

# Georgios Smaragdakis

<http://www.smaragdakis.net>  
gsmaragd@csail.mit.edu

## Research Interests

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My research brings a measurement-driven approach to analyze and improve Internet resilience, security, and sustainability. I have designed, developed, and evaluated (i) measurement and data analytics techniques to assess the state and health of the Internet as it expands and under stress (attacks, failures), and (ii) scalable mechanisms to improve collaboration among different stakeholders of the Internet ecosystem to cope with the ever-increasing online content demand.

## Appointments

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### Technical University of Berlin, Germany

Professor, Head, Internet Measurement and Analysis (IMA) group February 2017 – present  
Senior Researcher, Internet Network Architectures (INET) group October 2008 – July 2014

### Massachusetts Institute of Technology, USA

Research Affiliate, Computer Science and Artificial Intelligence Laboratory August 2017 – present  
Research Affiliate, MIT Internet Policy Research Initiative October 2015 – present  
Marie Curie Fellow, Computer Science and Artificial Intelligence Laboratory August 2014 – August 2017

### Akamai Technologies, Cambridge, MA, USA

Research Collaborator, Custom Analytics group August 2014 – present

### Deutsche Telekom Laboratories, Berlin, Germany

Senior Researcher, Strategic Research group Oct. 2008 – July 2014

### Telefónica Research, Barcelona, Spain

Research Intern, Internet Systems and Networking group January-May 2008

## Education

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Ph.D. in Computer Science, **Boston University**, USA 2003-2008 (awarded Jan. 2009)

Dissertation Title: *“Overlay Network Creation and Maintenance with Selfish Users”*

Dissertation Committee: Azer Bestavros, Nikolaos Laoutaris, and John W. Byers.

Diploma in Computer Engineering, **Technical University of Crete**, Greece October 2002

Thesis Title: *“TCP Performance over the UMTS Network”*.

Advisor: Michael Paterakis

## Honors and Awards

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- Best paper award in IEEE INFOCOM 2017 for [19].
- Best paper award in ACM SIGCOMM Internet Measurement Conference (IMC) 2016 for [20].
- European Research Council (ERC) Starting Grant Award, 2015.
- Best paper award in ACM CoNEXT 2015 for [22].
- Marie Curie International Outgoing Fellowship, 2013.
- Best paper award in ACM SIGCOMM Internet Measurement Conference (IMC) 2011 for [34].
- Fast-track papers to journals: [19] (IEEE/ACM Transactions on Networking), [36] (IEEE Internet Computing) and [45] (Computer Networks journal).
- Boston University Graduate Fellow, 2003-2008.
- Honorable Mention Award from the Center for Information and Systems Engineering - Best Posters presented at the Boston University Science and Engineering Research Symposium, 2007.
- 2<sup>nd</sup> Place Award - Best Posters for Boston University/Computer Science Research Day, 2007.
- Honorable Mention Award from the Center for Information and Systems Engineering - Best Posters presented at the Boston University Science and Engineering Research Symposium, 2006.
- 2<sup>nd</sup> Place Award - Best Posters for Boston University/Computer Science Research Day, 2006.
- 1<sup>st</sup> ERICSSON Award of Excellence in Telecommunications, 2003.
- Summa cum laude, Class of 2002, Technical University of Crete, 2002.
- Annual Scholarship of the Technical Chamber of Greece, 1999-2000.
- Annual Scholarship of the Greek National Fellowship Foundation, 1998-2000.
- Academic Excellence Award, Greek Ministry of Labor and Social Affairs, 1998-2000.
- Annual Scholarship of the Paidia Foundation, 1999-2000.
- Honorary Diploma of the municipality of Piraeus for the Social, Environmental and Economic analysis of the City of Piraeus, 1996.
- 1<sup>st</sup> Awards of Excellent Studies from Greek Ministry of Education, 1990-1996.

## Research Summary

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**Internet Sustainability:** We explore data-driven models and architectures towards a more sustainable Internet in light of the ever-increasing traffic demand, cyber-attack activity, infrastructure deployment and maintenance cost, and competitiveness in the Internet ecosystem. We develop algorithms and techniques to detect and analyze critical Internet infrastructure outages towards understanding and mitigating evolving threats in an increasingly inter-dependent Internet ecosystem [17], as well as to infer attack mitigation by Internet stakeholders [18]. We also develop and evaluate algorithms for incremental and sustainable upgrades of ISP networks [19] and innovative use of in-network storage [3], as well as a multi-discipline analysis of the forces that shape Internet content delivery [2]. This is a collaboration with MIT, Akamai, RIPE, DE-CIX, Yale University, Trinity College Dublin, and University of Freiburg. (2017-present, see also: <http://www.smaragdakis.net/research/ResolutioNet>).

**Internet and Content Delivery Analytics:** We develop novel and scalable techniques to assess the state [20] and health of the Internet and to improve content delivery in a rapidly changing Internet [5, 25, 21]. We push the envelope in Internet measurement by relying on a voluminous amount of data collected from both public and private vantage points [26, 27, 28, 29, 5] and introduce new techniques to map peering interconnections to the level of a single building [22]. We also exploit the distributed platform of a large content delivery network, composed of thousands of servers around the globe, to assess the performance characteristics of the Internet’s core [23]. We investigate the cost-performance tradeoffs the different interconnection service offerings that are available to networks in today’s Internet in one and the same colocation facility would go a long way towards putting this debate on scientifically solid foundations [21, 24]. In the process, we designed a fully decentralized, open-source analytics system for network traffic data that relies on smart partitioning storage schemes to support fast join algorithms and efficient execution of filtering queries [4]. In collaboration with Akamai, we report on the IPv4 active address space evolution during the last eight years and we provide new insights on the activity patterns at different time granularities for individual IPs that have the potential to have significant implications on Internet governance, measurement practice, network management and security, and content delivery alike [20]. (2014–2017, see also: <http://www.smaragdakis.net/research/CDN-H>)

**ISP-CDN Collaboration:** We develop protocols and systems to enable the collaboration between ISPs and CDNs. We design and evaluate a service provided by an ISP, called *PaDIS*, to improve end-users experience based on the network information and end-user location available to an ISP, as well as server and path diversity information gathered by an ISP [36, 12]. We also introduce *Content-aware Traffic Engineering* (CaTE) which dynamically adapts server selection for CDNized content by utilizing server and path diversity and without changing routing [10, 33]. Moreover, we show how to enable CDN and ISP collaboration, with our *NetPaaS* prototype, in light of recent CDN-ISP alliances and advances in network function virtualization. Our results show that CDN-ISP Collaboration leads to a win-win situation for both parties and improves end-user experience [25, 9, 1, 32] and has the potential to reduce energy consumption [38]. This project is a collaboration with Akamai. **A spin-off of Deutsche Telekom was founded to commercialize the results the project and the awarded patents.** (2009–2016, see also: <http://www.smaragdakis.net/research/Collaboration>)

**Content Cartography and DNS:** We propose a lightweight and fully automated approach to discover hosting infrastructures based only on DNS measurements and BGP routing table snapshots [34]. Our classification enables us to derive content-centric AS rankings that complement existing AS rankings and sheds light on recent observations about shifts in interdomain traffic and the AS topology. We also show that recent DNS extensions unveil operational practices of their adopters and we develop an automated system to perform network and caching analytics based on collected measurements [31]. In a parallel effort we undertake a large scale study to assess DNS performance in the wild and we highlight the implications of DNS deployment to end-users, ISPs and applications [37]. We also show that a significant part of Internet traffic is back-office traffic to support the ever-increasing complexity of Web applications [28] and that traceroutes can be a proxy for network traffic estimation [29]. (2009–2016, see also: <http://www.smaragdakis.net/research/Cartography>)

**IXP Data Analysis:** Large Internet Exchange Points (IXPs) are responsible for exchanging tens of Petabytes of data daily but unfortunately have received very little attention from the research community. We have established a pioneer research project to assess the importance of IXPs for today’s Internet ecosystem [8, 5]. Our measurement results show that large IXPs are unique vantage points to get an excellent visibility of the global Internet, observe trends in content delivery [30] and application mix [26]. We also shed light on the usage and operation of route servers at IXPs [27]. This project is collaboration with DE-CIX. (2012–2016, see also: <http://www.smaragdakis.net/research/IXP>)

**Bulk Transfers on the Internet:** We design and evaluate scheduling algorithms, some assisted by network-attached storage, to transfer delay tolerant bulk data over the Internet with the most cost effective way [7, 39]. Moreover, we investigate the effect of in-node storage on end-to-end delay [35]. In an earlier study we evaluated the robustness of memory-reduced routers in the presence of aggressive high speed transport protocols for bulk data transfers [47]. (2003-2005, 2008-present, see also: <http://hermes.tid.es>)

**Selfish Neighbor Selection:** We re-examine the problem of overlay network creation, taking into consideration the existence of selfish overlay nodes. We develop a general game-theoretic framework that provides a unified approach to modeling neighbor selection procedures on behalf of selfish nodes [11, 42]. To capitalize on the substantial performance improvement of best response wirings for overlay nodes, we design, deploy and evaluate, EGOIST, a selfish neighbor selection inspired prototype [40]. We also show the benefits selfish neighbor selection may offers to applications, e.g. swarming applications [13, 41]. (2006-2013, see also: <http://www.smaragdakis.net/research/SNS>).

**Distributed Facility Location:** We design and evaluate distributed algorithms for scalable and efficient service deployment and migration offered by network, application and cloud providers [6, 43]. (2006-2013, see also: <http://www.smaragdakis.net/research/DFL>).

**Distributed Selfish Caching:** We studied resource allocation and sharing issues where the exposed resource is the storage of each (selfish) node, and the nodes cooperate using on-line caching algorithms. We identified the causes and implications of mistreatment in distributed caching groups [15, 44], and we designed a novel framework to mitigating mistreatment in such groups [16, 45]. (2005-2007, see also: <http://www.smaragdakis.net/research/DSC>).

**A Stable Election Protocol for clustered heterogeneous wireless sensor networks:** We designed and evaluated distributed leader election protocols to prolong the lifetime of heterogeneous wireless networks [48]. (2003-2004, see also: <http://www.smaragdakis.net/research/SEP>)

**A Large Deviations approach to Statistical Traffic Anomaly Detection:** We developed a Large Deviations framework to rigorously identify, in real-time, Network Anomalies by assessing deviations of empirical measures in computer networks [14, 46]. (2004-2008)

## List of Publications

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**Bibliometrics: 2,930 citations, h-index: 22, i10-index: 38**

### Book Chapters

- [1] Benjamin Frank, Ingmar Poese, Georgios Smaragdakis, Anja Feldmann, Steve Uhlig, Bruce Maggs, and Fabian Schneider. Collaboration Opportunities for Content Providers and Network Infrastructures. *ACM SIGCOMM ebook on Recent Advances in Networking*, 1(1):305–377, August 2013.

## Journal Papers

- [2] Volker Stocker, Georgios Smaragdakis, William Lehr, and Steven Bauer. The Growing Complexity of Content Delivery Networks: Challenges and Implications for the Internet Ecosystem. *Telecommunications Policy Journal*, 41(10):1003–1016, November 2017.
- [3] George Iosifidis, Iordanis Koutsopoulos, and Georgios Smaragdakis. Distributed Storage Control Algorithms for Dynamic Networks. *IEEE/ACM Transactions on Networking*, 25(3):1359–1372, June 2017.
- [4] Dimitrios Sarlis, Nikolaos Papailiou, Ioannis Konstantinou, Georgios Smaragdakis, and Nectarios Koziris. Datix: A System for Scalable Network Analytics. *ACM SIGCOMM Computer Communication Review*, 45(5), October 2015.
- [5] Nikolaos Chatzis, Georgios Smaragdakis, Anja Feldmann, and Walter Willinger. Quo vadis Open-IX? Trying to boost public peering in the US. *ACM SIGCOMM Computer Communication Review*, 45(1), January 2015.
- [6] Georgios Smaragdakis, Nikolaos Laoutaris, Konstantinos Oikonomou, Ioannis Stavrakakis, and Azer Bestavros. Distributed Server Migration for Scalable Internet Service Deployment. *IEEE/ACM Transactions on Networking*, 22(3):917–930, June 2014.
- [7] Nikolaos Laoutaris, Georgios Smaragdakis, Rade Stanojevic, Pablo Rodriguez, and Ravi Sundaram. Delay Tolerant Bulk Data Transfers on the Internet. *IEEE/ACM Transactions on Networking*, 21(6):1852–1865, December 2013.
- [8] Nikolaos Chatzis, Georgios Smaragdakis, Anja Feldmann, and Walter Willinger. There is More to IXPs than Meets the Eye. *ACM SIGCOMM Computer Communication Review*, 43(5):18–28, October 2013.
- [9] Benjamin Frank, Ingmar Poese, Yin Lin, Georgios Smaragdakis, Anja Feldmann, Bruce Maggs, Jannis Rake, Steve Uhlig, and Rick Weber. Pushing CDN-ISP Collaboration to the Limit. *ACM SIGCOMM Computer Communication Review*, 43(3):34–44, July 2013.
- [10] Ingmar Poese, Benjamin Frank, Georgios Smaragdakis, Steve Uhlig, Anja Feldmann, and Bruce Maggs. Enabling Content-aware Traffic Engineering. *ACM SIGCOMM Computer Communication Review*, 42(5):21–28, October 2012.
- [11] Georgios Smaragdakis, Nikolaos Laoutaris, Vassilis Lekakis, Azer Bestavros, John W. Byers, and Mema Roussopoulos. Selfish Overlay Network Creation and Maintenance. *IEEE/ACM Transactions on Networking*, 19(6):1624–1637, December 2011.
- [12] Ingmar Poese, Benjamin Frank, Bernhard Ager, Georgios Smaragdakis, Steve Uhlig, and Anja Feldmann. Improving Content Delivery with PaDIS. *IEEE Internet Computing*, 16(3):46–52, May-June 2012. **[Invited from ACM IMC 2010]**.
- [13] Georgios Smaragdakis, Nikolaos Laoutaris, Pietro Michiardi, Azer Bestavros, John W. Byers, and Mema Roussopoulos. Distributed Network Formation for n-way Broadcast Applications. *IEEE Transactions on Parallel and Distributed Systems*, 21(10):1427–1441, October 2010.
- [14] Ioannis Ch. Paschalidis and Georgios Smaragdakis. Spatio-Temporal Network Anomaly Detection by Assessing Deviations of Empirical Measures. *IEEE/ACM Transactions on Networking*, 17(3):685–697, June 2009.
- [15] Nikolaos Laoutaris, Georgios Smaragdakis, Azer Bestavros, Ibrahim Matta, and Ioannis Stavrakakis. Distributed Selfish Caching. *IEEE Transactions on Parallel and Distributed Systems*, 18(10):1361–1376, October 2007.

- [16] Georgios Smaragdakis, Nikolaos Laoutaris, Azer Bestavros, Ibrahim Matta, and Ioannis Stavrakakis. Mistreatment-Resilient Distributed Caching. *Computer Networks*, 51(11):2917–2937, August 2007. [**Invited from Networking 2006**].

## Conference Papers

- [17] Vasileios Giotsas, Christoph Dietzel, Georgios Smaragdakis, Anja Feldmann, Arthur Berger, and Emile Aben. Detecting Peering Infrastructure Outages in the Wild. In *Proceedings of ACM SIGCOMM 2017*, Los Angeles, CA, August 2017.
- [18] Vasileios Giotsas, Georgios Smaragdakis, Christoph Dietzel, Philipp Richter, Anja Feldmann, Arthur Berger, and Emile Aben. Inferring BGP Blackholing Activity in the Internet. In *Proceedings of ACM IMC 2017*, London, UK, November 2017.
- [19] Konstantinos Poularakis, George Iosifidis, Georgios Smaragdakis, and Leandros Tassiulas. One Step at a Time: Optimizing SDN Upgrades in ISP Networks. In *Proceedings of IEEE INFOCOM 2017*, Atlanta, GA, May 2017. 🏆 [**Best paper award, Fast-track to IEEE/ACM Transactions on Networking**].
- [20] Philipp Richter, Georgios Smaragdakis, David Plonka, and Arthur Berger. Beyond Counting: New Perspectives on the Active IPv4 Address Space. In *Proceedings of ACM IMC 2016*, Santa Monica, CA, November 2016. 🏆 [**Best paper award**].
- [21] Volker Stocker, Georgios Smaragdakis, William Lehr, and Steven Bauer. Content may be King, but (Peering) Location matters: A Progress Report on the Evolution of Content Delivery in the Internet. In *Proceedings of ITS 2016*, Cambridge, UK, September 2016.
- [22] Vasileios Giotsas, Georgios Smaragdakis, Bradley Huffaker, Matthew Luckie, and kc claffy. Mapping Peering Interconnections at the Facility Level. In *Proceedings of ACM CoNEXT 2015*, Heidelberg, Germany, December 2015. 🏆 [**Best paper award**].
- [23] Balakrishnan Chandrasekaran, Georgios Smaragdakis, Arthur Berger, Matthew Luckie, and Keung-Chi Ng. A Server-to-Server View of the Internet. In *Proceedings of ACM CoNEXT 2015*, Heidelberg, Germany, December 2015.
- [24] Walter Willinger, Anja Feldmann, Philipp Richter, Georgios Smaragdakis, and Fabian Bustamante. Express or Local Lanes: On Assessing QoE over Private vs. Public Peering Links. In *NSF/FCC Workshop on Tracking Quality of Experience in the Internet*, Princeton, NJ, October 2015. [**Invited paper**].
- [25] Radu Stoenescu, Matei Popovici, Vladimir Olteanu, Joao Martins, Roberto Bifulco, Felipe Huici, Mohamed Ahmed, Georgios Smaragdakis, Mark Handley, and Costin Raiciu. In-NET: Enabling In-Network Processing for the Masses. In *Proceedings of ACM EuroSys 2015*, Bordeaux, France, April 2015.
- [26] Philipp Richter, Nikolaos Chatzis, Georgios Smaragdakis, Anja Feldmann, and Walter Willinger. Distilling the Internet’s Application Mix from Packet-Sampled Traffic. In *Proceedings of PAM 2015*, New York, NY, March 2015.
- [27] Philipp Richter, Georgios Smaragdakis, Anja Feldmann, Nikolaos Chatzis, Jan Boettger, and Walter Willinger. Peering at Peerings: On the Role of IXP Route Servers. In *Proceedings of ACM IMC 2014*, Vancouver, Canada, November 2014.
- [28] Enric Pujol, Philipp Richter, Balakrishnan Chandrasekaran, Georgios Smaragdakis, Anja Feldmann, Bruce Maggs, and K. C. Ng. Back-Office Web Traffic on The Internet. In *Proceedings of ACM IMC 2014*, Vancouver, Canada, November 2014.

- [29] Mario Sanchez, Fabian Bustamante, Balachander Krishnamurthy, Walter Willinger, Georgios Smaragdakis, and Jeffrey Erman. Inter-Domain Traffic Estimation for the Outsider. In *Proceedings of ACM IMC 2014*, Vancouver, Canada, November 2014.
- [30] Nikolaos Chatzis, Georgios Smaragdakis, Jan Boettger, Thomas Krenc, and Anja Feldmann. On the Benefits of Using a Large IXP as an Internet Vantage Point. In *Proceedings of ACM IMC 2013*, Barcelona, Spain, October 2013.
- [31] Florian Streibelt, Jan Boettger, Nikolaos Chatzis, Georgios Smaragdakis, and Anja Feldmann. Exploring EDNS-Client-Subnet Adopters in your Free Time. In *Proceedings of ACM IMC 2013*, Barcelona, Spain, October 2013.
- [32] Ingmar Poesse, Benjamin Frank, Simon Knight, Niklas Semmler, and Georgios Smaragdakis. PaDIS Emulator: An Emulator to Evaluate CDN-ISP Collaboration. In *Proceedings of ACM SIGCOMM 2012, Demo Session*, Helsinki, Finland, August 2012.
- [33] Benjamin Frank, Ingmar Poesse, Georgios Smaragdakis, Steve Uhlig, and Anja Feldmann. Content-aware Traffic Engineering. In *Proceedings of ACM SIGMETRICS 2012, Extended Abstract*, London, UK, June 2012.
- [34] Bernhard Ager, Wolfgang Mühlbauer, Georgios Smaragdakis, and Steve Uhlig. Web Content Cartography. In *Proceedings of ACM IMC 2011*, Berlin, Germany, November 2011. 🏆 [Best paper award].
- [35] George Iosifidis, Iordanis Koutsopoulos, and Georgios Smaragdakis. The Impact of Storage Capacity on End-to-End Delay in Time Varying Networks. In *Proceedings of IEEE INFOCOM 2011*, Shanghai, China, April 2011.
- [36] Ingmar Poesse, Benjamin Frank, Bernhard Ager, Georgios Smaragdakis, and Anja Feldmann. Improving Content Delivery using Provider-aided Distance Information. In *Proceedings of ACM IMC 2010*, Melbourne, Australia, November 2010. [Fast-track to IEEE Internet Computing].
- [37] Bernhard Ager, Wolfgang Mühlbauer, Georgios Smaragdakis, and Steve Uhlig. Comparing DNS Resolvers in the Wild. In *Proceedings of ACM IMC 2010*, Melbourne, Australia, November 2010.
- [38] Anja Feldmann, Andreas Gladisch, Mario Kind, Christoph Lange, Georgios Smaragdakis, and Fritz-Joachim Westphal. Energy Trade-offs among Content Delivery Architectures. In *Proceedings of CTTE 2010*, Ghent, Belgium, June 2010.
- [39] Nikolaos Laoutaris, Georgios Smaragdakis, Pablo Rodriguez, and Ravi Sundaram. Delay-Tolerant Bulk Data Transfer on the Internet. In *Proceedings of ACM SIGMETRICS 2009*, Seattle, WA, June 2009.
- [40] Georgios Smaragdakis, Vassilis Lekakis, Nikolaos Laoutaris, Azer Bestavros, John W. Byers, and Mema Roussopoulos. EGOIST: Overlay Routing using Selfish Neighbor Selection. In *Proceedings of ACM CoNEXT 2008*, Madrid, Spain, December 2008.
- [41] Georgios Smaragdakis, Nikolaos Laoutaris, Pietro Michiardi, Azer Bestavros, John W. Byers, and Mema Roussopoulos. Swarming on Optimized Graphs for n-way Broadcast. In *Proceedings of IEEE INFOCOM 2008*, Phoenix, AZ, April 2008.
- [42] Nikolaos Laoutaris, Georgios Smaragdakis, Azer Bestavros, and John W. Byers. Implications of Selfish Neighbor Selection in Overlay Networks. In *Proceedings of IEEE INFOCOM 2007*, Anchorage, AK, May 2007.
- [43] Nikolaos Laoutaris, Georgios Smaragdakis, Konstantinos Oikonomou, Ioannis Stavrakakis, and Azer Bestavros. Distributed Placement of Service Facilities in Large-Scale Networks. In *Proceedings of IEEE INFOCOM 2007*, Anchorage, AK, May 2007.

- [44] Nikolaos Laoutaris, Georgios Smaragdakis, Azer Bestavros, and Ioannis Stavrakakis. Mistreatment in Distributed Caching Groups: Causes and Implications. In *Proceedings of IEEE INFOCOM 2006*, Barcelona, Spain, April 2006.
- [45] Georgios Smaragdakis, Nikolaos Laoutaris, Ibrahim Matta, Azer Bestavros, and Ioannis Stavrakakis. A Feedback Control Approach to Mitigating Mistreatment in Distributed Caching Groups. In *Proceedings of IFIP Networking 2006*, Coimbra, Portugal, May 2006. [**Fast-track to Computer Networks journal**].
- [46] Ioannis Ch. Paschalidis and Georgios Smaragdakis. A Large Deviations Approach to Statistical Traffic Anomaly Detection. In *Proceedings of IEEE CDC 2006*, San Diego, CA, December 2006.
- [47] Dhiman Barman, Georgios Smaragdakis, and Ibrahim Matta. The Effect of Router Buffer Size on HighSpeed TCP Performance. In *Proceedings of IEEE Globecom 2004 - Global Internet and Next Generation Networks*, Dallas, TX, December 2004.
- [48] Georgios Smaragdakis, Ibrahim Matta, and Azer Bestavros. SEP: A Stable Election Protocol for clustered heterogeneous wireless sensor networks. In *Proceedings of Second International Workshop on Sensor and Actor Network Protocols and Applications (SANPA 2004)*, Boston, MA, August 2004.

## Dissertation and Thesis

- [49] Georgios Smaragdakis. Overlay Network Creation and Maintenance with Selfish Users. *Computer Science Department, Boston University*, September 2008.
- [50] Georgios Smaragdakis. TCP Performance over UMTS Network. *Diploma Thesis, Electronic and Computer Engineering Department, Technical University of Crete*, October 2002.

## List of Patents

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Seven patents awarded; six transferred to Deutsche Telekom AG and one to Telefónica SA (chronological order):

1. “A Method for Transferring TByte Sized Delay Tolerant Bulk Data Using Unutilized but Already Paid for Capacity of Commercial Internet Service Providers”, N. Laoutaris, P. P. Rodriguez, G. Smaragdakis, and R. Sundaram, (EP2315414, UY32962, AR078739).
2. \*“Method and System for Controlling Data Communication within a Network”, I. Poese, B. Frank, G. Smaragdakis, and A. Feldmann, (EP2385656, WO2011138033, CN102934396, US2013159509).
3. \*“System and Method of Processing DNS Request and DNS Reply”, I. Poese, B. Frank, G. Smaragdakis, and A. Feldmann, (EP2426894)
4. \*“Collaboration Between an Internet Service Provider (ISP) and a Content Distribution System as well as Among Plural ISP”, I. Poese, B. Frank, G. Smaragdakis, A. Feldmann, and S. Uhlig, (EP2495940, US2012226734)
5. \*“Network Traffic Engineering”, B. Frank, G. Smaragdakis, I. Poese, A. Feldmann, and S. Uhlig, (EP2512105, US2012314575)
6. “System for assigning an energy consumer to an energy provider”, S. Schmid, A. Fedmann, and G. Smaragdakis, (EP2775446)



7. “System for Assigning a Goods Consumer to a Goods Provider”, S. Schmid, A. Fedmann, and G. Smaragdakis, (EP2787471, WO2014161895, US2016034849)

\* **Patents 2, 3, 4, and 5 used for the foundation of a Deutsche Telekom spin-off (BENOCs)**, for which I had an executive role from the initial idea to incubation to launching.

## Research Funding

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**Budget: €5,590,000 total, €2,762,000 as PI**

– *H2020-ERC-2015-StG-679158 (European Research Council Starting Grant Award)* “ResolutioNet. Resolving the Tussle in the Internet: Mapping, Architecture, and Policy Making”. Role: Principal Investigator. Budget: €1,500,000. Duration: 2017-2022 (60 months).

– *FP7-PEOPLE-2013-IOF-628441 (EU Marie Curie International Outgoing Fellowship for Career Development)*: “CDN-H: Improving Performance and Cost of Content Delivery in a Hyperconnected World”. Role: Principal Investigator. Budget: €349,000. Duration: 2014-2017 (36 months). Hosts: David Clark (MIT) and Anja Feldmann (TUB).

– *FP7-ICT-2011-8-317858 (EU STREP Project)*: “BigFoot: Big Data Analytics of Digital Footprints”. Budget: €3,540,000 (TUB Budget: €717,000). Duration: 2012-2015 (36 months). Co-PIs: Pietro Michiardi and Marko Vukolic (Eurecom), Anastasia Ailamaki (EPFL), Anja Feldmann (TUB), Olivier Thonnard (Symantec), Filip Gluszak (GridPocket).

– *IKYDA (Germany-Greece Scholar Exchange Program Sponsored by DAAD and IKY)*: “Optimal Management of Storage in Communication Networks and Cloud Systems”. Budget: €10,000. Duration: 2012-2013 (24 months). Co-PI: I. Koutsopoulos (U. Thessaly).

– *Telekom Innovation Laboratories*: “Content Distribution Networks: Strategic Research Activities”, support for PhD and MSc students, and research hardware. €150,000. Duration: 2010-2014.

– *Deutsche Telekom Laboratories Strategic Research Project*: “Overclouds: Building Overlays on top of Clouds”. Budget: €40,000. Duration: 2009-2010 (24 months).

– I participated in the NSF Project (1413905): “NeTS: Large: Collaborative Research: Mapping Interconnection in the Internet: Colocation, Connectivity and Congestion” PIs: David Clark (MIT), kc Claffy (CAIDA/UCSD). Duration: 2014-2017 (36 months).

– I participated in the EU Project CHANGE (FP7-ICT-257422). PIs: Mark Handley (UCL, UK), Olivier Bonaventure (UCL, Belgium), Laurent Mathy (Lancaster University), Anja Feldmann (TU Berlin), Costin Raiciu (Politechnica University, Bucharest), Luigi Rizzo (University of Pisa), Peter Feil (Deutsche Telekom), Felipe Huici (NEC), Adam Kapovits (Eurescom). Duration: 2009-2013 (40 months).

## Professional Service

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### Technical Program Chair of:

PAM 2018

### Technical Program Committee Member of:

ACM IMC (2018, 2016, 2015, 2014, 2011),  
ACM CoNEXT 2018,  
ACM HotNets 2018,  
IEEE INFOCOM 2019,  
ACM SIGCOMM 2013,  
PAM (2017, 2016),  
IEEE ICNP (2017, 2015),  
TMA (2018, 2017, 2016, 2015, 2012),  
ITC (2018, 2017),  
SWFAN 2016,  
ACM SIGCOMM 2016 posters and demos session,  
ACM CoNEXT Student Workshop (2014, 2011, 2009),  
EWSDN (2015, 2014, 2013),  
IEEE P2P 2012,  
IEEE IPDPS 2012 PhD forum,  
DCPerf 2012,  
ACM SIGMETRICS 2010 (Shadow),  
IEEE Globecom 2009,  
ACM Simplex (2010, 2009),  
SSS 2009,  
ACM CoNEXT 2008 (Shadow).

### Organizer of:

ACM SIGMETRICS 2018 (Publication Chair),  
ACM CoNEXT 2016 (Publication Chair),  
ACM SIGCOMM 2015 (Publication Chair),  
ACM SIGCOMM 2011 (Registration Chair),  
ACM IMC 2011 (Local Arrangements co-Chair),  
IEEE AOC 2010 (Publicity Chair),  
IEEE HotWeb 2006 (Publication Chair),  
IEEE ICNP 2005 (Web Administrator),  
PAM 2005 (Local Arrangements Chair),  
IEEE ASWN 2004 (Publication Chair).

### Reviewer of:

IEEE/ACM Transactions on Networking,  
ACM SIGCOMM Computer Communication Review,  
ACM Computing Surveys,  
IEEE Transactions on Services Computing,  
IEEE Transactions on Parallel and Distributed Systems,  
IEEE Transactions Network and Service Management,

IEEE Transactions on Wireless Communications,  
IEEE Internet Computing,  
IEEE Communications Magazine,  
Elsevier Journal of Computer Networks,  
Elsevier Information Processing Letters,  
Elsevier Journal of Computer Communications,  
Elsevier Ad Hoc Networks,  
Telecommunication Systems Journal,  
International Journal of Sensor Networks,  
Journal of Communications and Networks,  
ACM IMC (2013, 2010, 2009),  
ACM CoNEXT 2009,  
ACM SIGMETRICS (2012, 2008, 2007),  
ACM PODC 2008,  
ACM Multimedia 2004,  
IEEE INFOCOM (2013, 2011, 2010, 2009, 2007, 2006, 2005),  
IEEE ICNP (2005, 2004),  
IEEE WCNC 2013,  
IEEE e-Energy 2011,  
IEEE IPDPS 2010,  
IEEE Global Internet Symposium 2007,  
IEEE ICDCS (2003),  
IEEE ICC (2005, 2004),  
IEEE RTSS 2004,  
IEEE PIMRC 2005,  
Euro-Par 2012.

**Editor of:**

Springer Journal of Internet Services and Applications, 2012–present.

**Proposal Reviewer for:**

- French National Research Agency - ANR (2018, 2015)
- Greek National Fellowship Program ARISTEIA II (2014)

Contributing Expert of the EU Roadmap for Advanced Cloud Technologies under Horizon 2020.

**Invited Talks and Keynotes**

“Deep Dive into BGP Communities”, SIGCOMM 2018 ERC Networking Symposium (August 24, 2018).

“The Measurement Lens: How to Improve and Protect the Internet”, Summer School ECE TUC Chania (July, 2018), Network Traffic Measurement and Analysis Conference (TMA) 2018 Experts Summit (June, 2018).

“Inferring BGP Blackholing Activity in the Internet”, Measurement and Analysis for Protocols Research Group (maprg) at IETF-101 (March 20, 2018).

“Understanding and Improving the Resilience of the Internet using the Measurement Lens”, Max Planck Institute for Informatics, (December 18, 2017).

“Detecting Peering Infrastructure Outages in the Wild”, Yale University, (October 5, 2017); Trinity College Dublin, (October 3, 2017).

“The Evolving Internet Market and the Role of Coordination”, 50th Freiburger Verkehrsseminar: The Future of the Internet - Innovation, Integration and Sustainability, University of Freiburg (7/2017).

“Mapping Peering Interconnections to a Facility”, The 6th Workshop on Internet Economics (WIE 2015), University of California San Diego/CAIDA (12/2015)

“Identifying and measuring points of congestion”, MIT Communications Futures Program (10/2015).

“Internet Exchange Points and the Internet”, Yale University (3/2015), Massachusetts Institute of Technology (10/2014); Akamai Technologies (10/2014).

“Improving Performance and Cost of Content Delivery in a Hyperconnected World”, The 5th Workshop on Internet Economics (WIE 2014), University of California San Diego/CAIDA (12/2014).

“Enabling CDN-ISP Collaboration”, Massachusetts Institute of Technology (09/2014); Plenary Talk at RIPE 67 (10/2013); University of Athens (06/2013); OTE Labs (06/2013).

“How to Explore a Few Thousand Middleboxes in Your Free Time” (09/2013), NEC Labs Europe.

“Pushing CDN-ISP Collaboration to the Limit”, University of Wisconsin at Madison (04/2013).

“On-demand Service Deployment in Microdatacenters”, Université catholique de Louvain (10/2012); LabsOpen workshop on Telekom Cloud, Berlin (05/2012); Technische Universität Berlin (04/2012).

“Big Data and Networks: Mind the Gap”, Institut Eurécom (10/2012).

“NetPaaS: Network Platform as a Service”, Telekom Innovation Laboratories, Berlin (08/2012).

“Web Content Cartography”, King’s College – University of London (06/2012); University College London (03/2012).

“Content-aware Traffic Engineering”, Athens University of Economics and Business (05/2013); University College London (06/2012); Universitatea Politehnica Bucuresti (05/2012); Boston University (07/2011); LabsOpen workshop on Network Architecture and Optimization, Berlin (08/2010).

“ISP-Applications Collaboration”, CloudS workshop, Sydney (11/2010).

“ORACLE: An ISP-P2P Collaboration System”, University of Athens (03/2009).

“Selfish Overlay Network Formation: Resource Allocation Strategies and Implications to Protocol Design”, Technische Universität München (12/2009), Centre Tecnològic de Telecomunicacions de Catalunya (04/2008); Deutsche Telekom Laboratories Berlin (03/2008); Telefónica Research Barcelona (03/2008); Boston University (12/2007).

“Resource Allocation Strategies for Scalable Content Delivery on the Internet”, Boston University (10/2007).

“The Selfish Neighbor Selection Problem In Overlay Networks”, University of Athens (07/2007).

“A Large Deviations Approach to statistical Traffic Anomaly Detection”, Boston University (02/2006).

## **Student Mentoring**

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I have been fortunate to work closely with a number of highly motivated and technically strong students at TU Berlin. The primary advisor is Prof. Anja Feldmann.

### **Doctoral level:**

Philipp Richter (TU Berlin, PhD 2017, “Empirical Analysis of the Effects and the Mitigation of IPv4 Address

Exhaustion”, → Postdoctoral Associate, MIT CSAIL),

Enric Pujol (TU Berlin, PhD 2016, “Web content delivery, monetization, and search: back-office and advertisement traffic on the Internet”, → Data Scientist, BENOCS),

Benjamin Frank (TU Berlin, PhD 2013, “Dynamic Deployment of Content Delivery Infrastructures using Network Cloud Resources” → SAP),

Ingmar Poesé (TU Berlin, PhD 2013, “Towards Informed and Collaborative Content Delivery”, → CTO, BENOCS),

George Iosifidis (University of Thessaly; primary advisor: Prof. Iordanis Koutsopoulos, PhD 2012, “Spectrum and Storage Capacity Management Using Network Economics and Optimization Methods” → Researcher, CERTH-Greece → Researcher, Yale University → Assistant Professor, Trinity College - University of Dublin),

Bernhard Ager (TU Berlin, PhD 2011, “Impact of Locality in Content Distribution” → Researcher, ETH Zürich).

#### **Master level:**

Jinji Shen (TU Berlin, MSc 2014, “Measuring the Indirect Prefix Delegations using Public Routing Information”),

Boxuan Li (TU Berlin, MSc 2014, “Measurement and Analysis of SoShare Hybrid Server-P2P System”),

Florian Streibelt (TU Berlin, MSc 2013, “Evaluating EDNS-client-subnet Extension in the Wild”),

Pinar Acar (TU Berlin, MSc 2013, “Comparing IPv4 and IPv6 Performance in the Wild”),

Alexander Kordecki (TU Berlin, MSc 2013, “Network Traffic Measurement of Data-intensive Computing Architectures”),

Jun Jiang (TU Berlin, MSc 2013, “Improving Video Streaming Applications with ISP-assisted Server Selection”),

Thomas Krenc (TU Berlin, MSc 2012, “Measurement and Characterization of Content Distribution in BitTorrent”),

Benjamin Frank (TU München, MSc 2009, “Developing Efficient Ranking Algorithms for the Oracle Service”),

Ingmar Poesé (TU Berlin, Diplom 2009, “The Oracle Server: Implementation and Performance Evaluation”),

Vassilis Lekakis (FORTH-ICS/University of Crete, MSc 2009, “The EGOIST Overlay Routing System”).

#### **Semester MSc project level:**

Thomas Krenc (TU Berlin 2012, Project name: “Measurement and Characterization of Video Streaming Architectures”).

Thomas Krenc, Tobias Jacobowitz, Sebastian Garn (TU Berlin 2011, Project name: “Season: A Dynamic Load Balancer for Virtual Environment”).

#### **Bachelor level:**

Thomas Krenc (TU Berlin, BSc 2010, “Demographic Measurement of Popular BitTorrent Swarms”).

## Teaching Experience

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### Instructor for:

*Internet Measurements* (TUB; Spring 2018, Spring 2014, Spring 2013),  
*Network Algorithms* (TUB; Fall 2017).

### Teaching Fellow for:

*Fundamentals of Computing Systems* (BU CS 350; Spring 2007),  
*Introduction to Data Structures* (BU CS 112; Spring 2005),  
*Quantitative Methods for Information Systems* (BU MET CS 546; Summer 2005),  
*Introduction to Computers* (BU CS 101; Spring 2006, Fall 2005, Spring 2004).

## Research Experience

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- *Research and Teaching Fellow* September 2003 – September 2008  
Boston University, Computer Science Department, Web and Internetworking Group.
- *Affiliated Researcher* July - August 2006  
University of Athens, Department of Informatics and Telecommunications.
- *Affiliated Researcher* April - August 2003  
Greek National Center for Scientific Research, Institute of Informatics and Telecommunications.
- *Undergraduate Affiliated Student* September 2001 - August 2002  
Technical University of Crete, Electronic and Computer Engineering Department, Information and Computer Networks Laboratory.

## Professional Experience

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- *Telecommunications Engineer internship* August - September 2002  
Value Added Services, NOKIA Networks, NOKIA Hellas.
- *Software Developer internship* September 2001 - February 2002  
Technical University of Crete, Electronic and Computer Engineering Department, Laboratory of Distributed Multimedia, Information Systems and Applications.
- *Programmer internship* August - September 1999, August 2001  
Social Security Institute, Greece.

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