SUPERFLUIDITY

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

Research and Innovation Action GA 671566

DELIVERABLE D8.4:

SECOND REPORT ON COMMUNICATION, DISSEMINATION ACTIONS, STANDARDISATION AND OPEN SOURCE CONTRIBUTIONS

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Abstract: This deliverable provides the second report on communication and dissemination actions progress as well as on resulting awareness and outcome from them. In addition to it, the document summarises the standardisation and open source contributions performed until M23, the impact that these have been perceived to have, as well as the plans for further standardisation contributions until 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	3/05/2017
1.1	Update activities and analytics (§2 and §3)	Maria Bianco CNIT	15/05/2017
1.2	Updates from Red Hat	Luis Tomás RED HAT	19/05/2017
1.3	Review by WP8 Leader	George Tsolis CITRIX	26/05/2017
1.4	Internal Review	Elisa Rojas TELCARIA	27/05/2017
1.5	Finalisation	Stefano Salsano CNIT	31/05/2017

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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 second 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 standardisation and open source contributions performed until M23, the impact that these have been perceived to have, as well as the plans for further standardisation and open source contributions until 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 organisations 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	Organisation of special sessions at events like OpenStack Summits and Xen Hackathons to disseminate SUPERFLUIDITY results. One SUPERFLUIDITY-organised Hackathon for deep-dive into SUPERFLUIDITY software.	2 Hackathon session (e.g., XEN)	1 QoS hackathon in Red Hat TLV office on July 2015
OBJ 5			2 OpenStack Summit presentation	4 - OpenStack Mitaka session "QoS - A Neutron n00bie" by Livnat Peer (Red Hat) - OpenStack Israel session by Livnat

				Peer “Networking QoS, Liberty, Mitaka and Newton” - OpenStack Newton session by Antoni Segura (RED HAT): “Networking approaches in a container world” - OpenStack Ocata session by Antoni Segura (RED HAT): “Kuryr-Kubernetes – The Seamless Path to Adding Pods to Your Datacenter Networking”
OBJ 6			1 SUPERFLUIDITY Hackathon	Originally planned on the second year. We are re-planning in order to be able to include more project results.
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	55 See Table 4
OBJ 8		Discussions with policy makers, social and environmental organisations regarding project results: SUPERFLUIDITY workshop organisation.	1 SUPERFLUIDITY Workshop	Originally planned for year 2, the project is considering if it is still a useful objective given the type of technical outcome that the project is producing

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	3 See § 3.1.4
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, INFOCOM, NSDI, OSDI, etc.), associated workshops, and magazine/journals (IEEE Transactions, ACM Computer Communications Review)	At least 2 per year	5 See § 3.1 Conferences
OBJ 13			At least 7 total	2 See § 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: 23 discussions in total See § 3.2.5 Twitter: 54 posts in total See § 3.2.4 YouTube: 409 views See § 3.2.5.
OBJ 16			1 press release per year	2 See § 3.2.5

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 - 23	ACTUAL M1 - 23
Web site	Number of Posts	15	12
	Number of Visitors	3000	8497
Brochure	Number Brochures distributed	600	160 CNIT
Press	Number of online/paper press publications	60	12 See § 3.2.5
Events	Number of Conferences, workshops, exhibition where the project is presented	20	55 See Table 4
SUPERFLUIDITY sponsored Events	Number of Attendees	50	129 SWFAN 2016: 40 attendees LANMAN 2016: 64 attendees SWFAN 2017: 25 attendees See § 3.1.3
Social Media	Number of Feedback collected	300	LinkedIn: 7 Twitter: 954 impressions (average) YouTube: 409 views
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	10	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).

SUPERFLUIDITY - Exhibitions, Fair, Congress, Workshop	Partner Involved/ Proposer	Name of the activity	Location	Date
EUCNC 2015 - NetWorld 2020 Workshop, 29 June - 2 July 2015, Paris (FR).	TELCARIA	Project Presentation	Paris, France	June 29-July 2, 2015
SDN World Congress	BT	Speech	Düsseldorf, Germany	October 13, 2015
SDN World Congress	CITRIX	Speech	Düsseldorf, Germany	October 15, 2015
IETF/IRTF-94	TID	Project Presentation	Yokohama, Japan	November 2-4, 2015
OSS in Era of SDN & NFV	BT	Project Presentation	London, UK	November 6, 2015
IEEE 5G Silicon Valley Summit	Vodafone Chair Prof. Gerhard Fettweis (TUD)	Speech	Santa Clara, California	November 16, 2015
IEEE GlobeCom 2015	CNIT	Project Presentation	San Diego, California	December 7, 2015
ETSI NFV workshop	BT	Project Presentation	Denver	January 2016
SWFAN 2016	ULG – BGU	Speech	San Francisco, CA	April 11, 2016

IEEE LANMAN 2016	UPB	Article Accepted	Rome	June 13 - 15, 2016
2016 Unikernels and More: Cloud Innovators Forum Call For Participation http://wiki.xenproject.org/wiki/2016_Unikernels_and_More:_Cloud_Innovators_Forum_Call_For_Participation	NEC	Speech	Pasadena CA	January 22, 2016
EUCNC 2016	CITRIX	Project Presentation	Athens Greece	June 27 , 30 2016
ETSI-MEC	TID	Project Presentation	Madrid	
Technion Computer Engineering Center - The 2nd Academia and Industry Research Event: Challenges in Network Functions Virtualization	RED HAT	Speech	Raanana - Israel	Apr 03, 2016
NFVRG IETF 95 Buenos Aires https://www.ietf.org/meeting/95/	TID	Speech	Buenos Aires - Argentina	April 3-8, 2016
IETF 95 Buenos Aires https://www.ietf.org/meeting/95/	NEC	Speech	Buenos Aires - Argentina	April 3-8, 2016
ACM SIGCOMM 2016	UPB	Article Accepted	Florianópolis - Brazil	August 22-26 2016
ITS European Congress 2016 - Workshop: 5G pushing the limits of innovation in Automotive	CNIT	Speech	Glasgow UK	June 6-9 , 2016
OpenStack Israel	RED HAT	Speech	Tel Aviv - Israel	June 2, 2016
IEEE LANMAN 2016	CNIT	Project Presentation	Rome Italy	June 13-15, 2016
IEEE QoMex 2016	USTR	Paper	Lisbon, Portugal	June 2016,
IBC 2016 International Broadcasting Convention	USTR	Talk	Amsterdam, The Netherland	8-12 Sept 2016
IETF/IRTF 96	TID, NEC, BT	Presentations	Berlin, Germany	July 17-22, 2016
Applied Networking Research Workshop 2016 (ANRW'16)	TID	Project Presentation	Berlin, Germany	16/07/2016

IEEE CAMAD 2016	CITRIX	Paper	Ryerson University, Toronto, ON, Canada	23-25 October 2016
2016 IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN)	CNIT	Paper	Palo Alto, California, USA	7-9 November 2016
ICUMT 2016 – The 8th International Congress on Ultra Modern Telecommunications and Control Systems.	CNIT	Keynote speech	Lisbon, Portugal	8 – 20 October, 2016
EWSDN 2016, co-located with the SDN World Congress 2016	CNIT	Invited Talk	The Hague, Netherlands	10-11 October 2016
Open Stack Summit	RED HAT	Project Presentation	Barcelona, Spain	October 25-28, 2016
Open Stack Summit	TID	Project Presentation	Barcelona, Spain	October 25-28, 2016
SUPERFLUIDITY's Taiwan tour	CNIT	Speech	Taiwan	31 October - 2 November 2016
ITUC Caleindoscope 2016 - In conjunction con ITU Telecom world	CNIT	Paper Presentation	Bangkok	15 November 2016
SDN World Congress 2016	BT	Speech	The Hague, Netherlands	10 - 14 October 2016
MEC Congress	ALB	Presentation	Munich, Germany	20-22 Sep 2016
SPIE Applications of Digital Image Processing	USTR	Presentation	San Diego (USA)	30 August 2016
ACM Multimedia Conference	USTR	Presentation	Amsterdam (NL)	16-19 October 2016
International Broadcasting Convention	USTR	Presentation	Amsterdam (NL)	19 Septembe r 2016

IEEE International Symposium on Information Theory (ISIT)	BGU	Presentation	Barcelona, Spain	July 10-15, 2016
IEEE 5G Summit Dresden	TUD	Presentation	Dresden, Germany	29.9.2016
5G-PPP cross-project workshop	CITRIX UPB	Presentation	Athens, Greece	February 6-7, 2017
INW 2017 - 14th Italian Networking Workshop	CNIT	Presentation	Falcade, Italy	January 13th 2017
Schloss Dagstuhl – Leibniz Center for Informatic	UPB - NEC	Project Presentation	Wadern, Germany	January 15-18, 2017
Schloss Dagstuhl – Leibniz Center for Informatic	TID	Workshop Organisation	Wadern, Germany	January 15-18, 2017
2017 Global Future Network Development Summit	ULG	Keynote speech	Nanjing, China	April 17, 2017
SWFAN 2017	CNIT – NOKIA IL	Workshop organisation	Atlanta, US-GA	May 1, 2017
EBU Broadthinking	USTR	Accepted talk	Geneva, CH	May 3-4, 2017
Open Stack Summit	RED HAT	Project Presentation	Boston, US	May 8-11, 2017
Open Stack Summit	RED HAT	Kuryr Project Onboarding	Boston, US	May 8-11, 2017

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.

EUCNC 2017	CNIT	Accepted talk	Oulu, Finland	June 12-15, 2017
EUCNC 2017	CNIT – NOKIA FR	Demo booth	Oulu, Finland	June 12-15, 2017
11th Cloud Control Workshop	RED HAT	Invited Talk	Stockholm, Sweden	Jun 12-14, 2017
IEEE CAMAD 2017	CITRIX	Special Session: Call for Paper	Lund, Sweden	June 19-21, 2017

Xen Project Developer and Design Summit	NEC	Accepted talks	Budapest, Hungary	July 11-14, 2017
Xen Project Developer and Design Summit	ONAPP	Accepted talk	Budapest, Hungary	July 11-14, 2017
Xen Project Developer and Design Summit	CITRIX - SUPERFLUIDITY	Sponsorship	Budapest, Hungary	July 11-14, 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
3. Simon Westbroek, USTR: **"Server Side Playlists: The alternative for manifest manipulation"**, International Broadcasting Convention, Amsterdam, The Netherlands, September 19, 2016
4. Stefano Salsano CNIT, Felipe Huici NEC: **"Superfluid NFV: VMs and Virtual Infrastructure Managers speed-up for instantaneous service instantiation"**, Invited talk, EWSDN 2016, co-located with the SDN World Congress 2016, The Hague, Netherlands, October 10-11, 2016
5. Giuseppe Bianchi, CNIT: **"Revisiting control/data plane separation in Software Defined Networking"**, SUPERFLUIDITY's Taiwan Tour: October 31: Distinguished Lecture speech at Institute of Information Science – Academia Sinica; November 1: Talk at National Chiao Tung University; November 2: talk at National Taiwan University of Science and Technology, 31 October – 2 November 2016.
6. Louise Krug, BT: **"Containers for NFV"**, Technology Forum SDN World Congress 2016, EWSDN 2016, co-located with the SDN World Congress 2016, The Hague, Netherlands, October 10-11, 2016.
7. Laurent Mathy, ULG: **"High-performance software data-plane for NFV"**, Keynote speech, 2017 Global Future Network Development Summit, Nanjing, China, April 17, 2017.
8. Rufael Mekuria, USTR: **"Extended Origin Functionalities"**, EBU Broadthinking, Geneva, Switzerland, May 3-4, 2017.
9. Stefano Salsano, CNIT: **"Deployment and orchestration of Unikernels in the NFV Infrastructure",** EuCNC 2017, Oulu, Finland, June 12-15, 2017.

10. Felipe Manco, NEC: **"uniprof: Transparent Unikernel Performance Profiling and Debugging"**, Xen Project Developer and Design Summit, Budapest, Hungary, July 11-14, 2017.
11. Florian Schmidt, NEC: **"NoXS: Death to the XenStore"**, Xen Project Developer and Design Summit, Budapest, Hungary, July 11-14, 2017.
12. Julian Chesterfield, Anastassios Nanos, ONAPP: **"Xen-lite for ARM – adapting Xen for a Samsung Exynos MicroServer with hybrid FPGA IO acceleration"**, Xen Project Developer and Design Summit, Budapest, Hungary, July 11-14, 2017.

Conference Papers

1. Radu Stoenescu, Matei Popovici, Lorina Negreanu, and Costin Raiciu, UPB – University Politehnica of Bucharest: **"SymNet – Scalable Symbolic Execution for Modern Networks"**, proc. of Conference on ACM SIGCOMM'16, August 22-26, 2016, Florianópolis, Brazil. DOI: 10.1145/2934872.2934881.

2. H. J. Asghar, L. Melis, C. Soldani, E. De Cristofaro, M. A. Kaafar, and L. Mathy, ULG – Univeristy of Liège: **"SplitBox: Toward Efficient Private Network Function Virtualization"** ACM SIGCOMM, proc. of the Workshop on Hot Topics in Middleboxes and Network Function Virtualization (HotMiddlebox 2016), Co-located with ACM SIGCOMM'16, August 22-26, 2016, Florianópolis, Brazil. DOI: 10.1145/2940147.2940150.

3. Giuseppe Siracusano, Roberto Bifulco, Simon Kuenzer, Stefano Salsano, Nicola Blefari Melazzi, Felipe Huici: **"On-the-Fly TCP Acceleration with Miniproxy"**, ACM SIGCOMM, proc. of the Workshop on Hot Topics in Middleboxes and Network Function Virtualization (HotMiddlebox 2016), Co-located with ACM SIGCOMM'16, August 22-26, 2016, Florianópolis, Brazil. DOI: 10.1145/2940147.2940149.

4. Radu Stoenescu, Dragos Dumitrescu, Costin Raiciu, UPB – University Politehnica of Bucharest: **"OpenStack networking for humans: symbolic execution to the rescue"** invited paper in IEEE LANMAN 2016, Rome, Italy, June 13 -15, 2016. DOI: 10.1109/LANMAN.2016.7548840.

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, Lisbon, Portugal, June 6-8, 2016.

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

7. Luca Chiaraviglio, Nicola Blefari Melazzi, William Liu, Jairo A. Gutierrez, Jaap Van De Beek, Robert Birke, Lydia Chen, Filip Idzikowski, Daniel Kilper, Paolo Monti, Jinsong Wu: **"5G in Rural and Low-Income Areas: Are We Ready?"**, ITU Kaleidoscope Conference, Bangkok, Thailand, November 2016.

8. Christos Tselios, George Tsolis: **"On QoE-awareness through Virtualized Probes in 5G Networks"**, paper accepted for publication at IEEE CAMAD 2016, 21st IEEE International Workshop on Computer Aided Modelling and Design of Communication Links and Networks, 23-25 October 2016, Ryerson University, Toronto, ON, Canada.

9. Pier Luigi Ventre, Claudio Pisa, Stefano Salsano, Giuseppe Siracusano, Florian Schmidtz, Paolo Lungaroni, Nicola Blefari Melazzi: **"Performance Evaluation and Tuning of Virtual Infrastructure Managers for (Micro) Virtual Network Functions"**, 2016 IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN), 7-9 November 2016, Palo Alto, California, USA.

10. Joseph Kampeas, Asaf Cohen, Omer Gurewitz: **"On Secrecy Rates and Outage in Multi-User Multi-Eavesdroppers MISO Systems"**, 2016 IEEE International Symposium on Information Theory (ISIT), 10-15 July 2016, Barcelona, Spain.

11. Alejandro Cohen, Asaf Cohen, Omer Gurewitz: **"Secure Group Testing"**, 2016 IEEE International Symposium on Information Theory (ISIT), 10-15 July 2016, Barcelona, Spain.

12. Arne Schwabe, Pedro A. Aranda Gutiérrez, Holger Karl: **"Composition of SDN applications: Options/challenges for real implementations"**, Applied Networking Research Workshop 2016 (ANRW'16), 17-22 July 2016, Berlin, Germany.

13. Rufael Mekuria, Pablo Cesar: **"MP3DG-PCC, Open Source Software Framework for Implementation and Evaluation of Point Cloud Compression"**, ACM Multimedia Conference 2016, 15-19 October 2016, Amsterdam, the Netherlands. DOI: 10.1145/2964284.2973806.

14. Khartik Ainala, Rufael N. Mekuria, Birendra Khathariya, Zhu Li, Ye-Kui Wang, Rajan Joshi: **"An improved enhancement layer for octree based point cloud compression with plane projection approximation"**, SPIE Applications of Digital Image Processing XXXIX, DOI:10.1117/12.2237753.

15. G. Aravinthan, H. Dalia, C.S. Chen, L. Roullet: **"Virtualization of Radio Access Network by Virtual Machine and Docker: Practice and Performance Analysis"**, IFIP/IEEE Integrated Network Management Symposium (IM 2017), May 8-12, 2016, Lisbon, Portugal.

16. Arjen Wagenaar, Dirk Griffioen, Rufael Mekuria: **"Unified Remix: a Server Side Solution for Adaptive Bit-Rate Streaming with Inserted and Edited Media Content"**, ACM Multimedia Systems Conference, Taipei, Taiwan, June 20-24, 2017

17. Paul Veitch, Edel Curley and Tomasz Kantecki: **"Performance Evaluation of Cache Allocation Technology for NFV Noisy Neighbour Mitigation"**, IEEE NetSoft 2017, Bologna, Italy, 3-7 July 2017.

18. Luca Chiaraviglio, Lavinia Amorosi, Stefania Cartolano, Nicola Blefari Melazzi, Paolo Dell'Olmo, Mohammad Shojafar, Stefano Salsano: **"Optimal Superfluid Management of 5G Networks"**, IEEE NetSoft 2017, Bologna, Italy, 3-7 July 2017.

19. Salvatore Pontarelli, Marco Bonola, Giuseppe Bianchi: **"Smashing SDN "built-in" actions: programmable data plane packet manipulation in hardware"**, IEEE NetSoft 2017, Bologna, Italy, July 3-7, 2017.

20. Luca Chiaraviglio, Nicola Blefari Melazzi, Carla-Fabiana Chiasserini, Bogdan Iatco, Francesco Malandrino, Stefano Salsano: **"An Economic Analysis of 5G Superfluid Networks"**, 18th IEEE International Conference on High Performance Switching and Routing (IEEE HPSR), Campinas, Brazil, June 18-21, 2017.

21. Laura Vasilescu, Vladimir Olteanu, Costin Raiciu: **"Sharing CPUs via endpoint congestion control"**, IEEE SIGCOMM KBNets 2017, Los Angeles, US-CA, August 21-25, 2017.

22. Marco Bonola, Roberto Bifulco, Luca Petrucci, Salvatore Pontarelli, Angelo Tulumello, Giuseppe Bianchi: **"Implementing advanced network functions for datacenters with stateful**

programmable data planes", IEEE LANMAN 2017 – The 23rd IEEE International Symposium on Local and Metropolitan Area Networks, Osaka, Japan, June 12-14, 2017.

23. Marco Bonola, Roberto Bifulco, Luca Petrucci, Salvatore Pontarelli, Angelo Tulumello, Giuseppe Bianchi: **"Demo: implementing advanced network functions with stateful programmable data planes"**, IEEE LANMAN 2017 – The 23rd IEEE International Symposium on Local and Metropolitan Area Networks, Osaka, Japan, June 12-14, 2017.

24. Ioannis Prevezanos, Andreas Angelou, Christos Tselios, Alexandros Stergiakis, Vassilis Tsogkas and George Tsolis: **"Hammer: A Real-world, end-to-end Network Traffic Simulator"**, IEEE CAMAD 2017, 22nd IEEE International Workshop on Computer Aided Modelling and Design of Communication Links and Networks, Lund, Sweden, 19-21 June 2017.

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.
   IEEE Transactions on Network and Service Management, Vol. 13, Issue 1, March 2016, pp. 138-153

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.

   Transactions on Emerging Telecommunications Technologies, Vol. 27, Issue 9, September 2016, pp 1178–1186, Wiley.

3.1.2 Sponsored and organised 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 intense 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 Organisers:

CNIT – Nicola Blefari Melazzi, Giuseppe Bianchi

NOKIA IL – Danny Raz, Erez Biton.

TPC Co-Chair:

NOKIA IL - Erez Biton

Superfluidity participation to 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

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 virtualisation 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, Dragos Dumitrescu, Costin Raiciu (University Politehnica of Bucharest).

Figure 2 – IEEE LANMAN 2016 Symposium

SWFAN 2017

SUPERFLUIDITY has driven the organisation of the **2nd International Workshop on Software-Driven Flexible and Agile Networking** that has been organised in conjunction with IEEE INFOCOM 2017. The organising committee included three SUPERFLUIDITY's representatives out of seven persons:

CNIT - Giuseppe Bianchi,

CNIT - Nicola Blefari Melazzi,

NOKIA IL - Danny Raz, Technion

TPC Co-Chair: CNIT - Stefano Salsano.

The two keynotes planned and the high quality of the papers presented stimulated many questions and interesting discussions among the participants.

The audience reached the number of 25 attendees.

Figure 3 – SWFAN 2017

3.1.3 Exhibitions

Second 5G Global Event: "Enabling the 5G ecosphere"

SUPERFLUIDITY Consortium participated at the second **5G Global Event** held in Rome on 9th and 10th November 2016, by organising an exhibition booth and attending the conference. The local organisation was coordinated by CNIT, which offered the Volunteers Team to the Conference organisers and funded the SUPERFLUIDITY's booth costs.

The SUPERFLUIDITY's booth was organised by Francisco Fontes from Altice Labs, John Thomson from ONAPP, Shahar Beiser from Nokia – Alcatel Lucent Israel, Lionel Natarianni and Bessem Sayadi from Nokia Bell Lab France. There were exhibited two demos: 1) rapid deployment/reconfiguration of a software-defined wireless network (C-RAN), integrated with Mobile Edge Computing, for efficient video delivery from the edge; 2) Demand-driven orchestration for 5G deployments.

Figure 4 – Exhibition Booth

During the event, Mr. Roberto Viola DG Connect visited the exhibition area, and John Thomson depicted the demos and the results achieved so far. Dr. Diego R. Lopez from Telefonica, Chair of ETSI NFV visited the SUPERFLUIDITY's booth as well. Dr. Diego R. Lopez participated at the conference with a presentation on "Software Networks in the Transition to 5G", in the Session 4 – 5G network management & software networks. The event was very successful with a numerous participation, about 400 attendees.

Figure 5 – Special guests at SUPERFLUIDITY's Booth

Figure 6 – SUPERFLUIDITY's representatives

In occasion of the booth preparation, CNIT produced a new general poster about SUPERFLUIDITY project and a new leaflet. One hundred leaflets were distributed during the exhibitions.

Figure 7 – SUPERFLUIDITY's new poster

The new poster and leaflet are available for download on the web site from the section "Communication".

The SUPERFLUIDITY's booth also exhibited posters dedicated to demos.

As mentioned before, three demos were exhibited:

1. Demand-driven orchestration for 5G deployments;
2. Software-Defined “Superfluid” Wireless Network;
3. Video transmuxing at the edge, using MEC.

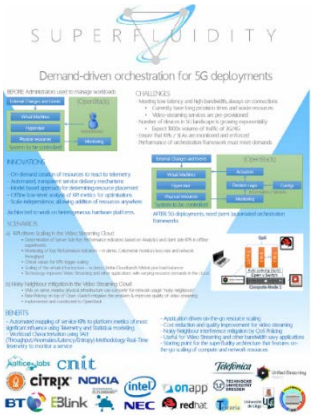
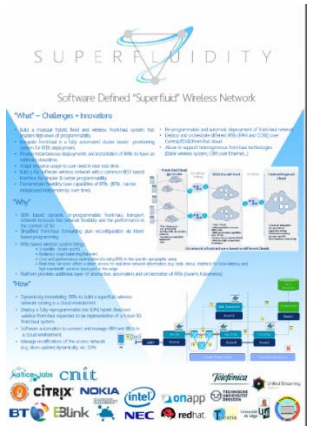
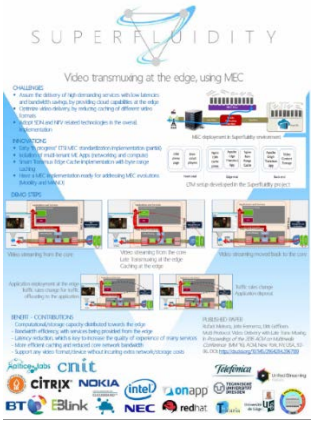
All these posters are available for download on the web site (http://superfluidity.eu/download/) Demo 1 - Demand-driven orchestration for 5G deployments	
Demo 2 - Software Defined “Superfluid” Wireless Network	
Demo 3 - Video transmuxing at the edge, using MEC	

Figure 8 – Demos’ posters

3.1.4 World Dissemination Tours and Education

1. **1st International Workshop on Software-Driven Flexible and Agile Networking**: Keynote speaker Laurent Mathy – ULG
2. SUPERFLUIDITY's Taiwan Tour on **"Revisiting control/data plane separation in Software-Defined Networking"**, Giuseppe Bianchi – CNIT.
3. 2017 Global Future Network Development Summit: **"High-performance software data-plane for NFV"** Laurent Mathy – ULG

3.1.5 Education, Community Building and Hackathon

1 Undergraduates/graduate course on **"Virtualization of cloud communication services"**: Co-organised by BGU and NOKIA IL, Beersheba, Israel.

2 **Ninux Day 2016.** The Ninux Day is the national meeting of the Italian wireless community network ninux.org. Community networks are network infrastructures with a decentralised management, built bottom-up by individuals and organisations employing mostly COTS wireless hardware. CNIT's researcher gave a talk about SUPERFLUIDITY's work on the chaining of Virtual Network Functions and how this can be applied to the ninux.org network.

3 OpenStack Boston Summit. **Kuryr Project On-Boarding Session.** Organised by Red Hat.

4 **Xen Project Developer and Design Summit.** Design Session: "Unikernel support for NFV-like applications on Xen ARM 64bit". Hosted by OnApp and CITRIX (Budapest, July 11-14, 2017).

4.1 General Communication and Dissemination Channels

4.1.1 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 realisation. 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*: In this page, all activities related to Communication on Community Building, World Dissemination Tour and collaboration with 5G PPP are regularly updated.
- *Results -> Communication -> Download*: In this section, it is possible to download general communication such as Presentations, Leaflets and Posters. Posters related to demos presented in exhibitions are also available. 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, Standardisation works and papers are published.
- *Results -> Deliverables*: In this page, the complete list of Deliverables has been published. Public deliverables can be downloaded by the general public, while confidential deliverables can be downloaded only through a private account to the web site. A private access has also been delivered to the EC Officer and monitors on the occasion of the First Period Review.
- *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, 12 news have been published. In the following paragraphs, we will describe the communication activities performed through Social Networks. Here below we report a screenshot of the News' page.

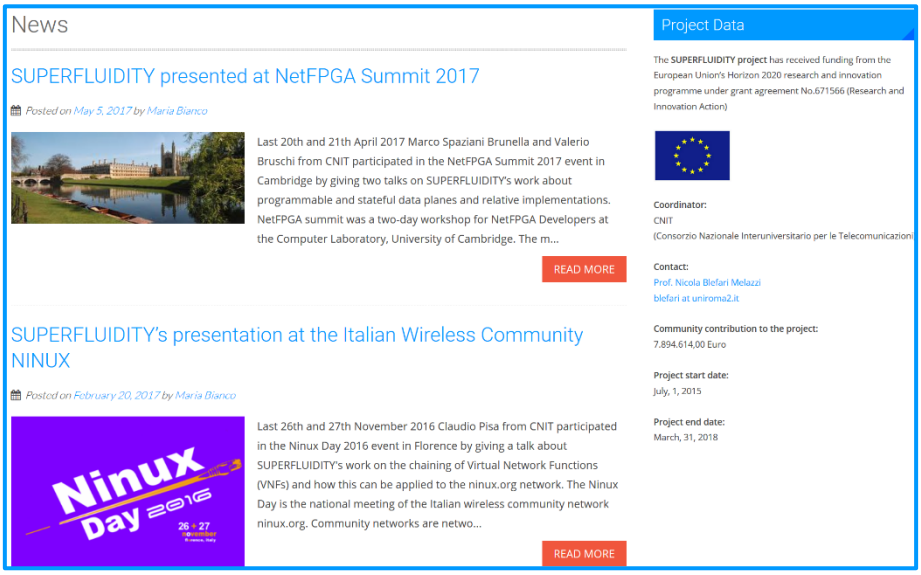


Figure 9 – SUPERFLUIDITY News page

4.1.1.1 Google Analytics Overview

We have added the Google Analytics tracking code in the template of SUPERFLUIDITY website, thus enabling the tracking of statistics of the project's website. Key statistics are shown in Figure 10 below. The SUPERFLUIDITY web site shows the following main access data since the beginning of the web site:

- N. of Session: 11.132
- N. of Users: 8.497
- Page Views: 24.632
- Page/Session: 2.21
- Average session Duration: 1 min 30 sec
- Bounce Rate: 67.10%
- % New Session: 76.33%

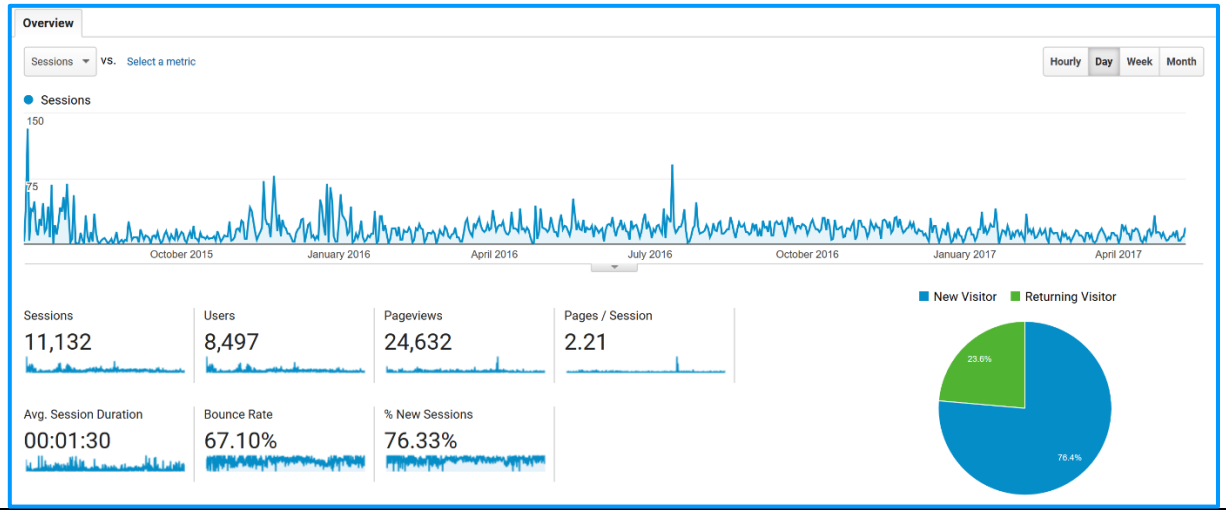
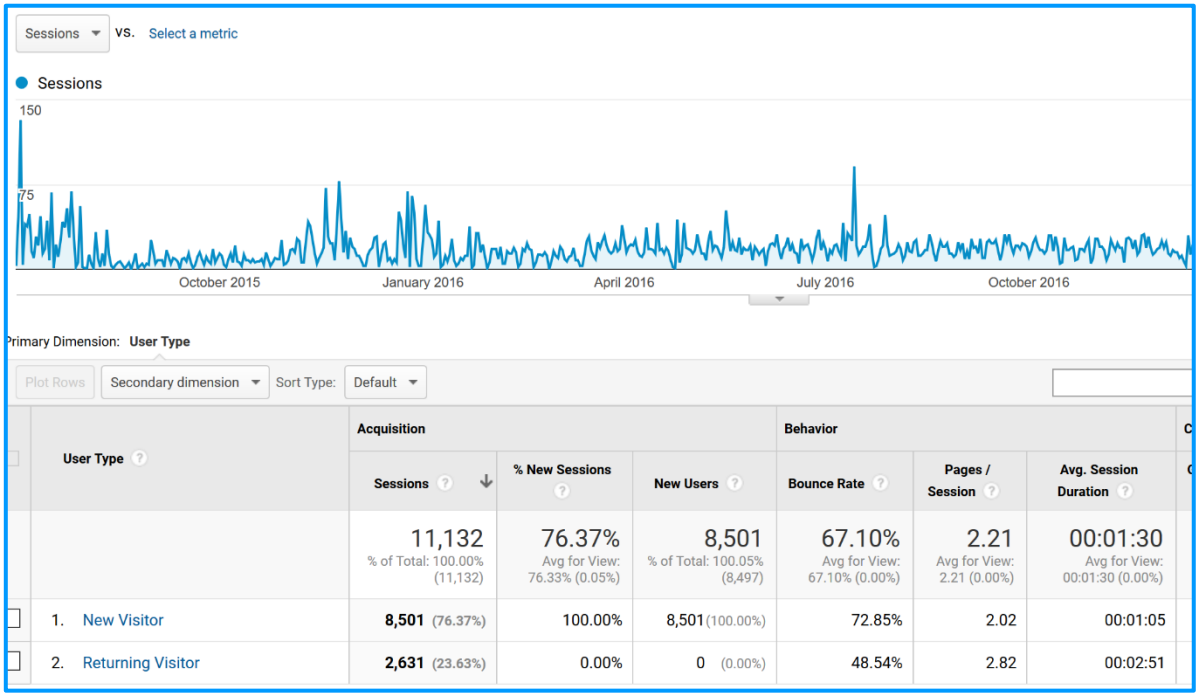


Figure 10 – Audience General Overview

4.1.1.1.1 New vs Returning

Concerning the Audience, we can see that 73.37 % of users are New Visitors. In the figure below, we can see that Returning Visitors performed in the period 2631 sessions with a lower Bounce Rate (48.54% instead of 50.42% related to the first year) and an Average Session Duration about 2.21 minutes.



User Type	Acquisition			Behavior		
	Sessions	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	11,132 % of Total: 100.00% (11,132)	76.37% Avg for View: 76.33% (0.05%)	8,501 % of Total: 100.05% (8,497)	67.10% Avg for View: 67.10% (0.00%)	2.21 Avg for View: 2.21 (0.00%)	00:01:30 Avg for View: 00:01:30 (0.00%)
1. New Visitor	8,501 (76.37%)	100.00%	8,501 (100.00%)	72.85%	2.02	00:01:05
2. Returning Visitor	2,631 (23.63%)	0.00%	0 (0.00%)	48.54%	2.82	00:02:51

Figure 11 – New Visitors and Returning Visitors

4.1.1.1.2 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. In this case since the creation of the web site.

- 1 day: 17 users
- 7 days: 55 users
- 14 days: 109 users
- 30 days: 275 users

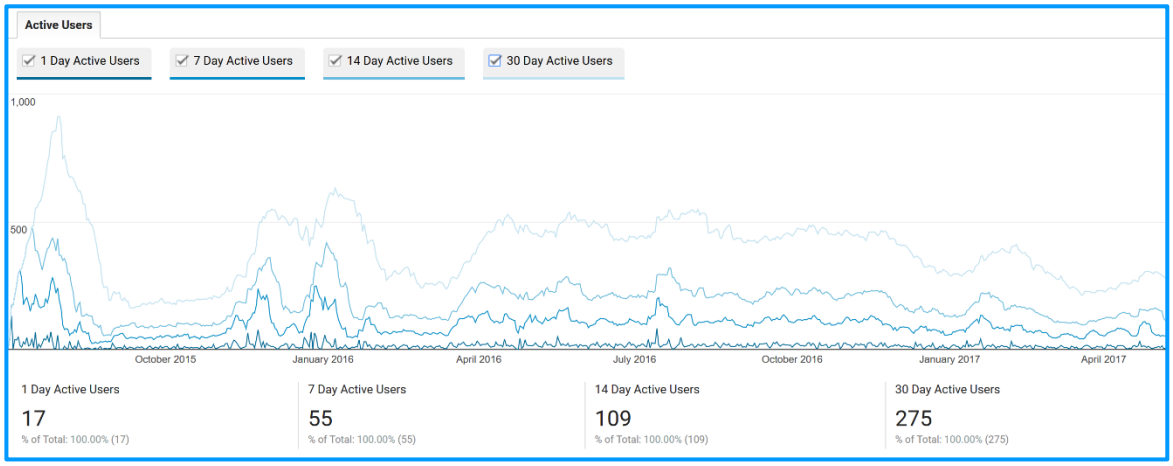


Figure 12 – Number of unique users per n. of days

4.1.1.1.3 Location

The figure below shows an Analytics map about the number of accesses from different countries.

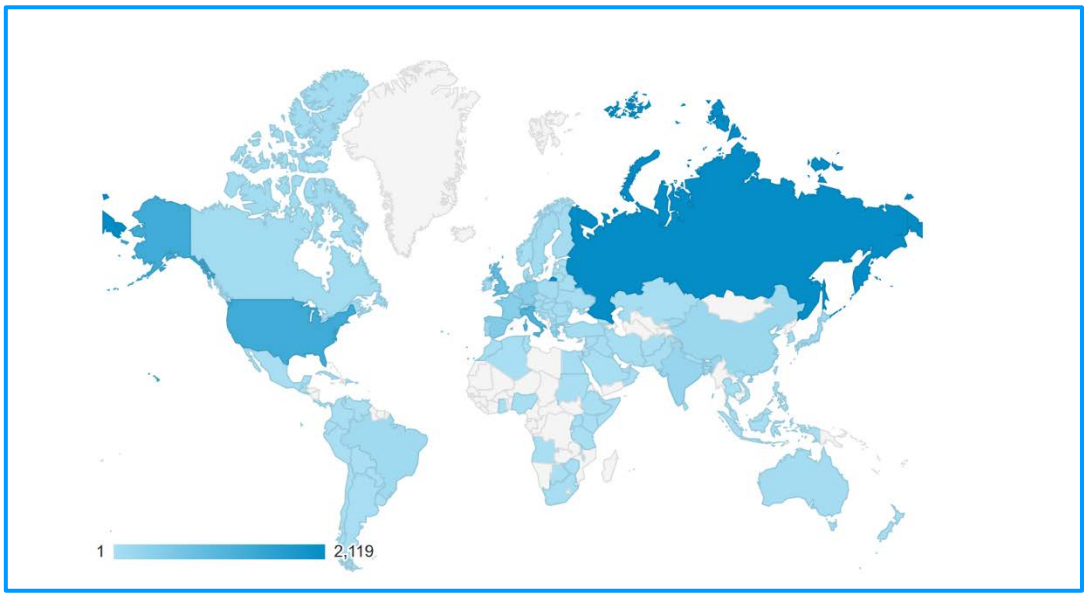


Figure 13 – World Map of Users

The list below reports the number of access for the top 10 countries. 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
	11,132 % of Total: 100.00% (11,132)	76.37% Avg for View: 76.33% (0.05%)	8,501 % of Total: 100.05% (8,497)	67.10% Avg for View: 67.10% (0.00%)	2.21 Avg for View: 2.21 (0.00%)	00:01:30 Avg for View: 00:01:30 (0.00%)
1. Russia	2,119 (19.04%)	78.43%	1,662 (19.55%)	90.42%	1.49	00:00:38
2. United States	1,357 (12.19%)	89.24%	1,211 (14.25%)	77.75%	1.67	00:00:48
3. Italy	1,141 (10.25%)	43.47%	496 (5.83%)	42.24%	3.21	00:03:10
4. United Kingdom	872 (7.83%)	77.06%	672 (7.90%)	52.52%	2.77	00:01:50
5. (not set)	822 (7.38%)	94.40%	776 (9.13%)	78.10%	1.50	00:00:28
6. Spain	507 (4.55%)	63.51%	322 (3.79%)	50.30%	2.94	00:01:52
7. Germany	448 (4.02%)	77.23%	346 (4.07%)	49.55%	3.29	00:02:34
8. France	437 (3.93%)	80.32%	351 (4.13%)	57.21%	2.65	00:01:50
9. Greece	296 (2.66%)	60.14%	178 (2.09%)	37.16%	3.53	00:02:53
10. India	250 (2.25%)	74.40%	186 (2.19%)	65.20%	2.40	00:01:54

Figure 14 – Number of Session per Countries

4.1.1.1.4 Page Business Performance Efficiency

The table below shows pages with the best performing contents.

Page Title	Unique Pageviews ↓	Pageviews	Entrances / Pageviews	Bounce Rate	Avg. Time on Page
	19,629 % of Total: 100.00% (19,629)	24,632 % of Total: 100.00% (24,632)	45.02% Avg for View: 45.02% (0.00%)	67.10% Avg for View: 67.10% (0.00%)	00:01:14 Avg for View: 00:01:14 (0.00%)
1. Superfluidity Project | the ability to instantiate internet services on-the-fly	3,575 (18.21%)	4,561 (18.52%)	66.92%	40.81%	00:01:20
2. (not set)	2,348 (11.96%)	3,258 (13.23%)	72.07%	97.74%	00:00:40
3. Home page	1,882 (9.59%)	1,882 (7.64%)	90.91%	100.00%	00:00:00
4. Partners | Superfluidity Project	1,353 (6.89%)	2,227 (9.04%)	12.08%	34.57%	00:00:43
5. Deliverables | Superfluidity Project	726 (3.70%)	821 (3.33%)	14.13%	69.57%	00:02:54
6. Specific Objectives | Superfluidity Project	618 (3.15%)	712 (2.89%)	15.73%	77.68%	00:01:44
7. Dissemination | Superfluidity Project	522 (2.66%)	603 (2.45%)	17.41%	69.16%	00:01:44
8. Communication | Superfluidity Project	421 (2.14%)	487 (1.98%)	6.57%	66.67%	00:00:41
9. News | Superfluidity Project	408 (2.08%)	509 (2.07%)	9.43%	68.75%	00:01:04
10. Intel Research & Development Ireland Ltd | Superfluidity Project	388 (1.98%)	468 (1.90%)	63.03%	62.71%	00:01:35

Figure 15 – Best Performing Contents

4.1.2 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 57 members.

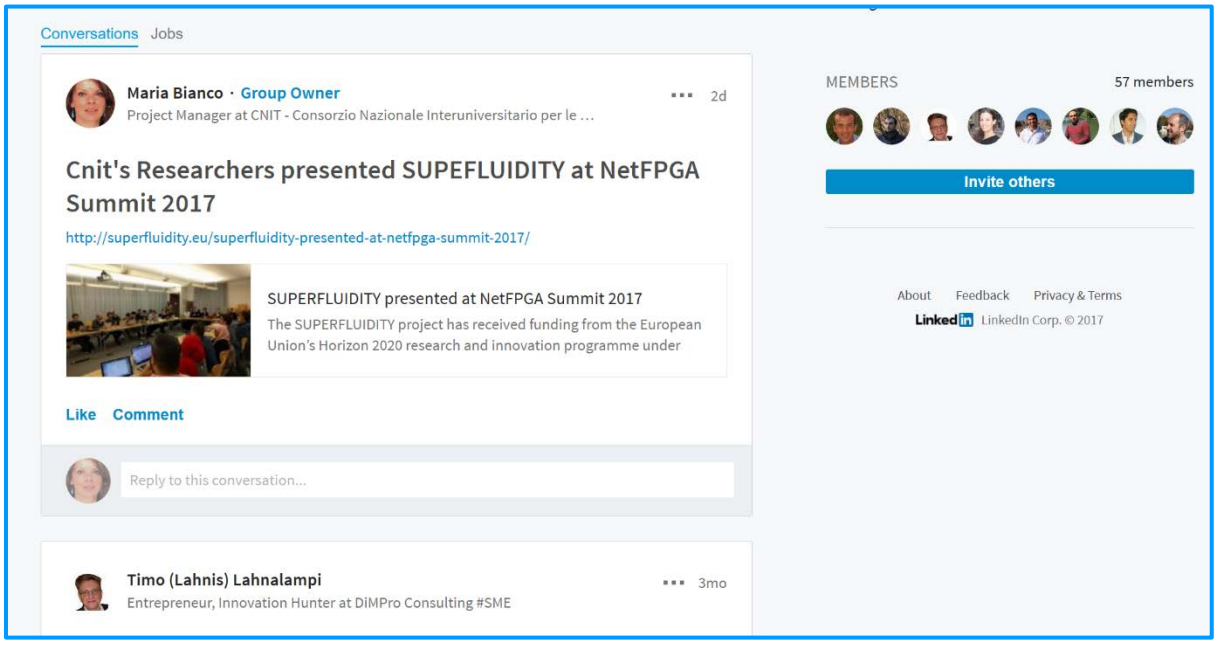


Figure 16 – SUPERFLUIDITY's LinkedIn Group

On the LinkedIn group all the News and Information published on the SUPERFLUIDITY web site have been shared. To date, 23 discussions were published.

4.1.3 Twitter

Twitter is the constant posting system that rests on the idea of 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 2015 and to date it counts 152 followers (91 followers more in one year). 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
- ITNAC: annual telecommunication network and applications conference run in Australia and New Zealand
- EUCHINA-IoT5G: The EU-China Study on IoT and 5G, analises the research and innovation ecosystem for IoT and 5G in China and compares it with the European model.

Figure 17 – SUPERFLUIDITY's Twitter home page

SUPERFLUIDITY tweeted 54 posts and received appreciations and retweets from ETSI, 5GPPP, Telecom News.

Concerning the audience interest, the figure below reports the interest categories to which followers belong to.

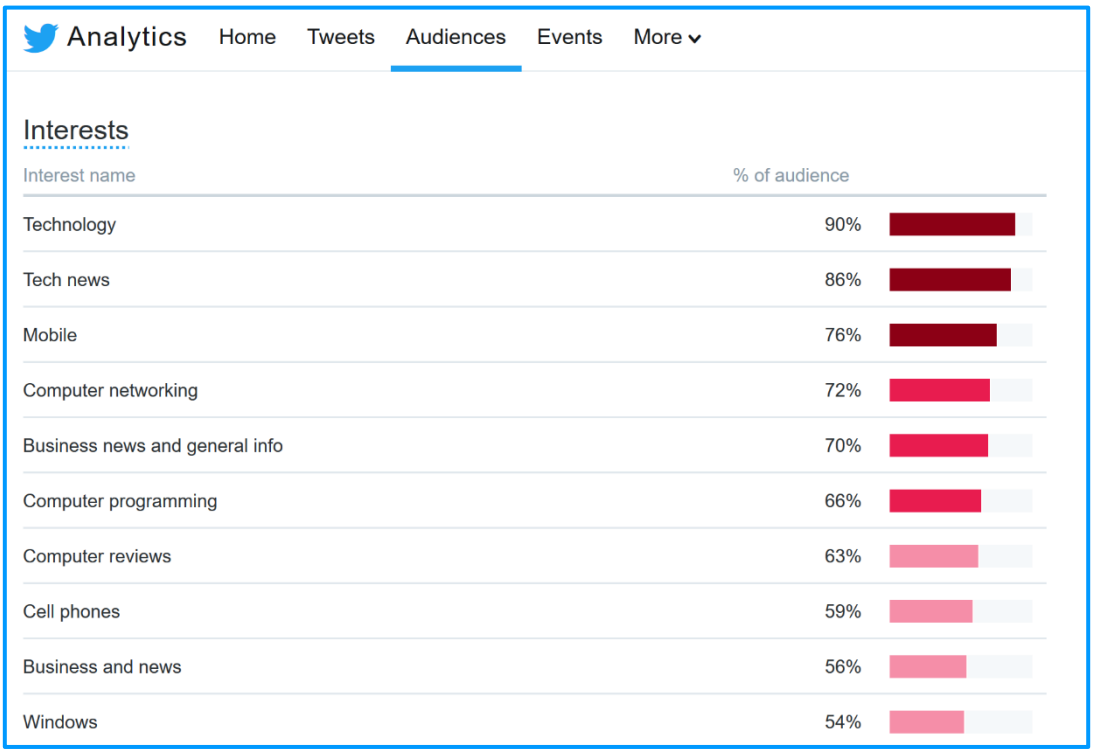


Figure 18 – Audience Interests

4.1.4 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 conferences and other events.

For instance, CNIT realised a SUPERFLUIDITY video, presented at the conference IEEE Globecom 2015, San Diego, California, in a demo booth organised and run by the 5G Architecture Working Group. This Project video is available at: https://www.youtube.com/watch?v=6xEMZMFB1XU.

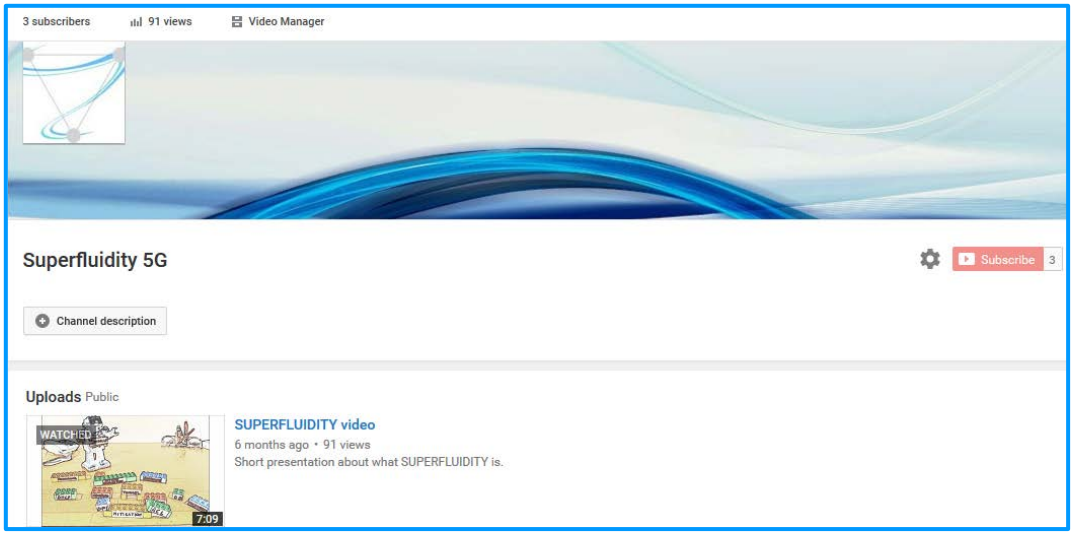


Figure 19 – SUPERFLUIDITY's YouTube channel

Figure 20 – Screenshot of SUPERFLUIDITY's video

To date, the channels counts 8 subscribers and an overall number of views of 409.

Over the months, since the issue of the D8.2, two more videos have been uploaded on occasion of the Demos Exhibition at the Second 5G Global Event.

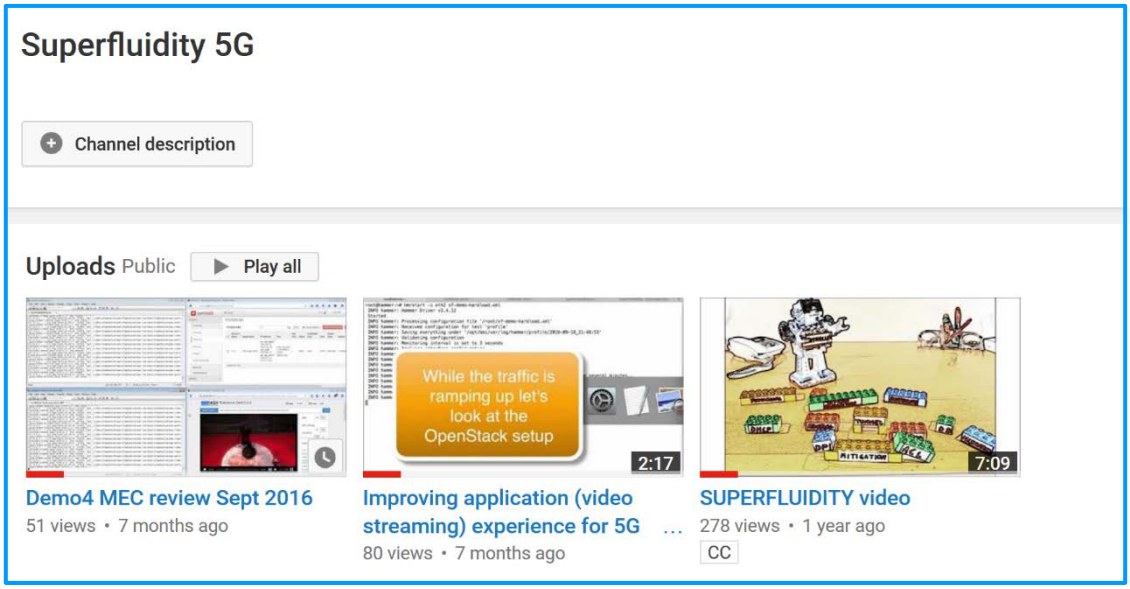


Figure 21 – List of uploaded video.

4.1.5 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/

Unified Streaming published on its own web site an article entitled "5G Superfluidity and the future of streaming video" on November 2016: http://www.unified-streaming.com/blog/5g-superfluidity-and-future-streaming-video

Luis Tomas Bolivar from RED HAT published on his personal blog five different articles describing the SUPERFLUIDITY's results and activities:

1- Superfluidity: Containers and VMs in the Mobile Network (Part 1): https://ltomasbo.wordpress.com/2017/01/16/superfluidity-containers-and-vms-at-the-mobile-network-part-1/
2- Superfluidity: Containers and VMs in the Mobile Network (Part 2): https://ltomasbo.wordpress.com/2017/01/24/superfluidity-containers-and-vms-deployment-for-the-mobile-network-part-2/
3- Side-by-side and nested Kubernetes and OpenStack deployment with Kuryr: https://ltomasbo.wordpress.com/2017/01/29/side-by-side-and-nested-kubernetes-and-openstack-deployment-with-kuryr/
4- Kuryr Ports Pool: Speeding up containers booting time on Neutron networks: https://ltomasbo.wordpress.com/2017/05/09/kuryr-ports-pool-speeding-up-containers-booting-time-on-neutron-networks/
5- OpenShift with Kuryr on top of OpenStack VMs: step by step set up: https://ltomasbo.wordpress.com/2017/05/19/openshift-with-kuryr-on-top-of-openstack-vms-step-by-step-set-up

5 Contributions to Standardisation

5.1 ALB

5.1.1 Contributions

5.1.1.1 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.

5.1.2 Future Plans

5.1.2.1 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.

5.2 NOKIAIL

5.2.1 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 selected as the deployment language of choice.

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.

5.3 Telefónica, I+D

5.3.1 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).

5.3.2 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).

5.4 Unified Streaming

5.4.1 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

5.5 British Telecom

5.5.1 Contributions

BT is one of the companies that created the original work at ETSI and defined 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)

6 Contributions to Open Source Projects

6.1 RED HAT

6.1.1 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 stabilisation 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 stabilisation 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 stabilisation 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 functional tests for QoS agent	OpenStack code	Testing for QoS support.
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 stabilisation 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 stabilisation 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 stabilisation 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 generalisation 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 stabilisation 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 stabilisation of QoS feature.
Feature: Gracefully handle duplicate rule creation	OpenStack code	This feature is being a part of an ongoing work towards stabilisation 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 stabilisation 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 stabilisation 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 stabilisation of QoS feature.

6.1.2 OpenStack Kuryr Project

SUMMARY	CONTRIBUTION LINKS	IMPACT ON SUPERFLUIDITY PROJECT
Feature: Nested-Containers: trunk subports management	OpenStack code	Part of the work to support nested containers at Kuryr
Feature: Enable subports are deleted after container deletion	OpenStack Code	Part of the work to support nested containers at Kuryr
Testing: Make segmentation driver testable	OpenStack Code	Testing of nested containers at Kuryr
Feature: Add randomness to the returned vlan_ids	OpenStack Code	Part of the work to support nested containers at Kuryr
Feature: Moving from device_owner to tagging	OpenStack Code	Part of the work to support nested containers at Kuryr
Feature: Change DEVICE_OWNER to make it more Neutron compliant	OpenStack Code	Part of the work to support nested containers at Kuryr
Testing: Add ddt to test-requirements	OpenStack Code	Part of the work to support nested containers at Kuryr
BugFix: Fix KeyError problem at cni/api.py when subnets have dns_nameservers	OpenStack Code	Part of the work to support nested containers at Kuryr
Document: Kuryr Kubernetes port manager design reference document	OpenStack Developer Reference Document	Part of the work to speed up container creation at Neutron Network with Kuryr

Feature: Add support for nested pods with Vlan trunk port	OpenStack Code	Part of the work to support nested containers at Kuryr
Feature: nested-containers: vlan driver	OpenStack Code	Part of the work to support nested containers at Kuryr
Feature: Add devstack support for https k8s api server	OpenStack Code	Making Kuryr deployment more secure
BugFix: delete docker socket file only if exists	OpenStack Code	Kuryr Devstack
BugFix: fix kuryr devstack systemd unit file issues	OpenStack Code	Kuryr Devstack update
Feature: Adding ports pools to speed up containers booting and deletion	OpenStack Blueprint	Part of the work to speed up container creation at Neutron Network with Kuryr

6.1.3 Future Plans for Open Source Contributions

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

6.2 NOKIABLF

6.2.1 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 features start 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 virtualisation 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.

6.2.2 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.

6.3 NOKIAIL

6.3.1 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.

6.3.1.1 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 virtualised 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.

6.3.1.2 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.

6.3.2 Future Plans for Open Source Contributions

NOKIA IL plans to continue its contribution to the above projects and constantly evaluating contribution to other open source bodies such as Open Source MANO (OSM) and OPEN-O.

6.4 INTEL

6.4.1 Open Source Contributions

Intel has not produced any Open Source contributions during this period. Intel has mainly concentrated on raising the awareness of the project internally among business units. Intel is founding 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.

6.4.2 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.

6.5 CNIT

6.5.1 Open Source Contributions

CNIT has released an open source project called RDCL 3D, which is the result of the Superfluidity activity. RDCL 3D is a web framework for the design of NFV services and components. The framework allows editing, validating, visualizing the descriptors of services and components both textually and graphically.

The platform is designed with a modular approach, allowing developers to "plug in" the support for new models (project types). Currently supported project types are:

- ETSI Release 2 NS and VNF descriptors
- TOSCA Simple Profile for NFV
- Click modular router configurations
- Superfluidity-ETSI (ETSI R2 + Click)

The RDCL 3D source code is available on Github (https://github.com/superfluidity/RDCL3D) and it has been released under the Apache 2.0 License.

6.5.2 Future Plans for Open Source Contributions

CNIT will continue to work on the project mentioned in the previous section.

6.6 TELCARIA

6.6.1 Open Source Contributions

Telcaria has not performed any Open Source Contributions until M12. However, recently Telcaria joined as a participant in the Open Source MANO (OSM) community, and therefore, it will concentrate in pushing SUPERFLUIDITY results to this community.

6.6.2 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), Open Network Operating System (ONOS), OpenStack or Open Source MANO (OSM).

6.7 Telefónica, I+D

6.7.1 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.

6.7.2 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.

6.8 Unified Streaming

6.8.1 Future Plans for Open Source Contributions

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

6.9 ULG

6.9.1 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/

7 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 standardisation and open source contributions.

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

- D8.6 Final Report on Communication, Dissemination Actions (M33)
- D8.7 Final Report on Standardisation and Open Source Contributions (M33)

8 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 has been identified and is updated on a regular basis by the WP8 leader. These events are listed below.

Industry Events		
Event	When	Where
Open Source Summit Japan	May 31 - June 2, 2017	Tokyo, JP
IEEE 5G Summit	June 5, 2017	Istanbul, TK
IEEE 5G Summit	June 5-6, 2017	Honolulu, US-HI
IEEE 5G Summit	June 8, 2017	Dallas, TX
OPNFV Summit	June 12-15, 2017	Beijing, CN
5G World	June 13-15, 2017	London, UK
LinuxCon + ContainerCon + CloudOpen China	June 19-20, 2017	Beijing, CN
Net Futures 2017	June 28-29, 2017	Brussels, BE
IEEE 5G Summit	July 1, 2017	Trivandrum, IN
Xen Project Developer Summit	July 11-13, 2017	Budapest, HU
IEEE 5G Summit	July 11, 2017	Thessaloniki, GR
IEEE 5G Summit	July (TBD), 2017	Kingston, JM
IEEE 5G Summit	July 27, 2017	Bhubaneswar, IN
IEEE 5G Summit	July 27-28, 2017	Shanghai, CN
IEEE 5G Summit	August 19, 2017	Reston, VA
Open Source Summit North America (LinuxCon + ContainerCon + CloudOpen + Community Leadership)	September 11-13, 2017	Los Angeles, US-CA
IEEE 5G Summit	September 12-13, 2017	Taipei, TW
Mobile World Congress Americas	September 12-14, 2017	San Francisco, US-CA
IBC	September 14-18, 2017	Amsterdam, NL
IEEE 5G Summit	September 18, 2017	Helsinki, FI
IEEE 5G Summit	September 19, 2017	Dresden, DE
IEEE 5G Summit	September 22, 2017	Tokyo, JP
MEC Congress	September 26-28, 2017	Berlin, DE
NFV & Carrier SDN	September 27-28, 2017	Denver, US-CO
Network Virtualization Asia	October 3-4, 2017	Singapore
IEEE 5G Summit	October 9, 2017	Montreal, CA-QC

SDN NFV World Congress 2017	October 9-13, 2017	The Hague, NL
IEEE 5G Summit	October 14, 2017	Nanjing, CN
Open Source Summit Europe (LinuxCon + ContainerCon + CloudOpen + Community Leadership)	October 23-25, 2017	Prague, CZ
KVM Forum	October 25-27, 2017	Prague, CZ
4th Global 5G Event	November 22-24, 2017	Seoul, KR
IEEE 5G Summit	November (TBD), 2017	New York, US-NY
AWS re:Invent	November 27 - December 1, 2017	Las Vegas, US-NV
IEEE 5G Summit	Fall (TBD), 2017	San Antonio, US-TX
CloudNativeCon + KubeCon North America	December 6-7, 2017	Austin, US-TX

ACADEMIC EVENTS		
EVENT	WHEN	WHERE
TNC17	May 29 - June 2, 2017	Linz, AT
QoMEX 2017	May 31 - June 2, 2017	Erfurt, DE
EUCNC 2017	June 12-15, 2017	Oulu, FI
12th Workshop on Virtualization in High-Performance Cloud Computing (VHPC'17)	June 18-22, 2017	Frankfurt, DE
IEEE CAMAD 2017	June 19-21, 2017	Lund, SE
/ Special Session on 5G: An Era of Agile, Brisk and Superfluid Networking	June (TBD), 2017	Lund, SE
ACM Multimedia Systems 2017	June 20-23, 2017	Taipei, TW
/ ACM NOSSDAV 2017	June 20-23, 2017	Taipei, TW
/ ACM MoVid 2017	June 20-23, 2017	Taipei, TW
3rd IEEE Conference on Network Softwarization (NetSoft 2017) (including Workshops of interest)	July 3-7, 2017	Bologna, IT
9th International Conference on Ubiquitous and Future Networks (ICUFN) 2017	July 4-7, 2017	Milan, IT
HotCloud '17	July 10-11, 2017	Santa Clara, US-CA
ACM, IRTF & ISOC Applied Networking Research Workshop 2017 (co-located with IETF-99)	July 15, 2017	Prague, CZ
ACM SIGCOMM 2017	August 21-25, 2017	Los Angeles, US-CA
/ MECOMM 2017	August (TBD), 2017	Los Angeles, US-CA

/ Internet-QoE 2017	August (TBD), 2017	Los Angeles, US-CA
/ HotConNet 2017	August (TBD), 2017	Los Angeles, US-CA
/ NetPL 2017	August (TBD), 2017	Los Angeles, US-CA
NGMAST 2017: 11th International Conference on Next Generation Mobile Applications, Security and Technologies	August (TBD), 2017	(TBD)
AlgoCloud 2017	September 4-5, 2017	Vienna, AT
IEEE Conference on Standards for Communications and Networking (CSCN) 2017	September 18-21, 2017	Helsinki, FI
MASCOTS 2017: Modeling, Analysis, and Simulation On Computer and Telecommunication Systems	September 20-22, 2017	Banff, CA-AB
WiMob 2017: The 13th IEEE International Conference on Wireless and Mobile Computing, Networking and Communications	October 9-11, 2017	Rome, IT
LCN 2017: The 42nd IEEE Conference on Local Computer Networks	October 9-12, 2017	Singapore
ICNP 2017: 25th IEEE International Conference on Network Protocols	October 10-13, 2017	Toronto, CA-ON
ACM Multimedia 2017	October 23-27, 2017	Mountain View, US-CA
IEEE NFV-SDN 2017	November 6-8, 2017	Berlin, DE
IEEE CloudNA 2017: The Third IEEE International Workshop on Cloud-based Networks and Applications	November (TBD), 2017	(TBD)
IEEE GlobeCom 2017	December 4-8, 2017	Singapore
ACM SIGCOMM CoNEXT 2017	December 12-15, 2017	Seoul, KR
CloudCom 2017: The 9th IEEE International Conference on Cloud Computing Technology and Science	December 11-14, 2017	Hong Kong

JOURNALS/MAGAZINES/SPECIAL ISSUES/BOOK CHAPTERS	
EVENT	IMPACT FACTOR
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 Transactions on Multimedia	2.536
IEEE Communications Magazine	
IEEE Wireless Communications Magazine	
IEEE Network Magazine	
Computer Standards & Interfaces (Elsevier)	1.268
Journal of Network and Computer Applications (Elsevier)	2.331
Computer Communications (Elsevier)	2.099
/ Special Issue on Mobile Video in the 5G/IoT Era	
Ad Hoc Networks (Elsevier)	1.660
Computer Networks (Elsevier)	1.446
Digital Communications and Networks (Elsevier)	
/ Special Issue on Resilient Networks Modeling Design and Applications	
Journal of Grid Computing (Springer)	1.561
Mobile Networks and Applications (Springer)	1.538
Multimedia Tools and Applications (Springer)	1.331
The Journal of Supercomputing (Springer)	1.088
Wireless Networks (Springer)	1.006
Journal of Computer Science and Technology (Springer)	0.475
Journal of Networks and Systems Management (Springer)	1.078
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)

STANDARDISATION EVENTS		
EVENT	WHEN	WHERE
IETF/IRTF-99	July 16-21, 2017	Prague, CZ
NFV#19	September 12-15, 2017	Denver, US-CO
IETF/IRTF-100	November 12-17, 2017	Singapore
NFV#20	December 5-8, 2017	(TBC)