Andrés García Saavedra

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BRIEF BIO

I received my B.Sc. (2009) in Telecommunication Engineering from University of Cantabria (UNICAN), M.Sc. (2010) and Ph.D. (2013) in Telematics Engineering from University Carlos III of Madrid (UC3M). I moved to Hamilton Institute at National University of Ireland, Maynooth (NUIM) as a Research Fellow until the end of 2014 when I moved to Trinity College Dublin, Ireland (TCD).

My research interests lie in the application of fundamental mathematics to real-life computer communications systems, both wired and (especially) wireless; including resource allocation problems, energy efficiency, network coding, and design of network protocols and systems. I particularly enjoy building real prototypes and carrying out experimental performance evaluations of protocols and communication systems.

I have published 22 papers in top conferences and journals of the field of communications and networking, obtained over 176 citations since 2010 and hold an H-index of 6. See my Google Scholar profile for more details: http://scholar.google.es/citations?user=zH4j6GcAAAAJ&hl=en

WORK EXPERIENCE

Jan. '14 – Currently **Postdoctoral Research Fellow**
School of Computer Science and Statistics
Trinity College Dublin

Nov. '13 – Dec -14 **Postdoctoral Research Fellow**
Hamilton Institute
Maynooth University, Ireland

Sept. '09 – Nov. '13 **Teaching Assistant**
Department of Telematics engineering
University Carlos III of Madrid

EDUCATION

November 2013 **Ph.D. in Telematics Engineering**
University Carlos III of Madrid (Spain)
Supervisor: Dr. Albert Banchs, Dr. Pablo Serrano

September 2010 **M.Sc. in Telematics Engineering**
University Carlos III of Madrid (Spain)
Supervisor: Dr. Albert Banchs, Dr. Pablo Serrano

January 2009 **B.Sc. in Telecommunications Engineering**
University of Cantabria (Spain)
Supervisor: Dr. Ramon Aguero

OTHER

July 2012 – Dec. 2012 **Visitor scholar at University of Texas at Austin**
Scheduling of resources in Cloud Radio Access Networks
Under the supervision of Dr. Gustavo de Veciana

PUBLICATIONS

Journals

[1] “Adaptive Mechanism for Distributed Opportunistic Scheduling", A. Garcia-Saavedra, A. Banchs, P. Serrano, J. Widmer. **IEEE Transactions on Wireless Communications**, accepted for publication, February 2015. Cites: N/A Journal Impact (2013): Q1 JCR in two categories, Impact factor 2.762, 5-Year Impact factor 3.265, Total cites 13350

[2] "Thwarting Selfish Behavior in 802.11 WLANs", A. Banchs, J. Ortin, A. Garcia-Saavedra, D. Leith, P. Serrano**. IEEE/ACM Transactions on Networking**, accepted for publication, October 2014. Cites: N/A. Journal Impact (2013): Q1 JCR in four categories, Impact factor 1.986, 5-Year Impact factor 2.969, Total cites 5302

[3] "Per-frame Energy Consumption in 802.11 Devices and its Implication on Modeling and Design", P. Serrano, A. Garcia-Saavedra, G. Bianchi, A. Banchs, A. Azcorra. **IEEE/ACM Transactions on Networking**, accepted for publication, April 2014. Cites: N/A. Journal Impact (2013): Q1 JCR in four categories, Impact factor 1.986, 5-Year Impact factor 2.969, Total cites 5302

[4] "SOLOR: Self-Optimizing WLANs with Legacy-Compatible Opportunistic Relays", A. Garcia-Saavedra, B. Rengarajan, P. Serrano, D. Camps-Mur, X. Costa-Pérez**. IEEE/ACM Transactions on Networking**, accepted for publication, April 2014. Cites: N/A. Journal Impact (2013): Q1 JCR in four categories, Impact factor 1.986, 5-Year Impact factor 2.969, Total cites 5302

[5] "Energy-efficient Optimization for Distributed Opportunistic Scheduling", A. Garcia-Saavedra, P. Serrano, A. Banchs. **IEEE Communications Letters**, vol.18, no.6, pp.1083-1086, April 2014. Cites: N/A. Journal Impact (2013): Q2 JCR, Impact factor 1.463, 5-Year Impact factor 1.468, Total cites 5491

[6] "A Game-Theoretic Approach to Distributed Opportunistic Scheduling", A. Banchs, A. Garcia-Saavedra, P. Serrano, J. Widmer**. IEEE/ACM Transactions on Networking**, vol.21, no.5, pp.1553-1566, Oct. 2013. Cites: 5. Journal Impact (2013): Q1 JCR in four categories, Impact factor 1.986, 5-Year Impact factor 2.969, Total cites 5302

[7] "Device-to-device communications with Wi-Fi Direct: overview and experimentation", D. Camps-Mur, A. Garcia-Saavedra, P. Serrano. **IEEE Communications Magazine**, vol.20, no.3, pp.96-104, June 2013. Cites: 62. Journal Impact (2013): Q1 JCR in two categories, Impact factor 4.460, 5-Year Impact factor 4.755, Total cites 8466

[8] "Balancing energy efficiency and throughput fairness in IEEE 802.11 WLANs", A. Garcia-Saavedra, P. Serrano, A. Banchs, M. Hollick. **Elsevier Pervasive and Mobile Computing**, vol.8, no.5, pp.31-645, Oct. 2012. Cites 6. Journal Impact (2012): Q1 JCR in two categories, Impact factor 1.629, Total cites 427

Conferences

[9] "Energy consumption anatomy of 802.11 devices and its implication on modeling and design", A. Garcia-Saavedra, P. Serrano, A. Banchs, G. Bianchi. **ACM CoNEXT 2012** - The 8th international conference on Emerging networking experiments and technologies, pp.169-180, Dec. 2012. 17.6% accepted, 176 submitted.

[10] "Distributed Opportunistic Scheduling: A control theoretic approach", A. Garcia-Saavedra, A. Banchs, P. Serrano, J. Widmer. **IEEE INFOCOM 2012** - The 31st International Conference on Computer Communications, pp.540-548, March 2012. 18% accepted, 1547

submitted.

[11] "Energy-efficient fair channel access for IEEE 802.11 WLANs", A. Garcia-Saavedra, P. Serrano, A. Banchs, M. Hollick. **IEEE WoWMoM 2011** - The 12th International Symposium on a World of Wireless, Mobile and Multimedia Networks, pp.1-9, June 2011. 18.5% accepted, 173 submitted

[12] "CARMEN: resource management and abstraction in wireless heterogeneous mesh networks", N. Bayer, K. Loziak, A. Garcia-Saavedra, C. Sengul, P. Serrano. **ACM SIGCOMM 2010 (demo)** - ACM SIGCOMM 2010 conference, Demo session, pp.481-482. Aug. 2010. 12% accepted, 276 submitted

[13] "On the energy efficiency of IEEE 802.11 WLANs", P. Serrano, A. Garcia-Saavedra, M. Hollick, A. Banchs. **EW 2010** - The 16th European Wireless Conference, pp.932-939, April 2010

[14] "Investigating Bit Error Patterns for Radar Pulse Detection in IEEE 802.11", C. Pisa, A. Garcia-Saavedra, and D. J. Leith. **ICWMC 2014** - The 10th International Conference on Wireless and Mobile Communications, pp.164-168. June 2014.

[15] "On the scalability of carrier-grade mesh network architectures", J. Lessmann, A. De La Oliva, C. Sengul, A. Garcia-Saavedra, M. Kretschmer, S. Murphy, P. Patras. The 20th Future Network and Mobile Summit Future Network & Mobile Summit, pp.1-8, June 2011.

Other publications

[16] "Rigorous and Practical Proportional-Fair Allocation for Multi-Rate Wi-Fi", P. Patras, A. Garcia-Saavedra, D. Malone, D. J. Leith. 2014. **Draft, arXiv**: http://arxiv.org/abs/1411.6685. Under review in Elsevier AdHoc Networks. Journal Impact (2013): Q2 JCR in two categories, Impact factor 1.456, 5-Year Impact factor 1.957, Total cites 1312

[17] "Analysis and optimal configuration of distributed opportunistic scheduling techniques in wireless networks", A. Garcia-Saavedra. **Ph.D. thesis**, University Carlos III of Madrid (UC3M), Nov. 2013. Grade: Summa Cum Laude. I was granted an extraordinary award for my Ph.D. thesis at University Carlos III of Madrid.

[18] "Energy-efficient fair channel access for IEEE 802.11 WLANs", A. Garcia-Saavedra. **M.Sc. thesis**, University Carlos III of Madrid (UC3M), June 2010.

PROJECTS

2011 – 2013 **Collaboration project with NEC Laboratories Europe**
This project involved the experimental assessment of a novel energy saving scheme for WiFi-Direct. The results were published in [6].

2011 – 2013 **FLAVIA European Project (7th FWP)**
I designed and prototype a novel energy efficient relaying scheme for WiFi networks under the framework of the project's architecture. The results of my contributions to this project have been published in [3].

2009 – 2011 **CARMEN European Project (7th FWP)**
I implemented the low-level resource allocation layer for a generic WiFi MAC in the context of the overall carrier-grade mesh network proposed in the project. I showed a demonstration of this prototype in [11].

TEACHING

- **Theory of networks** (10/11, 11/12, 12/13): Introduction to probability, Markov models and

queueing theory. B.Sc. Telematics Eng. University Carlos III of Madrid

- **Audiovisual mobile systems** (12/13): Introduction to wireless communication systems. B.Sc. Telematics Eng. University Carlos III of Madrid
- **Networks and Services** (09/10, 10/11, 11/12): General introduction to communication networks. B.Sc. Telematics Eng. University Carlos III of Madrid

A BRIEF SUMMARY OF MY PREVIOUS AND CURRENT WORK

Ever since I started my research career I have been interested in a research that bridges the gap between fundamental mathematics and real-life computer communication systems and protocols, particularly in the field of wireless access technologies. My work focuses on four dimensions of the area: *maximize energy efficiency* e.g. to extend mobile devices' lifetime, *maximize capacity of wireless channels* e.g. to accommodate more users with minimal costs of investment, *minimize delay* e.g. to support high-quality real-time communications, and *protect* wireless resources against misuse e.g. to avoid the “tragedy of the commons”.

Energy efficiency. My work of [2][8] consists of a detailed experimental study of the power consumption behavior of wireless devices. The (rather disruptive) results of our findings have provided me with a deep understanding of the relationship between the different components of a network operation and their energy requirements. This knowledge has rooted other contributions towards enhancing the energy efficiency of wireless systems in [4][7][10][12][3][6] and serves as a baseline reference for future research activities in the area.

Capacity of wireless channels. The ever-increasing demands for wireless network capacity of a growing population of users severely compromises the return of investment (ROI) for network operators that are *forced* to increase the density of access points in order to meet such tough requirements. In this way, it is of paramount importance to squeeze as much capacity out of the channels as possible to maximize the efficiency of such costly network infrastructure. I refer the reader to some of my past and current contributions in the area [3][9][13][14].

Protection of wireless resources against misuse. The distributed nature of many wireless access systems (including IEEE 802.11, WiFi) fosters an incentive to *misbehave* in selfish users; that is, to adopt a configuration that grants them more resources from the shared channel at the expense of other well-behaved users that collaborate for the *common good* (a fair share of resources). The key idea of my work in this area is to remove this incentive with a deployable penalization algorithm that punishes selfish behaviors. My contributions on this topic can be found in [1][5].

Low-delay transport protocol. A large number of applications have severe delay constraints (e.g. real-time video streaming). While some of the novel advances in the area of transport protocols (e.g. MPTCP -- Multipath TCP and *network coding*) have mostly focused on increasing throughput performance, less attention has been paid to the exploitation of these techniques to improve delay performance. I am currently working on a *stochastic* scheduler and a low-delay error-correction *coding scheme* for multipath communications. The scheduler models the problem as a stochastic optimization problem where channel average delays as well as their variances are taking into account. The coding scheme helps us to recover from erasures in the channel faster than ARQ for channels with high bandwidth delay product.

REFERENCES (provided on demand)

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Albert Banchs received the degree in telecommunications engineering and Ph.D. in telematics engineering from the Polytechnic University of Catalonia, Barcelona, Spain, in 1997 and 2002, respectively. He received a national award for the best Ph.D. thesis on broadband networks. He was a Visiting Researcher with the International Computer Science Institute (ICSI), Berkeley, CA, in 1997, and worked for Telefonica I+D, Madrid, Spain, in 1998, and for NEC Europe, Ltd., Heidelberg, Germany, from 1998 to 2003. He has been with the University Carlos III of Madrid, Leganes, Spain, since 2003. Since 2009, he also has a double affiliation as Deputy Director of the Institute IMDEA Networks, Madrid, Spain. He has authored over 80 publications in peer-reviewed journals and conferences and holds six patents. Dr. Banchs is an Area Editor for Computer Communications and has been Senior and Associate Editor for the IEEE Communications Letters and Guest Editor for IEEE Wireless Communications, Computer Networks, and Computer Communications. He has served on the TPC of a number of conferences and workshops including IEEE INFOCOM, IEEE ICC, and IEEE GLOBECOM and has been TPC chair for European Wireless 2010, IEEE HotMESH 2010, and IEEE WoWMoM 2012.

Dr. Albert Banchs has been my supervisor since 2009 when I joined the M.Sc program at UC3M and also during my Ph.D.

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Pablo Serrano received the degree in telecommunication engineering and Ph.D. degree in telematics engineering from University Carlos III of Madrid (UC3M), Leganes, Spain, in 2002 and 2006, respectively. He has been with the Telematics Department, UC3M, since 2002, where he currently holds the position of Associate Professor. In 2007, he was a Visiting Researcher with the Computer Network Research Group, University of Massachusetts, Amherst. He has authored over 40 scientific papers in peer-reviewed international journals and conferences. His current work focuses on performance evaluation of wireless networks. Dr. Serrano also serves as a TPC member of several international conferences, including IEEE GLOBECOM and IEEE INFOCOM.

Dr. Pablo Serrano has co-supervised my work during both my M.Sc. and Ph.D. since I joined the department at UC3M.

Arturo Azcorra

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IMDEA Networks Institute

Arturo Azcorra received the M.Sc. and Ph.D. degrees in telecommunications engineering from the Universidad Politécnica de Madrid, Madrid, Spain, in 1986 and 1989, respectively. He also received the M.B.A. from the Instituto de Empresa, Madrid, Spain, in 1993. He has a double appointment as Full Professor (with chair) with the Telematics Engineering De-partment, University Carlos III of Madrid, Leganes, Spain, and as Director of IMDEA Networks, Madrid, Spain. He has coordinated and served as a Program Committee Member in numerous international conferences and has published over 100 scientific papers in books, international journals, and conferences. Professor Arturo Azcorra has also been elected member of the Partnership Board of the 5G Infrastructure Association. This body provides European-wide leadership in the design of next-generation advanced communication systems. The ultrafast mobile broadband technology of the future, branded as 5G, will be the foundation of the future Internet, and is expected to withstand data connections 1,000 times heavier than today's.

Gustavo de Veciana

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The University of Texas at Austin

Gustavo de Veciana received his B.S., M.S, and Ph.D. in electrical engineering from the University of California at Berkeley in 1987, 1990, and 1993 respectively. He is currently a Professor at the Department of Electrical and Computer Engineering and recipient of the Temple Foundation Centennial Fellowship. He served as the Director and Associate Director of the Wireless Networking and Communications Group (WNCG) at the University of Texas at Austin, from 2003-2007. His research focuses on the analysis and design of wireless and wireline telecommunication networks; architectures and protocols to support sensing and pervasive computing; applied probability and queueing theory. Dr. de Veciana has served as editor for the IEEE/ACM Transactions on Networking. He was the recipient of a National Science Foundation CAREER Award 1996, co-recipient of the IEEE William McCalla Best ICCAD Paper Award for 2000, co-recipient of the Best Paper in ACM Transactions on Design Automation of Electronic Systems, Jan 2002-2004, co-recipient of the Best Paper in the International Teletraffic Congress (ITC-22) 2010, and of the Best Paper in ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems 2010. In 2009 he was designated IEEE Fellow for his contributions to the analysis and design of communication networks. He is on the technical advisory board of IMDEA Networks.

Dr. Gustavo de Veciana has been my supervisor during my stay at University of Texas at Austin from July to December 2012.

Giuseppe Bianchi

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University of Roma Tor Vergata

Giuseppe Bianchi is Full Professor of Networking at the University of Roma Tor Vergata since January 2007. His research activity includes Wireless LANs, IP networking, privacy and security, traffic monitoring, and is documented in about 180 peer-reviewed international journal and conference paper. He has served as editor for IEEE/ACM Transactions on Networking, IEEE Transactions on Wireless Communication (area editor) and Elsevier Computer Communication. He has chaired several international networking conferences, including IEEE Infocom 2014, ACM SRIF 2013, ACM Wintech 2011, IEEE WoWMoM 2010, etc.

Douglas Leith

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Trinity College Dublin

Doug Leith graduated from the University of Glasgow in 1986 and was awarded his PhD, also from the University of Glasgow, in 1989. Prof. Leith moved to the National University of Ireland, Maynooth in 2001 to establish the Hamilton Institute (www.hamilton.ie) of which he was founding Director from 2001-2014. Towards the end of 2014, Prof Leith moved to Trinity College Dublin to take up the Chair in Computer Systems in the School of Computer Science and Statistics. He is the author of over 200 journal and conference papers. His current research interests include transport layer error-correction/coding, privacy in communications networks and distributed low-communication resource allocation. He currently leads a number of research grants on communications networks and next generation networks, both of which deal with problems arising in 802.11 networks. Prof Leith is a senior editor of IEEE Journal on Selected Areas in Communications. Recent TPC membership includes ITC 2013, MobiHoc 2013, WiMob 2013, INFOCOM 2014, CONTROL 2014 and MACOM 2014. He is a reviewer for numerous other conferences and journals. He is a member of the Institute of Electrical and Electronics Engineers and the Association for Computing Machinery, and has acted as a reviewer for SFI, EU, Enterprise Ireland and UK EPSRC projects.

David Malone

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Hamilton Institute

David Malone is a member of faculty at the Hamilton Institute with interests in wireless, powerline communications, security Internet measurement and IPv6. He has published 80 journal/conference papers and is the author of O'Reilly's book on IPv6 Network Administration. He has reviewed papers at various conferences and journals including Computer Communication Review, Globecom, WiOpt, WirelessCom, AUUG, WoWMoM, ICC, IEEE Transactions on Networking, Transactions on Wireless Communications and IEEE Communications Letters. He cochaired WiNMee 2008, IPOM 2006 and has been on the TPC for INFOCOM, SIGCOMM and CoNEXT. Dr Malone is also a developer on the FreeBSD project, which develops an advanced Open Source operating system that runs on server, desktop and embedded computer systems.