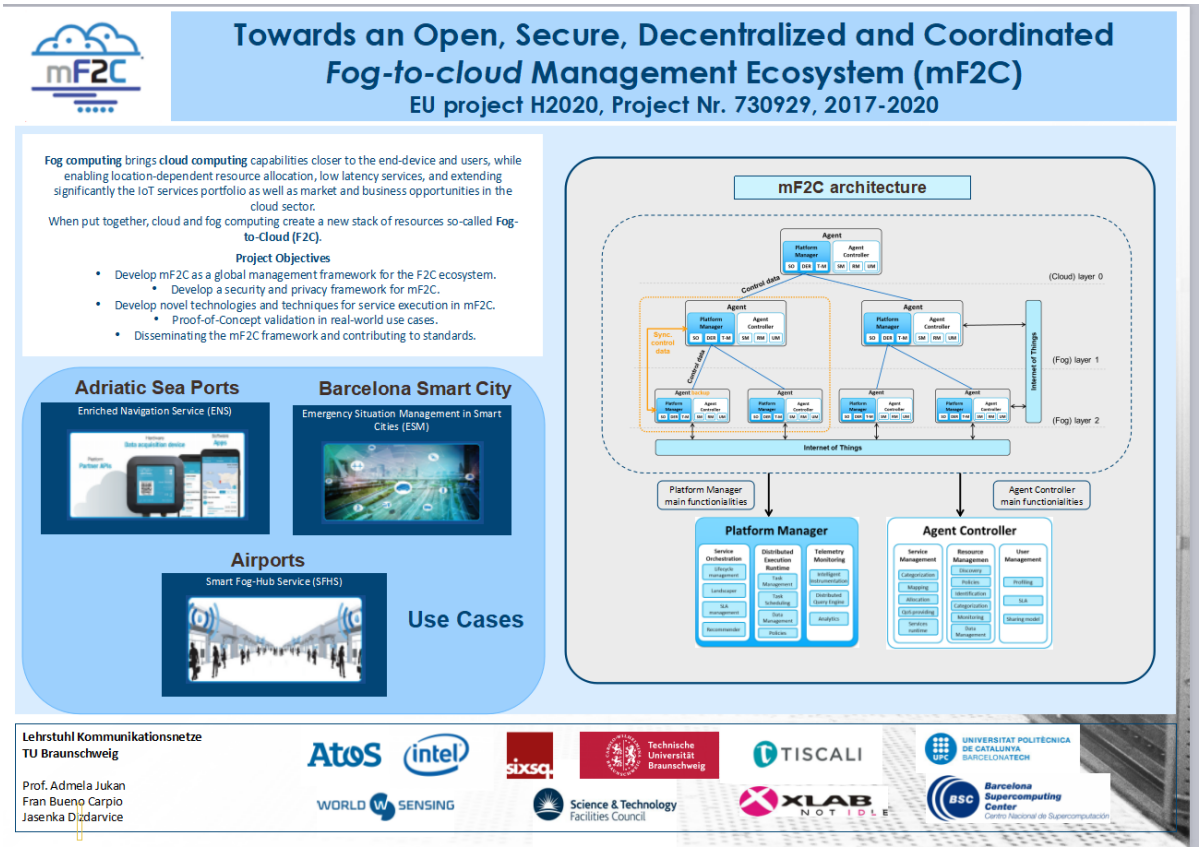


Figure 12 Poster created by TUBS and used within TU Braunschweig premises

For the coming year a refined version of Flyer and Poster will be elaborated and made available, trying to introduce more details about technical solution, progress in the project, key achievements, added value and benefits for the different stakeholders.

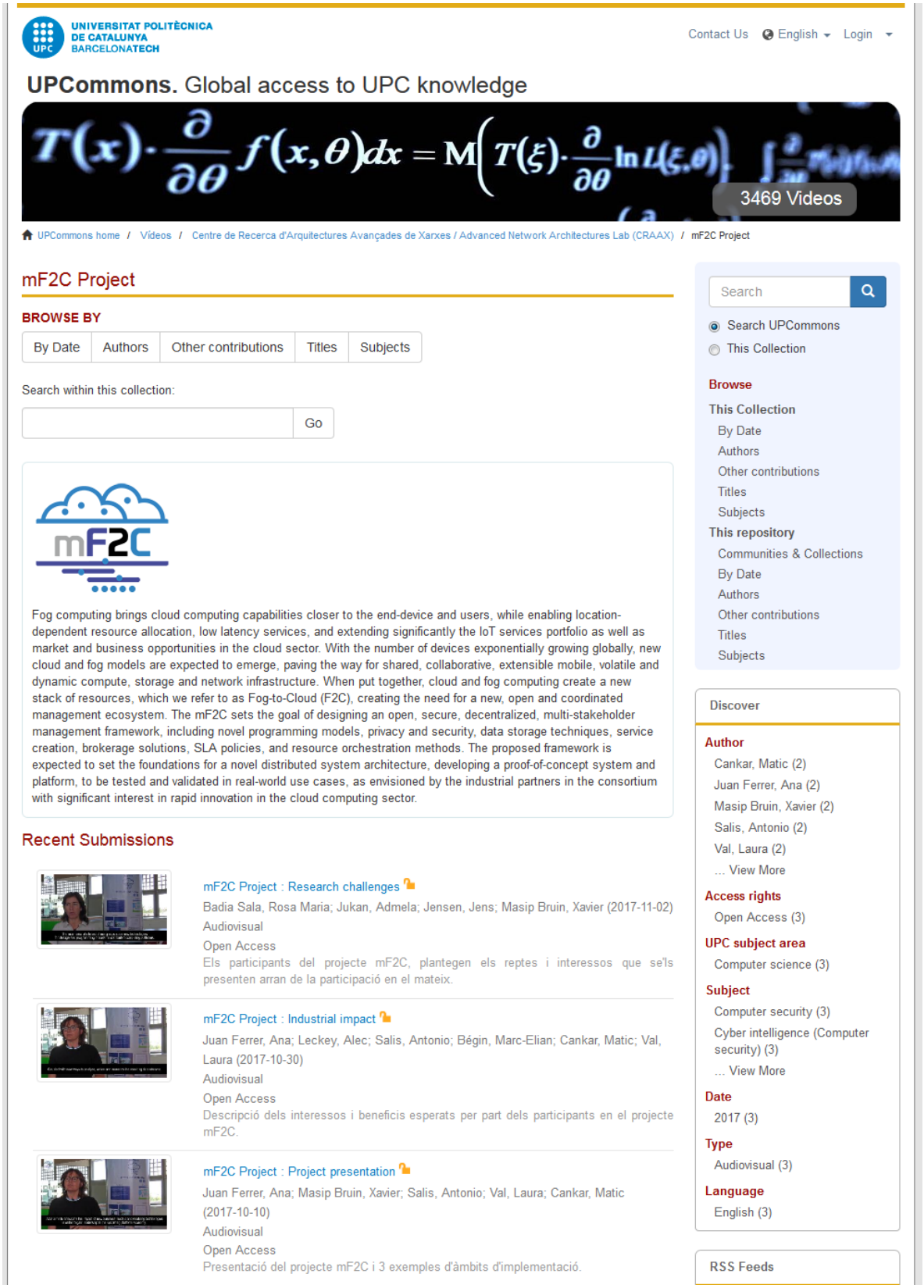


Figure 13 UPCommons page with published videos

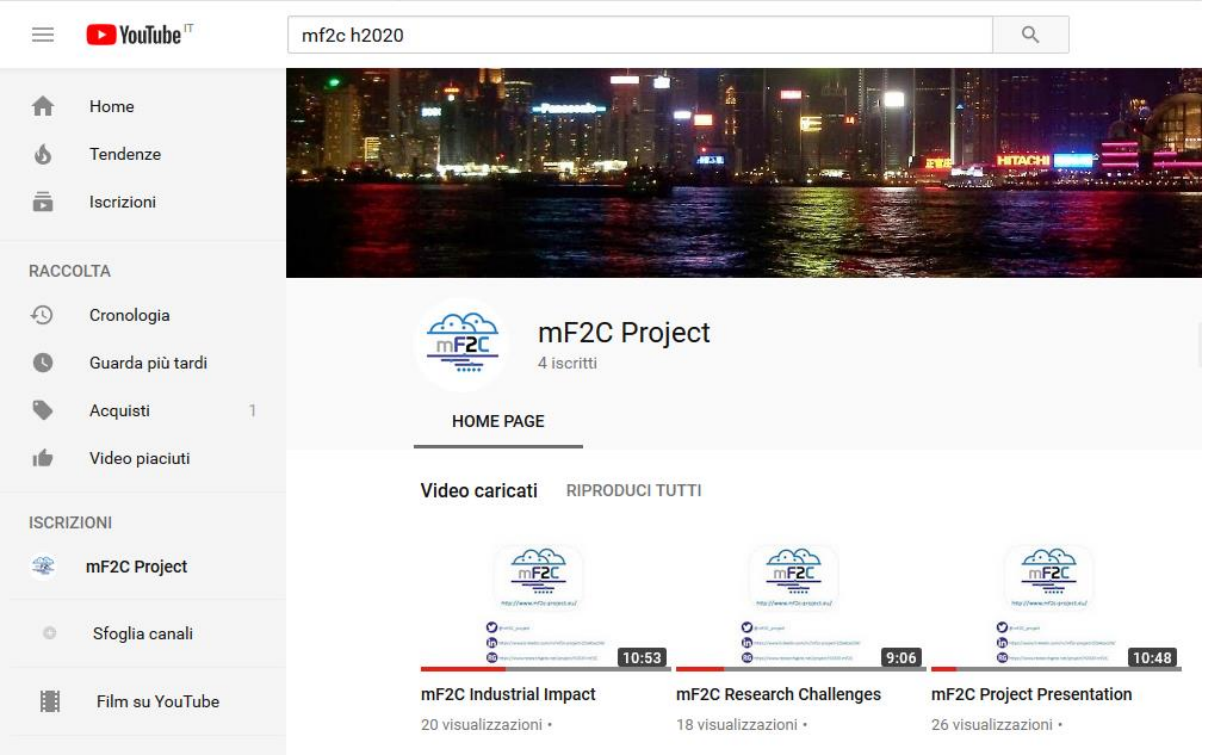


Figure 14 YouTube channel with published videos

For the coming year more videos have been planned, with room for tutorials about the usage of available mF2C software, hands-on webinars, etc. [1]

2.1.11 mF2C newsletter and Blog

Within the dissemination activities other tools have been setup to keep in touch with relevant stakeholders: Newsletters and project Blog.

The Newsletter aims at informing all subscribed stakeholders about latest updates and news of mF2C project, including software code releases, forthcoming events, deliverables, milestones reached. Even if a specific metric has not been set, the consortium agreed to send 2 newsletters per year, the first one has been sent on May 2017 (by Engineering), while the second is in preparation for December 2017 (by UPC).

By now the number of subscribers is only 32 (with an associated mailing list), so one of the recommended actions would be to invite all partners to get some more subscribers, particularly from outside the consortium, to widen the audience.

For the coming year a schedule has been prepared to with two more newsletters.

Period	Title	Owner
June 2018	Newsletter – Summer 2018	STFC
December 2018	Newsletter – Winter 2018	ATOS

Table 23. Coming Newsletters

The consortium decided for the creation of a project Blog, with a social media strategy to be used. The consortium decided a monthly frequency of publication and a schedule for all the partners. The mF2C blog content should be related to the main knowledge areas of the project, but also

[1] mF2C YouTube presence: https://www.youtube.com/channel/UCHLm6stUM9UaOw66Qn3dwdQ

understandable by a wider audience, without formalisms or any need of deep technical knowledge, For this mF2C blog a specific section in the mF2C website has been created.

One paper has been anticipated in May, then the blog has been started in September, articles have been published according to the agreed schedule, then re-tweeted in Twitter and posted in LinkedIn. The main topics addressed in the first 5 entries have been: Fog Computing, IoT, Smart Cities, standards in cloud and fog computing and machine learning.

- May 2017: What is a Fog Computing and why it matters, by Engineering, [29].
- September 2017: What is a Smart City? by SixSq, [30].
- October 2017: IoT, cloud, fog, edge, … do I hear more? by UPC, [31]
- October 2017: Bringing Clarity to the Fog – the role of standards, by INTEL, [32]
- November 2017: Machine learning and fog-to-cloud computing by TUBS, [33]

For the coming year a schedule has been already agreed with assignment to partners:

Entry	Partner	Internal deadline	Publication deadline
January 2018	ATOS	Jan 25	Jan 31
February 2018	BSC	Feb 23	Feb 28
March 2018	ENG	Mar 25	Mar 31
April 2018	SIXSQ	Apr 24	Apr 30
May 2018	STFC	May 25	May 31
June 2018	WOS	Jun 24	Jun 30
July 2018	UPC	Jul 25	Jul 31
August 2018	INTEL	Aug 26	Aug 31
September 2018	TUBS	Sep 25	Sep 30
October 2018	XLAB	Oct 26	Oct 31
November 2018	ATOS	Nov 25	Nov 30
December 2018	BSC	Dec 18	Dec 22

Table 24. Planned 2018 blog entries

2.2 Dissemination through Open Source

2.2.1 Open Source License

To ensure the industrial sustainability of the project results, a non-commercial limiting in nature and weak copyleft model (similar to Apache, BSD, or Eclipse Public licenses) is currently being discussed by all partners. Most background IP solutions being imported into the project are actually using the Apache 2.0 licence. This will drive interest in the project with potentially repeat visitors viewing the project's code repository. It is intended that the project's software releases will be hosted here, including documentation, generating interest in the project.

2.2.2 Open Source Modules

The common source code repository is hosted on GitHub [34]. The project consortium intends to publish several open-source releases throughout the lifespan of the project that will include full source code, usage, installation, and developer documentation. As development begins in earnest, we will be able to show in future deliverables the levels of activity, e.g., contributions, contributors, dates, etc. This can be broken down per each of the current repositories available:

DataClay:

Contains the code for the next generation object store enabling programmers to store objects using the same model as their application.

Landscaper

Contains the code for the Landscaper module that is responsible for constructing a graph model describing a computing infrastructure.

User Management

Will store the code for the User Management module, a component of the Platform Manager

Lifecycle Management

Contains the code for the Service Lifecycle Manager, a key module for deploying services within the Platform Manager

mF2C

Will contain some of the other modules and libraries that will be used to in the mF2C Platform Manager and Agent Controller.

Service Management

Contains the code for the Service Management module, a component of the Platform Manager

Emmy:

A library for sigma protocols and zero-knowledge proofs

SLA Management

Contains the code for the Service Level Agreement manager, a key module of the Platform Manager.

COMPSs

Repository for all the code for distributed runtime system, COMPSs

Documentation

Global documentation. Single point of information for the entire platform. Contains a user and developer guides.

E2EE Server

This is a server for storage of files which are encrypted by the E2EE client. It provides REST API for user accounts, data storage, and sharing information between users.

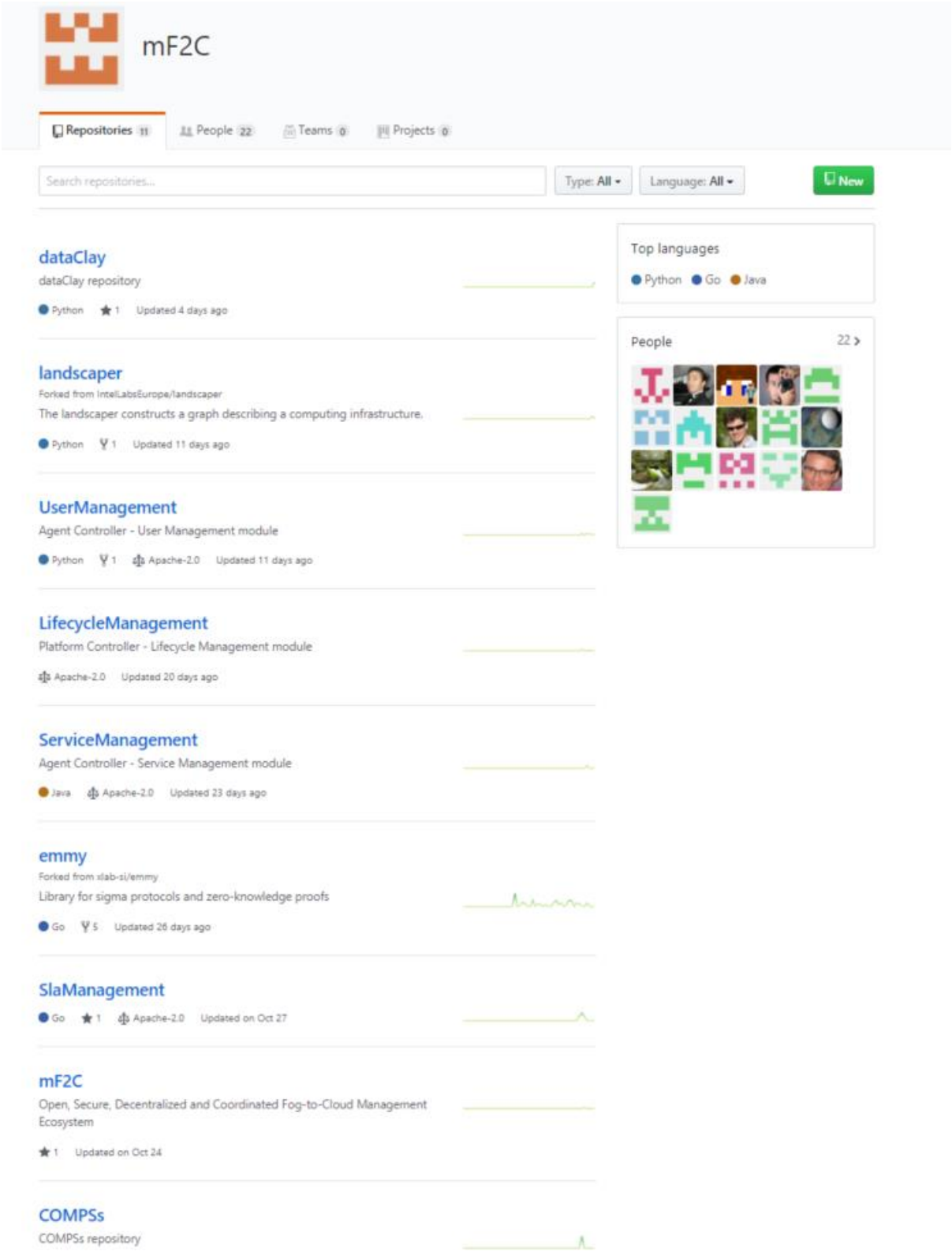


Figure 15 mF2C presence on GitHub

Technical developments driven by mF2C will be open-sourced where possible and promoted via well-established community portals such as GitHub, and community events such as developer conferences.

2.2.3 Development Strategy

Due to the project's ambitious objectives, the development strategy for this collaborative open source project requires the adoption of standard techniques and approaches best suited for the development of early prototype technologies. Key components of this approach include:

- *Re-use of open source software:* The re-use and adoption of existing open source software will be attempted as much as possible, making sure that time is not unnecessarily spent re-implementing components that are already available and so that the development activities can be more focused on the implementation of the innovative features of the platform.
- *Continuous integration and testing:* A central source repository hosted on github.com, has been established. As the amount of code developed increases, a central build/integration/testing infrastructure may be established. This will allow for nightly builds running the latest code merges, executing a series of unit, component, integration and performance tests, and a monitoring and notification facility to keep all development teams up to date on status, failures and issues. The proposed technologies under review are Maven as the build system, Jenkins as the build server, Junit/Cobertura/Mockito for Java, PyUnit/Coverage/Mock for Python to cover unit testing, code coverage and object mocking respectively.
- *Release often:* The open source code and binary distribution releases for the project developers, external end users and developers.

Collaborative development in a large project of 10 organizations based in remote locations is a challenging task and requires effective approaches and mechanisms to achieve project goals. In mF2C, we will adopt many approaches for communication, such as instant messaging, email, conference calls, and collaboration tools such as Slack for shared workspace environment [35] and Waffle, an automated project management tool for GitHub issues and pull requests [36].

In addition to these general communication tools, as code matures, and to ensure the longevity of the results after the project finishes, all finalised designs, developer docs and the integration articles will be transferred to the GitHub supported wiki which is public. Our initial proposed development strategy is based upon the branching features of Git, see Figure 16.

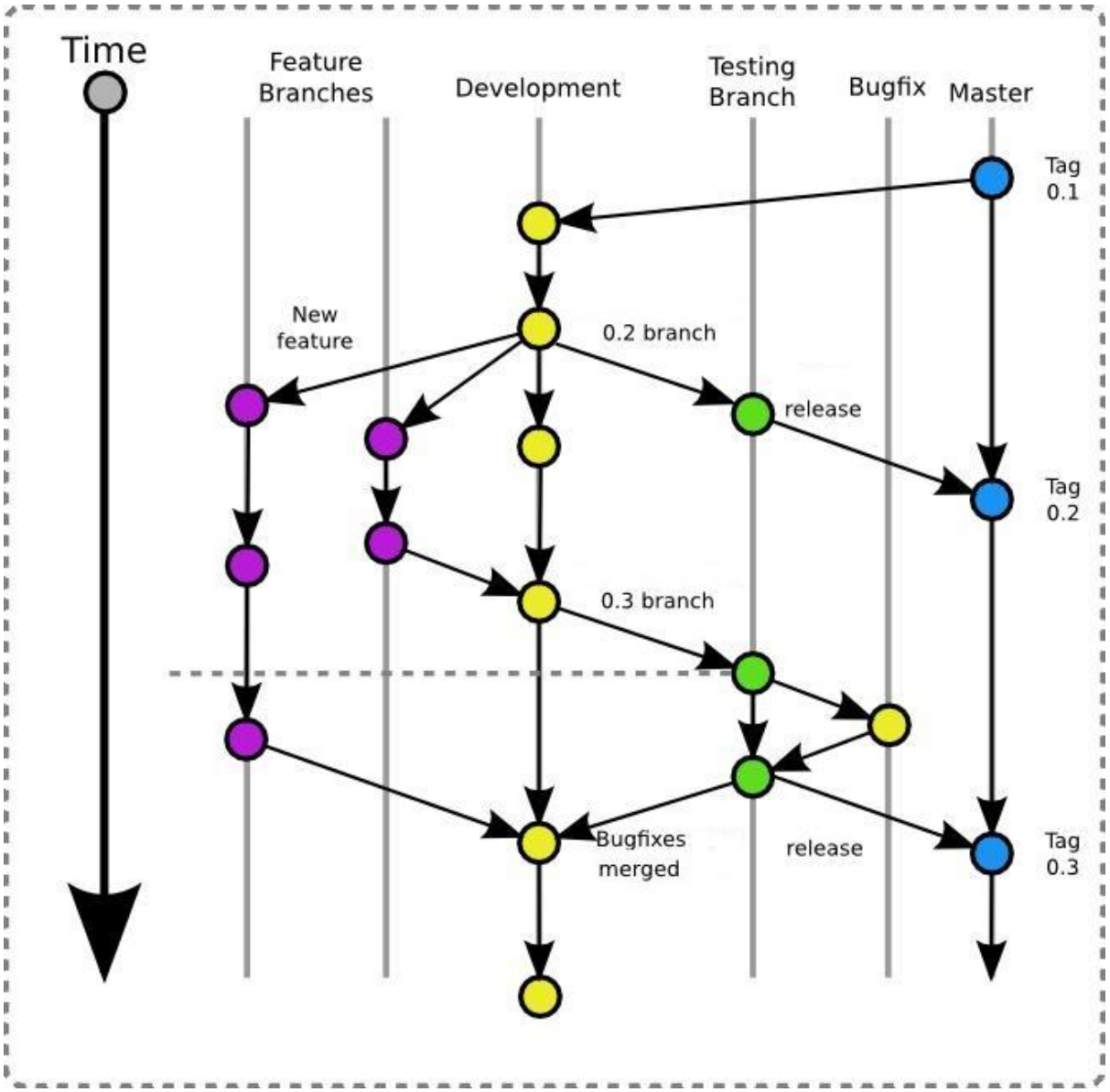


Figure 16 Proposed mF2C development and branching strategy

3 Standardisation Activities

The mF2C project is focused on delivering a management framework for the challenging fog-to-cloud domain. A future where mobile wireless devices can discover each other, interconnect, share resources and manage services appropriately and securely will require shared understandings and agreed interfaces. Formal standards have a critical role to play in enabling this future.

While tackling the challenge of interoperability, standards also have the potential to enhance security, and encourage innovation. Given the rapid advancements of technologies in this space, standards should also be designed with an eye to the future. Extensibility and forward compatibility should be considered to maximise value and opportunity going forward.

To this end, mF2C are monitoring standards initiatives across a variety of communities, by industry, and at regional and international levels. Some of these initiatives are introduced below.

3.1 OpenFog Consortium

The *OpenFog Consortium* [37] was founded in November 2015 to address technical challenges in Fog computing. The consortium is organised into numerous committees, with the Technical Committee structured into Working Groups dedicated to Architecture, Communications, Manageability, Security, Software Infrastructures and Testbeds. They define Fog Computing as "A horizontal, system-level architecture that distributes computing, storage, control and networking functions closer to the users along a cloud-to-thing continuum". With a strong industry focus, in January 2017 they published the OpenFog Reference Architecture Technical Paper [38]. It describes eight OpenFog pillars: Security, Scalability, Open, Autonomy, RAS (reliability, availability, serviceability), Agility, Hierarchy and Programmability. It covers medium-to-high level considerations that address security, cognition, agility, latency and efficiency.

In terms of mF2C member activities to date, it should be noted that INTEL are a founding member of the OpenFog Consortium, and colleagues of the INTEL mF2C team are active contributors to the work of the consortium. Both UPC and INTEL mF2C teams have been paying close attention to the outcomes of the OpenFog Consortium, and reviewed and considered the OpenFog Reference Architecture when defining the architecture for mF2C.

In terms of future plans, both UPC and INTEL will continue to monitor the output of this standards group, and look for opportunities to align with technical standards and specifications when they emerge. When the mF2C implementation matures, direct contact with the OpenFog Consortium will be established to see if mF2C could help inform the outputs of the group. Perhaps mF2C could assist in areas such as device identification, advertisement, discovery, and security.

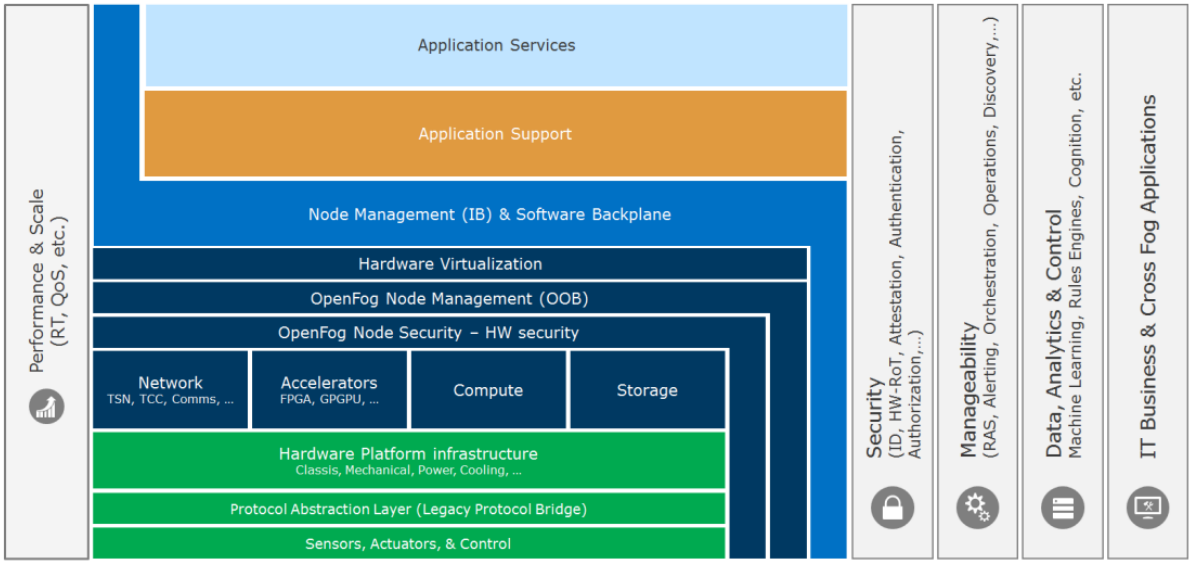


Figure 17 Architecture and Perspectives of the OpenFog Reference Architecture release 1.0 [38]

3.2 Open Connectivity Foundation

The *Open Connectivity Foundation* [39] was announced in February 2016 to drive the specification of standards to enable connected devices communicate with each other. It is an amalgamation of the Open Interconnect Consortium (OIC), Universal Plug and Play (UPnP) Forum and many key industry players. Devices in scope include computers, mobile phones, sensors and the full range of IoT devices. The standards consider the device technology stack from silicon through software, platform and finished-goods. OCF published the OIC Specification 1.1 [40] in February 2017. It includes a base resource schema, and specifications for OIC core (architecture, interfaces, protocols and services), security and smart home devices are defined. OCF also sponsors IoTivity [41], an open-source reference implementation, published under the Apache 2.0 license.

In terms of mF2C member activities to date, it should be noted that INTEL are a Diamond member of the Open Connectivity Foundation, and colleagues of the INTEL mF2C team are active contributors to the work of the foundation.

In terms of future plans, INTEL will monitor the output of this initiative, and look for opportunities to align with technical standards and specifications when they emerge. When the mF2C implementation matures, direct contact with the Open Connectivity Foundation will be established to see if mF2C could help inform the outputs of the group. Perhaps mF2C could assist in areas such as device identification, advertisement, discovery, and security.

On a related note, while not a standards organisation per se, the Linux Foundation hosts the EdgeX Foundry [42], an open source project tackling the software implementation challenges of IoT computing at the edge.

3.3 Open Grid Forum

The *Open Grid Forum* [43] is an open community dedicated to developing best practices and standards for advanced, applied, distributed computing. It includes a working group dedicated to Open Cloud Computing Interfaces: OCCI [44]. OCCI have developed a set of interoperability standards to enable infrastructure management tasks. Based on the OCCI Core Model, customised extensions can be defined to target functionality in specific areas. Researchers have recently demonstrated how mobile robotics [45] could be managed via an OCCI extension

In terms of mF2C member activities to date, it should be noted that INTEL are a co-chair of the OCCI working group. Members of the STFC and INTEL mF2C teams are active contributors to OGF and to the standards that working groups such as OCCI develops and maintains.

In terms of future plans, STFC and INTEL will monitor the activities of this working group, and look for opportunities to align with OGF standards as they are published. In time, the possibility of mF2C developing an OCCI extension explicitly to support management of fog deployments will be considered.

3.4 ETSI

The *European Telecommunications Standards Institute* (ETSI) [46] develops global standards for Information and Communications technologies. It focuses much of its efforts on telecommunications, with some of its clusters dedicated to Interoperability, Connecting Things, Wireless Systems, and Networks. ETSI's Multi-Access Edge Computing (MEC) Industry Specification Group (ISG) recently signed a Memorandum of Understanding with the OpenFog Consortium to work together on standards that enable 5G, mission-critical, data-dense applications through fog computing and networking.

In terms of mF2C member activities to date, it should be noted that INTEL is a member of ETSI, and in December 2017 Intel Munich's Dr. Markus Mueck was elected to vice-chair of the Board of ETSI. Colleagues of the INTEL mF2C team are active contributors to ETSI, and the mF2C team monitors ETSI for developments that may be of interest to mF2C.

In terms of future plans, INTEL will continue to monitor the activities of this standards group. The focus of ETSI is on technical standards for telecommunications infrastructure which is of indirect interest to mF2C. However, ETSI's new Memorandum of Understanding with the OpenFog Consortium is of relevance and will be followed with interest.

3.5 ISO/IEC JTC1

At a formal international level, ICT technologies are standardized by the *ISO/IEC JTC1* organisation [47]. This joint technical committee has spawned numerous subcommittees. Of particular interest to mF2C are SC38 responsible for Cloud Computing and Distributed Platforms, and the new SC41 responsible for Internet of Things and related technologies.

In terms of mF2C member activities to date, it should be noted that in 2017 INTEL's Phil Wennblom was selected to be the incoming chair of JTC1 for the next three years. INTEL's mF2C team members are active in various subcommittees of JTC1 as described in the following sections, and colleagues of INTEL's mF2C team are active in monitoring and contributing to JTC1 activities.

In terms of future plans, INTEL will continue to monitor activities at the JTC1 level and engage with any activities that may be appropriate, through the appropriate international channels.

3.6 ISO/IEC JTC1 SC38 - Cloud Computing and Distributed Platforms

ISO/IEC JTC1 SC38 [48] has driven standards in terminology and architectures for the cloud, has recently published a standard on Data and their Flow across Devices and Cloud Services, and in December 2017 released a standard on Cloud Interoperability and Portability. The subcommittee is starting to investigate the Edge computing landscape, and also emerging concepts and technologies including containerization and serverless computing. All of these areas are of interest to mF2C.

In terms of mF2C member activities to date, it should be noted that INTEL's mF2C team members are active in SC38, and engage as national experts via the National Standards Association of Ireland's official mirroring subcommittee: NSAI/TC2/SC11. INTEL mF2C team members monitor SC38 activities, contribute via their active membership of the Irish mirroring subcommittee, and help inform the Irish national position on SC38 matters and ballots.

In terms of future plans, INTEL will continue to actively engage in SC38 activities, highlight any SC38 standards that may be of interest to the mF2C consortium, and inform contributions to SC38 based on their learnings from mF2C. The SC38 work on the Edge computing landscape is perhaps of most immediate relevance to mF2C.

3.7 ISO/IEC JTC1 SC41 - Internet of Things and related technologies

ISO/IEC JTC1 SC41 [49] was formed in 2017 and is progressing a vocabulary, reference architecture, and an interoperability framework for Internet of Things. It is liaising closely with SC38 and other relevant organizations to minimise overlap and maximise compatibility.

In terms of mF2C member activities to date, it should be noted that colleagues of INTEL's mF2C team are active in SC41. INTEL mF2C team members monitor SC41 activities for topics of interest.

In terms of future plans, INTEL will continue to monitor SC41 activities, highlight any SC41 standards that may be of interest to the mF2C consortium, and engage with colleagues on SC41 should opportunities for mF2C contributions to SC41 activities be identified.

In late 2017 it was announced that a new subcommittee SC42 will be formed to pursue standards in the area of Artificial Intelligence (AI). The adoption and distribution of AI techniques across networked environments is of interest to mF2C so there are many complex challenges, some of which AI may be able to tackle efficiently. INTEL will monitor developments in SC42 also.

3.8 DMTF

The *Distributed Management Task Force* (DMTF) [50] was founded in 1992 to simplify the manageability of technologies being exposed over the network. It is primarily driven by industry, and at time of writing has technical working groups, forums and task forums active in areas such as Cloud Management, CIM Profiles, Platform Management, and Systems Management. In 2012 DMTF published v1.0.1 of CIMI, a Cloud Infrastructure Management Interface [51]. Starting in 2015, DMTF started to publish the RedFish set of standards, designed to support the scalable and secure provisioning and management of infrastructure within the data centre [52].

In terms of mF2C member activities to date, it should be noted that members of SixSq have been monitoring developments in CIMI, and colleagues of INTEL's mF2C team are on the board of DMTF, and active in developing DMTF standards including CIMI and RedFish.

In terms of future plans, BSC and INTEL will continue to monitor DMTF activities, highlight any standards that may be of interest to the mF2C consortium, and engage should any opportunities for mF2C contributions to DMTF activities such as CIMI or RedFish be identified. SixSq has a production implementation of CIMI, which is used on top of the company's products, and will be re-used for mF2C.

3.9 OASIS

OASIS [53] has its roots in the Standard Generalized Markup Language Open consortium launched in 1993, and now includes over 600 member organisations working to "drive the development, convergence and adoption of open standards for the global information society". Current member sections are dedicated to tackle concerns such as AMQP, Emergency Interoperability, LegalXML, Web Service Interoperability. OASIS has published an extensive set of standards and committee specifications covering a broad range of topics including security, Internet of Things, cloud computing, energy, and content technologies.

In terms of mF2C member activities to date, it should be noted that XLAB is a member of OASIS and is actively participating in discussions on relevant topics. XLAB is mostly active in Cloud Computing related fields, particularly in TOSCA (Topology and Orchestration Specification for Cloud Applications), and in several Security and Privacy Technical Committees. XLAB's standardisation

activities focus on creating best practices that could be integrated into open standards. INTEL is also a member of OASIS and colleagues of the INTEL mF2C team are active in various areas of OASIS work.
In terms of future plans, XLAB will continue its participation in TOSCA (Topology and Orchestration Specification for Cloud Applications), and in a variety of OASIS Security and Privacy Technical Committees. They will engage with the broader mF2C consortium should activities of relevance to the consortium arise.

3.10 IETF

The *Internet Engineering Task Force* [54] was launched in 1986 as a US-government funded initiative to bring researchers together to agree technical standards and protocols for the internet. In 1993 it was relocated under the auspices of the Internet Society and is now an international organisation which develops and promotes various voluntary internet standards, including the standards associated with the TCP/IP stack.

In terms of mF2C member activities to date, STFC team members in particular are monitoring IETF activities, in particular developments in standards associated with security.

In terms of future plans, STFC see the possibility for mF2C both implementing and developing IETF standards. In particular, there may be opportunities to take existing standards and apply them to an edge environment – e.g. for X.509, elliptic curve cryptography is recommended, and for tokens JWT has a “compact” form. Regarding contributions to standards, there may be opportunities for developing delegation, particularly in non-web scenarios.

3.11 In General

While the mF2C partners have specific engagements and interests in the aforementioned standards organisations, there are additional standards organisations which some partners are already involved with. For example, STFC has existing relationships with MQTT, OGC – the Open Geospatial Consortium, and W3C. Partners like STFC will continue to engage with these standards organisations, and should opportunities arise for mF2C to consume or contribute to standards, they will engage the wider consortium as appropriate.

Finally, with responsibilities for coordination of standardization activities in mF2C, Intel will continue to oversee the management of standards related activities across the consortium. This will include maintaining a list of particularly relevant standards being consumed by partners, as well as opportunities for contributions to standards in this rapidly developing area.

4 Conclusions and Next Steps

This deliverable reported all the dissemination and standardization activities carried during the first year of the project. In the first half of the year, the consortium was focused mainly on creating awareness about the mF2C project culminating in a dissemination and standardization plan. This was documented in the deliverable *D6.1 Dissemination strategy and Plan*. In the second half of the year, the focus was on implementing these activities, which will continue into years 2 and 3 of the project.

The dissemination activities performed during the year involved sharing information about the project's goals, plans and potential results with other related projects. We established connections with these projects with the view of following their results and setting up a cycle of feedback between projects. These also included participating in workshops and events organized by these related projects. These contacts will be followed up as results become available, such as prototype releases and scientific papers. The project generated a number of scientific papers some of which have been published, some which are still under review for 2018 publications. This is in keeping with key performance indicators that were set in the D6.1 targeting scientific, general publications, and participation in events and conferences. The project will continue to adhere to these targeted goals in the second year of the project.

The main standardization activities performed during this first year has been to approach the standardization bodies particularly relevant to the project ie, fog, cloud, IoT, etc. The consortium has been monitoring standards initiatives across a variety of communities, by industry, and at regional and international levels. The challenge of interoperability requires standardizing solutions, while increasing security, and encouraging innovation. Our plans for the future include potentially participating in the evolution of some of these standards to advocate the results of some of the mF2C innovations.

This deliverable has been complementary to deliverable *D6.5 mF2C Annual Exploitation Plans and Market Analysis* as dissemination of the project's results is an initial step to exploitation of these same results in future products and services.

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