

# Stefano Avallone

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## Personal Information

Education *Master's Degree (2001) and PhD (2005) in Computer Engineering from University of Napoli "Federico II" - Italy*

Current Position *Associate professor at the University of Napoli "Federico II" - Italy*

Previous Experiences *Visiting researcher (2003-2004) at the Delft University of Technology (the Netherlands) in the NAS (Network Architectures and Services) group, led by Prof. Piet Van Mieghem. Visiting researcher (2005) in the BWN (Broadband Wireless Networking) laboratory of the Georgia Institute of Technology, Atlanta (USA). The BWN lab is headed by Prof. Ian Akyildiz.*

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## Publications

Stefano Avallone authored more than 70 scientific papers published on international journals, books and conferences. The full list of publications is available at <http://wpage.unina.it/stavallo/publications.html>.

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## Research activities

The research interests of Stefano Avallone fall in the area of computer networks and, in particular, wireless networks. A brief description of the research activities carried out by Stefano Avallone follows:

### Wireless Mesh Networks

In recent years, Stefano Avallone has developed a number of algorithms dealing with various problems in the field of multi-radio wireless mesh networks. In such a context, the main challenge is to assign the available frequency channels to the radios in such a way to minimize the interference and maximize the throughput. Such a problem is NP-complete, hence mainly heuristics have been proposed. A key role in such a context is also played by the routing algorithm. The proposed algorithms have been the subject of a number of publications on top international journals in the field of computer networking. An experimental study has also been conducted on the Orbit wireless testbed (hosted by the University of Rutgers) to evaluate the impact of switching channels on the achieved throughput and on the stability of the routing tables. In such experiments, OLSR has been selected as the routing protocol.

### Open source software development

Stefano Avallone is currently the maintainer of the traffic-control module of the ns-3 network simulator. He designed and implemented most of this module in the last couple of years. As of ns-3.26, the traffic-control module includes various Active Queue Management (AQM) algorithms such as RED, CoDel, FQ-CoDel and PIE, besides the default pfifo\_fast. Also included is Byte Queue Limit (BQL), a technique used by the Linux kernel to dynamically adapt the size of the transmission queues of the devices. Queued for inclusion in ns-3.27 is a rework of the Queue class to make it extremely

simple to add support for flow control and BQL to netdevices using a Queue to store their packets, the conversion of WifiMacQueue to a subclass of Queue and the addition of the mq multi-queue aware queueing discipline. This work will finally enable to experiment with AQMs and scheduling algorithms on Wifi netdevices in ns-3.

Stefano Avallone is also one of the maintainers of the Wifi code in the ns-3 network simulator (with regard to sleep/energy aspects). He implemented the support for the sleep state of Wifi netdevices and the necessary callbacks to put (resume) a radio in (from) the sleep state depending on the energy stored in the attached battery.

Stefano Avallone is author of WiMesh (<http://wpage.unina.it/stavallo/WiMesh/>), an open source software tool to evaluate and compare the performances of a number of algorithms proposed in the literature to assign channel, transmission rate and power to the radios of a wireless mesh network. In order to perform packet level simulations that enable to evaluate performance metrics such as throughput, delay and packet loss, WiMesh allows to automatically setup and run an ns-3 simulation starting from the network topology as returned by the selected channel assignment algorithm.

Finally, Stefano Avallone is one of the authors of D-ITG (<http://traffic.comics.unina.it/software/ITG/>), a widely used distributed Internet traffic generator (packages are available for, e.g., Debian and Arch Linux).

### **Experimental testbeds**

Stefano Avallone has conducted several activities related to the setup and management of experimental testbeds. For instance, he defined an MPLS splitting technique that allows to bind an incoming MPLS label to multiple outgoing labels (such a behavior is compliant with the standard definition of MPLS). For each incoming packet, a proper policy determines which outgoing label to use, i.e., which neighbor to send the packet to. The MPLS splitting technique allows multi-path routing and has a number of advantages over single-path routing (e.g., improved resilience with respect to node/link failures). The MPLS splitting technique has been implemented in the Linux kernel as an extension of a patch adding the support for MPLS (which, with some modifications, has been later applied upstream) and demonstrated in a testbed setup at University of Napoli.

Another experimental work consisted in the definition and development of an architecture for managing a network by using traffic engineering (TE) principles. Basically, a TE algorithm computes an explicit path for each flow request that satisfies the flow requirements in terms of bandwidth. If such a path is found, the nodes along the path are configured to guarantee the required bandwidth. Several tools and protocols have been employed to setup a testbed managed by such an architecture: MPLS (to allow the configuration of explicit paths), RSVP-TE (to signal the amount of bandwidth to reserve for a flow), the Linux traffic control system (to actually reserve bandwidth), D-ITG (to generate the traffic flows), etc.

Finally, in the context of the ONELAB2 european project, Stefano Avallone contributed to the integration of a wireless mesh testbed in PlanetLab and to the setup of an OMF-based framework for the reservation, configuration and execution of experiments and the collection of the experimental results.

### **TE and QoS routing algorithms for wired networks**

The focus of Stefano Avallone during his PhD was on Traffic Engineering and Quality of Service routing algorithms for wired networks. The former focus on the required bandwidth and aim to maximize the number of accepted flow requests. The latter consider a multi-constrained shortest path problem, which is NP-complete, and aim to find the best possible solution (according to different definitions of path length) for a given flow request. One of the main contribution of Stefano Avallone in this field is the definition of a routing algorithm pursuing both the objectives. Basically, the path length function takes into account not only the additive measures (delay, jitter, logarithm of packet loss) but also the available bandwidth. The goal is to both satisfy the QoS requirements of each single

flow and route each flow in such a way to maximize the number of accepted requests. More recently, Stefano Avallone is exploiting his expertise in Traffic Engineering and QoS routing in the context of segment routing and Software Defined Networks (SDNs).

## Teaching

Since 2005, Stefano Avallone teaches a number of classes at the University of Napoli on various topics, including Computer Networks, Wireless Networks, Computer programming, Computer Architectures and Algorithms and data structures.

He is also author of a textbook (in italian) on wireless networks ([http://www.catalogo.mcgraw-hill.it/catLibro.asp?item\\_id=2970](http://www.catalogo.mcgraw-hill.it/catLibro.asp?item_id=2970)).

## Research Projects

Stefano Avallone participated in the activities of several research projects funded both by the national ministry of education and by the european commission. A list of projects where he has been involved follows.

2016–2018 **Follow.Me.**

The project aims to design and develop a platform (smartwatch app, smartphone app and cloud backend) to localize elderly people and send notifications when they leave a predefined area. See <http://www.aal-europe.eu/projects/follow-me/>.

2008–2010 **INSPIRE**, *INcreasing Security and Protection through Infrastructure REsilience*.

The project aims to analyze and model the dependencies between critical infrastructures and the underlying communication networks and define a self-reconfigurable architecture for SCADA systems. See <http://www.inspire-strep.eu>.

2008–2010 **ONELAB2.**

The project aims to develop an experimental infrastructure which is open, generic and shared, large-scale and sustainable, that allows european enterprises and universities to innovate and assess the performance of their own solutions. ONELAB led to the creation of PlanetLab Europe and to the integration of wireless technologies such as WiMax, UMTS e Wi-Fi. See [www.onelab.eu](http://www.onelab.eu).

2008–2009 **INTERSECTION**, *INfrastructure for heTERogeneous, Resilient, SEcure, Complex, Tightly Inter-Operating Networks*.

The project aims to strengthen the knowledge of european enterprises and research centers in the field of security through the protection of heterogeneous infrastructures and networks. See <http://www.intersection-project.eu>.

2006–2009 **CONTENT.**

The project is a Network of Excellence aiming to create expertise in the area of content delivery networks, with particular regard to the transmission of real-time multimedia content. See [www.onelab.eu](http://www.onelab.eu).

2006–2008 **NETQOS**, *Policy based Management of Heterogeneous Networks for guaranteed QoS*.

The project aims to define an architecture for the policy-based management of heterogeneous wired/wireless networks. End-to-end quality of service and efficient utilization of the resources are primary objectives. The proposed approach consists in taking decisions based on predetermined constraints and objectives, automatic learning and identification of the operating context. See [www.ist-netqos.eu](http://www.ist-netqos.eu).

2004–2006 **E-NEXT**, *Emerging Network Technologies*.

The project aims to create a network of excellence to concentrate the competencies in the area of advanced networking owned by european researchers. See [www.ist-e-next.net/index.php](http://www.ist-e-next.net/index.php).

2002–2004 **CADENUS**, *Creation and Deployment of End-User Services in Premium IP Networks*.  
Project goals are the development, implementation, validation and demonstration of an architecture for the configuration of a network in order to deliver services to the users with guaranteed QoS. *See [www.cadenus.fokus.fraunhofer.de/](http://www.cadenus.fokus.fraunhofer.de/).*

## Professional Activities

Stefano Avallone is currently a member of:

- the Editorial Board of Elsevier Ad Hoc Networks (since January 2009)
- the Editorial Board of International Journal of Distributed Sensor Networks (since April 2014)
- the Technical Committee of Elsevier Computer Communications (since August 2014)

He served as chair for the following workshops/conferences:

- IEEE WiMob 2016 (Chair of the WNMN Symposium)
- IEEE HotMesh 2013 (General co-chair)
- IEEE MASS 2013 (Publicity co-chair)
- IEEE HotMesh 2012 (TPC chair)

He served as program committee member for a number of international conferences, including:

- IEEE ICC 2015 2013 (Ad-hoc and Sensor Networking Symposium)
- IEEE WCNC 2015 2014 2012 (Mobile and Wireless Networks Track)
- IEEE WoWMoM 2015 2014 2013 2012 2011
- IEEE GLOBECOM 2015 2013 2012 (Ad Hoc and Sensor Networking Symposium)
- IEEE IFIP Med-Hoc-Net 2015 2014
- IFIP NTMS 2015 2014 2012 2011 2009 (Mobility Track)
- IEEE WiMob 2014 2013 2012 2011 2010 2009 2008
- WiOpt 2014 2013 2012 2011 2010
- IFIP Wireless Days 2014 2013 2012 2011 2010
- ACM MobiHoc 2013
- IEEE MASS 2013 2012
- IEEE VTC2013-Fall (Ad-hoc, Mesh and Sensor Networks Track)
- IEEE VTC2013-Spring (Ad-hoc, Mesh, Machine-to-Machine and Sensor Networks Track)

Finally, he serves as reviewer for the top international journals in the field of computer networking (IEEE/ACM Transactions on Networking, IEEE Transactions on Mobile Computing, IEEE Transactions on Wireless Communications, IEEE Transactions on Vehicular Technology, IEEE Transactions on Parallel and Distributed Systems, IEEE Journal on Selected Areas of Communications, Ad Hoc Networks, Computer Networks, Computer Communications).