



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Fabio Palumbo

XXXIII Cycle

Training and Research Activities Report – First Year

Tutor: Prof. Antonio Pescapè



1. Information

I received a M. Sc. Degree cum laude in Computer Engineering at the University of Napoli Federico II in July 2017. I am a PhD student attending the XXXIII Cycle of the ITEE PhD program at the Department of Information Technology and Electrical Engineering of the University of Napoli Federico II. I have a “PON Dottorati innovativi a caratterizzazione industriale” fellowship, and my tutor is Prof. Antonio Pescapè. I am currently part of the COMICS research group, studying in the field of Computer Networks.

2. Study and Training activities

a. Courses

- i. *Big Data Analytics and Business Intelligence*, Prof. A. Picariello, 06/03/18-07/06/18, 6 Credits.
- ii. *Network Security*, Prof. S.P. Romano, 24/09/18-21/12/18, 6 Credits
- iii. *Tecnologie digitali e scienze umane*, Prof. G. Tamburrini, 12/01/18-11/05/18, 3 Credits
- iv. *Green Economy and Management in Engineering Projects*, Prof. G. Zollo, Prof. G. Ferruzzi, Prof. P. Rippa, Prof. G. Bruno, Prof. C. Piccolo, Prof. I. Quinto, Prof. A. Castiglione, Prof. L. Landoli 06/06/18-27/06/18, 3 Credits
- v. *Learning and decision-making processes*, Prof. F. Verde, 05/02/18-05/03/18, 3 Credits
- vi. *Ciberconflitti: sicurezza informatica, difesa, stabilità internazionale e diritto umanitario*, Prof. G. Siroli, Prof. G. Tamburrini, Gen. F. Vestito, Prof. S.P. Romano, Prof. D. Amoroso 28/11/2018, 0.8 Credits
- vii. *Author Seminar: How to publish a scientific paper*, Dr. A. Birukou, E. Magistrelli, 26/11/18, 0.4 Credits

b. Seminars

- i. *IBM Q: Building the first quantum computer for business and science*, Dr. F. Mattei and Dr. N. Said, 16/05/18, 0.4 Credits
- ii. *The Napoli Federico II IEEE Student Branch*, Eng. S. Marrone, 17/07/18, 0.4 Credits
- iii. *Logic-based language and systems for big data applications*, Prof. C. Zaniolo, 13-15/03/18, 0.8 Credits
- iv. *Model-based API testing of Apache Zookeeper*, Prof. C. Artho, 19/03/18, 0.3 Credits
- v. *Large scale integrative bioinformatics and systems biology in cancer genomics*, Prof. M. Ceccarelli, 18/01/18, 0.3 Credits
- vi. *PhD School: 2nd international Summer School on Deep Learning*, Prof. S. Kung, P. Baldi, T. Adali, J. M. Buhmann, D. N. Metaxas, L. E. Li et al., 23-27/07/18, 3 Credits
- vii. *Parallel and distributed computing with MATLAB*, Eng. S. Marrone, 21/11/18, 0.4 Credits

c. Credit Summary:

Credits year 1							
	1	2	3	4	5	6	
Estimated	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	Summary
Modules	20	0	3	12	0	0	7,2
Seminars	5	0,3	1,1	0,4	3,2	0	5,4
Research	35	9,7	5,9	0	6,8	10	35
	60	10	10	12	10	10	62

3. Research activity

My research activity involves the study of cloud infrastructures for telemedicine applications, with particular emphasis on *telepathology*. The *cloud* paradigm has greatly contributed to reduce costs for telemedicine services, by allowing IT resources (computational, storage and network ones) to be provisioned rapidly and on-demand according to a pay-as-you-go model. The adoption of cloud is a key enabler for innovation in the healthcare field, allowing to build more advanced services in heterogenous infrastructures.

However, there are some scenarios where, for its own design, the cloud paradigm may not satisfy requirements of specific applications. Indeed, some applications require computation on massive amount of data, imposing a heavy burden on the core network, and have strict latency constraints. In particular, this is the case for telepathology, which requires digitizing tissue samples, and also remote control of medical equipment, such as a microscope.

Therefore, the *Fog* and *Dew* computing paradigms were introduced to address the aforementioned issues, by deploying IT resources not only in the core cloud datacenters, but also at the edge of the network, either in the telecom operator access network (as in the case of *Fog*) or even leveraging other users' devices (as in *Dew* computing).

My research is focused on the analysis of the constraints and the applicability of Cloud, Fog and Dew infrastructures in the field of telepathology. In particular, since the adoption of cloud services offers limited visibility into the obtainable performance, there are several problems for what concerns predictability and quality guarantees. The main steps of my research activity during the first year are outlined as follows:

- 1. Design and evaluation of a network-level monitoring methodology for telepathology in mobile scenarios.** To this aim, we have evaluated an important metric, the available bandwidth, in mobile broadband network scenarios, using active and passive, Software Defined Network-based techniques. This study has led to two conference papers published in international conferences. As outcome of these works, I have assessed that bandwidth in mobile scenarios can greatly differ according to country, network operator, and time of day.
- 2. Analysis of cloud performance monitoring techniques and schemes.** During this study, we have considered different Key Parameter Indicators (KPI), such as bandwidth, delay, jitter and packet loss, considering how these metrics are evaluated in existing literature.
- 3. Analysis of the performance of existing cloud providers.** In particular, focusing on latency, which is one of the key requirements for telepathology applications, I measured the latency experienced by users testing different public cloud providers from distributed points around the world (paper in preparation).

Finally, my activities require an active **collaboration** with industries and other universities. In particular, I am collaborating with **System Management S.p.A.** and with **Prof. Flavio Esposito** from **Saint Louis University** (USA).

References:

- [1] Bavier, A., Berman, M., Brinn, M., McGeer, R., Peterson, L., & Ricart, G. (2018). Realizing the Global Edge Cloud. *IEEE Communications Magazine*, 56(5), 170–176. <https://doi.org/10.1109/MCOM.2018.1700131>

[2] Shi, Y., Ding, G., Wang, H., Roman, H. E., & Lu, S. (2015). The fog computing service for healthcare. 2015 2nd International Symposium on Future Information and Communication Technologies for Ubiquitous HealthCare (Ubi-HealthTech), 1–5.

[3] Tomanek, O., Mulinka, P., & Kencl, L. (2016). Multidimensional cloud latency monitoring and evaluation. *Computer Networks*, 107(Part 1), 104–120.

[4] Hu, Z., Zhu, L., Ardi, C., Katz-Bassett, E., Madhyastha, H. V., Heidemann, J., & Yu, M. (2014). The need for end-to-end evaluation of cloud availability. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 8362 LNCS, 119–130.

[5] Verbelen, T., Simoens, P., Turck, F. De, & Dhoedt, B. (2012). Cloudlets: Bringing the cloud to the mobile user. *Mcs 2012*, 29–36.

[6] Aazam, M., & Huh, E. N. (2016). Fog Computing: The Cloud-IoT/loE Middleware Paradigm. *IEEE Potentials*, 35(3), 40–44.

[7] Soyata, T., Muraleedharan, R., Funai, C., Kwon, M., & Heinzelman, W. (2012). Cloud-Vision: Real-time face recognition using a mobile-cloudlet-cloud acceleration architecture. *Proceedings - IEEE Symposium on Computers and Communications*, 000059–000066.

4. Products

a. Publications

i. Conference Papers

1. G. Aceto, F. Palumbo, V. Persico and A. Pescapé, "Available Bandwidth vs. Achievable Throughput Measurements in 4G Mobile Networks", 14th International Conference on Network and Service Management (CNSM), Rome, November 5-9, 2018.
2. G. Aceto, F. Palumbo, V. Persico, A. Pescapé and H. Chen, "Evaluation of SDN-based bandwidth estimation in Mobile Broad Band networks", 2018 24th Asia-Pacific Conference on Communications (APCC), Ningbo, November 12-14, 2018.

ii. Papers in preparation:

1. "Measuring latency in public cloud networks" (tentative title)
2. "REMBRANDT: REproducible MoBile tRaffic Analysis aND moniToring" (tentative title)

5. Conferences and Seminars

I attended the 14th International Conference on Network and Service Management (CNSM), 2018, in Rome, from 5-9/11/18.

I presented the paper titled "Available Bandwidth vs Achievable Throughput Measurements in Mobile Broadband Networks" at CNSM 2018.

6. Activity abroad

I have not spent time abroad during the first PhD year.

7. Tutorship

Teaching assistant for the B. Sc. Course **Reti di Calcolatori I**