

# Curriculum Vitae

## INFORMAZIONI PERSONALI

**Nome** ILENIA  
**Cognome** TINNIRELLO  
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ilenia.tinnirello@tti.unipa.it

## FORMAZIONE TITOLI

- From June 2007 to July 2007: Visiting Researcher at the Seoul National University
- From June 2006 to July 2006: Visiting researcher at the Nanyang Technological University of Singapore, invited by Prof. Francis Lee.
- Since January 2005: Assistant Professor at the University of Palermo.
- From March 2004 to November 2004: Visiting researcher at the Seoul National University, Seoul, Korea, invited by Prof. Sunghyun Choi.
- February 2004: Ph.D. dissertation about Resource Management in Wireless Packet Networks, advisor Prof. Giuseppe Bianchi.
- January 2001: state examination for engineering professional qualification.
- Since November 2000: PhD Student on Communications, Università di Palermo. About the PhD formation program, she attended the International School for PhD Students on Information Engineering at Napoli Univeristy Federico II, on February 2001, 2002 and 2003 and, at Padova University on July 2001 e 2002. Moreover, she attended a course on sensor networks at Università la Sapienza di Roma, by prof. Mani Srivastava, June 2003.
- April 2000: Laurea degree in Electrical Engineering, Università di Palermo, summa cum laude. Final thesis about Handover and Admission Control in wireless packet networks, supervised by Prof. Giuseppe Bianchi.

Ilenia Tinnirello spoken and written English skills are at least equivalent to B2 level.

## ATTIVITA' DIDATTICA

1. At the University of Palermo, mainly in the field of Communication and Information Theory. In particular:

a. Wireless Networks for Undergraduate Students

Regular course of 50 hours in the Academic Years 2005/2006, 2006/2007

b. Wireless Networks for Graduate Students

Regular course of 60 hours in the Academic Years 2006/2007, 2007/2008, 2008/2009, 2009/2010;

Regular course of 90 hours in the Academic Years 2010/2011, 2011/2012, 2012/2013

c. Computer Networks for Students of the old Laurea Program

Regular course of 60 hours in the Academic Year 2006/2007.

d. Queuing Theory.

Regular course of 40 hours in the Academic Year 2011/2012.

e. Telecommunication Systems.

Part of the course (30 hours) in the Academic Years 2009/2010 and 2011/2012.

f. Local Area Networks for Home and Building Automation

Regular course (30 hours) within the Master Program for Experts in Domotic Applications, coordinated by Prof. M. Ippolito.

g. Numerical Signal Processing

Practical lessons (15 hours) in the Academic Years 2001/2002 and 2002/2003, about MATLAB software use for filter design, analysis of quantization effects, spectral estimation, kalman filters.

h. Object Oriented Programming and distributed applications (C++, JAVA).

Practical lessons (15 hours) in the Academic Years 2002/2003, 2003/2004.

2. Courses in other schools

a. Computer network

Compact course for the Center of Research Electronic in Sicily (CRES) held in October/November 2006;

b. Numerical Signal Processing

Compact course for the Center of Research Electronic in Sicily (CRES) held in October/November 2005;

c. Evolution of Wireless Local Area Networks

Compact course (12 hours) at the University La Sapienza di Roma, invited by Prof. Chiara Petrioli, in December 2006 and December 2007.

d. Performance study of IEEE 802.11 networks

Seminars (8 hours) at the Seoul National University, Korea, invited by Prof. Sunghyun Choi, June 2007.

e. Evolution of IP Networks

Compact course (20 hours) at the ITALTEL S.P.A. Education Center, October 2007.

3. Other teaching activities

a. Coordinator of the Erasmus Program for the Students in Telecommunication Engineering

b. Thesis supervision: from 2005 to today, supervisor of more than 50 Master Thesis, co-supervisor of 2 Ph.D Students, currently supervisor of 6 Ph.D.

Students, mostly about: handover algorithms and mobility management, scheduling policies in wireless networks, quality of service in IEEE 802.11 networks, load balancing algorithms in wireless packet networks, cognitive and programmable networks.

c. Seminar organization: Seminar organization: from 2005, organization of several seminars at the University of Palermo, among which seminars held by: Prof. Dimitris Vergados in Dicember 2007 from the Piraeus University, Dr. Seongwan Kim, from Seoul National University, in January 2008; Prof. Sunghyun Choi from Seoul National University in April 2010, Dr. Domenico Giustiniano from Telefonica in April 2010, Dr. Giovanni Neglia from INRIA in December 2011.

COORDINATION OF THE WIRELESS NETWORK RESEARCH GROUP at the University of Palermo

The group is currently composed by 6 Ph.D. Students (Domenico Garlisi, Fabrizio Giuliano, Pierluigi Gallo, Fabio Di Franco, Cettina Barcellona and Giuseppe Di Bella) and 1 post-doc (Pietro Cassara'). The group is also part of the Palermo Research Unit in the Consorzio Nazionale Inter-universitario per le Telecomunicazione (CNIT), for which I. Tinnirello is the local scientific coordinator.

## SHORT-TERM VISITS IN OTHER FOREIGNER UNIVERSITIES and RESEARCH INSTITUTES

- a. 19/10/2008 – 26/10/2008 at the Seoul National University, within the bilateral Italian-Korean Scientific Cooperation Project INFINITY.
- b. 26/3/2008 – 30/03/2008 at the Piraeus University, within the bilateral Italian-Greek Scientific Cooperation Project PITAGORA.
- c. 27/5/2007 – 22/06/2007 at the Seoul National University, within the bilateral Italian-Korean Scientific Cooperation Project INFINITY.
- d. June 2008 at Telefonica Research, Barcelona, invited by Dr. Alberto Lopez Toledo.
- e. October 2008 at the INRIA Research Center, Sophia Antipolis, invited by Dr. Giovanni Neglia of the Maestro Research Group.

## RICERCHE FINANZIATE

### FUNDED PROJECTS

- |    |  |    |                           |
|----|--|----|---------------------------|
| 1. | PRIN 2005: Misure sperimentali e Modelli di traffico dati multiServizio a pAcchetto (MIMOSA)   | 24 | Research Unit Coordinator |
| 1. | FP7-ICT-2007-2: Pan-European Laboratory Infrastructure Implementation  | 30 | Participant               |
| 1. | FIRB 2004-2006: Piattaforme riconfigurabili per comunicazioni radiomobili a larga banda (PRIMO)  | 36 | Participant               |
| 1. | FAR Nomadic Access On IP Networks (NAIN) 2005-2008. Research Unit Budget: about 300 Keuro.   | 12 | Research Unit Coordinator |
| 1. | Progetto di collaborazione bilaterale MAE Italia-Corea: Interoperable WIFI/WIMAX connectivity (INFINITY) 2007-2009   | 36 | Italian Coordinator       |
| 1. | Progetto di collaborazione bilaterale MAE Italia-Grecia: a programmable wireless internet architecture for managing optimizations, roaming and accounting (PITAGORA) 2006-2008 | 36 | Italian Coordinator       |
| 1. | PRIN 2004: ToWards Enhancing 802.11 support of differentiated service LeVEls (TWELVE)  | 24 | Participant               |
| 1. | FP7-ICT-2009-1.1: FLExible Architecture for Virtualizable wireless future Internet Access (FLAVIA). Total budget: 3.5 Meuro (milion euros); Research Unit Budget: 600 Keuro    | 36 | Technical Manager         |
| 1. | POR Sicilia: Nuove Tecnologie per la Trasmissione Broadcast (TTB) 2012-2015. Total budget about 1 Meuro, Research Unit Budget 500 Keuro  | 30 | Project Coordinator       |
| 1. | Progetto di collaborazione bilaterale MAE Italia-Polonia: Advanced wifi networks for HOme Customized applications (ADHOC) 2013-2015  | 36 | Italian Coordinator       |
| 1. | FP7-CREW2012-CO2: The Wireless MAC Processor over CREW: enabling Cognitive Access BenchmarkING (CABIN-CREW). Total Budget 120 Keuro  | 12 | Project Coordinator       |
| 1. | PON 04 Smart Cities and Communities: Innovation for green EXchange in TransportatON (iNEXT).   | 30 | Particip. - Task Manager  |

## ASSOCIAZIONI SCIENTIFICHE

### CONFERENCE ORGANIZATION and TUTORIALS

- General chair of the international conference *Privacy in Statistical Databases (PSD 2012)*, September 2012, Palermo, Italy. (<http://unescoprivacychair.urv.cat/psd2012/index.php?m=organization>).
- Tutorial on Programmability of Wireless Networks, *ACM SIGCOM 2012*, August 2012, Helsinki, Finland (<http://conferences.sigcomm.org/sigcomm/2012/pwn.php>).
- Co-chair for the workshop *multiMedia Applications over Wireless Networks (MediaWin)* in the editions 2006, 2007, 2008 e 2009, jointly organized with the international conference *European Wireless* in 2006 and *IEEE ISCC* in 2007, 2008, and 2009.
- Co-Chair of the international conference *IEEE ISWPC 2010*, May 2010, Modena, Italy.
- Local Organizer of the 6th *Spain, Italy, and Netherlands Meeting on Game Theory (SING 6)*, Palermo, Italy, July 2010.
- Local Organizer of the *Annual Mediterranean Ad Hoc Networking Workshop (MedHoc) 2011*, Favignana, Italy, June 2011.

### PARTICIPATION TO TECHNICAL PROGRAM COMMITTEES:

- WoWMoM 2006/2007/2010/2011 (World of Wireless, Mobile and Multimedia Networks)*
- IEEE WCNC 2005/2009 (Wireless and Communication Networking Conference)*
- IEEE ICC 2010/2011/2013 (International Conference on Communication)*
- IEEE WONS 2013 (Wireless On-Demand Network Systems and Services)*
- IEEE WD 2012 (Wireless models and Simulations)*
- IEEE GLOBECOM 2010/2011/2013 (Global Communication Conference)*
- IEEE WiFlex 2013 (International Conference on Wireless Access Flexibility)*
- IEEE INFOCOM 2013 (International Conference on Computer Communications)*

### REVIEWER for the following main JOURNALS:

- IEEE Transactions on Communications, IEEE Transactions on Networking, Journal of Selected Areas in Communications, IEEE Transactions on Vehicular Technology, ACM Wireless Networks, Computer Networks.*

### PANELS AND INVITED TALKS

- Panel Organizer and Moderator for the *Second GENESI Workshop 12th*, June 2012, Catania. Panel title: "Challenges and Opportunities for long-lasting wireless monitoring".
- Opening Talk "Evolution of the WLAN Access Protocols and Infrastructures" for *MediaWin 2006*, April 2006, Athens
- Opening Talk "The wild world of WLAN cards: can QoS confide on simulations and models?", *Mediawin 2007*, Aveiro, Portugal.
  
- Invited Talk "Dissecting WLAN unexpected performance: from theory to vendor-affected reality" for the *Italy-Korea Workshop on Wireless Communication Today and Tomorrow*, October 2008, Seoul
  
- Invited Talk "When your smartphone becomes your guide dog" for the international Workshop "La tecnologia al servizio dell'uomo: soluzioni innovative per aiutare le persone a superare i limiti imposti dalle loro disabilità", organized by the *Andrea Bocelli Foundation Pisa*, July 2012 (<http://www.andreabocellifoundation.org/?p=446&lang=it>).

### PARTICIPATION TO OTHER COMMITTEES at the UNIVERSITY OF PALERMO:

- Scientific Coordinator of the *Palermo Research Unit* in the *Consorzio Nazionale Inter-universitario per le Telecomunicazione (CNIT)*
- Technical committee for the evaluation of the proposals for the internal research funding;
- Technical committee for the evaluation of the teaching quality (2006-2010).

## PUBBLICAZIONE

1. 2012 - Contributo in Atti di convegno  
*Tinnirello I, Bianchi G., Gallo P., Garlisi D., Giuliano F., Gringoli F. (2012). Wireless MAC processors: Programming MAC protocols on commodity hardware. In: Proceedings - IEEE INFOCOM; IEEE Conference on Computer Communications, INFOCOM 2012. Orlando, FL (USA), 25 March 2012 through 30 March 2012, p. 1269-1277, ISBN: 978-146730775-8, doi: 10.1109/INFOCOM.2012.6195488*

2. 2012 - Contributo in Atti di convegno  
Grunenberger Y, Tinnirello I, Gallo P, Goma E, Bianchi G (2012). *Wireless card virtualization: From virtual NICs to virtual MAC machines*. In: *Proc. of Future Network & Mobile Summit (FutureNetw)*, 2012.
3. 2012 - Contributo in Atti di convegno  
Gallo P, Krasilov A, Lyakhov A, Tinnirello I, Bianchi G (2012). *Breaking Layer 2: A New Architecture for Programmable Wireless Interfaces*. In: *Proc. of ICTC 2012*.
4. 2012 - Contributo in Atti di convegno  
Tinnirello I, Cassara P, Di Bella G (2012). *Performance Analysis in Spatially Correlated IEEE 802.11 Networks*. In: *Proc. of ICTC 2012*.
5. 2012 - Contributo in Atti di convegno  
Bianchi G, Gallo P, Garlisi D, Giuliano F, Gringoli F, Tinnirello I (2012). *MAClets: Active MAC Protocols over Hard-Coded Devices*. In: *Proc. of ACM CoNEXT 2012*.
6. 2011 - Articolo in rivista  
Tinnirello I, Giarre L, Neglia G (2011). *MAC Design for WiFi Infrastructure Networks: A Game-Theoretic Approach*. *IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS*, vol. 10, p. 2510-2522, ISSN: 1536-1276, doi: 10.1109/TWC.2011.062011.100193
7. 2011 - Contributo in Atti di convegno  
GRINGOLI F, GARLISI D, GALLO P, GIULIANO F, MANGIONE S, TINNIRELLO I (2011). *MAC-Engine: a new architecture for executing MAC algorithms on commodity WiFi hardware*. In: *WiNTECH '11 Proceedings of the 6th ACM international workshop on Wireless network testbeds, experimental evaluation and characterization*. Las Vegas, NV (USA), 19 September 2011 through 23 September 2011, p. 99-100, ISBN: 978-1-4503-0867-0, doi: 978-1-4503-0867-0
8. 2011 - Contributo in Atti di convegno  
DI PIAZZA FI, MANGIONE S, TINNIRELLO I (2011). *Maximizing network capacity in an heterogeneous macro-micro cellular scenario*. In: *Proceedings IEEE ISCC 2011, Computers and Communications (ISCC), 2011 IEEE Symposium on*. Kerkyra, July 2011, ISBN: 978-1-4577-0678-3, doi: <http://dx.doi.org/10.1109/ISCC.2011.5983865>
9. 2011 - Contributo in Atti di convegno  
GALLO P, GRINGOLI F, TINNIRELLO I (2011). *On the Flexibility of the IEEE 802.11 Technology: Challenges and Directions*. In: *Proceedings IEEE Future Network & Mobile Summit (FutureNetw)*, 2011. Warsaw, 15-17 June 2011, p. 1-10, ISBN: 978-1-4577-0928-9
10. 2011 - Contributo in Atti di convegno  
Tinnirello I, Giarre L, Badalamenti R, La Rosa FG (2011). *Utility-based Resource Allocations in Ad hoc Wireless Networks*. In: *Proceedings of IEEE Conference on Network Games, Control and Optimization (NetGCooP)*, 2011. Parigi, 11-14/10/2011, p. 1-7, ISBN: 978-1-4673-0383-5
11. 2011 - Contributo in Atti di convegno  
Tinnirello I, Giarre L, Neglia G (2011). *Achieving Fair Bandwidth Distribution in WiFi Networks: A Game Theoretical Approach*. In: *Proceedings of the 18th IFAC World Congress 2011*. Milano, Italia, 28 agosto - 2 settembre, doi: 10.3182/20110828-6-IT-1002.00761
12. 2011 - Contributo in Atti di convegno  
Giarre L, La Rosa FG, Pesenti R, Tinnirello I (2011). *Coloring-based resource allocations in ad-hoc wireless networks*. In: *Proceedings of the 10th IEEE Mediterranean Ad Hoc Networking Workshop (Med-Hoc-Net)*, 2011. Favignana, Giugno 2011, p. 123-126, ISBN: 978-1-4577-0898-5, doi: 10.1109/Med-Hoc-Net.2011.5970477
13. 2010 - Articolo in rivista  
Lee H, Tinnirello I, Yu J, Choi S (2010). *A performance analysis of block ACK scheme for IEEE 802.11e networks*. *COMPUTER NETWORKS*, vol. 54, p. 2468-2481, ISSN: 1389-1286, doi: <http://dx.doi.org/10.1016/j.comnet.2010.04.001>
14. 2010 - Articolo in rivista  
TINNIRELLO I, BIANCHI G (2010). *Interference Estimation in IEEE 802.11 Networks*. *IEEE CONTROL SYSTEMS*, vol. 30, p. 30-43, ISSN: 1066-033X, doi: 10.1109/MCS.2009.935570
15. 2010 - Articolo in rivista  
Tinnirello I, Bianchi G, Xiao Y (2010). *Refinements on IEEE 802.11 Distributed Coordination Function Modeling Approaches*. *IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY*, vol. 59, p. 1055-1067, ISSN: 0018-9545
16. 2010 - Articolo in rivista  
Tinnirello I, Bianchi G (2010). *Rethinking the IEEE 802.11e EDCA performance modeling methodology*. *IEEE-ACM TRANSACTIONS ON NETWORKING*, vol. 18, p. 540-553, ISSN: 1063-6692, doi: 10.1109/TNET.2009.2029101
17. 2010 - Contributo in Atti di convegno  
Tinnirello I, Giarre L, Neglia G (2010). *A game theoretic approach to MAC design for infrastructure networks*. In: *Proceedings IEEE Conference on Decision and Control (CDC)*, 2010. Atlanta, USA, p. 1933-1938, ISBN: 978-1-4244-7745-6, doi: 10.1109/CDC.2010.5717759
18. 2010 - Contributo in Atti di convegno  
TINNIRELLO I, GIARRÈ L, PESENTI R (2010). *Decentralized Synchronization for Zigbee wireless sensor networks in Multi-Hop Topology*. In: *PROCEEDINGS OF THE 2ND IFAC WORKSHOP ON DISTRIBUTED ESTIMATION AND CONTROL IN NETWORKED SYSTEMS*. ANNECY, FRANCE, SEPTEMBER, 13 - 14 2010, doi: 10.3182/20100913-2-FR-4014.00025
19. 2010 - Contributo in Atti di convegno  
TINNIRELLO I, GIARRÈ L, MINEO F. (2010). *Opportunistic Synchronization for Improving IEEE 802.15.4 MAC Performance in Chain Topologies*. In: *Proceedings of EVER 2010, the International Conference and Exhibition on Ecological Vehicles and Renewable Energies*. Principality of Monaco, 25-28 March 2010
20. 2010 - Abstract in Atti di convegno  
Tinnirello I, Giarre L, Neglia G (2010). *Contention-based infrastructure networks: a protocol based on the game-theoretical approach*. In: *Proceedings of the 6th Spain, Italy and Netherlands meeting on game theory (SING 6) 2010*. Palermo, July 6-9

21. 2009 - Articolo in rivista  
Giarre' L, Neglia G, Tinnirello I (2009). *Medium Access in WiFi Networks, Strategies of Selfish Nodes* . IEEE SIGNAL PROCESSING MAGAZINE, vol. 26, p. 124-128, ISSN: 1053-5888
22. 2009 - Articolo in rivista  
TINNIRELLO I, GIUSTINIANO D, SCALIA L, BIANCHI G (2009). *On the side-effects of proprietary solutions for fading and interference mitigation in IEEE 802.11b/g outdoor links* . COMPUTER NETWORKS, vol. 53, p. 141-152, ISSN: 1389-1286
23. 2009 - Contributo in Atti di convegno  
GIARRE' L, NEGLIA G., TINNIRELLO I (2009). *Performance analysis of selfish access strategies on WiFi infrastructure networks* . In: *Proceedings of IEEE Global Telecommunications Conference, 2009. GLOBECOM 2009* . HONOLULU (HW, USA), 30 NOVEMBRE-4 DICEMBRE 2009, p. 1-5, ISBN: 978-1-4244-4148-8, doi: 10.1109/GLOCOM.2009.5425511
24. 2009 - Contributo in Atti di convegno  
GIARRÈ L, NEGLIA G, TINNIRELLO I (2009). *Resource sharing optimality in WiFi infrastructure networks* . In: *Proceedings of the 48th IEEE Conference on Decision and Control, 2009 (CDC 2009)* . Shanghai, China, p. 5877-5882, ISBN: 978-1-4244-3871-6, doi: 10.1109/CDC.2009.5399621
25. 2009 - Contributo in Atti di convegno  
Tinnirello I, Giarre L, Neglia G (2009). *The role of the Access Point in Wi-Fi networks with selfish nodes*. In: *Proceeding GameNets'09 Proceedings of the First ICST international conference on Game Theory for Networks* . istanbul, may 2009, p. 631-637, ISBN: 978-1-4244-4176-1
26. 2009 - Contributo in Atti di convegno  
Tinnirello I, Scalia L, Campoccia F (2009). *Improving IEEE 802.11 Performance in Chain Topologies through Distributed Polling and Network Coding* . In: *Proceedings of IEEE International Conference on Communications (ICC) 2009. Dresden (Germany), 14 June 2009 through 18 June 2009*, p. 1-6, ISBN: 978-1-4244-3435-0, doi: 10.1109/ICC.2009.5199076
27. 2008 - Contributo in Atti di convegno  
D. GIUSTINIANO, TINNIRELLO I, L. SCALIA, A. LEVANTI (2008). *Revealing Transmit Diversity Mechanisms in Commercial IEEE 802.11 Cards*. In: *Proc. of IT-NEWS 2008. Venezia, 13-15 Febbraio*, p. 135-141, ISBN: 978-1-4244-1844-2
28. 2008 - Contributo in Atti di convegno  
A. SGORA, D.J. VERGADOS, D.D. VERGADOS, TINNIRELLO I, I. ANAGNOSTOPOULOS, D. VOUIYOUKAS (2008). *Joint routing and per-flow fairness in wireless multihop networks*. In: *Proc. of IEEE ISWPC 2008. Santorini, Greece, 7-9 May 2008*, p. 701-711, ISBN: 978-1-4244-1652-3
29. 2008 - Contributo in Atti di convegno  
L. SCALIA, D. GIUSTINIANO, TINNIRELLO I (2008). *Side Effects of Ambient Noise Immunity Techniques on Outdoor IEEE 802.11 Deployments*. In: *Proc. of IEEE Globecom 2008. New Orleans, USA, 30 Novembre - 4 Dicembre 2008*, p. 1-6, ISBN: 978-1-4244-2324-8
30. 2008 - Contributo in Atti di convegno  
TINNIRELLO I (2008). *Kalman filter estimation of the contention dynamics in error-prone IEEE 802.11 networks*. In: *Proc. of ISCCSP 2008. Malta, St. Giulians, 12-14 Marzo*, p. 671-676, ISBN: 978-1-4244-1688-2
31. 2008 - Contributo in Atti di convegno  
D. GIUSTINIANO, G. BIANCHI, L. SCALIA, TINNIRELLO I (2008). *An Explanation for Unexpected 802.11 Outdoor Link-level Measurement Results*. In: *Proc. Of INFOCOM 2008. Phoenix, USA, 13-15 Aprile 2008*, p. 2432-2440, ISBN: 978-1-4244-2025-4
32. 2008 - Contributo in Atti di convegno  
G. BIANCHI, D. GIUSTINIANO, L. SCALIA, TINNIRELLO I (2008). *Vendor-Affected" WLAN experimental results: A Pandora's Box?*. In: *Proc. of IEEE. San Pietroburgo, 16-19 June 2008*, p. 1-6, ISBN: 978-1-4244-2035-3
33. 2008 - Contributo in Atti di convegno  
TINNIRELLO I, A. SGORA (2008). *A Kalman Filter Approach for Distinguishing Channel and Collision Errors in IEEE 802.11 Networks*. In: *Proc. of IEEE Globecom 2008. New Orleans, USA, 30 November - 4 Dicembre 2008*, p. 1-5, ISBN: 978-1-4244-2324-8
34. 2008 - Contributo in Atti di convegno  
Campoccia F, Incontrera I, Riva E, Tinnirello I (2008). *An architecture Wi-fi and GPRS for efficient management of distribution electrical networks*. In: *Proceedings of IEEE Universities Power Engineering Conference, UPEC 2008. Padova, 1-4 Sept. 2008*, p. 1-5, ISBN: 978-1-4244-3294-3, doi: 10.1109/UPEC.2008.4651543
35. 2007 - Contributo in Atti di convegno  
LEVANTI A, GIORDANO F, TINNIRELLO I (2007). *A CAPWAP-Compliant Solution for Radio Resource Management in Large-Scale 802.11 WLAN*. In: *50th Annual IEEE Global Telecommunications Conference, GLOBECOM 2007. Washington, 26-30 Nov 2007*, p. 3645-3650, ISBN: 978-1-4244-1043-9
36. 2007 - Contributo in Atti di convegno  
L. SCALIA, TINNIRELLO I (2007). *Performance Analysis of IEEE 802.11 DCF in Multi-Hop Chain Topologies*. In: *WILLOPAN 2007. Bangalore, India, 12 Gennaio*, p. 1-6
37. 2007 - Contributo in Atti di convegno  
LEVANTI A, GIORDANO F, TINNIRELLO I (2007). *A CAPWAP Architecture for Automatic Frequency Planning in WLAN*. In: *Proceedings - IEEE Symposium on Computers and Communications; 12th IEEE International Symposium on Computers and Communications, ISCC '07. Aveiro, Portogallo, 1-4 Luglio*, p. 51-56, ISBN: 978-1-4244-1521-2
38. 2007 - Contributo in Atti di convegno  
LEE HYEWON, TINNIRELLO I, YU JEONGGYUN, CHOI SUNGHYUN (2007). *Throughput and Delay Analysis of IEEE 802.11e Block ACK with Channel Errors*. In: *Proceedings of the 2007 2nd International Conference on Communication System Software and Middleware and Workshops, COMSWARE 2007 . Bangalore, India, 7-12 Gennaio*, p. 1-7, ISBN: 1-4244-0614-5

39. 2007 - Contributo in Atti di convegno  
BIANCHI, A. DI STEFANO, C. GIACONIA, L. SCALIA, G. TERRAZZINO, TINNIRELLO I (2007). *Experimental assessment of the backoff behavior of commercial IEEE 802.11b network cards*. In: *Proceedings IEEE International Conference on Computer Communications (INFOCOM) 2007*. Anchorage, Maggio 2007, p. 1181-1189, ANCORAGE:IEEE, ISBN: 1-4244-1047-9, doi: 10.1109/INFOCOM.2007.141
40. 2007 - Contributo in volume (Capitolo o Saggio)  
GIUSEPPE BIANCHI, SUNGHYUN CHOI, TINNIRELLO I (2007). *Performance Study of IEEE 802.11 DCF and IEEE 802.11e EDCA*. In: BENNY BING. *Emerging Technologies in Wireless LANs: Theory, Design and Deployment*. p. 63-127, ISBN: 9780521895842
41. 2007 - Articolo in rivista  
TANTRA JW, CH FOH, TINNIRELLO I, BIANCHI G (2007). *Out-of-Band Signaling Scheme for High Speed Wireless LANs*. *IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS*, vol. 6, p. 3256 -3267, ISSN: 1536-1276, doi: 10.1109/TWC.2007.06029
42. 2006 - Contributo in Atti di convegno  
A. BAIOCCHI, S. MERLIN, D. MESSINA, M. MORETTI, B. SCANAVINO, TINNIRELLO I, A. TODINI, A. VALLETTA, D. VERONESI (2006). *Cross-layer design of optimized packet scheduling and radio resource allocation algorithms for 4th generation cellular wireless systems*. In: *Proceedings WPMC 2006*. San Diego, Settembre 2006, p. 1-6
43. 2006 - Contributo in Atti di convegno  
J.W. TRANTRA, C.H. FOH, TINNIRELLO I, G. BIANCHI (2006). *Analysis of the IEEE 802.11e EDCA Under Statistical Traffic*. In: *Proceedings of IEEE International Conference on Communications (ICC) 2006*. Istanbul, Giugno 2006, vol. 2, p. 546-551, ISBN: 1-4244-0355-3, doi: 10.1109/ICC.2006.254852
44. 2006 - Contributo in Atti di convegno  
D. MESSINA, L. SCALIA, TINNIRELLO I, S. MERLIN, A. ZANELLA, M. MORETTI (2006). *Allocation algorithms for PRIMO system*. In: *Proceedings WIRTEP 2006*. p. 1-6
45. 2006 - Contributo in Atti di convegno  
A. DI STEFANO, G. TERRAZZINO, L. SCALIA, TINNIRELLO I, G. BIANCHI, C. GIACONIA (2006). *On the anomalous behavior of IEEE 802.11 commercial cards*. In: *Proceedings MedHoc Net 2006*. Lipari, Giugno 2006, p. 1-6
46. 2006 - Contributo in Atti di convegno  
L. SCALIA, TINNIRELLO I, J.W. TRANTRA, C.H. FOH (2006). *Dynamic MAC Parameters Configuration for Performance Optimization in 802.11e Networks*. In: *Proceedings of the IEEE Global Telecommunications Conference (GLOBECOM) 2006*. SAN FRANCISCO, 28 Novembre, 2 Dicembre 2006, p. 1-6, ISBN: 1-4244-0356-1, doi: 10.1109/GLOCOM.2006.751
47. 2006 - Contributo in Atti di convegno  
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## ATTIVITA' SCIENTIFICHE

Ilenia Tinnirello research activities have been focused on wireless networks and in particular on distributed local area networks (based on 802.11 technology and its evolution) and on highly reconfigurable and programmable wireless networks. The research activities have been based on: i) the definition of new network ARCHITECTURES and the design/development of the relevant prototypes; ii) the definition of new ANALYTICAL MODELS for characterizing the emerging wireless access solutions,



iii) the design of new EXPERIMENTAL frameworks and BENCHMARKING solutions for comparing analytical, simulation and experimental results, iv) the analysis of COMPLEX NETWORK SYSTEMS by means of simulators and system theory. For dealing with these activities, Ilenia Tinnirello has extensively working on developing custom-made object-oriented network simulators, using simulation tools shared in the research community, designing new drivers/firmwares for network cards, designing a new node prototype on FPGA board network interface prototypes velopMost of the research papers can be categorized according to these categories.

Following the enumeration of the publication list, we describe each contribution more into details in the following points.

## 1. ARCHITECTURES

- a. New flexible architectures for next generation access networks. This research activity, mainly carried out within the EU project FLAVIA, lead to the definition of a new powerful architecture for programming the behavior of the wireless cards [3] even in terms of low-level medium access operations. The key idea of the approach is an opportunistic splitting between the card 'primitives' (i.e. elementary operations hard-coded on the card) and protocol logic control (i.e. the MAC program, that can be composed in terms of an abstract state machine). Thanks to the introduction of a MAC interpreter, called MAC Engine [1, 7, 9], it is also possible to easily implement different virtualization strategies [2] and cognitive paradigms, including the possibility to negotiate, distribute and activate new MAC protocols [5] in the network. The approach has been validated by means of the design and development of a MAC Engine prototype working on an ultra-cheap commercial card. The work has received a significant attention in several important conferences and industrial fora (such as INFOCOM 2012, SIGCOMM 2012, WiFi Summit 2012, WINTECH 2011, etc.), as documented by the downloading of the prototype code and documentation.
- a. Programmable Handover and Load Balancing. This work has been carried out during the initial research activities (it is indeed part of Ilenia Tinnirello's Ph.D. Thesis). New metrics for quantifying the network load and driving the handover decisions have been proposed [72, 73, 74]. It has been shown that the new decision metrics allows to significantly improve the network performance and reduce the impact of different network configuration parameters (such as the cell overlapping ratio, the transmission power used by the model station, etc.) on the overall performance [63]. By abstracting the decision metric, we also contributed to the definition of a framework [65-67] for making the handover algorithm programmable. Finally, we extended the framework in case of heterogeneous access networks [58] by defining a platform-independent handover logic, decoupled by the platform-specific monitoring functions.

## 1. MODELS

- a. Analytical Models for medium access protocols. This activity has been focused on the understanding of the DCF extensions for supporting quality of service (EDCA) and to the DCF performance optimization in several network contexts. Starting from the bi-dimensional Bianchi's model for DCF [15], we proposed an alternative and more general approach for deriving the channel access probability. The key idea of the approach is decoupling the model of the backoff decrement from the contention window updates [55]. We also proposed a completely different and powerful model for EDCA systems, in which station access rules are no more modeled in terms of an equivalent p-persistent protocol [16]. The model is able to also work under non-saturated traffic conditions and several heterogeneous parameters between the contending stations [16, 40, 49, 50, 64]. A last modeling activity has been dedicated to the quantification of the benefits introduced by the new cumulative acknowledgement schemes and burst transmissions [13, 38, 51, 53, 54, 60]. Finally, to better understand the differences between DCF and EDCA, we evaluated low-level performance figures by means of simulations [36, 41, 43, 46, 56, 64, 68].
- a. Estimation of the congestion state in distributed network. We introduced the concept of network state for quantifying the cell load in distributed access networks [69, 71]. Specifically, for IEEE 802.11 networks, we proposed a methodology for estimating the number of competing terminals on the basis of channel observations. The methodology is based on a Kalman-based filtering technique applied to measurements independently carried out by each contending station [69]. The filtering is combined with a change-detector filter (based on a CUSUM test) for promptly identifying the arrival or the departure of each station. The metric has been used for also improving the routing in multi-hop networks [28]. Recently, the approach has been generalized to networks affected by channel errors, in order to better estimate the interference conditions suffered in these networks, by discriminating between collisions and channel impairments [14, 30, 33].

## 1. EXPERIMENTAL ACTIVITIES

- a. Comparison between experimental and analytical/simulation results for 802.11 network benchmarking. We tried to motivate the discrepancies between theoretical performance results (provided by models and/or simulations) and experimental results in 802.11 networks [45, 57]. Specifically, we proposed a methodology for assessing the backoff the behavior of 802.11 commercial cards [47] for distinguishing between unexpected card behaviors due to implementation limits from malicious non-standard behaviors [32]. We identified anomalous backoff behaviors [39], ineffective (proprietary) antenna diversity schemes [27] and arbitrary ambient noise immunity solutions [22, 29-31], by also enlightening serious coexistence problems between cards produced by different vendors.

Benchmarking problems for cognitive networks has also been recently considered within the new EU Project CABIN-CREW.

- a. Hardware and Software prototypes: The methodological analysis has been enabled by the design and development of a radio sniffer, able to detect channel idle and busy states.

We also contributed to design and implement from scratch an 802.11 medium access protocol over FPGA for benchmarking purposes and for testing protocol extensions (with time critical requirements) in actual tests [39]. Recently, we worked on the prototyping of the Wireless MAC Processor, i.e. a new architecture for MAC protocol execution based on a MAC interpreter and MAC programs defined in terms of extended state machines [1].

## 1. COMPLEX NETWORK SYSTEMS

- a. Implications of wireless network flexibility. This research activity has shown the potentialities [14, 15, 16, 26] and the risks [11, 22-25] emerged in the context of highly programmable wireless networks with several interacting nodes. Indeed, because of the proliferation of open-source drivers and growing interest for cognitive networks, modern wireless cards offer the opportunities to access and configure several card internal parameters. Although this flexibility allows to dramatically improve the card capabilities to monitor and react to different operation conditions [14-16, 20] and specific network contexts (such as topologies and services) [26], it also creates several consistency problems between different network nodes. For example, this flexibility can be exploited for implementing selfish behaviors [6, 22-26] non compatible with standard solutions [22]. We proposed to study these conflicts by means of game theory for characterizing network equilibrium conditions and proposing mechanisms able to prevent too greedy access behaviors [6].
- a. New medium access solutions for improving the resource utilization under emerging multi-hop topologies and PHY technologies. New resource sharing solutions have been proposed and analyzed, in order to better interact with the emerging PHY and multi-hop topologies (with several hidden nodes). Specifically, a new cross-layer MAC/PHY scheme based on OFDMA [8, 42, 44] has been designed by formulating the resource allocation problem in terms of a linear programming problem. A similar cross-layer approach has been applied to power-line networks, due to the similarity between wireless and power-line channel impairments. In this case, the access scheme has been defined in terms of an hybrid reservation/polling scheme tuned on the basis of the estimated channel features [62]. For multi-antenna stations, new DCF extensions have been evaluated for exploiting multiple trans-receivers at the base stations [52] or separating data and control data in different channels [41, 59]. We also studied some resource allocation problems in a multi-cellular scenario, enlightening the problems arisen by the simultaneous usage of partially overlapping channel [37] and by proposing new frequency planning solutions specific for carrier-sense based networks [35-37]. Finally, hybrid scheduled and contention access solutions have also investigated for energy-limited sensor networks [18, 19] and multi-hop topologies with severe packet loss rates due to hidden nodes [4, 10, 12, 26].

## AMBITI DI RICERCA

Ilenia Tinnirello research activities have been focused on wireless networks and in particular on distributed local area networks (based on 802.11 technology and its evolution) and on highly reconfigurable and programmable wireless networks. The research activities have been based on: i) the definition of new network ARCHITECTURES and the design/development of the relevant prototypes; ii) the definition of new ANALYTICAL MODELS for characterizing the emerging wireless access solutions,

iii) the design of new EXPERIMENTAL frameworks and BENCHMARKING solutions for comparing analytical, simulation and experimental results, iv) the analysis of COMPLEX NETWORK SYSTEMS by means of simulators and system theory. For dealing with these activities, Ilenia Tinnirello has extensively working on developing custom-made object-oriented network simulators, using simulation tools shared in the research community, designing new drivers/firmwares for network cards, designing a new node prototype on FPGA board network interface prototypes velopMost of the research papers can be categorized according to these categories.