SUPERFLUIDITY

A SUPER-FLUID, CLOUD-NATIVE, CONVERGED EDGE SYSTEM

Research and Innovation Action GA 671566

DELIVERABLE D8.2:

FIRST REPORT ON COMMUNICATION, DISSEMINATION
ACTIONS, STANDARDIZATION AND OPEN SOURCE CONTRIBUTIONS

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Abstract: | This deliverable provides a first report on communication and dissemination actions progress as well as on resulting awareness and outcome from them. In addition to it, the document summarizes the standardization and open source contributions performed till M12, the impact that these have been perceived to have as well as the plans for further standardization contributions till the end of the project.
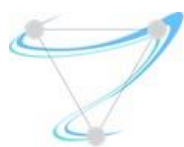
Keyword List: | Communication, Dissemination, Standardisation, Open Source.

VERSION CONTROL TABLE			
VERSION N.	PURPOSE/CHANGES	AUTHOR	DATE
1	First release	SUPERFLUIDITY Project	30/06/2016
1.1	Revision	Nicola Blefari Melazzi	30/06/2016

INDEX

List of Figures

List of Tables

Glossary

SUPERFLUIDITY DICTIONNARY	
TERM	**DEFINITION**
Communication	Targeted information to multiple audiences (including the media and the public) aimed at non specialists, including stakeholders whose interest is in potential application of the results
Results	Any tangible or intangible output of the Action, such as data, knowledge and information whatever their form or nature, whether or not they can be protected, which are generated in the Action as well as any rights attached to them, including Intellectual Property Rights.
OpenStack	Free and open-source software platform for cloud computing, mostly deployed as an infrastructure-as-a-service (IaaS). The software platform consists of interrelated components that control hardware pools of processing, storage, and networking resources throughout a datacentre.
Neutron	Neutron is an OpenStack project to provide "networking as a service" between interface devices (e.g., vNICs) managed by other OpenStack services (e.g., Nova).
Open Source Mano (OSM)	ETSI-hosted project to develop an Open Source NFV Management and Orchestration software stack aligned with ETSI NFV.
OpenDayLight (ODL)	An open source platform for programmable, software-defined networks.

Table 1 – SUPERFLUIDITY Dictionary

1 Introduction

This deliverable provides a first report on the communication actions and dissemination actions taken, overall progress against plan, as well as on awareness and results achieved for the project from them. Moreover, it describes the standardization and open source contributions performed till M12, the impact that these have been perceived to have as well as the plans for further standardization and open source contributions till the end of the project.

2 Communication and Dissemination Objectives

Key performance indicators have been identified to monitor the efficacy of the dissemination activity at the proposal stage.

The following table captures the planned objectives as reported in Deliverable D8.1 "Communication and Dissemination plan" (and identified already at the proposal stage), as well as the overall progress against each objective. The column "Progress Summary" refers to the section of this document describing the performed activity or directly describes the progress achieved or the planned activity.

N. OBJ	WHAT	DESCRIPTION	KEY PERFORMANCE INDICATOR (KPI)	PROGRESS SUMMARY
OBJ 1	Open Source Contributions	Contributions to open source projects at TRL 6 (technology demonstration): e.g., OpenStack, OpenDaylight, Xen, OPNFV, DPDK, cnp.neclab.eu, netmap/vale, Open Air Interface.	At least 1 per project per year	See § 5
OBJ 2	Proof of Concepts (PoCs)	Application and demonstration of project's concepts at TRL 6 (relevant environment): a representative prototype system which goes well beyond discrete component level breadboarding.	At least 2 in total	Multiple PoC/demos planned by partners (please refer to D8.1)
OBJ 3	Contributions to Standards	Contributions to standardisation organizations related to 5G: 3GPP, ETSI NFV ISG and MEC ISG, ONF W&M WG, IETF/IRTF NFV-RG, SDN-RG and SFC-WG, NGMN, DASH-IF, etc.	At least 2 per year	See § 4
OBJ 4	Attend industrial and academic events and present key findings	Organization of special sessions at events like OpenStack Summits and Xen Hackathons to disseminate SUPERFLUIDITY results.	2 Hackathon session (e.g., XEN)	1 QoS hackathon in Red Hat TLV office on July 2015
OBJ 5		One SUPERFLUIDITY-organized Hackathon for deep-dive into SUPERFLUIDITY software.	2 OpenStack Summit presentation	1 OpenStack Mitaka session "QoS - A Neutron n00bie" by Livnat Peer (Red Hat) OpenStack Israel

				session by Livnat Peer "Networking QoS, Liberty, Mitaka and Newton"
OBJ 6			1 SUPERFLUIDITY Hackathon	Planned on the second year: 2017 CNIT and NEC Tentative dates: April - August 2017
OBJ 7	Industry events and ad-hoc meetings	"Marketing-oriented" presentations at industry events (e.g., Mobile World Congress, Open Networking Summit, Layer123 SDN Congress, RIPE / NANOG / DENOG, World Hosting Days (6.000 visitors in 2014), Hosting Con events.	At least 2 presentations per year	20 See Table 4
OBJ 8		Discussions with policy makers, social and environmental organizations regarding project results: SUPERFLUIDITY workshop organization.	1 SUPERFLUIDITY Workshop	Planned for year 2
OBJ 9	Collaboration with 5G-PPP stakeholders	Cooperate with other peer 5G-PPP projects in the framework of the 5G-PPP overall programme	Allocate resources as described in the WP1 table	Participation to 5G-PPP Steering Board and Technical Board work and meetings. Participation and contributions to the 5G Architecture WG and 5G Soft-Nets WG. Contributions to the 5G Architecture White Paper and to the SDN/NFV White Paper.
OBJ 10	Education and Training	World-wide dissemination tour	2 world-wide dissemination tours	1 keynote at SWFAN 2016 Laurent Mathy ULG
OBJ 11		SUPERFLUIDITY's academic workshop and winter school camp events.	1 academic workshop and 2 winter schools	Planned on Project second year: 2017 ULG and UPB
OBJ 12	Publications	Key scientific publications at top tier conferences (e.g., SIGCOMM, CONEXT,	At least 2 per year	5 See § 3.1 Conferences

SUPERFLUIDITY Del. D8.2 First Report on Communication, Dissemination Actions, Standardization and Open Source Contributions

Page 9 of 45

OBJ 13		INFOCOM, NSDI, OSDI, etc.), associated workshops, and magazine/journals (IEEE Transactions, ACM Computer Communications Review)	At least 7 total	2 § 3.1 Journals
OBJ 14	Web site, Social Networks, Press Releases	Wiki-style website allowing easy retrieval of main project data (including software repositories), as well as social networks presence. Press releases targeting the public at large to allow for wide dissemination of project concepts and results.	Website up and running from M1	Website up and running from M1: www.superfluidity.eu superfluidity.eu See § 3.2.6
OBJ 15			Social networks' account ready from M2, 1 post/update per month	LinkedIn: 13 discussions in total See § 3.2.5 Twitter: 27 posts in total See § 3.2.4 YouTube: 91 views See § 3.2.5.
OBJ 16			1 press release per year	2 See Paragraph 3.2.56

Table 2 – Dissemination Key Performance Indicators

The following table captures the expected progress of other success indicators, introduced in Deliverable D8.1 "Communication and Dissemination plan", along with the actual results.

COMMUNICATION CHANNEL	INDICATOR	PROGRESS	
		EXPECTED M1 − 12	ACTUAL M1- 12
Web site	Number of Posts	5	7
	Number of Visitors	1000	4779
Brochure	Number Brochures distributed	300	60 CNIT
Press	Number of online/paper press	20	8 See § 3.2.5

	publications		
Events	Number of Conferences, workshops, exhibition where the project is presented	10	20 See Table 4
SUPERFLUIDITY sponsored Events	Number of Attendees	-	SWFAN 2016: 40 attendees LANMAN 2016: 64 attendees
Social Media	Number of Feedback collected	100	168 LinkedIn: 6 Twitter: 71 YouTube: 91
Other Projects	Number of participation to meetings organised by other projects		3 ALB: Carlos Parada – has participated in 1 SELFNET meeting, as ALB is partner of both projects NOKIA IL: Danny Raz and Erez Biton attended COGNET workshop at EUCNC 2016
Other Projects	Number of people from other projects participating in SUPERFLUIDITY events	-	6

Table 3 – Additional Success Indicators

3 Communication and Dissemination Activity

3.1 Scientific and Industrial Dissemination

The Table below shows the activities performed so far by SUPERFLUIDITY's partners as regards participation to scientific and industrial dissemination. The table lists the industrial and scientific events where SUPERFLUIDITY Partners represented in different ways the SUPERFLUIDITY Project. The column "Activity" specifies the kind of contribution (Project Presentation, Technical Speech or other contribution).

EVENT	PARTNER INVOLVED	ACTIVITY	LOCATION	DATE
EUCNC 2015- NetWorld 2020 Workshop	TELCARIA	Project Presentation	Paris, France	June 29-July 2, 2015
SDN World Congress	BT Andy Reid	Technical Speech	Düsseldorf, Germany	October 13, 2015
SDN World Congress	CITRIX Constantine Polychronopoulos	Technical Speech	Düsseldorf, Germany	October 15, 2015
IETF/IRTF-94	Telefonica Pedro Aranda Gutierrez	Project Presentation	Yokohama, Japan	November 2-4, 2015
OSS in Era of SDN & NFV	BT Andy Reid	Project Presentation	London, UK	November 6, 2015
IEEE 5G Silicon Valley Summit	Vodafone Chair Prof. Gerhard Fettweis (TUD)	Technical Speech	Santa Clara, California	November 16, 2015
IEEE GlobeCom 2015	CNIT Video presented at a demo booth organized and run by the 5G Architecture	Project Presentation	San Diego, California	December 7, 2015

	Working Group			
ETSI NFV workshop	BT Andy Reid	Project Presentation	Denver	January 2016
2016 Unikernels and More: Cloud Innovators Forum	NEC	Technical Speech	Pasadena CA	January 22, 2016
ETSI-MEC	TID Pedro Aranda Gutierrez	Project Presentation	Madrid	March, 2016
Challenges in Network Functions Virtualization	RED HAT Livnat Peer	Technical Speech	Raanana - Israel	Apr 03, 2016
NFVRG IETF 95 Buenos Aires https://www.ietf.org/meeting/95/	TID Diego Lopez	Technical Speech	Buenos Aires - Argentina	April 3-8, 2016
IETF 95 Buenos Aires https://www.ietf.org/meeting/95/	NEC Felipe Huici	Technical Speech	Buenos Aires - Argentina	April 3-8, 2016
2016 SWFAN	ULG Laurent Mathy NOKIAIL Danny Raz	Technical Speech	San Francisco, CA	April 11, 2016
OpenStack Israel	RED HAT Livnat Peer	Technical Speech	Tel Aviv - Israel	June 2, 2016
IEEE QoMex 2016	USTR	Conference Paper	Lisbon, Portugal	June 6-8, 2016
ITS European Congress 2016 - Workshop: 5G Pushing the Limits of Innovation in Automotive	CNIT, Lorenzo Bracciale	Technical Speech	Glasgow UK	June 6-9, 2016
IEEE-LANMAN 2016	CNIT Nicola Blefari Melazzi	Project Presentation	Roma, Italy	June 13 - 15, 2016
IEEE LANMAN 2016	CNIT	Sponsorship	Rome, Italy	June 13-15, 2016

IEEE LANMAN 2016	UPB	Conference Paper	Rome, Italy	June 13-15, 2016
EUCNC 2016	CITRIX George Tsolis NOKIA IL Erez Biton TID Pedro Aranda Gutierrez	Project Presentation	Athens Greece	June 27-30, 2016
5G World	ALB Francisco Fontes	Technical Speech - SDN & NFV contributions towards 5G	London, UK	Jun 30, 2016

Table 4 –Participation to conferences and other events

The Table below shows the planned and confirmed conferences where SUPERFLUIDITY Partners will present Project results and perform dissemination activities in the next months.

ACM SIGCOMM 2016	UPB	Conference Paper	Florianópolis - Brazil	August 22-26 2016
HotMiddlebox 2016	CNIT – NEC-ULG	2 Workshop papers	Florianópolis - Brazil	August 22-26 2016
IBC 2016 International Broadcasting Convention	USTR	Technical Speech	Amsterdam The Netherlands	8-12 Sept 2016
MEC Congress 2016	ALB Carlos Parada	Technical Speech - Case Study: Implementing the ETSI MEC Architecture – Challenges and Lessons	Munich, Germany	Sep 21, 2016

		Learnt		
ACM Multimedia	USTR	Conference Paper	Amsterdam, The Netherlands	15 - 19 October 2016
Schloss Dagstuhl – Leibniz Center for Informatic	UPB	Seminar	Wadern - Germany	Dec 2016 - Jan 2017

Table 5 – Confirmed presentations at upcoming conferences

3.1.1 Talks and published papers

Below, we give more details about talks and published papers.

Conference Talks

1. Simon Kuenzer, NEC Europe: "**Building the Superfluid Cloud with Unikernels**", 2016 Unikernels and More: Cloud Innovators Forum, Pasadena, CA, January 22, 2016.

2. Lorenzo Bracciale, CNIT: "**OpenGeoBase: Spatial Database Applications Supported by Innovative Communications Networks**", Workshop: 5G pushing the limits of innovation in Automotive – ITS European Congress, Glasgow, UK, June 7, 2016.

Conference Papers

1. Radu Stoenescu, Matei Popovici, Lorina Negreanu, and Costin Raiciu, UPB – University Politehnica of Bucharest: "**Scalable Symbolic Execution for Modern Networks**", ACM SIGCOMM 2016, Florianópolis, Brazil, August 22-26, 2016.

2. H. J. Asghar, L. Melis, C. Soldani, E. De Cristofaro, M. A. Kaafar, and L. Mathy: "**SplitBox: Toward Efficient Private Network Function Virtualization**" ACM SIGCOMM Workshop on Hot Topics in Middleboxes and Network Function Virtualization (HotMiddlebox 2016), Co-located with ACM SIGCOMM'16, August 22-26, 2016, Florianópolis, Brazil.

3. Giuseppe Siracusano, Roberto Bifulco, Simon Kuenzer, Stefano Salsano, Nicola Blefari Melazzi, Felipe Huici: "**On-the-Fly TCP Acceleration with Miniproxy**", ACM SIGCOMM Workshop on Hot Topics in Middleboxes and Network Function Virtualization (HotMiddlebox 2016), Co-located with ACM SIGCOMM'16, August 22-26, 2016, Florianópolis, Brazil.

4. Radu Stoenescu, Dragos Dumitrescu, Costin Raiciu: "**OpenStack Networking for Humans: Symbolic Execution to the Rescue**" invited paper, IEEE LANMAN 2016, Rome, Italy, June 13 - 15, 2016.

5. Rufael Mekuria, Michael McGrath, Christos Tselios, Dirk Griffioen, George Tsolis, Shahar Beiser: **"KPI Mapping for Virtual Infrastructure Scaling for a Realistic Video Streaming Service Deployment"**, 8th International Conference on Quality of Multimedia Experience (QoMEX), Lisbon, Portugal, June 6-8, 2016.

6. R.Mekuria, J. Fennema, R. Belleman, D. Griffioen, USTR – Unified Streaming: **"Multi-Protocol Video Delivery with Late Trans-Muxing"** accepted paper at ACM Multimedia, 15 - 19 October 2016, Amsterdam, The Netherlands.

Journals

1. **"Hybrid IP/SDN networking: open implementation and experiment management tools"**.

    S. Salsano, P. L. Ventre, F. Lombardo, G. Siracusano, M. Gerola, E. Salvadori, M. Santuari, M. Campanella, L. Prete.

    Article accepted for publication on IEEE Transactions on Network and Service Management

2. **"Superfluidity: A Flexible Functional Architecture for 5G Networks"**

    G. Bianchi, E. Biton, N. Blefari-Melazzi, I. Borges, L Chiaraviglio, Pedro de la Cruz Ramos, P. Eardley, F. Fontes, M. J. McGrath, L. Natarianni, D. Niculescu, C. Parada, M. Popovici, V. Riccobene, S. Salsano, B. Sayadi, J. Thomson, C. Tselios, G. Tsolis.

    Article accepted for publication on Transactions on Emerging Telecommunications Technologies, Wiley.

3.1.2 Sponsored and organized events

SWFAN 2016

SUPERFLUIDITY co-organised and sponsored the 1st International Workshop on Software-Driven Flexible and Agile Networking (SWFAN, http://www.swfan.org) held on the 11th of April, 2016 in San Francisco, CA, USA in conjunction with IEEE INFOCOM 2016. SWFAN was held with great success and in a very interactive atmosphere, as both keynote talks and most paper presentations stimulated a lot of discussions. The attendance was very high and the feedback from speakers and attendees was very positive. We had up to 45 attendees. Several Partners' representatives gave key contributions:

Workshop Organizers:

    CNIT – Nicola Blefari Melazzi, Giuseppe Bianchi

    NOKIA IL – Danny Raz, Erez Biton.

TPC Co-Chair:

    NOKIA IL - Erez Biton

Members of the Technical Programme Committee:

    NOKIA IL - Erez Biton

    BGU - Omer Gurewitz,

    NEC – Felipe Huici

    INTEL - Michael McGrath

Keynote #1:

    ULG - Laurent Mathy: "Foggy Networking: Networking in the cloud"

Keynote #2:

    NOKIA IL - Danny Raz: "Network and Cloud optimization: it's all about the model"

Figure 1 – SWFAN 2016 Workshop

IEEE LANMAN 2016

SUPERFLUIDITY supported as Technical Sponsor and with key contributions the **22th IEEE International Symposium in Local and Metropolitan Area Networks** (IEEE LANMAN 2016).

LANMAN is the forum for presenting and discussing the latest technical advances in local and metropolitan area networking. This year, the symposium's central theme was "**Adaptive, Agile and Fluid networking**, a broad topic encompassing autonomic and reconfigurable networking, network function virtualization and software defined networking and of clear interest for SUPERFLUIDITY. During the Conference, SUPERFLUIDITY Project was introduced by the Project Coordinator, Prof. Nicola Blefari Melazzi and informational material, such as brochures, were distributed to attendees. The symposium was hosted by the Italian National Research Council in Rome on 13 -15 June 2016.

Several Partners' representatives gave key contributions:

General Co-Chair:

    CNIT – Nicola Blefari Melazzi

TPC Co-Chair:

    CNIT –Giuseppe Bianchi

Publication Chair:

    CNIT –Luca Chiaraviglio

Invited Paper:

OpenStack networking for humans: symbolic execution to the rescue, Radu Stoenescu (University Politehnica of Bucharest); Dragos Dumitrescu (University Politehnica of Bucharest); Costin Raiciu (University Politehnica of Bucharest).

Figure 2 – IEEE LANMAN 2016 Symposium

3.2 General Communication and Dissemination Channels

3.2.1   SUPERFLUIDITY Web Site

A public website for SUPERFLUIDTY project was set up at the beginning of the project and will be available after the end of the project. The website is accessible online at http://superfluidity.eu. The website is regularly updated with project-related activities and announcements. The main Structure of the Web Site has been described in the Deliverable D8.1, delivered in due time at month 6 (December 2015).

At Content level, the Web Site has been enriched with the description of activities and achievements along the activities realization. Here below we provide a description of the alive pages, which are regularly updated.

- About -> Step by Step - SUPERFLUIDITY Road Map
- About -> Related Projects: In this page related Projects' logos and links have been added. We expect to add more EU projects and initiatives to collaborate with in the future
- Results -> Communication -> Download: in this section it is possible to download general communication such as Presentation and Leaflet. Download section is accessible from the Footer menu as well.
- Results -> Dissemination: in this page all the dissemination activities so far have been recorded such as Participation at International Conferences, Fairs and Publications.
- Results -> Standardization: in this page Standardization works and papers are published
- Results -> Deliverables: in this page the complete list of Deliverables has been published. Public deliverable can be downloadable by the general public, while confidential deliverables can be downloadable only through a private account to the web site.
- News: this section is the blog of the Web site. The news published in this section are shared through LinkedIn and Twitter Account. To date, 7 News have been published. In the following paragraphs, we will describe the communication activities performed through Social Network. Here below we report a screenshot of the NEWS' page.

Figure 3 – SUPERFLUIDITY NEWS page

3.2.1.1 Google Analytics Overview

We have added the Google Analytics tracking code in the template of SUPERFLUIDITY website, enabling the tracking of statistics of the project's website. Key statistics are shown in Figure 4 below.

The SUPERFLUIDITY Web Site shows the following main access data since the beginning of the web site:

- N. of Session: 6090
- N. of Users: 4779
- Page Views: 12979
- Page/Session: 2.13
- Average session Duration: 1 min 27 sec
- Bounce Rate: 69.90%
- % New Session: 78.47%
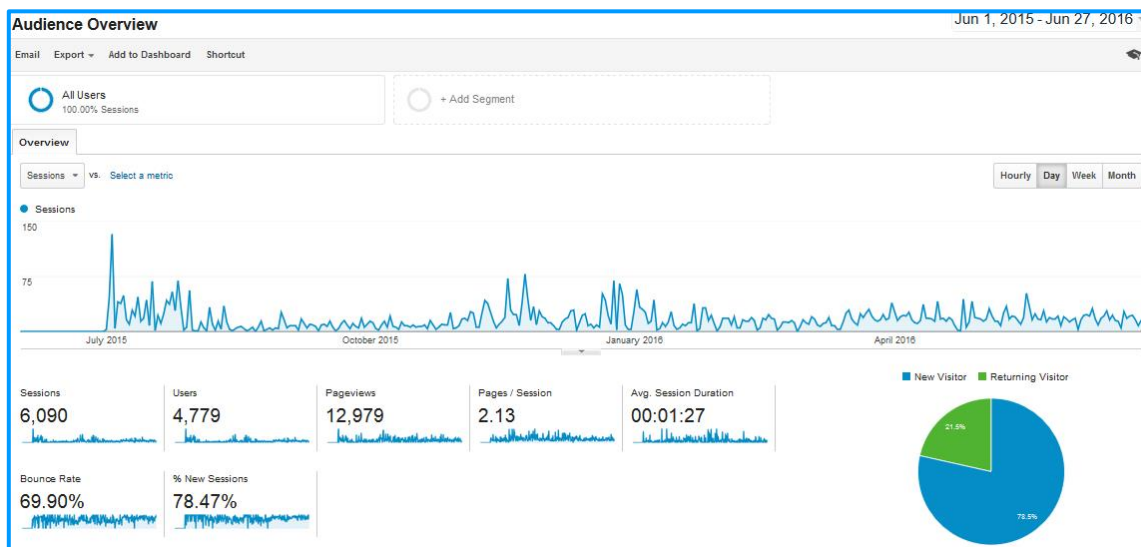
Figure 4 – Audience General Overview

3.2.1.1.1   New vs Returning

Concerning the Audience, we can see that 78.51 % of users are New Visitors. In the figure below, we can see that Returning Visitors performed in the referring period 1309 sessions with a lower Bounce Rate (50.42%) and an Average Session Duration about 3 minutes.
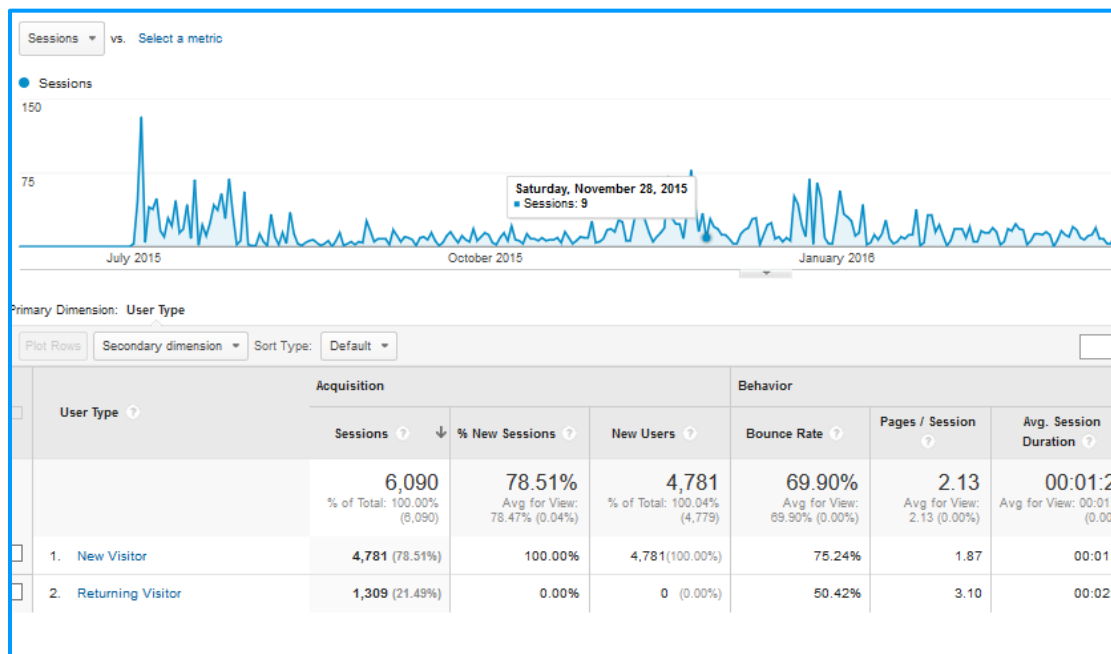
Figure 5 – New Visitors and Returning Visitors

3.2.1.1.2   Active Users

The figure shows the number of Active Users per period. "Active Users" means the number of unique users who visited the website in the last 1 day – 30 days in the selected period.

1 day: 2 users

7 days: 98 users

14 days: 196 users

30 days: 418 users
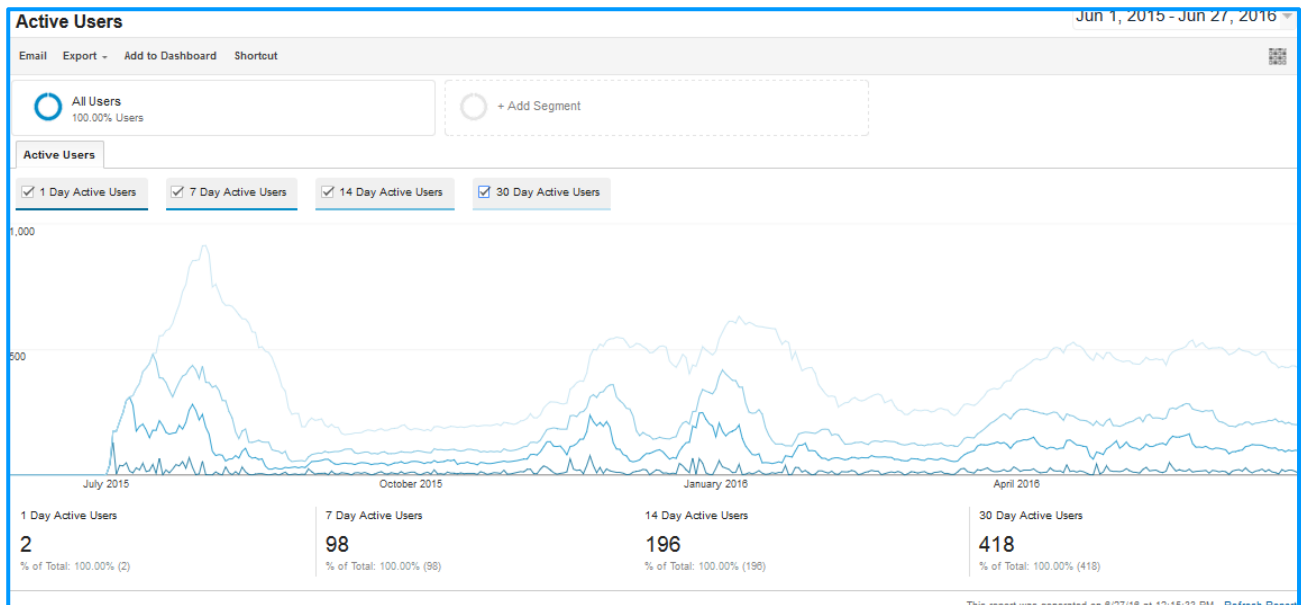
Figure 6 – Number of unique users per n. of days

3.2.1.1.3   Location

Here below is shown an Analytics map about the number of accesses from different countries.
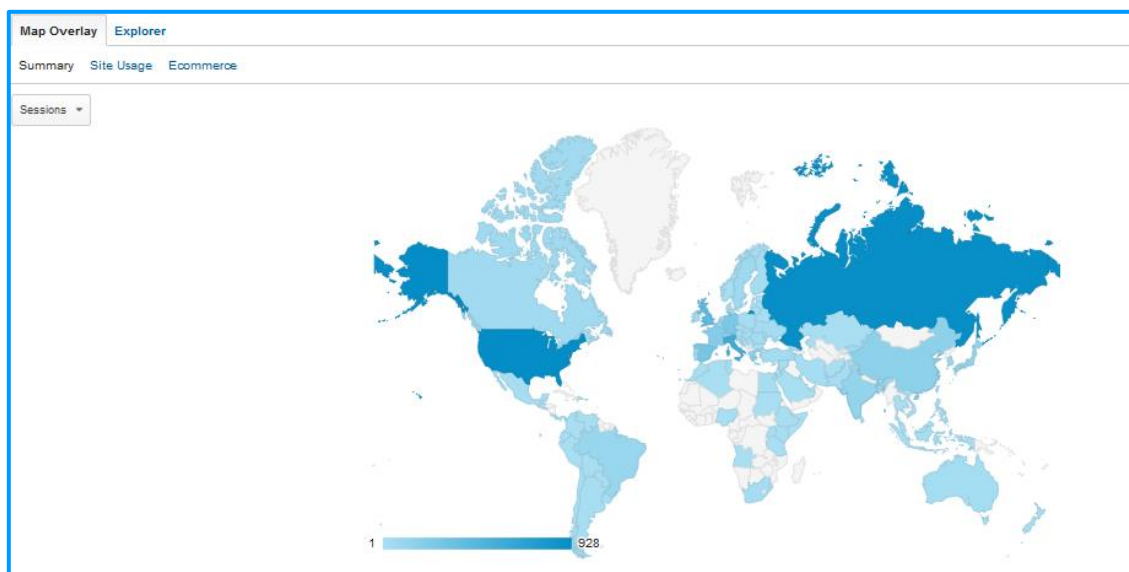
Figure 7 – World Map of Users

Here below are reported the number of access for the first 10 countries in the list. We can see a relevant number of accesses from: United States, Russia, Italy and UK.

Country	Acquisition			Behavior		
	Sessions ↓	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	6,090 % of Total: 100.00% (6,090)	78.51% Avg for View: 78.47% (0.04%)	4,781 % of Total: 100.04% (4,779)	69.90% Avg for View: 69.90% (0.00%)	2.13 Avg for View: 2.13 (0.00%)	00:01:27 Avg for View: 00:01:27 (0.00%)
1. 🇺🇸 United States	928 (15.24%)	91.70%	851 (17.80%)	83.41%	1.42	00:00:39
2. 🇷🇺 Russia	911 (14.96%)	78.38%	714 (14.93%)	95.72%	1.06	00:00:18
3. (not set)	711 (11.67%)	94.80%	674 (14.10%)	84.11%	1.38	00:00:31
4. 🇮🇹 Italy	585 (9.61%)	45.47%	266 (5.56%)	41.71%	3.31	00:03:17
5. 🇬🇧 United Kingdom	412 (6.77%)	70.87%	292 (6.11%)	50.73%	3.24	00:02:09
6. 🇪🇸 Spain	287 (4.71%)	57.84%	166 (3.47%)	47.04%	3.12	00:01:59
7. 🇩🇪 Germany	261 (4.29%)	75.10%	196 (4.10%)	44.83%	3.74	00:02:36
8. 🇫🇷 France	200 (3.28%)	88.50%	177 (3.70%)	57.50%	2.96	00:02:00
9. 🇨🇳 China	160 (2.63%)	90.00%	144 (3.01%)	72.50%	1.85	00:01:52
10. 🇬🇷 Greece	146 (2.40%)	64.38%	94 (1.97%)	34.93%	3.92	00:03:17

Figure 8 – Number of Session per Countries

3.2.1.1.4   Page Business Performance Efficiency

Table below shows pages with the best performing contents.

Primary Dimension: Page Title

Plot Rows | Secondary dimension ▾ | Sort Type: Default ▾

| Page Title	Entrances ↓	Users	Bounces	Pageviews	Avg. Time on Page
	6,051 % of Total: 100.00% (6,051)	4,791 % of Total: 100.00% (4,791)	4,257 % of Total: 100.00% (4,257)	12,979 % of Total: 100.00% (12,979)	00:01:17 Avg for View: 00:01:17 (0.00%)
1. Home page	1,630 (26.94%)	1,801 (19.83%)	1,630 (38.29%)	1,801 (13.88%)	00:00:00
2. Superfluidity Project	the ability to instantiate internet services on-the-fly	1,471 (24.31%)	1,117 (12.30%)	550 (12.92%)	2,314 (17.83%)	00:01:18
3. (not set)	1,056 (17.45%)	930 (10.24%)	1,032 (24.24%)	1,080 (8.32%)	00:10:36
4. Home Page	257 (4.25%)	257 (2.83%)	86 (2.02%)	257 (1.98%)	00:03:54
5. Partners	Superfluidity Project	160 (2.64%)	549 (6.05%)	62 (1.46%)	1,354 (10.43%)	00:00:48
6. Intel Research & Development Ireland Ltd	Superfluidity Project	137 (2.26%)	175 (1.93%)	83 (1.95%)	239 (1.84%)	00:01:27
7. Related projects	Superfluidity Project	111 (1.83%)	173 (1.91%)	18 (0.42%)	231 (1.78%)	00:00:51
8. Alcatel Lucent Bell Labs France	Superfluidity Project	85 (1.40%)	130 (1.43%)	68 (1.60%)	157 (1.21%)	00:01:13
9. Telcaria	Superfluidity Project	74 (1.22%)	114 (1.26%)	36 (0.85%)	193 (1.49%)	00:01:47

Figure 9 – Best Performing Contents

3.2.2   LinkedIn

A SUPERFLUIDITY Group page has been created on LinkedIn (SUPERFLUIDITY – 5GPPP) and all the Partners Team individuals have been invited to join the Group. The LinkedIn group is available at: https://www.linkedin.com/groups/8416290. The group includes 40 members.
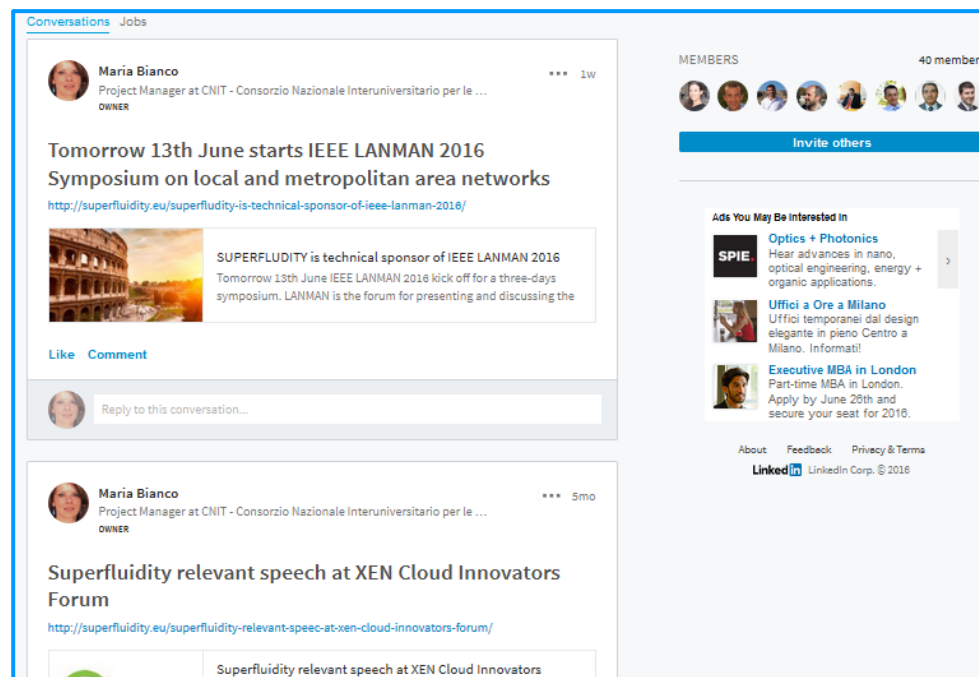
Figure 10 – SUPERFLUIDITY's LinkedIn Group

On the LinkedIn group all the News and Information published on the SUPERFLUIDITY web site have been shared. To date, 13 discussions were published.

3.2.3   Twitter

Twitter is the constant posting system that rests on the idea of the short sentences and reactions that show the positive or negative attitudes of its users. Messages can link to the SUPERFLUIDITY website, photos, videos, etc. This link provides followers the opportunity to spend more time interacting with SUPERFLUIDITY online.

SUPERFLUIDITY account (https://twitter.com/Superfluidity5g) was created in October 2016 and to date it counts 57 followers. Among these followers we list:

- EC Net Technologies: Official European Commission account on Network Technologies.
- H2020-ICT: Ideal-Ist: worldwide ICT support network consisting of more than 70 ICT National Contact Points (NCP) from all over the world

Figure 11 – SUPERFLUIDITY's Twitter home page

SUPERFLUIDITY tweeted 27 posts and received appreciations and retweets from ETSI, 5GPPP, Telecom News.

3.2.4   YouTube Channel

The SUPERFLUIDITY project has set-up its own YouTube channel at:

https://www.youtube.com/channel/UCUEOAQ5x5BC3ANYwe22DICA.

This channel is used to share videos presented at conference and other events.

For instance, CNIT realised a SUPERFLUIDITY Video, presented at the conference IEEE Globecom 2015, San Diego, California at a demo booth organized and run by the 5G Architecture Working Group. This Project Video is available at: https://www.youtube.com/watch?v=6xEMZMFB1XU.
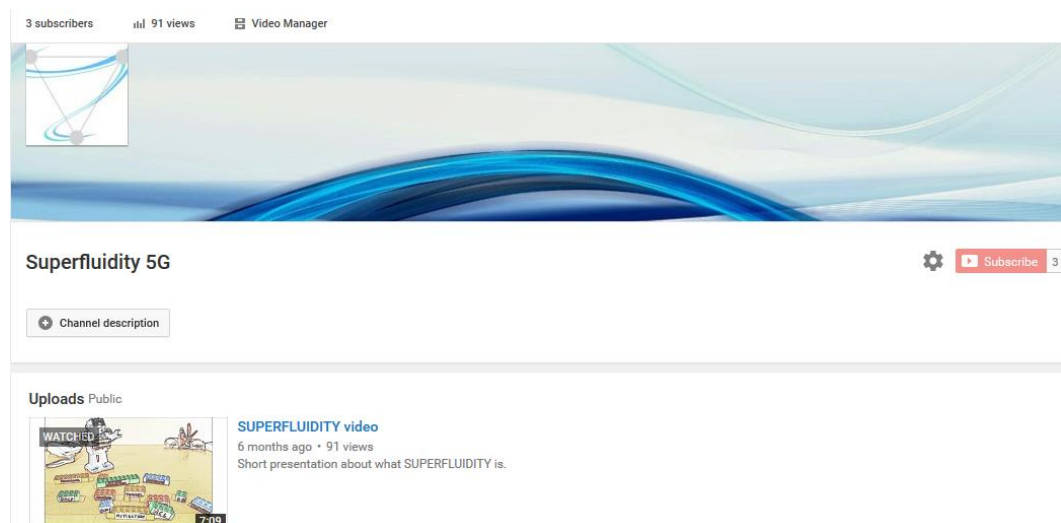
Figure 12 – SUPERFLUIDITY's You Tube channel
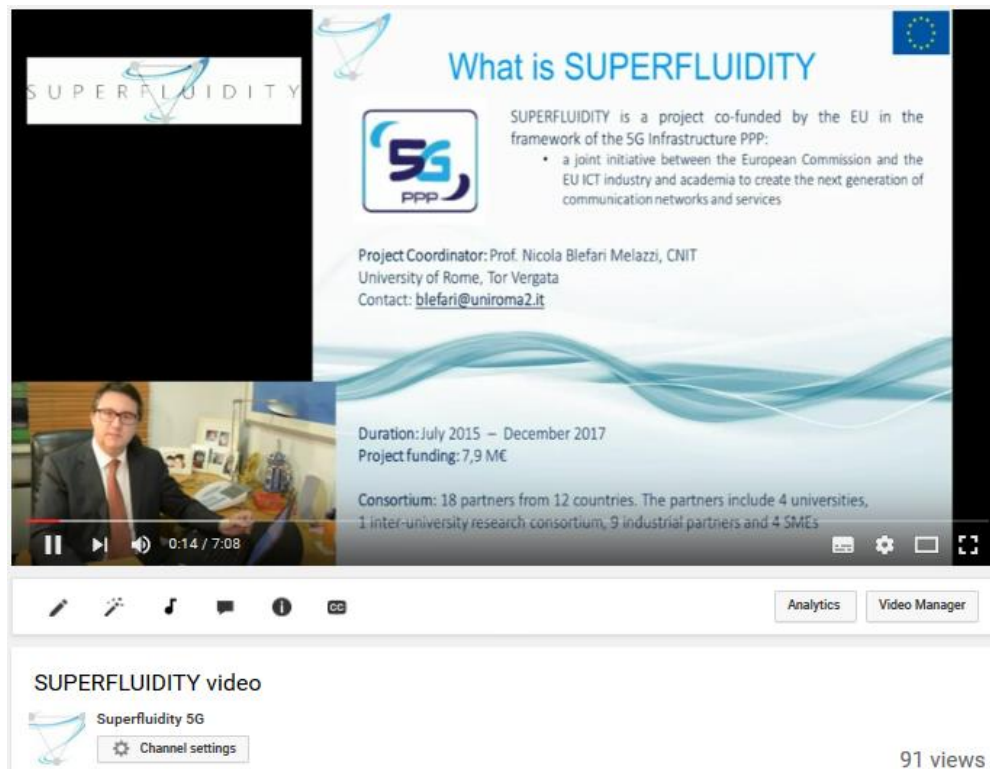
Figure 13 – Screenshot of SUPERFLUIDITY's Video

3.2.5   Press Releases and Public Interviews

On September 2015, the First Press release was released by NEC. The contents were shared and agreed by all the partners.

The Press Release (http://www.nec.com/en/press/201511/global_20151109_02.html) was followed by an interview of Saverio Niccolini from NEC on Telecom TV. (http://www.telecomtv.com/articles/5g/defining-superfluidity-as-a-key-piece-in-the-5g-jigsaw-puzzle-13018/)

The Interview was published by several online newspapers listed below:

1. TelecomsTech: http://www.telecomstechnews.com/news/2015/nov/10/superfluidity-project-wants-build-cloud-based-5g-network/

2. Telecoms.com: http://telecoms.com/451992/euro-consortium-to-develop-cloud-based-5g/

3. Telecompaper: http://www.telecompaper.com/news/nec-joins-eus-superfluidity-5g-development-project—1112462

4. Business Cloud News: http://www.businesscloudnews.com/2015/11/09/nec-and-partners-in-europe-to-develop-converged-cloud-based-5g-network/

5. Equities.com (via M2):
   http://www.equities.com/index.php?option=com_k2&view=newsdetail&id=464697

6. Wireless: http://www.wireless-mag.com/News/39517/nec-joins-european-5g-virtual-network-and-service-platform-project.aspx

A second Press release was issued by CNIT in the framework of the common communication activities planned:

https://5g-ppp.eu/superfluidity-a-super-fluid-cloud-native-converged-edge-system/

4 Contributions to Standardization

4.1 ALB

4.1.1 Contributions

4.1.1.1 ETSI MEC

The following table shows where ALB has contributed to the ETSI MEC activities. The purpose of these contributions is to influence the standards and be ready to develop a MEC Proof-of-Concept (PoC).

SUMMARY	CONTRIBUTION LINKS	IMPACT ON SUPERFLUIDITY PROJECT
Reference: MEC Architecture [GS MEC 003]	MEC ARCH	Defines the MEC overall architecture, including the edge level and system level. This is a key document that will guide the development work on the MEC area.
Reference: End-to-End Mobility [GS MEC 010-2]	MEC Mobility	Defines how the end-to-end user mobility is handled along the MEC system. This is an advanced MEC feature that will be targeted by the Superfluidity project.
Reference: LifeCycle Management (LCM) [GS MEC 018]	MEC LCM	Defines how the lifecycle of the MEC Applications is managed. This is an advanced MEC feature that will be targeted by the Superfluidity project.

4.1.2 Future Plans

4.1.2.1 ETSI MEC

ALB is actively contributing to ETSI MEC and will continue to be involved in the working items mentioned above and eventually on others that will be raised in the future and have particular relevant interest.

4.2 NOKIAIL

4.2.1   Contributions

NOKIA IL is active in two main SDOs, ETSI NFV and OASIS TOSCA. In the ETSI NFV ISG, the architecture (IFA) group deals with the architecture of a MANO system. To this end, it defines the interfaces of the different components, such as the NFVO and the VNFM, as well as the descriptor and VNF packaging format. We follow the ETSI activities very closely and regularly attend the IFA meetings. Moreover, we provide feedback to ETSI on implementation aspects and contribute to the discussions on the descriptor formats. These descriptors play an important part in SUPERFLUIDITY vision to allow QoS based and dynamic deployment of RFBs.

The recently created SOL WG has gathered a great attention in NFV community. Since the only current work item and many of the envisaged ones deal with service and VNF descriptors, there are important opportunities to contribute. Specifically, the TOSCA work of SOL is of great interest to SUPERFLUIDITY, as it is a leading candidate to be chosen as our deployment language.

In accordance to the SOL work NOKIA IL keeps its involvement in TOSCA to push new descriptors to support the deployment and life cycle management functionalities envisioned by SUPERFLUIDITY.

4.3 Telefónica, I+D

4.3.1   Contributions

Telefónica, I+D has been promoting the SUPERFLUIDITY project in different Standardisation bodies. In this line, we presented the project objectives at the Internet Research Task Force (IRTF) during the IETF'94 in Yokohama. The project was presented both to the Software-Defined Networks Research Group (SDN-RG) and to the Network Function Virtualisation Research Group (NFV-RG).

4.3.2   Future Plans

Near term standardisation plans include presenting the current activities around the integration of Virtual Network Function Descriptors (VNFD) into the Network Modelling (NEMO) language to provide a human readable specification language for the Recursive Function Blocks (RFBs). The current scope of this work extends RFBs beyond VNFs to ETSI-NFV Network Services and allows RFBs to be used in VNF Forwarding Graphs. The contribution is uploaded under [https://www.ietf.org/internet-drafts/draft-aranda-nfvrg-recursive-vnf-00.txt] and should be presented at the IETF'97 (Berlin, July 2016).

4.4 Unified Streaming

4.4.1   Contributions

MPEG JTC1/SC29/WG11 Geneva May/June (http://mpeg.chiariglione.org/):

   m38753 MP3DG-PCC Software Platform for Point Cloud Compression (input)

   m38754 Proposal for MPEG-4 PCC features roadmap (input)

   m38801 Plane Projection Approximation for Voxel Colour Attributes Compression (input)

   m38816 Point Cloud Geometry Compression with Plane Projection Approximation and Learning Based Compression (input)

   W16333 Draft-dataset-point-cloud-coding (output)

   W16334 Draft Call for Proposals for Point Cloud Compression (output)

   W16335 Evaluation Criteria for Point Cloud Compression (output)

   W16336 Use Cases for Point Cloud Compression (output)

   W16337 Requirements for Point Cloud Compression (output)

DASH-IF:

   Following of the MPEG DASH SAND Taskforce

4.5 British Telecom

4.5.1   Contributions

BT is one of the companies that created the original work at ETSI and created the concept of network virtualisation. BT believes that standardisation is key in the telecoms field, and certainly in the NFV space, in order to ensure interoperability and allow us to source components from different / multiple vendors.

BT has continued to play a leading role in NFV standardisation at ETSI Industry Steering Group. Andy Reid is Vice Chair of Open Source MANO (OSM), and Chair of the End User Advisory Group. He led the discussions for a new work item on 'end to end process descriptions' and is now Rapporteur for the Work Item. We have also input our requirements for OSM. We also played a key role in the ISG's initiative to bring together the Information Models of many SDOs and industry groups.

- OSM(16)000039: BT Input on Requirements for OSM
- NFV(16)000118: New Work Item "Report on End to End Process Descriptions" (DGS/NFV-EVE1)

5 Contributions to Open Source Projects

5.1 RED HAT

5.1.1 OpenStack Neutron Project

SUMMARY	CONTRIBUTION LINKS	IMPACT ON SUPERFLUIDITY PROJECT
Feature: QoS policy RBAC DB setup and migration	OpenStack code blueprint/RFE documentation	Allows segregation per tenant of qos policies. Any Superfluidity MEC/CRAN data centre site can benefit from it by defining a set of qos policies per service/application.
Bugfix: Forbid attaching rules if policy isn't accessible	OpenStack code	Network QoS is a prerequisite for Superfluidity architecture. This bugfix is being one of ongoing upstream work towards stabilization of QoS feature support.
Bugfix: Fix the low level OVS driver to really do egress	OpenStack code	Fixes and allows egress traffic bw limit for Superfluidity MEC/CRAN data centre's tenants. Allows preventing from a noisy service from starving other bandwidth demanding services.
Bugfix: Pass the extension driver exception to plugin	OpenStack code	Network QoS is a prerequisite for SUPERFLUIDITY's architecture. This bugfix is being a part of an ongoing upstream work towards stabilization of QoS feature.
Testing: OVS agent functional test for policy rule delete	OpenStack code	Testing for QoS support.
Bugfix: QoS core extension: fixed dict extension when QoS policy is unset	OpenStack code	Network QoS is a prerequisite for SUPERFLUIDITY's architecture. This bugfix is being a part of an ongoing upstream work towards stabilization of QoS feature.
Documentation: devref: update quality of service	OpenStack developers reference	Developers' documentation is required for the ongoing upstream development work.
Testing: Update port	OpenStack code	Testing for QoS support.

functional tests for qos agent		
Testing: Functional test for QoS policy bandwidth rule update	OpenStack code	Testing for QoS support.
Feature: Add thread locks on port routines for qos ext	OpenStack code blueprint	Network QoS is a prerequisite for SUPERFLUIDITY's architecture. This feature is being a part of an ongoing upstream work towards stabilization of QoS feature.
Testing: OVS agent QoS extension functional test for bandwidth limit rules	OpenStack code	Testing for QoS support.
Bugfix: resources_rpc: fixed singleton behaviour for ResourcesPullRpcApi	OpenStack code	Allows version upgrades for QoS policies.
Feature: Propagate notifications to agent consumers callbacks	OpenStack code	This feature is being a part of an ongoing upstream work towards stabilization of QoS feature.
Feature: Add rpc agent api and callbacks to resources_rpc	OpenStack code	This feature is being a part of an ongoing work towards stabilization of QoS feature.
Feature: Introduce base interface for core resource extensions	OpenStack code	This feature is being a part of an ongoing upstream work towards generalization of QoS feature.
Feature: Don't claim Linux Bridge ml2 driver supports bandwidth limit QoS rules	OpenStack code	This feature is being a part of an ongoing work towards stabilization of QoS feature.
Feature: Clean up QoS rules first, then QoS policies	OpenStack code	This feature is being a part of an ongoing work towards stabilization of QoS feature.
Feature: Gracefully handle duplicate rule creation	OpenStack code	This feature is being a part of an ongoing work towards stabilization of QoS feature.
Testing: Add API tests for non-accessible policies	OpenStack code	Testing for QoS support.
Feature: Guarantee there is only one bandwidth limit rule per policy	OpenStack code	This feature is being a part of an ongoing work towards stabilization

		of QoS feature.
Feature: use single transaction to update qos policy association	OpenStack code	This feature is being a part of an ongoing work towards stabilization of QoS feature.
Feature: L2 agent extension manager: read extensions list from config file	OpenStack code	This feature is being a part of an ongoing work towards stabilization of QoS feature.

5.1.2 Future Plans for Open Source Contributions

Red Hat is a significant contributor and maintainer of major key parts of OpenStack and we will continue focusing our efforts in it. The main effort so far was in the networking infrastructure (Neutron). On the follow up side we will invest our effort in service function chaining (SFC) project and it would include specs, blueprints and code along with ongoing work on Neutron.

5.2 NOKIABLF

5.2.1 Open Source Contributions

As part of the Cloud RAN research, Nokia BLF is using the OpenAirInterface (www.openairinterface.org) software which is an open source platform implementing a standard-like LTE protocols of the radio interface between a MN (Mobile Node), also referred as UE (User Equipment), and a Base Station (eNodeB). The MN and eNodeB code is implemented on PC platforms running Linux. All the processing of the LTE physical layer is done in software on the PC. New 5G feature starts to be supported like a new waveform Filtered OFDM. Thanks to this software capability, Nokia BLF selected the choice to use OAI for Cloud RAN research facilitating the virtualization and the cloudification work.

Nokia BLF is working on splitting the OAI into a set of functions following a split design (PHY-PHY, PHY-MAC, RLC-PDCP). This split is the cornerstone cloud RAN facilitating the shift of functions from the cloud to the remote antenna and vice-versa according to the service requirements.

Aware that the 5G ecosystem is moving very fast, Nokia BLF joined recently the OAI alliance which aims to provide a similar ecosystem for the core (EPC) and access-network (EUTRAN) of 3GPP cellular systems with the possibility of interoperating with closed-source equipment in either portion of the network. In the context of the evolutionary path towards 5G, there is clearly the

need for open-source tools to ensure a common R&D and prototyping framework for rapid proof-of-concept designs.

5.2.2   Future Plans for Open Source Contributions

As part of the Open Air Alliance, Nokia BLF is collaborating closely with different actors to provide PHY-MAC split. In addition, Nokia BLF is working on controlling the split via an SDN controller which requires an interaction with the OAI. For that, an SDN agent is under implementation.

Nokia BLF will continue actively contributing to OAI in the different working items related to the split and 5G technology integration.

5.3 NOKIAIL

5.3.1   Open Source Contributions

NOKIA IL is working in the open source community to advance NFV in general and the concept of SUPERFLUIDITY in particular. Specifically, NOKIA IL contributes mostly to OpenStack and to OPNFV.

5.3.1.1   Open Stack Contributions

NOKIA IL contributes to three main projects within OpenStack, namely, (i) Mistral, (ii) Heat, and (iii) Vitrage.

Mistral is a key component in SUPERFLUIDITY Generic VNFM, enabling efficient life cycle management of the various VNFs and MEC applications. Thus, NOKIA IL is highly involved in this project, and indeed recently Mistral PTL, Renat Akhmerov became a CloudBand (NOKIA IL) employee.

Within Mistral, we designed and developed many features that are important for NFV use cases such as supporting large datasets and expiration policies. We found and fixed issues that occurred when running Mistral in full HA mode – a must in a Telco grade application and the default topology we use in CloudBand node. Additionally, CloudBand created the Mistral puppet module installation and contributed it as a whole back to the community. RedHat are now using this project in order to install Mistral as part of their OpenStack distribution.

Hot, the Heat template, is considered as a leading deployment description language, when it comes to virtualized resource managed by OpenStack. Accordingly, we introduced NFV use cases to the core team in Heat as early as the Kilo release. At that point OpenStack did not consider NFV use cases as valid and our discussions helped shaping key features in Heat (e.g., we prevented ResourceGroup index variable removal that is important for VNFs in order to support

personalisation like slotId). More recently, we found, reported and fixed many issues that concern VNF use cases starting from backward compatibility issues like Heat template fail from Kilo release on validation and performance to performance issues on massive loads like missing index on stack.owner_id. Furthermore, we designed and contributed to resource types that are important for the Mistral based VNFM like the OS::Mistral::Workflow.

Last but not least NOKIA IL initiated the Vitrage project, which is now under the OpenStack big tent, to allow collection on infrastructure data correlate the data and perform Root Cause Analysis.

5.3.1.2 OPNFV

In addition to OpenStack, NOKIA IL further works with OPNFV to support its work and disseminate NOKIA IL and SUPERFLUIDITY concepts. Here, for now we mostly contribute to Doctor, where we have Vitrage as a reference implementation for this project.

5.3.2 Future Plans for Open Source Contributions

NOKIA IL plans to continue its contribution to the above projects and constantly evaluating contribution to other opensource bodies such as Open MANO and Open O.

5.4 INTEL

5.4.1 Open Source Contributions

Intel has not produced any Open Source contributions during this period. We have mainly concentrated on raising the awareness of the project internally among our business units. Intel is found member of the Open Source Mano Community and will look to identify opportunities to exploit OSM as a potential opportunity to downstream outputs from SUPERFLUIDITY.

5.4.2 Future Plans for Open Source Contributions

Intel will focus efforts on contributing SUPERFLUIDITY results in the leading open source project such as Open Source Mano (OSM) and OPNFV.

5.5 TELCARIA

5.5.1   Open Source Contributions

Telcaria has not performed any Open Source Contributions till M12. However, recently Telcaria joined as a participant in the Open Source Mano Community, and therefore, it will concentrate in pushing SUPERFLUIDITY results to this community.

5.5.2   Future Plans for Open Source Contributions

Telcaria plans to contribute by pushing SUPERFLUIDITY results to projects in the open source community, such as OpenDaylight (ODL), OpenStack or Open Source Mano (OSM).

5.6 Telefónica, I+D

5.6.1   Open Source Contributions

Telefónica, I+D has not produced any Open Source contributions during this period. We have mainly concentrated on raising the awareness of the project with regards to the OpenMANO initiative and its applicability in the scope of the project. To this avail, we have presented it to the project and kept them informed about its evolution, as well as of the efforts in the context of ETSI to create and kickstart the Open Source MANO (OSM) initiative.

5.6.2   Future Plans for Open Source Contributions

Now that the practical work in the project has started, we are confident that the OpenMANO code will be part of the software infrastructure of the project and have planned following extensions to it:

SUMMARY	RATIONALE	EXPECTED IMPACT ON SUPERFLUIDITY PROJECT
Support of Docker containers for OpenMANO	Make OpenMANO capable of controlling environments that have a finer granularity than Virtual Machine images	Supporting Docker containers will allow OpenMANO to handle virtualisation payloads that are more in line with the SUPERFLUIDITY objectives. It will also allow us provide a proof-of-concept for the integration of other minimalistic payloads such as Unikernels.

5.7 Unified Streaming

5.7.1   Future Plans for Open Source Contributions

Maintenance and development MPEG PCC Software platform (https://github.com/RufaelDev/pcc-mp3dg/).

5.8 ULG

5.8.1   Open Source Contributions

Improvements to Click[1], netmap[2] and FastClick[3] (our own extension of Click).

1: https://github.com/kohler/click

2: https://github.com/luigirizzo/netmap

3: http://fastclick.run.montefiore.ulg.ac.be/

6 Conclusion

As reported by this deliverable, the SUPERFLUIDITY project is exhibiting progress in terms of fulfilling the communication and dissemination objectives, as well as the standardization and open source contributions.

Further progress in executing the project's Communication and Dissemination Plan (please refer to D8.1) will be reported in:

- D8.4 Second report on Communication, Dissemination Actions, Standardization and Open Source Contributions (M20)
- D8.6 Final Report on Communication, Dissemination Actions (M30)
- D8.7 Final Report on Standardization and Open Source Contributions (M30)

7 References

[1] OpenStack code review system https://review.openstack.org/

[2] Mobile Edge Computing (MEC) Framework and Reference Architecture
https://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=46046

[3] Open Source Mano https://osm.etsi.org/

[4] OpenDaylight https://www.opendaylight.org/

Annex A: Communication and Dissemination Opportunities

A list of forthcoming events and journals of possible interest for SUPERFLUIDITY dissemination have been identified and are updated on a regular basis by the WP8 leader. They are listed below.

INDUSTRY EVENTS		
EVENT	WHEN	WHERE
5G World	June 28-30, 2016	London, UK
IEEE 5G Summit	July 1, 2016	Aalborg, DK
HostingCon	July 24-27, 2016	New Orleans, USA
IEEE 5G Summit	August 2, 2016	Austin, TX
LinuxCon + ContainerCon	August 22-24, 2016	Toronto, Canada
Xen Project Developer Summit	August 25-26, 2016	Toronto, Canada
Mobile Edge Computing Congress	September 20-22, 2016	Munich, DE
OpenDaylight Summit	September 27-29, 2016	Seattle, WA
IEEE 5G Summit	September 29, 2016	Dresden, DE
LinuxCon + ContainerCon Europe	October 4-6, 2016	Berlin, DE
SDN & OpenFlow World Congress	October 11-14, 2016	The Hague, NL
OSCON EU 2016	October 17-20, 2016	London, UK
OpenStack Summit	October 25-28, 2016	Barcelona, ES
IEEE 5G Summit	November 2, 2016	Berlin, DE
AWS re:Invent	November 28 - December 2, 2016	Las Vegas, NV
Carrier Network Virtualization	December 6-8, 2016	Palo Alto, CA
Mobile World Congress	February 27 - March 2, 2017	Barcelona, ES

Open Networking Summit	April 3-6, 2017	Santa Clara, CA	
NFV World Congress 2017	May 2-5, 2017	San Jose, CA	
SDN World Congress 2017	October 10-13, 2017	The Hague, NL	

ACADEMIC EVENTS			
EVENT	WHEN	WHERE	SUBMISSION DATES
AlgoCloud 2016	August 22-26, 2016	Aarhus, DK	Submission Deadline: June 27, 2016
CCSNA 2016: The 5th IEEE International Workshop on Cloud Computing Systems, Networks, and Applications 2016 (http://www.ieee-ccsna.org/ccsna_gc16/)	December 4-8, 2016	Washington DC	Submission Deadline: July 1, 2016 Notification Due: September 1, 2016 Final Version Due: October 1, 2016
http://2016.cloudcom.org/	December 12-15, 2016	Luxembourg City, LU	Abstract Registration: June 8, 2016 [EXPIRED] Submission Deadline: June 15, 2016 [EXPIRED] Notification Due: August 15, 2016 Final Version Due: September 15, 2016
IEEE INFOCOM 2017	April 23-27, 2017	Atlanta, GA	Abstract submission: July 22, 2016 Full paper submission: July 29, 2016 Final submission: January 15, 2017
IEEE International	May 21-25, 2017	Paris, FR	Paper Submission:

Conference on Communications			October 14, 2016 Workshop Proposals: July 8, 2016

JOURNALS/MAGAZINES/SPECIAL ISSUES/BOOK CHAPTERS			
EVENT	WHEN	IMPACT FACTOR	SUBMISSION DATES
IEEE Communications Surveys & Tutorials		6.806	
IEEE Journal On Selected Areas In Communications		3.453	
IEEE Transactions on Mobile Computing		2.543	
IEEE Transactions on Wireless Communications		2.496	
IEEE Transactions on Communications		1.992	
IEEE/ACM Transactions On Networking		1.811	
IEEE Transactions on Cloud Computing			
IEEE Transactions on Network and Service Management			
IEEE Communications Magazine			
IEEE Wireless Communications Magazine			
IEEE Network Magazine			
Computer Standards &			

Interfaces (Elsevier)			
Journal of Network and Computer Applications (Elsevier)		2.229	
/ Special Issue on Intelligent Systems for Heterogeneous Networks			Submission Deadline: August 1, 2016
Computer Communications (Elsevier)		1.352 -> 1.695 (est.)	
Ad Hoc Networks (Elsevier)		1.53	
Computer Networks (Elsevier)		1.282 -> 1.256 (est.)	
/ Special Issue on Survivability Strategies for Emerging Wireless Networks			Submission Deadline: June 30, 2016
Digital Communications and Networks (Elsevier)			
/ Special Issue on Resilient Networks Modeling Design and Applications			Submission Deadline: January 24, 2017
Journal of Grid Computing (Springer)		1.507	
Mobile Networks and Applications (Springer)		1.496 -> 1.045 (est.)	
Multimedia Tools and Applications (Springer)		1.058 -> 1.346 (est.)	
The Journal of Supercomputing (Springer)		0.858	

Wireless Networks (Springer)		0.961	
Journal of Computer Science and Technology (Springer)		0.672	
Journal of Networks and Systems Management (Springer)		0.438 -> 0.796 (est.)	
Journal of Cloud Computing (Springer)	(Open Access)		
Journal of Internet Services and Applications (Springer)	(Open Access)		
Journal of Software Engineering Research and Development (Springer)	(Open Access)		
Cloud Computing: Principles, Systems & Applications, 2nd Edition (Springer)			Abstract Registration: May 31, 2016 [EXPIRED] Submission Deadline: August 31, 2016 Notification Due: September 30, 2016 Final Version Due: October 31, 2016