Inria, Evaluation of Theme Networks and Telecommunications

Project-team MAESTRO

March 21-23, 2012

Project-team title: MAESTRO

Scientific leader: Philippe Nain

Research center: Sophia Antipolis - Méditerranée

Contents

1 Personnel

Personnel (November 13-14, 2007)

	Misc.	Inria	CNRS	University	**Total**
DR (1) / Professors		3			**3**
CR (2) / Assistant Professors		2		0.5	**2.5**
Permanent Engineers (3)					
Temporary Engineers (4)	1				**1**
PhD Students	4	1		3.5	**8.5**
Post-Doc.	2	1			**3**
Total	**7**	**7**		**4**	**18**
External Collaborators					
Visitors (>1 month)					

(1) "Senior Research Scientist (Directeur de Recherche = DR)"
(2) "Junior Research Scientist (Chargé de Recherche = CR)"
(3) "Civil servant (CNRS, Inria, ...)"
(4) "Associated with a contract (Ingénieur Expert or Ingénieur Associé)"

Personnel (March 21-23, 2012)

	Misc.	Inria	CNRS	University	**Total**
DR / Professors		3			**3**
CR / Assistant Professor		3			**3**
Permanent Engineer					
Temporary Engineer					
PhD Students		1		4	**5**
Post-Doc.					
Total		**8**	**3**		**11**
External Collaborators				3	**3**
Visitors (>1 month)				1	**1**

Changes in staff

	Misc.	Inria	CNRS	University	**Total**
DR / Professors					
CR / Assistant Professors		1		0.5	**1.5**
Arrival		1			**1**
Leaving				0.5	**0.5**

Comments: Giovanni Neglia was hired in 2008 at Inria/MAESTRO as a Junior Research Scientist (CR2). Anne-Elisabeth Baert, Assistant Professor at the University of Montpellier II, who was completing part of her research within MAESTRO, left the team in 2009.

Current composition of the project-team (March 21-23, 2011):

- Philippe Nain, DR0 Inria, project-team leader
- Eitan Altman, DR1 Inria

- Alain Jean-Marie, DR2 Inria
- Konstantin Avrachenkov, CR1, Inria
- Sara Alouf, CR1, Inria
- Giovanni Neglia, CR1, Inria
- Marina Sokol, 3rd year PhD student (advisors: P. Gonçalves (Inria project-team RESO) and P. Nain)
- Manjesh Kumar Hanawal, 3rd year PhD student (advisors: E. Altman and R. El-Azouzi (LIA[1]))
- Nicaise Choungmo Fofack, 2nd year PhD student (advisors: S. Alouf and P. Nain)
- Mahmoud El Chamie, 1st year PhD student (advisors: K. Avrachenkov and G. Neglia)
- Julien Gaillard, 1st year PhD student (advisors: E. Altman, Marc El-Bèze (LIA) and Emmanuel Ethis (LIA))
- Laurie Vermeesch, administrative assistant.

Rachid El-Azouzi, Yezekael Hayel and Tania Jimenez, all from LIA in Avignon, are **external collaborators** of MAESTRO. Nicola Accettura, 3rd year PhD student at Politecnico di Bari is visiting MAESTRO for 6 months since February 2012.

Eitan Altman, Manjesh Kumar Hanawal and Julien Gaillard are hosted by LIA in Avignon. Alain Jean-Marie is hosted by LIRMM[2] in Montpellier. All other members of MAESTRO are located in Sophia Antipolis.

Delia Ciullo, ERCIM postdoctoral researcher, will join MAESTRO on April 1st, 2012 and will stay for one year.

Current position of former project-team members (including PhD students during the 2008-2011 evaluation period):

Permanent positions [3]

- Utku Acer (MAESTRO postdoctoral researcher), **Staff Researcher** at Bell Labs, Alcatel-Lucent, Antwerpen, Belgium
- Anne-Elisabeth Baert (part-time assistant professor in MAESTRO), **Assistant Professor** at the University of Montpellier II, France
- Alberto Blanc (MAESTRO postdoctoral researcher), **Assistant Professor** at Telecom Bretagne, Rennes, France
- Damiano Carra (MAESTRO postdoctoral researcher), **Assistant Professor** at University of Verona, Italy

[1] LIA = Computer Science Laboratory of the University of Avignon et des Pays du Vaucluse (UAPV).

[2] LIRMM = The Montpellier Laboratory of Informatics, Robotics, and Microelectronics, a joint CNRS - University of Montpellier II research lab.

[3] In both sections Permanent/Temporary positions only are listed PhD students who carried out their entire PhD at MAESTRO and postdoctoral researchers who stayed in MAESTRO for at least one year.

- Abdulhalim Dandoush (MAESTRO PhD student – defended his thesis on March 29, 2010), **Assistant Professor** at University of Latakia, Syria
- Mouhamad Ibrahim (MAESTRO PhD student – defended his thesis on November 14, 2008), **Engineer** at France Telecom, France
- Dinesh Kumar (MAESTRO PhD student – defended his thesis on November 26, 2008), **Staff Researcher** at IBM T.J. Watson Research Center, Hawthorne, USA
- Vincenzo Mancuso (MAESTRO postdoctoral researcher), **Staff Researcher** at IMDEA Networks, Madrid, Spain
- Giovanni Neglia (MAESTRO postdoctoral researcher), **Junior Research Scientist** at Inria, Sophia Antipolis, France
- Danil Nemirovsky (MAESTRO PhD student – defended his thesis on July 2, 2010), **Engineer** at Luxoft, Moscow, Russia
- Natalia Osipova (MAESTRO PhD student – defended her thesis on March 27, 2009), **Engineer** at Amadeus, Sophia Antipolis, France
- Sreenath Ramanath (MAESTRO PhD student – defended his thesis on October 6, 2011), **Engineer** at LEKHA Wireless, Bangalore, India
- Kavitha Voleti Veeraruna (MAESTRO postdoctoral researcher), **Assistant Professor** at SRM University, India.

Temporary positions

- Amar Prakash Azad (MAESTRO PhD student – defended his thesis on November 26, 2010), **Postdoctoral Researcher** at UC Berkeley, USA
- Majed Haddad (MAESTRO post-doctoral researcher), **Temporary Teaching and Research Assistant** (ATER) at University of Avignon, France
- Dorian Mazauric (MAESTRO/MASCOTTE PhD student – defended his thesis on November 7, 2011), **Postdoctoral Researcher** at Columbia University, USA
- Manoj Panda (MAESTRO post-doctoral researcher), **Postdoctoral Researcher** at Télécom SudParis, Evry, France
- Alonso Silva (MAESTRO PhD student – defended his thesis on June 7, 2010), **Postdoctoral Researcher** at UC Berkeley, USA
- Yuedong Xu (MAESTRO post-doctoral researcher), **Postdoctoral Researcher** at University of Avignon, France.

Last Inria enlistments

- Giovanni Neglia, hired in September 1st, 2008 as a Junior Research Scientist (CR2).

Other comments:

Giovanni Neglia was promoted at the Inria CR1 level in 2010, Eitan Altman was promoted at the Inria DR1 level in 2008, Philippe Nain was promoted at the Inria DR0 level in 2010. On April 29, 2010 Konstantin Avrachenkov was awarded the "Habilitation à Diriger des Recherches" (HDR) from the University of Nice - Sophia Antipolis.

2 Work progress

2.1 Keywords

Modeling, performance evaluation, stochastic processes, control theory, game theory, wired and wireless networks, social networks, Internet applications.

2.2 Context and overall goal of the project

MAESTRO is a project-team of Inria whose members are located in Sophia Antipolis (S. Alouf, K. Avrachenkov, P. Nain, G. Neglia), in Avignon (E. Altman) and in Montpellier (A. Jean-Marie). It is concerned with the modeling, performance evaluation, optimization and control of discrete-event dynamic systems (DEDS), with a strong emphasis on networks and their applications. The scientific contributions are both theoretical, with the development of new modeling formalisms, and applied with the development of algorithms and software tools for the performance evaluation of networks, carried out in the framework of industrial partnerships.

The main mathematical tools and formalisms used in MAESTRO include:

- theory of stochastic processes: Markov process, point process, large deviations;
- theory of dynamic discrete-event systems: queues, fluid (including mean-field) approximations;
- theory of control and scheduling: dynamic programming, Markov decision process, game theory, deterministic and stochastic scheduling, pathwise comparison;
- theory of singular perturbations;
- random matrix theory.

Our primary application area is networking and in particular, modeling, performance evaluation, optimization and control of protocols and network architectures. It includes:

- Internet infrastructures: TCP, high-speed congestion control, IP traffic estimation, quality of service;
- Internet applications: content distribution systems, peer-to-peer systems, overlay networks, video-on-demand, Web applications;
- Wireless (cellular, ad hoc, sensor) networks: WLAN, WIMAX, UMTS, delay-tolerant networks, power control, medium access control, transmission rate control, redundancy in source coding, mobility models, coverage, connectivity, routing;
- Network economics and network neutrality.

2.3 Objectives for the evaluation period

Objectives (1)-(3) below are cut and pasted from the 2003-2007 MAESTRO synthesis report.

(1) – Wireless networks (ad hoc, sensors, WIMAX, VANETs, mesh, etc.)

1. *We will study massively dense ad hoc networks and study their continuum limits as the node density increases and as the graph providing the available routes becomes a continuous area with location and congestion dependent costs.*

2. *The amazing technological advances in wireless devices has led networks to become heterogeneous and very complex. Biology inspired networks can provide strong tools to analyze and control future wireless (self-organized) networks. Part of this research will be performed in the context of European project BIONETS. This research direction includes some part of risk.*

3. *All performance studies in mobile ad hoc networks (MANETs) assume that mobiles move independently of each other, according to a handful of mobility models (Brownian motion, random waypoint, random direction). These mobility models exhibit nice mathematical properties (e.g. nodes uniformly distributed over the area in steady-state), but fail in general to capture real-life mobility patterns. We intend to develop and analyze more versatile mobility models, and to address their impact on the performance. We also intend to incorporate node unavailability in the performance studies, a feature that is in general not taken into account.*

4. *We plan to study the performance (e.g. stability) of distributed link scheduling algorithms for mesh networks under general node interference constraints and for general traffic patterns (e.g. multi-hop traffic).*

5. *We will investigate the performance of the IEEE 802.16 protocol, in particular we will characterize the session transfer delays. We will also optimize the power save mode according to the traffic dynamics. Part of this research will be performed in the context of the ANR WINEM.*

6. *We will pursue our research to evaluate the impact of fixed relay nodes (throwboxes) on the performance (e.g. delay) of MANETS. In particular, we plan to develop an asymptotic analysis as both the number of users and the number of throwboxes go to infinity. Such an analysis was developed by G. Sharma, R. R. Mazumdar and N. B. Shroff (Infocom 2006) in the absence of throwboxes.*

(2) – Social and information networks (Web, Web 2.0/3.0, CDS, P2P, reputation mechanisms, etc.)

1. *We will pursue our work on the performance evaluation of peer-to-peer storage networks. Experiments on PlanetLab will be performed to validate the models and gain insights on peers dynamics in such a testbed.*

2. *We will continue to study the properties of the Web graph as well as the properties of other information networks. We would like to study the clustering structure of the information networks and the process of their formation. Since typically information networks have a very large size, it is important to develop algorithms with linear or nearly linear complexity. We plan to continue the implementation of all theoretical and algorithmic advances in the Web Graph Analyzer software tool.*

3. *In the framework of the ANR project VOODDO we will develop efficient online algorithms for the problem of jointly: a) distributing redundant information over a CDN;*

b) satisfying the request of users, in a network-aware fashion, and in a stochastic environment. This objective will be pursued in conjunction with the VodDnet company, which is the principal partner of the VOODDO project.

(3) – Stochastic processes, discrete-event dynamic systems, dynamic games

1. *Many protocols and much of the operation of networks can be described using queueing theory. Branching theory plays an essential role in queueing models: polling systems (which model the operation of Bluetooth and of other local area networks), retrial queues (which model impatience of customers) the processor sharing queue and other models - can all be handled and analyzed using tools from branching processes. In particular, the theory of multi-type branching processes is useful for systems that offer several types of services. We have identified two major challenges in developing the theory of branching processes:*

   - *Branching processes with non-markovian random environment. This would allow to study the impact of correlation on the expected delays in the system.*
   - *Multi-type branching processes with continuous state-space. These processes allow the modeling of local area networks with several queues, whereas without the multi-type formalism, only networks with no more than two nodes can be analyzed explicitly.*

   We will study the case of no migration, after several years during which we have only focused on the case of migration.

2. *We will maintain our theoretical activities in optimal control, including singular perturbations of Markov decision processes, and in game theory, in particular evolutionary games. Founded by biologists to explain past evolution and to predict future evolution of species, evolutionary games enjoy several properties that make them appealing to study competition in large complex systems, such as ad hoc or sensor networks. We will develop the theory of evolutionary game with as objectives: (i) to make them useful not only to explain past and future evolution, but also as an engineering design tool for a framework for evolution of protocols and services. (ii) we will adapt this tool from biology to networking by including randomness, by allowing an individual to take several decisions during his life time, and by adding states such that the decisions taken by individuals affect not only their current reward (fitness) but also the transition probabilities to the next state. As an example, we will use this framework to study power control in which the state corresponds to the battery level.*

3. *We will study also other aspects of game theory, such as games with constraints, which can model power or signal to interference constraints in wireless networks.*

4. *All the theoretical developments are inspired by and applied to the various networking applications described in the objectives (1) and (2).*

Evolution of the objectives during the evaluation period

The creation of the Alcatel-Lucent Inria Joint Laboratory in 2008 and our involvement in the research action line "Semantic Networking" during the period 2008-2011 has had the consequence that we have kept working on IP networks with a focus on flow aware traffic management, an objective that did not appear in the 2008-2011 objectives (see details in Section 2.4). Four EU patents have been filled with Alcatel- Lucent Bell Labs in this framework [297, 298, 299, 300].

Regarding the 2008-2011 objectives (1)-(3), the vast majority of them has been fulfilled as shown in Sections 2.5-2.8, and sometimes beyond (e.g. objectives (2) and (3) related to wireless communications, stochastic processes and dynamic games – see achievements in Sections 2.5, 2.7, 2.8).

A few objectives were either not considered or only partially reached. In the first category, we find objective (1)-3 on the development of new mobility models and objective (2)-1 on experimental work on the PlanetLab platform for the validation of P2P storage models due to the lack of personnel. In the second category, we find objective (1)-4 on distributed link scheduling and, in particular, the part related to stability issue. This field is notoriously difficult (cf. the pioneering work by L. Tassiulas and A. Ephremides) and we were only able to derive necessary stability conditions [339] (on the positive side the latter work conducted by D. Mazauric and P. Nain, in collaboration with J-C. Bermond and V. Misra from Columbia Univ., is at the origin of the post-doc of Dorian Mazauric at Columbia). We also find objective (1)-6 in this second category despite the contribution in [168].

One new research topic has emerged during the evaluation period, network neutrality (see Section 2.4).

Below is a selection of **representative papers** which have contributed to the achievements of MAESTRO's 2008-2011 research objectives:

[93]: E. Altman, K. Avrachenkov and A. Garnaev, "Closed Form Solutions for Symmetric Water Filling Games", Proc. *IEEE INFOCOM*, 2008.

[28]: E. Altman, K. Avrachenkov, I. Menache, G. Miller, B. J. Prabhu and A. Shwartz, "Dynamic Discrete Power Control in Cellular Networks", *IEEE Transactions on Automatic Control*, 2009.

[42]: E. Altman, T. Basar and F. De Pellegrini, "Optimal Monotone Forwarding Policies in Delay Tolerant Mobile Ad-Hoc Networks", *Performance Evaluation*, 2010.

[61]: E. Altman and F. De Pellegrini, "Forward Correction and Fountain Codes in Delay-Tolerant Networks", *IEEE/ACM Transactions on Networking*, 2011.

[145]: E. Altman, P. Nain and J-C. Bermond, "Distributed Storage Management of Evolving Files in Delay Tolerant Ad Hoc Networks", Proc. *IEEE INFOCOM*, 2009.

[253]: E. Altman, P. Nain, A. Shwartz and Y. Xu, "Predicting the Impact of Measures Against P2P Networks on the Transient Behaviors", Proc. *IEEE INFOCOM*, 2011.

[33]: K. Avrachenkov, N. Litvak and K.S. Pham, "A Singular Perturbation Approach for Choosing the PageRank Damping Factor", *Internet Mathematics*, 2009.

[203]: K. Avrachenkov, B. Ribeiro and D. Towsley, "Improving Random Walk Estimation Accuracy with Uniform Restarts", Proc. *7th Int. Workshop on Algorithms and Models for the Web Graph* (WAW), 2010.

[66]: A. P. Azad, S. Alouf, E. Altman, V. Borkar and G. S. Paschos, "Optimal Control of Sleep Periods for Wireless Terminals", *IEEE Journal on Selected Areas in Communications*, 2011.

[207]: D. Carra, K. Avrachenkov, S. Alouf, A. Blanc, P. Nain and G. Post, "Passive Online RTT Estimation for Flow-Aware Routers Using One-Way Traffic", Proc. *IFIP Networking*, 2010 (yielded [297], EU Patent 09 305 207.4, Alcatel-Lucent and Inria).

[67]: D. Carra, G. Neglia, P. Michiardi, and F. Albanese. "On the Robustness of BitTorrent Swarms to Greedy Peers", *IEEE Transactions on Parallel and Distributed Systems*, 2011.

[279]: V. Mancuso and S. Alouf, "Power Save Analysis of Cellular Networks with Continuous Connectivity", Proc. *12th IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks* (WoWMoM), 2011.

[53]: H. Tembine, E. Altman, R. El-Azouzi and Y. Hayel, "Evolutionary Games in Wireless Networks", *IEEE Transactions on Systems, Man, and Cybernetics: Part B, Special Issue on Game Theory*, 2010.

[81]: I. Tinnirello, L. Giarré and G. Neglia, "MAC Design for WiFi Infrastructure Networks: a Game-Theoretic Approach", *IEEE Transactions on Wireless Communications*, 2011.

2.4 Objective 1 – IP networks: Executive summary

2.4.1 Personnel

Permanent researchers: S. Alouf, E. Altman, K. Avrachenkov, P. Nain, G. Neglia.
Postdoctoral researchers: A. Blanc, D. Carra.

2.4.2 Project-team positioning

For the last 10-15 years TCP/IP performance analysis and optimization have been one of the major subjects in networking. During the first years of this period the main research effort was concentrated on the performance evaluation and understanding of TCP mechanisms. We would like to mention the theoretical work of T. Ott and practical work of S. Floyd on the "square root" formula for the average TCP sending rate, the work of the Computer Networks Research Group (J. Kurose, D. Towsley) at UMass Amherst, on the refinement of the "square root" formula taking into account the details of the TCP mechanism, the work of F. Kelly (Cambridge) and S. Low (Caltech) on the utility function based-approach to the description of the TCP/IP networks with general topology.

Even though the performance of TCP provides up to the present an acceptable level of service, the new, notably high-speed, capabilities of modern IP routers and the wide spread of new delay and jitter sensitive applications (Skype, YouTube, ...) have prepared the ground for important modifications in TCP/IP networks. In particular, the quality of service and experience can be significantly improved by performing per flow quality of service differentiation. In this respect, during the last several years MAESTRO has worked on the design and evaluation of new high-speed versions of TCP, on size-based TCP connection differentiation, and on per flow traffic management. Other groups working on the design and the performance evaluation of high-speed TCP versions include the group of S. Low, the group of R. Srikant and T. Başar (UIUC), and the Hamilton Institute group. Other groups working on size-based TCP connection differentiation include the group of M. Harchol-Balter at CMU, the CWI-Eindhoven group (S. Borst and R. Núñez-Queija) and the Eurecom group of E. Biersack. Recently, we have shifted our effort to work on flow-aware traffic management. We collaborate significantly on this topic with Alcatel-Lucent in the framework of the Alcatel-Lucent Inria Joint Lab. Examples of other researchers and teams working on per flow traffic management are J. Roberts (now at Inria in project-team RAP), N. Duffield (AT&T Research), H. Tode (Osaka Prefecture Univ.). There is also a recent initiative to look at TCP/IP networks from a higher perspective

of Network Neutrality. MAESTRO is among the pioneering teams in this new research direction.

2.4.3 Scientific achievements

Flow-aware traffic management. In the framework of Alcatel-Lucent Inria Joint Lab we are working on flow-aware traffic management. In particular, we suggest first to divide the flows into "mice" and "elephants" classes and give priority to the flows from the "mice" class. This way we reduce the overall average number of flows and significantly reduce the delay and the jitter for "mice" flows. Then, typically there are only hundreds of large "elephant" flows backlogged at the bottleneck router which we can easily manage on per flow basis. We have proposed two mechanisms to control "elephant" TCP flows individually. These two mechanisms, Monitor Rate and Binary Search are filed as patents [298, 299].

Performing separation of "mice" and "elephants" in a practical and scalable fashion is not a trivial task. In [212, 267] we propose a new way of performing size-based scheduling in a scalable fashion, by identifying and "de-prioritizing" elephants only at times of high load. It is based on TCP's behavior by using a mechanism that detects a window of packets - called spikes - when the buffer length exceeds a certain threshold.

As another auxiliary problem for flow-aware traffic management, we have also solved the problem of estimating the round-trip time of long-lived TCP flows based on the traffic observed in one direction. The method uses spectral analysis along with a pattern-matching technique for the extraction of the fundamental frequency. The method was patented in [297] and published in [207].

High speed TCP. With the recent large increase of Internet link capacities, it turns out that the current New Reno TCP version can significantly under-utilize the links. The reason for this is that the linear increase of the TCP congestion window is too slow. To address this issue a number of new TCP variants (Highspeed TCP, Scalable TCP, FAST TCP, Compound TCP, etc...) have been proposed. Some versions of High speed TCP have already been implemented in operating systems. For example, Cubic TCP has been implemented in UNIX and Compound TCP has been implemented in Windows. In a series of papers [154, 153, 155] we have analyzed the performance Cubic and Compound TCPs. In particular, we have concluded that for smaller bandwidth delay products, Cubic can have a similar throughput to Reno while for larger values the throughputs of Cubic and Compound versions are similar and larger than Reno. Thus, TCP Cubic can be considered more TCP Reno friendly version.

Accuracy of fluid models for bandwidth-sharing networks. Optimal control of stochastic bandwidth-sharing networks is typically difficult. In order to facilitate the analysis, deterministic analogues of stochastic bandwidth-sharing networks, the so-called fluid models, are often chosen for analysis, as their optimal control can be found more easily. In [64] we study the efficiency of tracking and feedback policies, that is, how fast the fluid optimality can be achieved in the stochastic model with respect to the scaling parameter.

Interdisciplinary study of the Internet access and of network neutrality. We have identified large inefficiencies that occur when one allows one type of provider (e.g. access provider) to impose costs on another type of provider (e.g. content provider) [60]. This investigation has been pursued in various directions. In particular, we have studied

which incentives can be given and which policies can be implemented to rectify this situation. In [252] we have studied a hierarchical structure of ISPs, the economic impact of some cashing placement policies, and more complex demand functions (the demands of users for content). In [83] MAESTRO members in collaboration with the law specialist S. Wong (Univ. of A Coruña, Spain) analyze in cooperation with the impact of legislation related to network neutrality on the quality of service for the end users.

2.4.4 Collaborations

MAESTRO has collaborated extensively and continues collaboration with Alcatel-Lucent in the framework of the Alcatel-Lucent Inria Joint Lab on per flow IP traffic management. MAESTRO has collaborated with Orange Lab on the analysis of High Speed TCP versions. With the University of Liverpool MAESTRO has collaborated on accuracy of fluid models for bandwidth-sharing networks. Then, MAESTRO has worked on network neutrality jointly with a law specialist from the University of A Coruña in Spain.

2.4.5 External support

This research has been supported by ADR Grants from the Alcatel-Lucent Inria Joint Lab, by the Network of Excellence EuroNF and Inria ARC Meneur (See Section 4).

2.4.6 Self assessment

Our work on per flow based IP traffic management has a potentially significant practical impact. This is confirmed by three joint patents with Alcatel-Lucent and the fact that Alcatel-Lucent as well as the other telecom equipment providers such as Cisco and Xilinx implement per flow traffic management in their new models of IP routers. Orange Labs also continues to push for product implementation of the earlier developed size-based flow differentiation policies. On the topic of network neutrality MAESTRO is one of the pioneering teams in this research area. The research results have been published in good conferences and journals such as *Networking*, *Computer Networks Journal* and *Journal of Applied Probability* (JAP).

MAESTRO members are actively participating in NET-COOP and NETGCOOP Conference Series (E. Altman is in the steering committe and K. Avrachenkov is in the programme committee). The research theme of this conference is centered at Network Control and Optimization.

2.5 Objective 2 - Wireless communications : Executive summary

2.5.1 Personnel

Permanent researchers: S. Alouf, E. Altman, K. Avrachenkov, A.-E. Baert, P. Nain, G. Neglia. **PhD students:** A. P. Azad, M. El Chamie, M. K. Hanawal, M. Ibrahim, D. Kumar, D. Mazauric, S. Ramanath, A. Silva. **Postdoctoral researchers:** U. Acer, M. Haddad, V. Kavitha, V. Mancuso, M. Panda, Y. Xu.

2.5.2 Project-team positioning

During the evaluation period, we have addressed performance evaluation, optimization and control issues of wireless networks, namely large cellular networks, pico-cells networks, disruption tolerant networks and sensor networks. Our work is characterized, on one hand, by the development of new modeling formalisms and, on the other hand, by the

hot technological issues that we are addressing in close collaboration with our industrial partners (France Telecom, Alcatel-Lucent).

Many research groups worldwide investigate performance evaluation of wireless technologies. MAESTRO's specificity relies on the use of a large variety of analytical tools from applied probability, control theory and distributed optimization to study and improve wireless network functionalities. Among the research groups with a similar approach, let us mention the Computer Networks Research Group at UMass Amherst (D. Towsley, J. Kurose), the Laboratory for Information and Decision Systems (E. Modiano, A. Ozdaglar, D. Shah), the Laboratory for Computer Communications and Applications at EPFL (J.-P. Hubaux, J.-Y. Le Boudec, P. Thiran, M. Grossglauser), the System and Networking goup at Microsoft Research (P. Key, D. Gunawardena, B. Radunovic, M. Vojnovic), the Telecommunication Networks Group at Politecnico di Torino (M. Ajmone Marsan, P. Giaccone, M. Meo), Bell Labs (S. Borst), University of Waterloo (R. Mazumdar), University of Thessaly (L. Tassiulas) etc. In the area of wireless communications MAESTRO's work is complementary to those of Inria project-teams HIPERCOM, PLANETE, SWING and TREC.

2.5.3 Scientific achievements

Green networking. This refers to a new trend in network design that is more aware of the impact of technology on the environment and on humans. Our research in this area is devoted to understanding the tradeoffs between reducing energy and other performance measures such as coverage and delay, and enhancing wireless networks making them more efficient in terms of energy used. In [65] the focus is on WiMAX networks, whereas [279] considers cellular networks with continuous connectivity. The objective is to optimize the performance of the network, captured as energy consumption and response delay. In [66], the proposed techniques can be applied to cellular technology as well as other wireless access technologies. We attack the problem by means of dynamic programming. Important properties of the system are unveiled, and deep understanding is provided.

An important outcome of our work is that the algorithms proposed by the standards of current mobile networks are suboptimal in the sense that even if the parameters are optimally controlled, there exist other sleep policies which perform strictly better. Our work provides an important basis and critical intuition as regards energy saving in mobile terminals or in general saving power in the access layer of wireless networks.

Another line of research investigates policies for switching off base stations using two new tools: multimodularity [283] and stochastic geometry [85]. In [85], we address the problem of jointly minimizing energy as well as the effect of radio transmissions to human beings, making the network green for the human also from the health aspects as well. This is one of the most striking points in this line of research.

Optimal routing in disruption-tolerant networks (DTN). Routing in opportunistic delay tolerant networks usually relies on multiple copies of the information spreading at the same time in order to increase the delivery probability and reduce the delivery time. We have used different frameworks in order to determine optimal routing policies subject to resource constraints (e.g. energy or memory).

A first set of results relies on applying control theory to a fluid approximation of the system. In particular [42] applies the Pontriagin maximum principle to determine optimal static and dynamic policies when the number of copies in the system is a non-decreasing function of time; [59] uses the theory of linear quadratic regulator to derive explicit control policies when the cost to be minimized is a quadratic function of the state and/or of the

control. Optimal policies may require the knowledge of some global parameters (e.g. the number of nodes in the network), that may change over time. In [146] we show how these parameters may be learned through stochastic approximation techniques, so that adaptive optimal policies can be designed. [145] considers the case where contents to be spread are dynamic: they are periodically updated and their value from the users' point of view decreases over time. More recently, we have shown how risk sensitive control theory (well known in finance) can be used to determine optimal policies without the need to resort to a fluid approximation [251]. In [61], we investigate how network coding can improve the performance of DTNs by efficiently adding spatial redundancy to the network. The structure of optimal policies is identified and shown not always to be of a threshold type.

A different approach to optimize the parameters of the routing policy is to rely on an intelligent random exploration of the parameter space. In particular [26, 40] propose a framework inspired by genetic algorithms to learn the optimal policies using nodes' local knowledge.

Finally [176, 280] address the problem of optimal parameter selection using distributed subgradient methods, that converge to the optimum when the optimization goal can be expressed as sum of local convex functions.

Ferry based local area networks. We have used (and extended) the theory of polling systems to design optimal cyclic routes for message ferries, i.e. mobile nodes that can move in the field where a sparse sensor network is deployed in order to collect (/deliver) messages generated from (/destined for) the sensors. We have considered both a "bus" operation mode, where ferries can only stop at some specific locations [171, 226] and "taxi" operation mode where they can stop at any point of their trajectory [76].

Small cell networks. In the framework of the Alcatel-Lucent Inria Joint Lab we have worked on the problem of optimizing cell size in pico-cell networks. To achieve this goal, we have considered fluid models to calculate interference level and total power received at the base station [180], and random matrix theory to calculate the maximum number of users a multi-antenna cell can support for a given interference level [235]. In [77], we have characterized the performance of pico-cell networks in the presence of moving users, and determined how the size of the cell should take into account mobility characteristics. In particular we have shown how in a 2D scenario a bad configuration can lead to a dangerous operation with very small values of drop/blocking probabilities but almost zero useful transmission rates.

2.5.4 Collaborations

We had many fruitful collaborations during the evaluation period. The most significant ones were with: (*i*) IISc (A. Kumar, R. Sundaresan), India, on throughput analysis [22] and power control in WLANs [79], on optimal scheduling in VANETs [50], and on optimal forwarding policies in DTN [287]; (*ii*) TIFR (V. Borkar), India, on optimal control in DTN [251] and in WiMAX [66]; (*iii*) Create-Net (I. Carreras, F. De Pellegrini, D. Miorandi), Italy, on optimal control [40, 42, 59, 146, 197, 251] and network coding in DTN [61, 200]; (*iv*) University of Illinois at Urbana-Champaign (T. Başar), USA, on optimal control in DTN [42, 59, 197]; (*v*) University of Pennsylvania (M.H.R. Khouzani, S. Sarkar), USA, on optimal control of epidemic evolution [275], and on optimal defense and attack strategies in malware-infected mobile networks [89, 229, 230]; (*vi*) Orange Labs (Z. Altman, R. Combes), on self organization in cellular networks [68, 264]; (*vii*) Supelec (M. Debbah)

and Alcatel-Lucent (V. Kumar), on dimensioning [180] and asymptotic analysis of pico-cells [235]; (*viii*) Alcatel-Lucent (V. Capdeville, L. Roullet), on mobility management in small cells networks [300]; (*ix*) Politecnico di Torino (P. Giaccone), Italy, on routing in quasi-deterministic networks [55].

2.5.5 External support

Our efforts in green networking have been supported by the ANR WINEM, the Network of Excellence Euro-NF and the Inria associate team DAWN. The research on optimal routing in disruption-tolerant networks has been partially supported by the European project BIONETS and the COLOR CRasQuidem. The Alcatel-Lucent Inria Joint Lab has sponsored our activities in pico-cells through the ADR grant "Self-Optimizing Wireless Networks".

2.5.6 Self assessment

Our work on the design and dimensioning of small cell networks with mobile users has a high practical interest, as exemplified by the filing of a joint patent with Alcatel-Lucent. As concerns routing in DTN, we have studied the problem from different perspectives, using (and sometimes extending) tools from control theory, distributed optimization, genetic algorithms... An important aspect of our work on green networking is the aspiration to affect the standards of current mobile networks as well as the future ones. Our work can serve as a substratum for green networking research at the access layer. The relevance of our contribution has been recognized by the community as indicated by the Best Paper Award at the *IFIP Wireless Days 2009* conference [149] and the two papers published in *IEEE Journal on Selected Areas in Communications* (JSAC) [65, 66].

The results of our work on wireless networks were published in 24 journal papers: 5 in *Performance Evaluation*[11, 16, 42, 77, 68], 3 in *IEEE/ACM Transactions on Networking* (ToN) [22, 39, 61], 2 in JSAC and 2 in *IEEE Transactions on Automatic Control* [59, 89]; ToN and JSAC are the top 2 journals in computer science considering citations per paper.[4] We can also mention 14 papers presented at *IEEE INFOCOM* (5 out of them at the Mini-conference). Three papers have been awarded: [264], Best Paper Award at *CNSM 2011* conference (among 164 papers, acceptance rate 14.6%); [149], Best Paper Award at the *IFIP Wireless Days 2009* conference (among 186 papers); and [111], Best Student Paper Award at *VALUETOOLS 2008* conference (among 84 papers).

2.6 Objective 3 - Information systems : Executive summary

2.6.1 Personnel

Permanent researchers: S. Alouf, E. Altman, K. Avrachenkov, A. Jean-Marie, A.-E. Baert, P. Nain, G. Neglia. **PhD students:** N. Choungmo Fofack, A. Dandoush, D. Mazauric, D. Nemirovsky, S. Ramananath, M. Sokol. **Postdoctoral researchers:** D. Carra, M. Haddad, Y. Xu.

2.6.2 Project-team positioning

Many methods in information retrieval domain use networks. Let us mention several examples. Hyperlinks among documents in a hypertext document collection can be used for ranking and clustering of documents. In the case of ranking, each link can be interpreted

[4] `http://www.timeshighereducation.co.uk/story.asp?sectioncode=26\&storycode=406557`.

as a vote from one document to another document. Google uses PageRank as one of the main criteria for ranking answers to users' queries. PageRank can be interpreted as a stationary distribution of the random walk on the hypertext graph with uniform restart after a geometrically distributed number of steps. Many variations to the standard PageRank algorithm have been proposed (see e.g. the recent book [LM12][5] and references therein). Many researchers are currently working in the area of analysis of ranking algorithms. Let us just mention the main players in this research domain: A.N. Langville (College of Charleston), P. Boldi (University of Milano), F. Chung (UCSD), R. Baeza-Yates (Yahoo Research), D.F. Gleich (Purdue University). MAESTRO was also among the pioneering teams in this research domain. Another interpretation of a link between two hypertext document is a sign of their semantic proximity. Thus, hyperlinks can be used for clustering hypertext document collections. This is a very large area of research. A good overviews can be found in the survey papers [F10][6] and [OV10][7] The other important areas of application of ranking analysis and graph based clustering are: social networks, protein-protein interaction networks, citations analysis, ranking in sports.

There are many individuals/groups worldwide working on the performance evaluation of distributed/P2P systems. Let us mention A. Chaintreau (Columbia Univ), G. de Veciana (Univ. Texas at Austins), L. Massoulié (Technicolor), R. Núñez-Queija (Univ. Amsterdam/CWI), R. Srikant (UIUC), M. Vojnovic (Microsoft Research), etc.

Research on content-oriented networking is rapidly gaining interest and is led by the group of V. Jacobson at Xerox Park. Other groups working in this area are the groups of A. Simonian at Orange Labs., G. Carofiglio and D. Perino at Alcatel Lucent, J. Kurose at UMass, L. Tassiulas at University of Thessaly (non-exhaustive list). At Inria, project-teams PLANETE and RAP are also conducting research on content-oriented networking within the ANR Grant Connect.

2.6.3 Scientific achievements

Information retrieval (ranking, sampling, clustering). The research has focused on the design and performance analysis of algorithms for the computation and estimation of various Web graphs characteristics, including (non-exhaustive list) ranking of Web pages (centrality measure), degree distribution, quick detection of the top-k most important neighbors of a node, clustering of hyper-linked document collection [106]. Below, we briefly describe some significative results of this research.

A random walker can be used as a centrality measure of a directed graph, that is a measure that quantifies the importance of each node. However, if the graph is reducible, which is the case of the Web graph which has been shown to be composed of a giant Strongly Connected Component (SCC), an IN-component (IN) and an OUT-component (OUT), the random walker will be absorbed in some subset of nodes and will never visit the rest of the graph. In Google PageRank the problem was solved by the introduction of uniform random jumps with some probability c, a parameter called the damping factor. Up to now, there is no final answer regarding the choice of the damping factor (in PageRank $c = 0.85$, an empirical choice). The smaller c the larger the spectral gap and the faster the convergence to the stationary distribution (i.e. to the ranking). On the other hand, when c is too small the properties of the Web graph are distorted since with a high probability the random walker jumps uniformly to any node upon leaving a node. When c is close to 1

[5] [LM12] A.N. Langville and C.D. Meyer, *Who's #1?: The Science of Rating and Ranking*, Princeton University Press, 2012.

[6] [F10] S. Fortunato, "Community Detection in Graphs", *Physics Reports* 486, 75-174, 2010.

[7] [OV10] N. Oikonomakou and M. Vazirgiannis, "A Review of Web Document Clustering Approaches", chapter in *Data Mining and Knowledge Discovery Handbook*, Springer, pp.931-948, 2010.

it is shown in [33] that there exist nodes in the OUT component (nodes only linked to each other) that receive an unfairly high ranking. Therefore, one must find a tradeoff for the value of c. Through theoretical arguments and experimental validations the authors argue that c should be close to $1/2$. Since PageRank is very sensitive to the value of the damping factor, it is proposed in [46] to use four quasi-stationary distributions as parameter-free centrality measures. These four measures are shown to produce approximately the same ranking.

PageRank gives an approximation of the ranking of Web pages since the random surfer uses uniform distributions. This assumption is limited by nature. Personalized PageRank was designed to solve the problem but it is quite restrictive since it assumes non-uniform preferences when jumping to an arbitrary page and non-preferred behavior when following an out-going link. In [177] Weighted PageRank is proposed which allows weighting hyperlinks according to any possible preferred behavior of a user.

Numerous applications (finding local cuts in large graphs, estimation of similarity distance, person name disambiguation, etc.) rely on the detection of top-k Personalized PageRank (PPR) lists. In these settings it is important that the detection be fast whereas the exact order in the top-k list as well as the exact values of PPR are by far not as crucial. Also, a few number of wro¡ng elements in top-k lists does not really degrade the quality of top-k lists, but it can lead to significant computational saving. Based on Monte Carlo methods a quick detection of top-k PPR list is proposed in [241, 260], evaluated and stopping criteria are supplied. This technique was applied to the person name disambiguation problem and was ranked # 2 in the Web Person Search (WePS) 2010 competition (`http://nlp.uned.es/weps/weps-3/call-for-participation`). Authors have also demonstrated the effectiveness of their approach on the Web and Wikipedia graphs.

In [203] an hybrid sampling scheme mixing independent uniform node sampling and a random walker (RW)-based crawler is proposed and analyzed. This method enjoys the strengths of both uniform and RW sampling while minimizing their drawbacks. In particular, it increases the spectral gap of the RW, thereby accelerating the convergence to the stationary distribution. The authors applied their method to the estimation of the degree distribution of graphs.

To conclude, let us also mention the work in [62] which addresses the optimization of a crawling engine. The crawler finds new Web pages and updates existing ones in the database of the Web search engine. A crawling engine has several robots collecting information from the Internet. This paper addresses the optimal number of robots to be used at any time so that the system does not starve and at the same time the loss rate is minimized. Under very general statistical assumptions (batch Markov arrival process (BMAP) for the Web page arrival processe, phase-type distributions for the indexing time and the page obsolescence time) the authors calculate the best threshold policy within the class of all threshold policies.

Distributed/P2P systems (storage, file sharing, illegal downloading). In a series of papers the question of optimal data replication and placement in distributed video-on-demand (VOD) storage systems has been addressed [34, 35, 107, 108, 151, 234]. Optimality refers here to expected response time. Determining how much to replicate and where to replicate are difficult problems. Heuristics have been proposed and evaluated experimentally. The study was completed by theoretical resuts including the proof of optimaliy of particular configurations (case of two replicates, Steiner systems) and the analysis (mean and variance) of certain random algorithm.

Distributed systems using a network of peers has become an alternative solution for

storing data. These systems are based on three pillars: data fragmentation and dissemination among the peers, redundancy mechanisms to cope with peers churn and repair mechanisms to recover lost or temporarily unavailable data. Traditional redundancy schemes are replication and erasure codes. A new class of network coding (regenerating codes) has been proposed recently. In [159, 161, 160, 6] Markov models have been used to investigate and to compare the performance (data lifetime, availability) of P2P storage systems using either traditional redundant codes or regenerative codes.

In [253] the transient behavior of some P2P networks is studied. This work has two objectives: the first one is to study rigorously the transient behavior of some P2P networks whenever the information is replicated and disseminated according to epidemic-like dynamics, the second one is to use insight gained from the previous analysis in order to predict how efficient are measures taken against P2P networks. A Markov model is introduced which extends a classical epidemic model and characterize the P2P swarm behavior in presence of free riding peers. Another model is also considered in which a peer initiates a contact with another peer chosen randomly. In both cases the network is shown to exhibit a phase transition: a small change in the parameters causes a large change in the behavior of the network. It is shown, in particular, how the phase transition affects measures that content provider networks may take against P2P networks that distribute non-authorized music or books, and what is the efficiency of counter-measures.

The success of BitTorrent has fostered the development of variants to its basic components. Some of the variants adopt greedy approaches aiming at exploiting the intrinsic altruism of the original version of BitTorrent in order to maximize the benefit of participating to a torrent. BitTyrant is such a variant. A BitTyrant client tries to determine the exact amount of contribution necessary to maximize its download rate by dynamically adapting and shaping the upload rate allocated to its neighbors. It is shown in [67, 109] that the gain of a single BitTyrant client disappears in the case of a widespread adoption: results indicate a severe loss of efficiency that is analyzed in detail. In contrast, a widespread adoption of the latest version of the mainline BitTorrent client would provide increased benefit for all peers.

Content-Centric Networks (CCNs). We have investigated the performance (average cache occupancy, hit and miss probabilities/rates) of a CCN-like cache architecture whose cache replacement policy at each cache is based on Time-to-Lives (TTLs). Exact results have been obtained for some specific architectures with exponential TTL distributions (linear networks, tree networks) and accurate approximations (relative errors $< 10^{-2}$) have been derived for more general topologies and general TTL distributions [377]. This is in contrast with the celebrated LRU cache replacement policy for which there does not exist any exact result except for a single-node architecture. We have also started the investigation of CCN routing strategies for the requests (called interests) by casting the problem into the setting of multi-armed bandit model with delays. At each CCN node a learning algorithm determines to which CCN neigbhor(s) the interest should be forwarded when the node does not posses the required content.

2.6.4 Collaborations

We collaborate with N. Litvak from University of Twente on efficient methods for network centrality estimation. We collaborate with D. Towsley and B. Ribeiro from University of Massachusetts on sampling in social and information networks. We collaborate with V. Dobrynin from St. Petersburg State University on graph based methods for document sampling and classification. On the topic of network based methods for information re-

trieval we also collaborate with other Inria teams: with AXIS we work on expert search and person name diambiguation, with EDELWEISS we work on role discovery in social networks, and with Rueso and the Alcatel-Lucent Inria Joint Lab. we work on graph based clustering and classification methods.

The work on the transient behavior of P2P systems was carried out in collaboration with A. Shwartz (Technion). The work on the analysis of BitTyrant was done in collaboration with P. Minciardi (Eurecom).

The work on data replication and placement was done in conjuction with A. E. Baert, V. Boudet and X. Roche (Univ. Montpellier 2), then in collaboration with the MASCOTTE project-team.

2.6.5 External support

The research on CCN cache architecture is carried out in the framework of a research grant with Orange Labs (group of A. Simonian with B. Kauffmann and L. Muscariello). The work on optimal replication and placement in distributed VoD storage systems was carried out within the VOODDO project coordinated by the VodDnet company.

2.6.6 Self assessment

Our work has been published in visible journals (*Internet Mathematics*, *SIAM Journal of Numerical Analysis*, *IEEE Trans. on Parallel and Distributed Systems*, *Computer Networks*) and conferences (*Infocom*, *ITC*, *ValueTools*, *ICPP*, ...). For a better dissemination of our research to different (in particular, Web) communities, we have presented our work to a variety of (in general young) multidisciplinary conferences and workshops such as DIGIBIZ (*Int. Conf. in Digital Business*), CISIS (*Int. Conf. on Complex, Intelligent and Software Intensive Systems*), WAW (*Workshop on Algorithms and Models for the Web Graphs*), CLEF (*Conf. on Multilingual and Multimodal Information Access Evaluation*), *NIPS Big Learning Workshop*,...

MAESTRO has been one of the pioneering teams in the area of network based methods for information retrieval. K. Avrachenkov was Chair of the *6th Workshop on Algorithms and Models for the Web Graph* (WAW 2009).

The collaboration with the VodDnet startup company in the VOODDO project did not have the expected practical impact, due to its unfortunate bankrupcy. It has nevertheless produced interesting research topics, some of which are still being explored.

2.7 Objective 4 - Game theory applied to networking : Executive summary

2.7.1 Personnel

Permanent researchers: E. Altman (main contributor), K. Avrachenkov, G. Neglia. **PhD students:** A. Azad, S. Ramanath, A. Silva, H. Tembine.

2.7.2 Project-team positioning

Networking games have been investigated in many areas for almost a century, with the most active work being done in road traffic engineering. Towards 1999 the community of algorithmic games was formed with key figures such as E. Tardosh and T. Roughgarder. They introduced new game theoretic issues arising in computer science including computer networks. In parallel, game theory started penetrating electrical engeneering in which new

types of problems arise, namely those related to communication theory, to information theory and to energy consideration (an example is power control games).

Within Inria, the project-team DYONISOS has been working on topics related to networking games arising in the economy of networks. The MESCAL project-team has been working on learning in games, routing and flow control games and power control. MAESTRO has been collaborating with both teams.

2.7.3 Scientific achievements

Much of Game Theory has developed within the community of Economists, starting from the book *Theory of Games and Economic Behavior* (Princeton University Press, 1944) by J. Von Neumann and O. Morgenstern. To a lesser extent, it has had an impact on biology (with the development of evolutionary games) and on road traffic engineering (triggered by the concept of Wardrop equilibrium introduced already in 1952 along with the Beckmann potential approach introduced in 1956). Since 1999, game theory has had a remarkable penetration into computer science with the formation of the community of algorithmic game theory. Research conducted in MAESTRO aims at creating the foundations of game theory for the community of telecommuniction network engineering. We call games within this context "Networking Engineering Games" (NEG). NEG is concerned with competition that arises at all levels of a network. These include aspects related to information theory, to power control and energy management, to routing, to the transport and application layers of communication networks. It also includes competition arising in spread of information over a network as well as issues related to the economy of networks. Finally, it includes security issues, service denial attacks, spread of virus in computers and measures to fight it.

Our major contributions to NEG in the four last years have been in developing the foundations of dynamic network games, in contributing to the foundations of evolutionary games and in contributing to the foundations of routing games.

Dynamic network games. In dynamic networks, the topology of the network changes in time. Games over dynamic networks that we solved include network formation games [257] routing and access control in ad-hoc networks as well as routing in delay tolerant networks. These games also include power control games [93, 28], since in wireless communications the transmission power determines the quality of the radio channel as well as its capacity. In particular, it may have an impact on the topology of the network.

Our first major contribution in that area has been the creation of Epidemic Games. These include (i) zero-sum game models for analyzing and countering computer viruses [274] as well as (ii) competing epidemics, useful for issues related to the spread of useful content in a network [127, 146]. In both cases we obtained the structure of equilibrium policies; in [274] we used the Pontryagin maximum principle for that, where as in the other references we used especially sample path arguments along with coupling.

A second important contribution has been to study routing in massively dense ad hoc networks. The problem is formulated as a shortest routing problem in a graph in which one replaces a finite large number of links by a continum of links that is represented by the whole plan. The plan inherits from the original graph only the costs density. Not only was this problem a hard one, but also the scientific context in which to study this problem was unknown. The problem has been addressed in optics, electrostatics and electrodynamics. Our contribution was first to propose the appropriate scientific context in which this problem can be treated, that of continuum Wardrop equilibrium (from road traffic). We further provided numerical tools for deriving the equilibrium [52].

Evolutionary and population games. The Nash equilibrium notion in game theory is a set of policies which is robust against unilateral deviations: at equilibrium, a single player cannot benefit from a unilateral deviation. In games with a very large number of players, the notion of Nash equilibrium is not satisfactory: we prefer equilibria notions that describe robustness against deviations (also called "mutations") of a whole (possibly small) fraction of the population. Evolutionary game theory defines such an equilibrium as an Evolutionary Stable Strategy (ESS). Evolutionary games distinguish between populations of players; moreover, within each population one distinguishes between sub-populations that correspond to the different choices of strategies. The fitness of a player is determined by the actions of the players it interacts with along with its own action. The fitness is interpreted as the utility that a player tries to maximize and also as a measure for fertility - larger fitness results in a larger number of offsprings. The link between the rate of growth of subpopulations and the fitness are formulated in a concept called "replicator dynamics".

Our contributions to the foundation of evolutionary games have been

(1) to extend the framework from that of pairwize interactions to one with a general number of players, possibly random [53];

(2) to introduce and to study non-reciprocal evolutionary games, [53] in which if player A interacts with player B, this does not imply that player B interacts with player A. Such non-reciprocity occurs in wireless communications whenever players A and B stand for transmittors, and where the receiver of one player (say of B) is close to transmitter A, but the receiver of A is not close to transmitor B;

(3) to study the impact of delays on the stability of the replicator dynamics [80],

and, most importantly,

(4) the creation of a new paradigm in evolutionary games called "Markov Decision Evolutionary Games". In the latter, each player is associated with an individual state that evolves according to some Markov chain. The choice of actions of a player as well as of those players involved in an interaction with that player determine not only the immediate fitness of the player but also the transition probabilities of its Markov chain. Furthermore, we assume that the objective of a player is not anymore to maximize its instantaneous fitness but, instead, to maximize its expected total fitness accumulated during its lifetime or its expected average fitness [30].

We applied our results (1)-(3) to study evolution of protocols in both wireline and wireless communications [53] as well as to power control problems in wireless networks [73]. We used our framework (4) to study power control [73] problems, in which the individual state of a mobile is the energy level of its battery, an in which the objective of a player is to maximize the expected number of packets it would successfully transmit during his life time of its battery.

2.7.4 Collaborations

We have pursued our collaboration with leading Indian scientists and, in particular, with A. Kumar (IISc Bangalore) and R. Sundaresan (IIT Bombay) The cooperation was supported by IFCPAR (Indo-French Centre for Promotion of Advanced Research) during the period 2009-2012. The Indian group was selected by Inria to be part of a joint associate research group with MAESTRO during 2008-2010 (named DAWN). The collaboration will expand through an Indo-French Center for Applied Mathematics (IFCAM) launched in January. 2012. Networking games are at the heart of this cooperation.

Other long-term collaborations we had during the evaluation period were with I. Tinnirello and L. Giarré (Univ. Palermo, Italy) on optimal strategies for medium access in WiFi Networks [36, 81], and with A. Garnaev (St. Petersburg State University, Russia) on power control games.

2.7.5 External support

We have been working on networking games within the ANR Ecoscell since 2010. This grant supports two PhD students. The SelfNet and SemNet projects within the Alcatel-Lucent Inria Joint Lab (see Section 4) supported two other PhD students who worked part of their time on networking games. A two-year postdoc (K. Veeraruna Voleti) and the work of a PhD student (A. Silva) were supported by the European project IST FET "BIONETS" which ended in 2011. Within this project MAESTRO developed bio-inspired games as well as routing games in massively dense ad-hoc networks.

2.7.6 Self assessment

Our work on networking games has had a major impact even beyond our field of telecommunication networks. The new concepts in evolutionary games were published in the best journals and conferences in networking. For example, our work in networking games resulted in the publication of 13 papers at the *Infocom* conference [93, 227, 224, 215, 274, 286, 214, 100, 121, 144, 142, 143, 294], 4 papers in the *IEEE Journal of Selected Areas in Communications* [17, 15, 72, 90] (JSAC, which has the highest impact factor among all journals in networking) and 2 papers in *IEEE Signal Processing Magazine* [38, 36] (journal with the highest impact factor among all journals that cover Electrical and Electronic Engineering domains).

Other domains on which our work on networking games has had an impact are biology (we have published an invited paper [30] in the journal *Evolutionary Ecology Research*), cybernetics [53], information theory [51] and control theory [18, 31, 43, 82, 18]. And, of course, we have regularly published our results in conferences and journals that specialize in game theory. E. Altman is the Steering Committee Chair of the annual workshop Networking Games, Control and Optimization (NetGCoop).

2.8 Objective 5 – Stochastic processes, queueing, control theory and game theory: Executive summary

2.8.1 Personnel

Permanent researchers: E. Altman, K. Avrachenkov, A. Jean-Marie. **PhD students:** A. Azad, J. Gaillard, D. Nemirovsky, N. Osipova, A. Silva.

2.8.2 Project-team positioning

MAESTRO maintains a continued research activities on general stochastic and/or controlled models and queuing theory. Similar investigations are conducted in other Inria teams: TREC, RAP or DIONYSOS for stochastic modeling, DIONYSOS or MESCAL for dynamic systems, control and game theory.

The places in the world where queueing, control and game theories are being developed are too numerous to be listed, but large groups are not so frequent. An exception is the CWI-Eindhoven group (S. Borst and R. Núñez-Queija).

Our work on rolling horizon for optimal control is inspired by contributions by J-B. Lasserre and O. Hernández-Lerma or H. S. Chang and S. Marcus. We are maintaining

research activities in structural approaches in the vein of the "dutch school" around G. Koole, or persons like K. Papadaki.

2.8.3 Scientific achievements

Advances in game theory. E. Altman and his coworkers have developed many theoretical branches of Game Theory. Those include several flavors of evolutionary games, population games, cost-coupled stochastic games, stochastic games with delay, games with altruism, routing games, sequential anonymous games and Markov decision evolutionary games. They are more precisely described in Objective 4 where they are related to applications in Networking.

Advances in queueing theory. In the last several years, E. Altman has been developing the theory of *Branching Processes* with non-Markovian immigration process, and has been applying it to a large number of queueing problems: polling with correlated vacations, the infinite server with correlated arrivals and more. Branching processes can be written in the form $X_{n+1} = A_n(X_n) + B_n$ where B_n is the immigration and A_n is a subordinator (non-decreasing Lévy process) with the following central properties: (i) it is infinitely divisible and (ii) it has independent increments. In [27], this class of processes is extended in two ways: by dropping the requirement of independent increments in the process $\{A_n\}_n$, and by considering continuous state spaces. Explicit expressions for the first order-moments of X_n in steady-state under the weak assumption that the process $\{B_n\}$ is stationary and ergodic have been derived. The formalism has been applied to Delay Tolerant Networks in [217] and [348].

Many new results have been obtained on the *Processor Sharing Queue* and several of its variants. The well-known Discriminatory Processor Sharing (DPS) queue is useful for modeling and optimizing scheduling algorithms in networks and service centers. The Two-Level Processor-Sharing (TLPS) is convenient model to study the benefit of the file-size-based differentiation in TCP/IP networks.

Analytical expressions and qualitative properties for the expected conditional response time are derived for the Batch PS queue in [21]. For the TLPS with hyper-exponential job sizes, exact expressions and tight bounds are obtained in [32]. They are used to find an approximation of the optimal threshold in this policy. The dependence of expected sojourn times with respect to weights in the DPS queue is studied in [331].

We have obtained new fluid limit and overloaded traffic results for the PS and DPS queues. The analysis of the fluid limits in the Multiclass Processor Sharing queue is presented in [338], with applications in [152]. In [44], we study the rate of growth of the delays as well as the rate of growth of the population size in a DPS queue. A fixed point equation allows to compute the growth rate for any stationary ergodic service and arrival time process.

Control of queues. In [179] the Gittins optimality result is used to characterize the optimal scheduling discipline in a multi-class M/G/1 queue. When there is only one class it is known that the Least Attained Service (LAS) policy is optimal. We show that in the multi-class case the optimal policy is a priority discipline, where jobs of the various classes depending on their attained service are classified into several priority levels.

The problem of optimal service scheduling in queues with impatience is solved using the technique of propagation of properties through value iteration [74]. For this simple system, the optimal policy is "always serve" or "never serve", depending on a simple criterion on costs, the impatience probability and the discount factor.

We have studied in [14, 308] *Retrial Networks*, in which customers rejected due to finite capacities join a common retrial (orbit) queue. We have identified "benchmark" cases in which an explicit analytic solution can be derived. If the analytic solution is not available or too entangled, we suggest approximations using the fixed point principle, and mean-value analysis. The mean sojourn time of a job in the system, the mean number of visits to the orbit queue and fractions of blocked customers in the primary queues can be estimated this way.

Advances in control. *Singular perturbation theory* is concerned with the behavior of some parametrized dynamical systems, under small changes in some of the parameters. Its general applications include classical control and time-scale decomposition of Markov chains. K. Avrachenkov and his coworkers have progressed on the case of infinite state spaces. In [37], they consider a bounded not necessarily compact linear operator $A(z)$ between Hilbert spaces which depends analytically on a perturbation parameter z. If $A(0)$ is singular the authors find conditions under which $A^{-1}(z)$ is well defined on some region $0 < |z| < b$ by a convergent Laurent series with a finite order pole at the origin. Under certain conditions the results can be extended to Banach spaces. Multivariate perturbations of algebraic equations are considered in [47]. In general, it is not possible to represent the perturbed solution as a Puiseux-type power series in a connected neighborhood. For the case of two perturbation parameters the authors provide a sufficient condition that guarantees such a representation. Then, the authors extend this result to the case of more than two perturbation parameters.

Convergence of Rolling Horizon Control has been investigated by A. Jean-Marie and his coworkers. The problem is to assess convergence of the Rolling Horizon heuristic when the horizon length grows, and find error bounds. In the case of finite-state-space Markov Decision Processes with the long-term average expected gain, we have shown [311, 88] that convergence occurs whenever the value iteration algorithm converges. This is substantially weaker than the usual "unichain" assumption. As a side result, we show that a stopping rule for the Value Iteration algorithm, conjectured by Puterman, is not correct in general. We have then considered zero-sum semi-Markov games with discounted payoff [266, 315], for which we have proved geometric convergence under the usual assumptions of the literature.

Fundamentals of optimal control. Finally, several contributions are related to deterministic optimal control, with potential applications to life and environmental sciences. In [71], we have considered the general single-dimensional control model and asked the question of whether some impulse control or some continuous control should be optimal. We show that the optimality of impulse policies is strongly related to a submodularity property of the instantaneous cost function. In the context of optimal control of epidemics, we find in [275, 274, 89] the solution of optimal control or games models (obtained as fluid limits of stochastic counterparts), by means of the Pontriagin maximal principle.

2.8.4 Collaborations

Advances in game theory were obtained with colleagues from the Univ. of Avignon (R. El Azouzi, Y. Hayel, T. Jimenez and J. Rojas-Mora), Univ. Pierre and Marie Curie (R. Combes and S. Sorin), Supelec (M. Debbah, H. Tembine, E.V. Belmega), Univ. of Wroclaw (P. Wiecek) and others; see also paragraph 2.7.4.

The work on Processor Sharing involved U. Ayesta (CNRS) and P. Brown (Orange Labs).

Singular perturbations were studied jointly with australian colleagues: C. Pearce (Univ. of Adelaide), V. Ejov, J. Filar and P. Howlett (Univ. of South Australia). Convergence of Rolling Horizon is a joint research with the Univ. Rosario (E. Della Vecchia, S. Di Marco).

2.8.5 External support

The work on Processor Sharing was partly supported by France Telecom R&D grant on "Modélisation et Gestion du Trafic" and by a Post-Doctoral fellowship from CNRS.

2.8.6 Self assessment

Work on Branching Processes has advanced as foreseen, and will be now oriented towards processes in the "max-plus" algebra. The "background" activities on optimal control and singular perturbations have progressed as foreseen, with the development of new collaborations and multi-disciplinary applications. The work on game theory has had a spectacular development, see Section 2.7.6. Activities on queueing theory, in particular Processor Sharing, were a fruitful product of unforeseen collaborations.

3 Knowledge dissemination

3.1 Publications

	2008	2009	2010	2011	2012 (†)	Total
PhD Thesis	2	1	4	2		9
HDR (*)			1			1
Journal	15	12	16	22	13	78
Conference proceedings (**)	36	68	53	49	8	214
Book chapter		1		1		2
Book (written)						
Patent		1	2	1		4
Subtotal	53	83	76	75	21	308
Book (edited)	1	2	3	2		8
General audience papers						
Technical report	6	27	12	6	1	52
Total	60	112	91	83	22	368

(†) up to March 20, 2012
(*) Habilitation à diriger des Recherches
(**) Conference with a program committee

Indicate the major journals in the field and, for each, indicate the number of papers coauthored by members of the project-team that have been accepted during the evaluation period.

1. *Computer Networks* (COMNET, 2010 Impact Factor: 1.176) (9 papers)
2. *IEEE Journal on Selected Areas in Communications* (JSAC, 2010 Impact Factor: 4.232) (7)
3. *IEEE Transactions on Automatic Control* (2010 Impact Factor: 1.950) (7)
4. *Performance Evaluation* (PEVA, 2010 Impact Factor: 1.168) (7)

5. *Telecommunication Systems* (2010 Impact Factor: 0.67) (5)
6. *IEEE/ACM Transactions on Networking* (ToN, 2010 Impact Factor: 2.284) (3)
7. *Operations Research Letters* (2010 Impact Factor: 0.739) (3)
8. *Annals of Operations Research* (2010 Impact Factor: 0.675) (3)
9. *IEEE Transactions on Wireless Communications* (2010 Impact Factor: 2.152) (2)
10. *IEEE Transactions on Vehicular Technology* (2010 Impact Factor: 1.485) (2)
11. *IEEE Signal Processing Magazine* (2010 Impact Factor: 5.860) (2)
12. *Journal of Mathematical Analysis and Applications* (2010 Impact Factor: 1.174) (2)
13. *Computer Communications* (2010 Impact Factor: 0.815) (2)
14. *Mobile Networks and Applications* (2010 Impact Factor: 0.683) (2)
15. *IEEE Transactions on Information Theory* (2010 Impact Factor: 2.725) (1)
16. *IEEE Transactions on Mobile Computing* (2010 Impact Factor: 2.376) (1)
17. *Computers & Operations Research* (2010 Impact Factor: 1.769) (1)
18. *IEEE Transactions on Parallel and Distributed Systems* (2010 Impact Factor: 1.571) (1)
19. *IEEE Transactions on Communications* (2010 Impact Factor: 1.364) (1)
20. *The Computer Journal* (2010 Impact Factor: 1.327) (1)
21. *Annals of the International Society of Dynamic Games* (1)
22. *Internet Mathematics* (1)
23. *Linear Algebra and Its Applications* (2010 Impact Factor: 1.005) (1)
24. *Discrete Event Dynamic Systems* (DEDS, 2010 Impact Factor: 0.872) (1)
25. *Journal of Applied Probability* (JAP, 2010 Impact Factor: 0.768) (1).

Nota: 11 additional journal papers were published in 11 additional different journals (see Section 6.2 for the complete list of journal papers).

Indicate the major conferences in the field and, for each, indicate the number of papers coauthored by members of the project-team that have been accepted during the evaluation period.

1. *IEEE Infocom* (21 papers + 11 at the mini-conference, acceptance rate in 16.0%-19.7%)
2. *Intl. Symp. on Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks* (WiOpt) (15 papers, acceptance rate in 31.9%-33.3%)
3. *IFIP Networking* (9 papers, acceptance rate in 21.5%-26.9%)
4. *International Teletraffic Congress* (ITC) (6 papers, acceptance rate in 33.0%-33.3%)

5. *Intl. Workshop on Mobile Opportunistic Networking* (ACM MobiOpp) (2 papers, acceptance rate 28.6%)

6. *ACM CoNext* (1 paper, acceptance rate 17.4%)

7. *Intl. Conference on Network and Service Management* (CNSM) (1 paper, acceptance rate 14.6%)

Papers of members of MAESTRO were also accepted at *Intl. Conference on Performance Evaluation Methodologies and Tools* (VALUETOOLS) (9), *IEEE Conference on Decision and Control* (CDC) (10), *IEEE International Conference on Communications* (ICC) (4), *IEEE GLOBECOM* (2), etc. Complete list of conference papers is available in Section 6.3.

3.2 Software

3.2.1 Personnel

Permanent researcher: K. Avrachenkov. **PhD students:** D. Nemirovsky, M. Sokol.

Web Graph Analyzer The software Web Graph Analyzer is developed to collect, store and analyze Web graphs with the help of a convenient GUI. Web Graph Analyzer consists of two parts: a Web Crawler and a Graph Analyzer. The data is stored and managed efficiently by Oracle DBMS. To the best of our knowledge, our crawler is the only available crawler with a GUI. A user can easily specify the initial node for the graph collection, limit the area of the Web, adjust the speed of crawling. The part responsible for the graph analysis allows one to identify strongly connected components, to calculate and to display in- and out-degree distributions and PageRank, to cluster the graph, to visualize parts of the graph and its hierarchical structure based on clustering results and to search through the graph. All results are presented in a user friendly form. The main parts of the Web Graph Analyzer are programmed in Java. During the period 2008-2011 we have added to the analytic part the computation of more graph centrality measures and a module responsible for semi-supervised learning. We are in the process of making the project publically available.

3.3 Valorization and technology transfert

We would like to point out that most of MAESTRO's work is disseminated in visible journals and conferences. Technology transfer is mostly carried out through **direct** collaborations with major industrial partners, as exemplified by

- the patents filed with **Alcatel Lucent - Bell Labs** (ALU) [297, 298, 299, 300] which are the results of our participation in ALU Research Actions "Semantic Networking" (SemNet)and "Self Optimizing Wireless Networks" (SelfNet) during the period 2008-2011

- our grants with **Orange Labs** on "Content-Centric Networking" (2010-2012), "Quality of Service and Quality of Experience" (2010-2011) and "Self Optimization in Networks" (2009-2012)

- our participation in European projects involving industrial partners (IST FET BIONETS (2006-2009) and IST STREP ECODE (2008-2011)

- our involvement in national initiatives funded by the ANR (National Research Agency) such as ANR Telecommunication WINEM (2007-2009), ANR Multimedia VOODDO (2008-2010) and ANR Verso ECOSCELLS (2009-2012).

In addition, members of MAESTRO have always had an activity in the development of advanced and prototype softwares. Over the 2008-2011 evaluation period the development of the Web Graph Analyzer has been pursued by K. Avrachenkov and his collaborators – see description in Section 3.2.

3.4 Teaching

S. Alouf taught an undergraduate course on "Probability and Statistics" (11hrs of lecture and 28hrs of assignments in 2009, 8hrs of lecture and 22hrs of assignments in 2010) in the first year of the Applied Mathematics and Modeling Engineering degree (L3), University of Nice Sophia Antipolis (UNS), France.

E. Altman taught a graduate course on "Game Theory with Network Applications" at Politecnico di Milano (32hrs in 2010) and the same course at ENS Lyon (9hrs in 2010). In 2011 he taught a graduate course on "Network Engineering Games" (15hrs) at the University of Pierre and Marie Curie (UPMC).

K. Avrachenkov taught an undergraduate course on "Linear Algebra and Numerical Methods" (15hrs in 2010, 12hrs in 2011) and an undergraduate course on "Probability and Statistics" (18hrs in 2011) in the Master program (1st year) EuroAquae at PolyTech Nice - Sophia Antipolis School.

A. Jean-Marie taught a graduate course on "Evaluation of Performance" (15hrs in 2009), "Random Discrete Structures" (12hrs in 2008), a graduate course on "Metrology and Quality of Service for Networks" (12hrs in 2008, 25hrs in 2009, 12hrs in 2010, 12hrs in 2011) and a doctoral course on "Advanced Markov Modeling" (18hrs in 2010, 18hrs in 2011) all in Master in Computer Science of the University of Montpellier II as well as a graduate course on "Fundamentals of Network Modeling" (12hrs in 2011) at the University of Pierre and Marie Curie (UPMC). In 2008 he was invited to give a course on "Network Calculus" at the University of Valparaiso, Chile.

P. Nain taught a graduate course on "Performance Evaluation of Networks" in Ubinet (Ubiquitous Networking and Computing), an international track of the Master in Computer Science (master IFI) of the University of Nice Sophia Antipolis (21hrs in 2009, 2010 and 2011).

G. Neglia taught a graduate course on "Performance Evaluation of Networks" in Ubinet (Ubiquitous Networking and Computing), an international track of the Master in Computer Science (master IFI) of the University of Nice Sophia Antipolis (6 hrs in 2009, 15hrs in 2010 and in 2011), an undergraduate course in "Probability and Statistics" (2hrs of lectures, 24hrs of assignments in 2009, 1hr of lectures, 20hrs of assignments in 2010, 7hrs of lectures, 28hrs of assignments in 2011) in the first year of the Applied Mathematics and Modeling Engineering degree (L3), University of Nice Sophia Antipolis (UNS), France. He gave a graduate course on "Introduction to Fluid Models" (6hrs in 2011) at the University of Palermo, Italy and a graduate course on "Introduction to Game Theory" (4hrs in 2011), PhD school organized by the Italian Control Theory Society, Italy. He has also been responsible for the final projects of the Master Ubinet in 2010 and 2011.

3.5 General audience actions

S. Alouf delivered three 1-hour lectures at Leonard de Vinci High School of Antibes in 2009 and three conferences in 2011 at the public library of Antibes, at the International High School of Manosque, and at the Jean-Cocteau High School of Miramas.

3.6 Visibility

3.6.1 Editorial activities

P. Nain is Editor-in-Chief of *Performance Evaluation* (PEVA) (since January 1st, 2008).

E. Altman was Editor-in-Chief of *ICST Transactions on Networking Optimization and Control* in 2009.

During the evaluation period, MAESTRO members were Associate Editors (AEs) of the following journals (in alphabetical order):

Computer Communications (COMCOM) (**E. Altman** since 2010)

Discrete Event Dynamic Systems (DEDS) (**E. Altman** until 2010)

Dynamic Games and Applications (DGAA) (**E. Altman** since 2011).

Journal of Economic Dynamics and Control (JEDC) (**E. Altman**)

Operations Research Letters (**P. Nain** until 2011)

Performance Evaluation (PEVA) (**K. Avrachenkov**)

RAIRO - Operations Research (**A. Jean-Marie** until 2011)

Wireless Networks (WINET) (**E. Altman** until 2010)

E. Altman was co-editor of Special Issues of *Discrete Event Dynamic Systems* (DEDS) in 2008 [318], *Mobile Networks and Applications* [323] in 2010, and *Computer Networks* [321] in 2010 and [324] in 2011. He was Invited Editor of *LNCS no.5425* [319] in 2009, of *LNICST no. 39* [322] in 2010, and of *LNCS no. 7037* [325] in 2011. In 2009 **K. Avrachenkov** was Invited Editor of *LNCS no. 5427* [320].

3.6.2 Participation in the organization of conferences/workshops

S. Alouf was

- Workshops Co-Chair of the *3rd Intl. Conference on Performance Evaluation Methodologies and Tools* (Valuetools 2008), October 20-24, 2008, Athens, Greece
- Publicity Chair of ACM Sigmetrics 2010, June 14-18, 2010, Columbia University, NY, USA.

E. Altman was

- Steering Committee Co-Chair of the *Intl. Conference on Performance Evaluation Methodologies and Tools* (VALUETOOLS) in 2008, 2009 and 2011
- TPC Co-Chair of the *2nd Workshop on Network Control and Optimization* (NET-COOP 2008), September 8-10, 2008, Paris, France

- General Co-Chair of the *4th International Conference on Bio-Inspired Models of Network, Information, and Computing Systems* (Bionetics 2009), December 9-11, 2009, Avignon, France
- Steering Committee Chair of the *Intl. Symposium on Modeling in Mobile, Ad Hoc, and Wireless Networks* (WiOpt) in 2010, 2011 and 2012
- General Co-Chair of the *8th Intl. Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks* (WiOpt 2010), May 31-June 4, 2010, Avignon, France
- Co-Chair of the *2nd Intl. Workshop on Indoor and Outdoor Femto Cells* (IOFC 2010), September 26, 2010, Istanbul, Turkey
- Co-Chair of the *3rd Intl. Workshop on Indoor and Outdoor Femto Cells* (IOFC 2011), May 13, 2011, Princeton, NJ, USA
- Steering Committee Chair of the *Intl. Conference on NETwork Games, COntrol and OPtimization* (NetGCoop 2011), October 12-14, 2011, Paris, France
- TPC Co-Chair of the *2nd Conference on Decision and Game Theory for Security* (GameSec 2011), November 14-15, 2011, College Park, MD, USA

and in the Steering Committee of the following conferences:

- *Intl. Symposium on Modeling in Mobile, Ad Hoc, and Wireless Networks* (WiOpt) in 2008 and 2009
- *Workshop on Network Control and Optimization* (NET-COOP) in 2008, 2009 and 2010
- *Intl. Conference on Game Theory for Networks* (GameNets 2009), May 13-15, 2009, Istanbul, Turkey.

K. Avrachenkov was

- Co-Chair of the *3rd Intl. Workshop on Tools for Solving Structured Markov Chains*, October 20, 2008, Athens, Greece
- Co-Chair of the *6th Workshop on Algorithms and Models for the Web Graph* (WAW 2009), February 12-13, 2009, Barcelona, Spain
- Co-Chair of the *5th Workshop on Resource Allocation, Cooperation and Competition in Wireless Networks* (RAWNET/WNC3 2009), June 27, 2009, Seoul, Korea
- Chair and organizer of a special session on "Structured Markov Chains" at the *5th ICST Intl. Conference on Performance Evaluation Methodologies and Tools* (ValueTools 2011), May 16-20, 2011, Cachan, France.

A. Jean-Marie was Tutorial Chair of *QEST 2008*, September 14-17, 2008, St Malo, France.

P. Nain was in the

- Executive Committee of *Rescom 2009, Summer School on Networking*, June 7-13, 2009, Royan, France
- Steering Committee of *IFIP PERFORMANCE 2011*, October 18-20, 2011, Amsterdam, Netherlands.

G. Neglia was

- Co-Chair of the *3rd Workshop on Interdisciplinary Systems Approach in Performance Evaluation and Design of Computer and Communication Systems* (Inter-Perf 2008), September 24, Athens, Greece
- Co-Chair of the track on *Network Algorithms, Performance Evaluation and Theory* (NAPET) of the *19th International Conference on Computer Communications and Networks* (ICCCN 2010), August 2-5, 2010, Zurich, Switzerland
- a member of the organizing committee of the *6th Spain, Italy and Netherlands Meeting on Game Theory* (SING 6), July 7-9, 2010, Palermo, Italy.

3.6.3 Participation in technical program committees

2008:

1. ACM Sigmetrics 2008 (Annapolis, Maryland, USA) (**S. Alouf**)
2. IFIP Networking 2008 (Singapore) (**E. Altman**)
3. 13th Intl. Symposium on Dynamic Games and Applications (ISDGA 2008, Wroclaw, Poland) (**E. Altman**)
4. 16th IEEE Intl. Conference on Networks (ICON 2008, New Delhi, India) (**K. Avrachenkov**)
5. 7th Intl. Conference on Ad Hoc Networks and Wireless (AdHocNow 2008, Inria, Sophia-Antipolis) (**E. Altman**)
6. 2nd Intl. Conference on Autonomic Computing and Communication Systems (Autonomics 2008, Turin, Italy) (**G. Neglia**)
7. 2nd Intl. Conference on Game Theory and Management (GTM 2008, St. Petersburg, Russia), (**E. Altman**)
8. 15th Intl. Conference on Telecommunications (ICT 2008, St. Petersburg, Russia) (**K. Avrachenkov**)
9. 2nd Workshop on Network Control and Optimization (NET-COOP 2008, Paris, France) (**G. Neglia**)
10. Intl. Workshop on Multiple Access Communications (MACOM 2008, St. Petersburg, Russia) (**K. Avrachenkov**)
11. 2nd Intl. Workshop on Wireless Networks: Communication, Cooperation and Competition (WNC3 2008, Berlin, Germany) (**K. Avrachenkov**)
12. 2nd Intl. Workshop on Game Theory in Communication Networks (GameComm 2008, Athens, Greece) (**E. Altman**)
13. 2nd Intl. Workshop on NS-2 (WNS2 2008, Athens, Greece) (**E. Altman**)
14. 10th Workshop on Mathematical Performance Modeling and Analysis (MAMA 2008, Annapolis, MD, USA) (**A. Jean-Marie**, **P. Nain**).

2009:

1. IEEE Infocom 2009 (Rio de Janeiro, Brazil) (**P. Nain** TCP Area Chair, **S. Alouf**, **E. Altman**, **G. Neglia**)
2. ACM Sigmetrics/Performance 2009 (Seattle, WA, USA) (**S. Alouf**, **A. Jean-Marie**)
3. 4th Intl. Conference on Performance Evaluation Methodologies and Tools (ValueTools 2009, Pisa, Italy) (**K. Avrachenkov**, **A. Jean-Marie**)

4. 21st International Teletraffic Conference (ITC 2009, Paris, France) (**E. Altman**)
5. 16th Intl. Conference on Analytical and Stochastic Modelling Techniques and Applications (ASMTA 2009, Madrid, Spain) (**S. Alouf**)
6. 7th Intl. Symposium on Modeling and Optimization in Mobile Ad Hoc and Wireless Networks (WiOpt 2009, Seoul, Korea) (**S. Alouf**, **G. Neglia**)
7. 24th ACM Symposium on Situated Autonomic Computing (SAC 2009) track on Computer Networks (Honolulu, HI, USA) (**S. Alouf**)
8. 18th Intl. Conference on Computer Communications and Networks (ICCCN 2009, San Francisco, CA, USA) tracks on Network Algorithms and Performance Evaluation (NAPE) (**S. Alouf**) and on Peer-to-peer Networking (P2PN) (**G. Neglia**)
9. 6th Intl. Conference on Wireless On-demand Network Systems and Services (WONS 2009, Snowbird, UT, USA) (**E. Altman**)
10. 9th Intl. Conference on Next Generation Wired/Wireless Networking (NEW2AN 2009, St. Petersburg, Russia) (**K. Avrachenkov**)
11. 1st Intl. Conference on Advances in Future Internet (AFIN 2009, Athens/Glyfada, Greece) (**K. Avrachenkov**)
12. 3rd Workshop on Network Control and Optimization (NET-COOP 2009, Eindhoven, The Netherlands) (**K. Avrachenkov**)
13. 11th Workshop on Mathematical performance Modeling and Analysis (MAMA 2009, Seattle, WA, USA) (**A. Jean-Marie**, **P. Nain**)
14. 4th Workshop on the Economics of Networks, Systems and Computation (NetEcon 2009, Stanford, CA, USA) (**E. Altman**)
15. 2nd Intl. Workshop on Multiple Access Communications (MACOM 2009, Dresden, Germany) (**K. Avrachenkov**)
16. 2nd Euro-NF Workshop and Future Internet Cluster Meeting (Santander, Spain) (**E. Altman**)
17. 5th Workshop on Resource Allocation, Cooperation and Competition in Wireless Networks (RAWNET/WNC3 2009, Seoul, Korea) (**E. Altman**)
18. 6th Intl. Workshop on Internet Charging and QoS Technologies (ICQT 2009, Aachen, Germany) (**E. Altman**)
19. 3rd Intl. Workshop on Game Theory in Communication Networks (GameComm 2009, Pisa, Italy) (**K. Avrachenkov**)
20. Intl. Workshop on Network Simulation Tools (NStools, 2009, Pisa, Italy) (**E. Altman**).

2010:

1. IEEE Infocom 2010 (San Diego, CA, USA) (**G. Neglia**)
2. ACM Mobihoc 2010 (Chicago, IL, USA) (**S. Alouf**, **G. Neglia**)
3. ACM Sigmetrics 2010 (New York, NY, USA) (**A. Jean-Marie**)
4. IFIP Performance 2010 (Namur, Belgium) (**S. Alouf**, **P. Nain**)
5. 22nd International Teletraffic Conference (ITC 2010, Amsterdam, Netherlands) (**S. Alouf**, **E. Altman**)

6. 7th Intl. Conference on Quantitative Evaluation of SysTems (QEST 2010, Williamsburg, VA, USA) (**A. Jean-Marie**)
7. 8th Intl. Symposium on Modeling and Optimization in Mobile Ad Hoc and Wireless Networks (WiOpt 2010, Avignon, France) (**S. Alouf**, **E. Altman**)
8. 25th Intl. Symposium on Computer and Information Sciences (ISCIS 2010, London, UK) (**A. Jean-Marie**, **P. Nain**)
9. IEEE Intl. Symposium on Wireless Pervasive Computing (ISWPC 2010, Modena, Italy) (**G. Neglia**).
10. 5th Intl. ICST Conference on Bio-Inspired Models of Network, Information, and Computing Systems (Bionetics 2010, Boston, MA, USA) (**E. Altman**)
11. Conference on Decision and Game Theory for Security (GameSec 2010, Berlin, Germany) (**E. Altman**)
12. 19th Intl. Conference on Computer Communications and Networks (ICCCN 2010, Zurich, Switzerland) track on Network Algorithms, Performance Evaluation and Theory (NAPET) (**K. Avrachenkov**, **V. Mancuso**)
13. 10th Intl. Conference on Next Generation Wired/Wireless Networking (NEW2AN 2010, St. Petersburg, Russia) (**K. Avrachenkov**)
14. 2nd Intl. Conference on Advances in Future Internet (AFIN 2010, Venice, Italy) (**K. Avrachenkov**)
15. 4th Workshop on Network Control and Optimization (NET-COOP 2010, Ghent, Belgium) (**K. Avrachenkov**)
16. 12th Workshop on Mathematical performance Modeling and Analysis (MAMA 2010, New York, NY, USA), (**A. Jean-Marie**, **P. Nain**)
17. 3rd Intl. Workshop on Multiple Access Communications (MACOM 2010, Barcelona, Spain) (**K. Avrachenkov**)
18. Intl. Workshop on Dynamic Networks (WDN 2010, Avignon, France) (**A. P. Azad**)
19. 3rd Intl. Workshop on Wireless Networks: Communication, Cooperation and Competition (WNC3 2010, Avignon, France) (**A. P. Azad**).

2011:

1. IEEE Infocom 2011 (Shangai, China) (**G. Neglia**)
2. IFIP Performance 2011 (Amsterdam, The Netherlands) (**S. Alouf**, **P. Nain**)
3. 9th Intl. Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2011, Princeton, NJ, USA) (**S. Alouf**, **E. Altman**)
4. 46th IEEE Intl. Conference on Communications (ICC 2011, Kyoto, Japan) symposium on Next Generation Networking and Internet (NGNI) (**G. Neglia**)
5. 2nd Intl. Conference on Game Theory for Networks (GameNets 2011, Shanghai, China) (**E. Altman**)
6. 5th Intl. Conference on Game Theory and Management (GTM 2011, St. Petersburg, Russia) (**E. Altman**)
7. 11th Intl. Conference on Next Generation Wired/Wireless Networking (NEW2AN 2011, St. Petersburg, Russia) (**K. Avrachenkov**)
8. 3rd Intl. Conference on Advances in Future Internet (AFIN 2011, Nice/Saint Laurent du Var, France) (**K. Avrachenkov**)

9. Intl. Conference on Network Games, Control and Optimization (NETGCOOP 2011, Paris, France) (**K. Avrachenkov**, **M. Haddad**, **M. Panda**)
10. 2nd Conference on Decision and Game Theory for Security (GameSec 2011, College Park, MD, USA) (**K. Avrachenkov**, **M. Haddad**, **M. Panda**)
11. 26th Intl. Symposium on Computer and Information Sciences (ISCIS 2011, London, UK) (**A. Jean-Marie**)
12. 20th Intl. Conference on Computer Communications and Networks (ICCCN 2011, Maui, HI, USA) track on Network Algorithms and Performance Evaluation (NAPE) (**G. Neglia**)
13. 6th Intl. Conference on Broadband, Wireless Computing, Communication and Applications (BWCCA 2011, Barcelona, Spain) (**G. Neglia**)
14. 13th Workshop on Mathematical Performance Modeling and Analysis (MAMA 2011, San Jose, CA, USA) (**A. Jean-Marie**, **P. Nain**)
15. 4th Intl. Workshop on Multiple Access Communications (MACOM 2011, Trento, Italy) (**K. Avrachenkov**)
16. 5th Intl. IEEE WoWMoM Workshop on Autonomic and Opportunistic Communications (AOC 2011, Lucca Italy) (**G. Neglia**)
17. IEEE ICC Workshop on Game Theory and Resource Allocation for 4G (GeT-ReAl 2011, Kyoto, Japan) (**E. Altman**).

2012: (only events whose reviewing process ended before March 20, 2012

1. IEEE Infocom 2012 (Orlando, FL, USA) (**G. Neglia**)
2. ACM Sigmetrics/Performance 2012 (Seattle, WA, USA) (**A. Jean-Marie**)
3. 10th Intl. Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2012, Paderborn, Germany) (**S. Alouf**)
4. 19th Intl. Conference on Analytical and Stochastic Modelling Techniques and Applications (ASMTA 2012, Grenoble, France) (**K. Avrachenkov**)
5. ACM 3rd Intl. Workshop on Mobile Opportunistic Networks (MobiOpp 2012, Zurich, Switzerland) (**G. Neglia**)
6. 9th Workshop on Algorithms and Models for the Web Graph (WAW 2012, Halifax, Nova Scotia, Canada) (**K. Avrachenkov**)
7. 8th Spain, Italy and Netherlands Meeting on Game Theory (SING 8, Budapest, Hungary) (**E. Altman**)
8. IEEE 75th Vehicular Technology Conference (VTC 2012-Spring, Yokohama, Japan) (**S. Alouf**).

3.6.4 Plenary and invited talks

E. Altman was a keynote speaker at the First IEEE Intl. Workshop on Cognitive Radio and Networks (CRNETS 2008, September 15, 2008, Cannes, France) held in conjunction with the IEEE Intl. Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC 2008). He gave invited talks at:

- the Workshop in Honor of O. J. Boxma (June 3-4, 2009, Haifa, Israel)
- the 3rd Workshop on Network Control and Optimization (NET-COOP 2009, November 23-25, 2009, Eindhoven, The Netherlands)

- the 4th Intl. Conference on Bio-Inspired Models of Network, Information, and Computing Systems (Bionetics 2009, December 9-11, 2009, Avignon, France)
- COMmunnication Systems and NETworks (COMSNETS, January 5-8, 2010, Bangalore, India) entitled "Restricting Internet Access: Ideology and Technology"
- the Workshop on Network Science in Electrical Engineering and Computer Science (January 9-13, 2012, Bangalore, India) entitled "New Game Theoretic Models in Networking".

K. Avrachenkov gave the following invited talks:

- "Retrial Queues and Networks with Constant Retrial Rate" at the Euro-NF Intl. Conference on Network Control and Optimization (NET-COOP 2010, November 29 - December 1, 2010, Ghent, Belgium)
- "Monte Carlo Methods for Personalized PageRank" at PageRank Matrix Days (December 11, 2009, Toulouse, France)
- the Stochastics - Theoretical and Applied Research (STAR) seminar on Stochastic Networks (May 24, 2011, Amsterdam, The Netherlands).

A. Jean-Marie gave an invited talk entitled "Downloading Optimally in Real-Time" at the Workshop on Probability Models in Performance Analysis held at The Royal Society London on September 21, 2010, in honor of Erol Gelenbe's 65th birthday.

P. Nain gave the following invited talks:

- "Distributed Call Scheduling in Wireless Mesh Networks" at the Bell Labs-Inria Workshop on Fundamentals of Communications and Networking (June 1-2, 2009, Murray Hill, NJ, USA)
- "Content Dissemination in Peer-to-Peer Networks" at the Workshop on Probability Models in Performance Analysis held at The Royal Society London on September 21, 2010, in honor of Erol Gelenbe's 65th birthday.

G. Neglia gave the following invited talks:

- "From Computer Networks to Network Science: a Research Path" at the 5th French-Japanese Symposium on Frontiers of Science (January 22, 2011, Tokyo, Japan)
- "Distributed Subgradient Methods for Delay Tolerant Networks" at the Workshop on Algorithmic Game Theory: Dynamics and Convergence in Distributed Systems (AlgoGT, June 20, 2011, Grenoble, France).

Nota: The complete list of invited talks can be found in the 2008-2001 MAESTRO activity reports (Sections 9.3.2 (2008, 2010), 9.3.3. (2009), and 8.3.2 (2011)).

3.6.5 Leadership within the scientific community

P. Nain was a member of the Board of Directors of SIGMETRICS from July 1st, 2007 to June 30th, 2011.

E. Altman, **A. Jean-Marie** and **P. Nain** are (elected) members of the IFIP Working Group (WG) 7.3 on "Computer System Modeling".

P. Nain has been (an elected) vice-Chair of the IFIP Working Group (WG) 7.3 on "Computer System Modeling" since July 1st, 2007.

3.6.6 Awards

MAESTRO has been awarded a five-year funding by Inria (45KEuros/year) in the framework of the Carnot network institute label, for its involvement with industrial partners.

In 2011 Inria was awarded the Carnot network institute label (http://www.instituts-carnot.eu/en) in recognition to its involvement in enterprise innotation. This label comes with a 5-year funding from the French National Research Agency (ANR). Inria has allocated part of this funding to 15 Inria project-teams out of more than 190 Inria project-teams. Maestro is one of these teams.

E. Altman has been awarded the title of *IEEE Fellow* (Class of 2010) for contributions to analysis, optimization, and control of telecommunication networks.

A. Silva received the *Best Student Paper Award* of the Valuetools 2008 Conference (October 20-24, 2008, Athens, Greece) for his paper entitled "The Space Frontier: Physical Limits of Multiple Antenna Information Transfer", co-authored with R. Couillet, S. Wagner and M. Debbah [111].

A. Azad, S. Alouf and **E. Altman** received the *Best Paper Award* of the IFIP Wireless Days 2009 (15-17 December 2009, Paris, France) for their paper entitled "Vacation Policy Optimization with Application to IEEE 802.16e Power Saving Mechanism", co-authored with V. Borka and G. Paschos [149].

A. Dandoush and **A. Jean-Marie** received the *Best Paper Award* of the 3rd Intl. Conference on Communication Theory, Reliability, and Quality of Service (CTRQ2010, June 13, 2010, Athens, Greece) for their paper entitled "Flow-Level Modeling of Parallel Download in Distributed Systems" [209].

E. Altman received the *Best Paper Award* of the 7th Intl. Conference on Network and Service Management (CNSM 2011, October 24-28, 2011, Paris, France) for his paper entitled "Self-Organizing Relays in LTE networks: Queuing Analysis and Algorithms", co-authored with Z. Altman and R. Combes ("CIFRE" PhD student at Orange Labs, co-advised by E. Altman and S. Sorin (UPMC)) [264].

3.6.7 Research administration

[**Nota:** Only the most salient research administration activities are listed below. Other activities of members of MAESTRO can be found in Sec. 9.1.6 of MAESTRO 2008, 2009, 2010 Activity Reports and in Sec. 8.5.1 of MAESTRO 2011 Activity Report.]

P. Nain was the Scientific Deputy (Délégué Scientifique) of Inria Sophia Antipolis - Méditerranée and the Chair of its Project-Team Committee from July 1st, 2007 to June 30th, 2010 (**3 years**). During this period he was a member of the Inria Evaluation Committee. Since July 2011, he represents Inria at the Scientific Council of the University of Nice-Sophia Antipolis

A. Jean-Marie is the Scientific Coordinator of Inria research activities in Montpellier (since 2008). Since July 2010 he has been a member of the Managing Sub-Committee of the Project-Team Committee of Inria Sophia Antipolis - Méditerranée

A.-E. Baert was in charge of the Master in Combinatorics, Algorithms, Security and Administration of Networks at the University of Montpellier II.

4 External Funding

(k euros)	2008	2009	2010	2011
Inria Research Initiatives				
ARC† "OCOQS"				1
ARC "POPEYE"	4	45		
COLOR♣ "CRASQUIDEM"		12		
National initiatives				
ANR Verso "ECOSCELLS"				3
ANR Syscom "MODECOL"		0.1	0.2	0.2
ANR Multimedia "VOODDO"	10	10	20	
ANR Télécommunications "WINEM"	10	56	45	
European projects				
FP7 ICT STREP "ECODE"	10	35	30	15
FP7 IST FET "BIONETS"	85	100	8	22
FP7 Network of Excellence "EuroNF"	2	5	8	
Egide Eco-Net "Game Theory"	15	15		
Associated teams				
DAWN	22	11	10	
Industrial contracts				
Orange Labs CRE "CCN"♠				30
Orange Labs CRE "QoS &Quality of Experience"			25	35
Alcatel-Lucent ADR "Semantic Networking"	53	85	105	
Alcatel-Lucent ADR "Self-Opt. Wireless Networks"		43	50	37
Scholarships				
PhD *	112.5	102	96	103.5
Post Doc*		20	124	52
Other funding				
Australian Research Council Discovery	10	10		
Total	333.5	549.1	521.2	298.7

† Inria Cooperative Research Initiatives
♣ Inria Sophia Antipolis - Méditerranée Local Cooperative Initiative
♠ 120KE funding in 2012
∗ Other than those supported by one of the above projects

Inria Cooperative Research Initiatives (ARCs)

ARC OCOQS (2011-2013)

OCOQS (Optimal threshold policies in COntrolled Queuing Systems) is devoted to the structural analysis of Markov Decision Processes, with the objective to improve

the set of formal techniques available to prove that optimal control policies have a particular structure (typically, threshold-type). This project involves Inria project-teams MAESTRO and TREC, University of Paris Ouest and University of Twente. More at http://www.di.ens.fr/~busic/OCOQS/.

ARC POPEYE (2008-2010)

POPEYE (POPulation gamE theorY and Evolution) focused on the behavior of large complex systems involving interactions among one or more populations. The project brougth together researchers from different disciplines: computer science and network engineering, applied mathematics, economics and biology. Three Inria project-teams participated in this project (MAESTRO, MESCAL and TOSCA), three INRA groups (Biostatistics and Spatial Processes group in Avignon, Ecology of Insect Pararasitoids group in Sophia-Antipolis, LAMETA group in Montpellier) and three groups from the universities (Combinatorics and Optimization group from the University of Pierre and Marie Curie in Paris, LIA from University of Avignon, University of Nice - Sophia Antipolis). More at http://www-sop.inria.fr/maestro/POPEYE/home.html.

National initiatives

ANR Verso ECOSCELLS (2009-2012)

ECOSCELLS (Efficient Cooperating Small Cells) aims at developing algorithms and solutions which will be required for the deployment of small cell networks. The consortium gathers two main industrial groups in the telecommunication domain (Alcatel-Lucent Bell Labs and Orange Labs), together with three leading SMEs (3ROAM, SEQUANS and SIRADEL) and six academic partners (University of Avignon, Inria through its project-teams MAESTRO, MASCOTTE and SWING, Institut Eurecom, LAAS-CNRS and Laboratoire des Signaux et Systèmes/Supelec). More at http://perso.citi.insa-lyon.fr/hrivano/contrats/ecoscells.php and [87, 196, 232, 272, 278, 313].

ANR Syscom MODECOL (2009-2012)

MODECOL (Using mathematical MODeling to improve ECOLogical services of prairial ecosystems) is integrated in the framework of the urgent need for solutions for compensating human deterioration of the environment. New environmental policies point out natural ecosystems as key elements for providing ecological services such as water purification, soil detoxification, climate regulation and advocate for the creation of new ecosystems (as surrogates for the degraded natural systems) for increasing their positive effect on the environment. The project Modecol aims at developing a hybrid model, sufficiently realistic, that will simulate a prairial ecosystem (modelled through IBM) correlated through feedbacks to environmental conditions (modelled through PDEs). Participants are: UMR Ecobio (CNRS/Univ. Rennes 1), University of Houston (USA), University of Berkeley (USA), University of La Rochelle, and Inria through its project-teams MAESTRO, MODEMIC and TOSCA. More at http://ecobio.univ-rennes1.fr/modecol/gb/index.php.

ANR Multimedia VOODDO (2008-2010)

VOODDO aimed at developing an innovative visualization interface for video contents, based on a safe, reliable and optimized storage and transport infrastructure. It was coordinated by the VodDnet company, and involved researchers of LIRMM (University of Montpellier 2 and CNRS) and MAESTRO. See [374] and [376].

ANR Télécommunications WINEM (2007-2010)

WINEM (WiMAX Network Engineering and Multihoming) was about evaluating the coverage and capacity when relaying is possible, optimal joint radio resource management, evaluating energy saving mechanisms, and integrating the WiMAX simulators SimulX and Odyssée. Partners were France Telecom R&D, Institut Telecom, Inria project-teams DYONISOS and MAESTRO, Institut EURECOM and University of Avignon (LIA). `http://www.lia.univ-avignon.fr/index.php?id=502` and [92, 110, 113, 114, 128, 148, 149, 170, 214, 301] for the scientific output of the project.

Regional initiatives

COLOR CRASQUIDEM (2009)

CRASQUIDEM (Communication, Routing And Scheduling under QUasI DEterministic Mobility) addressed the problem of message routing and scheduling in quasi-deterministic DTNs. It involved the Telecommunication Networks Group of Politecnico di Torino and MAESTRO. See `http://www-sop.inria.fr/maestro/crasquidem/` and [55, 219, 245] for the scientific output of the project.

European projects

ICT STREP ECODE (2008-2011)

The goal of ECODE (Experimental COgnitive Distributed Engine) was to develop, to implement and to validate experimentally a cognitive routing system able to meet the challenges experienced by the Internet in terms of manageability and security, availability and accountability, as well as routing system scalability and quality. MAESTRO's task was the design and evaluation of flow management schemes that can deal with potentially sampled traffic information. The project had 7 partners, including Inria project-teams MAESTRO and PLANETE, and was coordinated by D. Papadimitriou (Alcatel-Lucent Bell, Belgium). See `http://www.ecode-project.eu/` and [179, 276].

IST FET BIONETS (2006-2009)

BIONETS (BIOlogically-inspired autonomic NETworks and Services) addressed the design of protocols that will allow evolution of services over a self-organizing wireless network that contains a huge amount of cheap sensors, as well as a limited number of intelligent terminals. The project followed an inter-disciplinary strategy for designing such networks (called bionets) by using methods and tools from biology, physics, economics. MAESTRO's task was to collect such tools and to adapt them to BIONETS. The project had 16 partners, including Inria project-teams MAESTRO and OASIS, and was coordinated by D. Miorandi (Create-Net, Italy). See scientific output of the project at `http://www.bionets.eu/`.

Network of Excellence EuroNF (2008-2009)

MAESTRO was a member of the Network of Excellence (NoE) EuroNF. "Its main target is to integrate the research effort of the partners to be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future" (excerpt from the EuroNF website `http://euronf.enst.fr/en_accueil.html`). See [176].

EGIDE ECO-NET Game theory for Wireless Networks (2008-2009)

This project investigated the application of game theory methods to wireless networks. Within this project a number of exchange visits have taken place among the three institutions involved, Inria/MAESTRO, St. Petersburg State University and Erevan State University. See [41, 56, 94, 105, 129, 130, 132, 133] for the scintific output of the project.

Associated teams and other international projects

Inria Associate Team DAWN (2008-2010)

MAESTRO has privileged collaborations with several INDIA institutes Associate team DAWN (Distributed Algorithms for Wireless Networks) involved three Inria project-teams teams (MAESTRO, the coordinator, MESCAL and TREC), the Indian Institute of Science (IISC) at Bangalore, the Tata Institute of Fundamental Research at Bombay and the University of Pennsylvania. DAWN's focus was on "Emerging Strategies for Wireless Communication Networks". More specifically, the project objectives were to model, analyze, optimize and invent protocols for both cellular as well as ad hoc wireless network. This project yielded many exchange visits and the publication of numerous research papers.

See `http://www-sop.inria.fr/maestro/DAWN/home.html`.

The new associate team GANESH (GAmes, Optimization and Analysis of NEtworkS: THeory and Applications) was lauched for a three-year period on January 1st, 2012. Partners of MAESTRO in GANESH are the Indian Institute of Science at Bangalore, the Indian Institute of Technology at Bombay, the Indian Institute of Technology at Madras and the University of Avignon (LIA).

Australian Research Council Linkage International and Discovery grants (2007-2009)

This was a bilateral collaboration between MAESTRO and the School of Mathematics of the University of South Australia. The topic of this collaboration was the development of new perturbation methods for solving singular operator equations with applications to Statistics and Complex System Analysis. See [37, 47].

Industrial contracts

Grant with Orange Labs on "Content-Centric Networking" (2010-2012)

The objective of this grant (CRE stands for "Contrat de Recherche Externalisée") is to develop mathematical models for the analysis of Content-Centric Networks (CCN). The research focuses on the design and performance evaluation of routing and caching policies. See [377].

Grant with Orange Labs on "QoS and Quality of Experience" (2010 -2011)

The objective of this grant (CRE) is to study the performance and to optimize protocols related to new applications over the Internet such as YouTube.

Grants with Alcatel-Lucent Bell Labs (2008-2011)

Since 2008 MAESTRO has been actively collaborating with Alcatel-Lucent Bell Labs (ALU) in the framework of the Alcatel-Lucent Inria Joint Laboratory. MAESTRO was involved in two of the three Research Actions (Actions de Recherche (ADR)

in French) of this laboratory, namely, ADR "Semantic Networking" (SemNet) and ADR "Self-Optimizing Wireless Networks" (SelfNet). MAESTRO's contributions to both ADRs are briefly described below.

ADR Semantic Networking: The paradigm of "semantic networking" for the networks of the future brings together "flow-based networking", "traffic-awareness" and "self-management" concepts to get "plug-and-play" networks. The natural traffic granularity is the flow. One task of MAESTRO was to design and evaluate fair flow scheduling mechanisms for routers. Another task devoted to MAESTRO was to evaluate the pros and cons of introducing very large packets that would coexist with other packets whose size will not change.

ADR Self-Optimizing Wireless Networks: MAESTRO was involved in the design of pico cell networks whose objective is to increase the capacity with lower energy requirements.

This collaboration with ALU has resulted in 4 patents [297, 298, 299, 300] and several (including joint) research papers.

Other funding

During the evaluation period, 5 MAESTRO PhD students were supported by scholarships awarded by the French Ministry of Higher Education and Research ("Allocation de thèse MESR"): Mouhamad Ibrahim (2005-2008), Abhulhalim Dandoush (2006-2010), Nicaise Choungmo Fofack (2010-present), Mahmoud El Chamie (2011-present) and Julien Gaillard (2011-present). Dorian Mazauric (2008-2011) was awarded a CNRS PACA PhD fellowship. Danil Nemirovsky (2007-2010) was awarded a PhD scholarship by Inria within the CORDI program. Marina Sokol (2009-present) is supported by Alcatel-Lucent Inria Joint Lab (through a grant with Inria project-team RESO). In addition, 3 MAESTRO postdoctoral researchers were supported by Inria fellowships: Utku Acer (2010), Manoj Panda (2011) and Yuedong Xu (2010). These fundings correspond to an overall budget of approximately **610KE** over the 2008-2011 period.

5 Objectives for the next four years

MAESTRO was created on October 1, 2003. Should the evaluation be positive the team will be extended until September 30, 2015 at which date it will be terminated, having reached the 12 years limit. The objectives below can therefore be seen as objectives that will be partially carried on by the successor of MAESTRO.

Network Science. We plan to contribute to a new fast growing research subject called "Network Science". "Network Science" or "Complex Network Analysis" aims at understanding the structural properties and the dynamics of a variety of large-scale networks in telecommunications (e.g. the Internet, the Web graph, peer-to-peer networks), social science (e.g. community of interest, advertisement, recommendation systems), bibliometrics (e.g. citations, co-authors), biology (e.g. spread of an epidemic, protein-protein interactions), and physics. It has been observed that the complex networks encountered in these areas share common properties such as power law degree distribution, small average distances, community structure, etc. It also appears that many general questions/applications (e.g. community detection, epidemic spreading, search, anomaly detection) are common in various disciplines which study networks. In particular, we plan to

understand the evolution of complex networks with the help of game theoretical tools in connection with Network Engineering Games, as described below. We shall design efficient tools for measuring specific properties of large scale complex networks and their dynamics. More specifically, we envisage to continue the work on the problem of distributed optimization in large networks where nodes cooperatively solve an optimization problem relying only on local information exchange.

Network Engineering Games. We plan to lay the foundations of *Network Engineering Games*. These are games arising in telecommunications engineering at all the networking layers. This includes considerations from information and communications theory for dealing with the physical and link layers, along with cross layer approaches. We shall focus on three areas: *routing games*, *evolutionary games* and *epidemic games*. In routing games we shall create the theory for costs that are not additive over links (such as packet losses or call blocking probabilities). We shall pursue our research in the stochastic extension of evolutionary game theory, namely the "anonymous sequential games" in which we shall study the total expected costs and the average cost. Within epidemic games we shall study epidemics that compete against each other. We shall apply this to social networks and will further study the coupling between various social networks (e.g. propagation strategies that combine Twitter, FaceBook and other social networks).

Green Networking. We plan to pursue our effort in the design and the analysis of future green networks. Our objective is to have a systematically "green" approach when solving optimization problems. The energy cost and the environmental impact should be considered in optimization functions along with traditional performance metrics such as throughput, fairness or delay.

Content-Oriented Networks. We want to push forward our study of networks of caches in order to provide design criteria for network operators. In particular we plan to address the problem of cache placement to improve the performance experienced by mobile users. A legitimate question is the following: is it worth to deploy content-oriented networks given that CDNs are going to be around no matter what? Can both architectures co-exist? Even from the only point of view of performance this question is worth investigation since as a "counter-measure" CDN operators may deploy more caches closer to the users which will diminish the advantages of a content-oriented architecture. We plan to address this question and, in particular, to identify scenarios when one architecture is more efficient than the other as far as performance is concerned.

Advances in Methodological Tools. We foresee a continuation of our general methodological activity on optimal control and game-theoretic models for optimal scheduling and resource allocation problems, in relationship with applications in networking, but also in other sciences such as Biology and Economics. Several of our recent contributions are related with time- or space-scale issues: fluid or mean-field limits, discrete vs. continuous control issues, etc. We shall pursue the understanding of these "multiscale" issues, which are also common to networking and other scientific disciplines. Finally, we envision to enhance our activity on general-purpose modeling algorithms and software for controlled and uncontrolled stochastic systems.

6 Bibliography of the project-team

6.1 Doctoral dissertations and "Habilitation" theses

[1] Konstantin Avrachenkov. *Stochatic methods for TCP/IP networks and the WWW*. HDR thesis, University of Nice Sophia Antipolis, April 29, 2010.

[2] Mouhamad Ibrahim. *Routing and performance evaluation of disruption tolerant networks*. Ph.D. thesis, University of Nice Sophia Antipolis, November 14, 2008. http://tel.archives-ouvertes.fr/tel-00339402.

[3] Dinesh Kumar. *Optimization and control in wireless and computer networks*. Ph.D. thesis, University of Nice Sophia Antipolis, November 26, 2008. http://www-sop.inria.fr/maestro/theses/Kumar-thesis.pdf.

[4] Natalia Osipova. *Improving resource sharing in computer networks with stochastic scheduling*. Ph.D. thesis, University of Nice Sophia Antipolis, March 27, 2009. http://www-sop.inria.fr/maestro/theses/Osipova-thesis.pdf.

[5] Amar Azad. *Advances in network control and optimization*. Ph.D. thesis, University of Avignon and the Vaucluse, November 26, 2010. http://www-sop.inria.fr/maestro/theses/Azad-thesis.pdf.

[6] Abdulhalim Dandoush. *Analysis and optimization of peer to peer storage systems*. Ph.D. thesis, University of Nice Sophia Antipolis, March 29, 2010. http://tel.archives-ouvertes.fr/tel-00470493.

[7] Danil Nemirovsky. *Monte Carlo methods and Markov chain based approaches for PageRank computation*. Ph.D. thesis, University of Nice Sophia Antipolis, July 2, 2010. Thesis in "cotutelle" with St. Petersbourg State University. http://www-sop.inria.fr/maestro/theses/Nemirovsky-thesis.pdf.

[8] Alonso Silva. *Design and optimization of wireless networks for large populations*. Ph.D. thesis, Supelec, June 7, 2010. http://www-sop.inria.fr/maestro/theses/Silva-thesis.pdf.

[9] Dorian Mazauric. *Optimisation discrète dans les réseaux de télécommunication : reconfiguration du routage, routage efficace en énergie, ordonnancement de liens et placement de données*. Ph.D. thesis, University of Nice Sophia Antipolis, November 7, 2011. http://tel.archives-ouvertes.fr/tel-00643513.

[10] Sreenath Ramanath. *Cell design and resource allocation for small cell networks*. Ph.D. thesis, University of Avignon and the Vaucluse, October 6, 2011. http://www-sop.inria.fr/maestro/theses/Ramanath-thesis.pdf.

6.2 Articles in referred journals and book chapters

[11] Ahmad Al Hanbali, Philippe Nain, and Eitan Altman. Performance of ad hoc networks with two-hop relay routing and limited packet lifetime (extended version). *Performance Evaluation*, 65(6-7):463–483, June 2008. http://dx.doi.org/10.1016/j.peva.2007.12.005.

[12] Eitan Altman, Konstantin Avrachenkov, Nicolas Bonneau, Mérouane Debbah, Rachid El-Azouzi, and Daniel Sadoc Menasche. Constrained cost-coupled stochastic games with independent state processes. *Operations Research*

Letters, 36(2):160–164, March 2008. http://dx.doi.org/10.1016/j.orl.2007.05.010.

[13] Eitan Altman, Tamer Başar, and Naceur Malouch. The role of information update in flow control. *IEEE Transactions on Communications*, 56(8):1331–1342, August 2008. http://dx.doi.org/10.1109/TCOMM.2008.050389.

[14] Konstantin Avrachenkov and Uri Yechiali. Retrial networks with finite buffers and their application to Internet data traffic. *Probability in the Engineering and Informational Sciences*, 22(4):519–536, October 2008. http://dx.doi.org/10.1017/S0269964808000314.

[15] Nicolas Bonneau, Mérouane Debbah, Eitan Altman, and Are Hjorungnes. Non-atomic games for multi-user systems. *IEEE Journal on Selected Areas in Communications*, 26(7):1047–1058, September 2008. Special Issue on Game Theory in Communication Systems. http://dx.doi.org/10.1109/JSAC.2008.080903.

[16] Tijani Chahed, Eitan Altman, and Salah Eddine Elayoubi. Joint uplink and downlink admission control to both streaming and elastic flows in CDMA/HSDPA systems. *Performance Evaluation*, 65(11-12):869–882, November 2008. Special Issue on Selected Papers from VALUETOOLS 2007. http://dx.doi.org/10.1016/j.peva.2008.03.004.

[17] Hisao Kameda and Eitan Altman. Inefficient noncooperation in networking games of common-pool resources. *IEEE Journal on Selected Areas in Communications*, 26(7):1260–1268, September 2008. Special Issue on Game Theory in Communication Systems. http://dx.doi.org/10.1109/JSAC.2008.080922.

[18] Hisao Kameda, Eitan Altman, and Odile Pourtallier. A mixed optimum in symmetric distributed computer systems. *IEEE Transactions on Automatic Control*, 53(2):631–635, March 2008. http://dx.doi.org/10.1109/TAC.2008.917653.

[19] Arzad Kherani, Ralph El-Khoury, Rachid El-Azouzi, and Eitan Altman. Stability-throughput tradeoff and routing in multi-hop wireless ad hoc networks. *Computer Networks*, 52(7):1365–1389, May 2008. http://dx.doi.org/10.1016/j.comnet.2008.01.015.

[20] Daniele Miorandi, Eitan Altman, and Giuseppa Alfano. The impact of channel randomness on coverage and connectivity of ad hoc and sensor networks. *IEEE Transactions on Wireless Communications*, 7(3):1062–1072, March 2008. http://dx.doi.org/10.1109/TWC.2007.060842.

[21] Natalia Osipova. Batch processor sharing with hyper-exponential service time. *Operations Research Letters*, 36(3):372–376, May 2008. http://dx.doi.org/10.1016/j.orl.2007.11.003.

[22] Venkatesh Ramaiyan, Anurag Kumar, and Eitan Altman. Fixed point analysis of single cell IEEE 802.11e WLANs: uniqueness and multistability. *IEEE/ACM Transactions on Networking*, 16(5):1080–1093, October 2008. http://dx.doi.org/10.1109/TNET.2007.911429.

[23] Saleh Yousefi, Eitan Altman, Rachid El-Azouzi, and Mahmood Fathy. Analytical model for connectivity in vehicular ad hoc networks. *IEEE Transactions*

on Vehicular Technology, 57(6):3341–3356, November 2008. http://dx.doi.org/10.1109/TVT.2008.2002957.

[24] Saleh Yousefi, Eitan Altman, Rachid El-Azouzi, and Mahmood Fathy. Improving connectivity in vehicular ad hoc networks: An analytical study. *Computer Communications*, 31(9):1653–1659, June 2008. http://dx.doi.org/10.1016/j.comcom.2007.10.045.

[25] Honggang Zhang, Giovanni Neglia, Don Towsley, and Giuseppe Lo Presti. Stability and efficiency of unstructured file sharing networks. *IEEE Journal on Selected Areas in Communications*, 26(7):1284–1294, September 2008. http://dx.doi.org/10.1109/JSAC.2008.080925.

[26] Sara Alouf, Iacopo Carreras, Alvaro Fialho, Daniele Miorandi, and Giovanni Neglia. Autonomic information diffusion in intermittently connected networks. In Mieso K. Denko, Laurence T. Yang, and Yan Zhang, editors, *Autonomic Computing and Networking*, chapter 17, pages 411–433. Springer, June 2009. http://dx.doi.org/10.1007/978-0-387-89828-5_17.

[27] Eitan Altman. Semi-linear stochastic difference equations. *Discrete Event Dynamic Systems*, 19(1):115–136, March 2009. http://dx.doi.org/10.1007/s10626-008-0053-4.

[28] Eitan Altman, Konstantin Avrachenkov, Ishai Menache, Gregory Miller, Balakrishna Prabhu, and Adam Shwartz. Dynamic discrete power control in cellular networks. *IEEE Transactions on Automatic Control*, 54(10):2328–2340, October 2009. http://dx.doi.org/10.1109/TAC.2009.2028960.

[29] Eitan Altman, Rachid El-Azouzi, Yezekael Hayel, and Hamidou Tembine. The evolution of transport protocols: an evolutionary game perspective. *Computer Networks*, 53(10):1751–1759, July 2009. Special Issue on Autonomic and Self-Organizing Systems. http://dx.doi.org/10.1016/j.comnet.2008.12.023.

[30] Eitan Altman, Yezekael Hayel, Hamidou Tembine, and Rachid El-Azouzi. Markov decision evolutionary games with expected average fitness. *Evolutionary Ecology Research*, 11(4):677–689, May 2009. Special Issue in Honor of Tom Vincent. Invited paper. http://www.evolutionary-ecology.com/issues/v11/n04/llar2429.pdf.

[31] Eitan Altman and Eilon Solan. Constrained games: the impact of the attitude to adversary's constraints. *IEEE Transactions on Automatic Control*, 54(10):2435–2440, October 2009. http://dx.doi.org/10.1109/TAC.2009.2029302.

[32] Konstantin Avrachenkov, Patrick Brown, and Natalia Osipova. Optimal choice of threshold in two level processor sharing. *Annals of Operations Research*, 170(1):21–39, September 2009. http://dx.doi.org/10.1007/s10479-008-0430-2.

[33] Konstantin Avrachenkov, Nelly Litvak, and Son Kim Pham. A singular perturbation approach for choosing the PageRank damping factor. *Internet Mathematics*, 5(1-2):47–69, September 2009. http://dx.doi.org/10.1080/15427951.2008.10129300.

[34] Anne-Elisabeth Baert, Vincent Boudet, and Alain Jean-Marie. Data replication optimisation in grid delivery network. *International Journal of Grid and Utility Computing*, 1(4):287–295, October 2009. http://dx.doi.org/10.1504/IJGUC.2009.027918.

[35] Anne-Elisabeth Baert, Vincent Boudet, Xavier Roche, and Alain Jean-Marie. Minimization of variance download times in a distributed VOD system. *Scalable Computing: Practice and Experience*, 10(1):75–86, March 2009. Special Issue on Simulation in Emergent Computational Systems. http://www.scpe.org/index.php/scpe/article/view/602.

[36] Laura Giarré, Giovanni Neglia, and Ilenia Tinnirello. Medium access in WiFi networks: strategies of selfish nodes. *IEEE Signal Processing Magazine*, 26(5):124–128, September 2009. Special Issue on Game Theory. http://dx.doi.org/10.1109/MSP.2009.933378.

[37] Phil Howlett, Konstantin Avrachenkov, Charles Pearce, and Vladimir Ejov. Inversion of analytically perturbed linear operators that are singular at the origin. *Journal of Mathematical Analysis and Applications*, 353(1):68–84, May 2009. http://dx.doi.org/10.1016/j.jmaa.2008.11.074.

[38] Simon Lasaulce, Mérouane Debbah, and Eitan Altman. Methodologies for analyzing equilibria in wireless games. *IEEE Signal Processing Magazine*, 26(5):41–52, September 2009. Special Issue on Game Theory. http://dx.doi.org/10.1109/MSP.2009.933496.

[39] Utku Günay Acer, Shivkumar Kalyanaraman, and Alhussein A. Abouzeid. Weak state routing for large-scale dynamic networks. *IEEE/ACM Transactions on Networking*, 18(5):1450–1463, October 2010. http://dx.doi.org/10.1109/TNET.2010.2043113.

[40] Sara Alouf, Giovanni Neglia, Iacopo Carreras, Daniele Miorandi, and Álvaro Fialho. Fitting genetic algorithms to distributed on-line evolution of network protocols. *Computer Networks*, 54(18):3402–3420, December 2010. http://dx.doi.org/10.1016/j.comnet.2010.06.015.

[41] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Fair resource allocation in wireless networks in the presence of a jammer. *Performance Evaluation*, 67(4):338–349, April 2010. Performance Evaluation Methodologies and Tools: Selected Papers from VALUETOOLS 2008. http://dx.doi.org/10.1016/j.peva.2009.08.002.

[42] Eitan Altman, Tamer Başar, and Francesco De Pellegrini. Optimal monotone forwarding policies in delay tolerant mobile ad hoc networks. *Performance Evaluation*, 67(4):299–317, April 2010. Performance Evaluation Methodologies and Tools: Selected Papers from VALUETOOLS 2008. http://dx.doi.org/10.1016/j.peva.2009.09.001.

[43] Eitan Altman and Yezekael Hayel. Markov decision evolutionary games. *IEEE Transactions on Automatic Control*, 55(7):1560–1569, June 2010. http://dx.doi.org/10.1109/TAC.2010.2042230.

[44] Eitan Altman, Tania Jiménez, and Daniel Kofman. Discriminatory processor sharing queues with stationary ergodic service times and the performance of TCP in

overload. *Computer Networks*, 54(9):1509–1519, June 2010. http://dx.doi.org/10.1016/j.comnet.2009.11.010.

[45] Konstantin Avrachenkov, Urtzi Ayesta, and Alexei Piunovskiy. Convergence of trajectories and optimal buffer sizing for AIMD congestion control. *Performance Evaluation*, 67(7):501–527, July 2010. http://dx.doi.org/10.1016/j.peva.2010.01.004.

[46] Konstantin Avrachenkov, Vivek Borkar, and Danil Nemirovsky. Quasi-stationary distributions as centrality measures for the giant strongly connected component of a reducible graph. *Journal of Computational and Applied Mathematics*, 234(11):3075–3090, October 2010. http://dx.doi.org/10.1016/j.cam.2010.02.001.

[47] Konstantin Avrachenkov, Vladimir Ejov, and Jerzy A. Filar. Multivariate polynomial perturbations of algebraic equations. *Journal of Mathematical Analysis and Applications*, 369(1):214–221, September 2010. http://dx.doi.org/10.1016/j.jmaa.2010.02.026.

[48] Konstantin Avrachenkov and Uri Yechiali. On tandem blocking queues with a common retrial queue. *Computers & Operations Research*, 37(7):1174–1180, July 2010. http://dx.doi.org/10.1016/j.cor.2009.10.004.

[49] Jean-Marc Kelif and Eitan Altman. Impact of macrodiversity on capacity and coverage of cellular network. *Telecommunication Systems*, 43(1-2):133–143, February 2010. Special Issue: Advances in Mobile and Wireless Networks. http://dx.doi.org/10.1007/s11235-009-9199-0.

[50] Venkatesh Ramaiyan, Eitan Altman, and Anurag Kumar. Delay optimal scheduling in a two-hop vehicular relay network. *Mobile Networks and Applications*, 15(1):97–111, February 2010. Special Issue on Advances and Applications in Vehicular Ad Hoc Networks. http://dx.doi.org/10.1007/s11036-009-0172-7.

[51] Saswati Sarkar, Eitan Altman, and Pramod Vaidyanathan. Information concealing games. *IEEE Transactions on Information Theory*, 56(9):4608–4630, September 2010. http://dx.doi.org/10.1109/TIT.2010.2053899.

[52] Alonso Silva, Eitan Altman, Pierre Bernhard, and Mérouane Debbah. Continuum equilibria for routing in dense static ad hoc networks. *Computer Networks*, 54(6):1005–1018, April 2010. Special Issue on Interdisciplinary Paradigms for Networking. http://dx.doi.org/10.1016/j.comnet.2009.10.019.

[53] Hamidou Tembine, Eitan Altman, Rachid El-Azouzi, and Yezekael Hayel. Evolutionary games in wireless networks. *IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics*, 40(3):634–646, June 2010. Special Issue on Game Theory. http://dx.doi.org/10.1109/TSMCB.2009.2034631.

[54] Yi Zhang, Alexei Piunovskiy, Urtzi Ayesta, and Konstantin Avrachenkov. Convergence of trajectories and optimal buffer sizing for MIMD congestion control. *Computer Communications*, 33(2):149–159, February 2010. http://dx.doi.org/10.1016/j.comcom.2009.08.008.

[55] Utku Günay Acer, Paolo Giaccone, David Hay, Giovanni Neglia, and Saed Tarapiah. Timely data delivery in a realistic bus network. *IEEE Transactions*

on Vehicular Technology, published online December 9, 2011. http://dx.doi.org/10.1109/TVT.2011.2179072.

[56] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Closed form solutions for water-filling problems in optimization and game frameworks. *Telecommunication Systems*, 47(1-2):153–164, June 2011. Special Issue on Game Theory in Communications Networks Dedicated to Papers from GameComm'08 and GameComm'07. http://dx.doi.org/10.1007/s11235-010-9308-0.

[57] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Jamming in wireless networks under uncertainty. *Mobile Networks and Applications*, 16:246–254, April 2011. Special Issue: Ad-hoc Wireless Network Systems. http://dx.doi.org/10.1007/s11036-010-0272-4.

[58] Eitan Altman, Urtzi Ayesta, and Balakrishna J. Prabhu. Load balancing in processor sharing systems. *Telecommunication Systems*, 47(1-2):35–48, June 2011. Special Issue on Game Theory in Communications Networks Dedicated to Papers from GameComm'08 and GameComm'07. http://dx.doi.org/10.1007/s11235-010-9300-8.

[59] Eitan Altman, Tamer Başar, and Francesco De Pellegrini. Optimal control in two-hop relay routing. *IEEE Transactions on Automatic Control*, 56(3):670–675, March 2011. http://dx.doi.org/10.1109/TAC.2010.2095930.

[60] Eitan Altman, Pierre Bernhard, Stephane Caron, Georges Kesidis, Julio Rojas-Mora, and Sulan Wong. A model of network neutrality with usage-based prices. *Telecommunication Systems*, published Online June 15, 2011. http://dx.doi.org/10.1007/s11235-011-9504-6.

[61] Eitan Altman and Francesco De Pellegrini. Forward correction and fountain codes in delay-tolerant networks. *IEEE/ACM Transactions on Networking*, 19(1):1–13, February 2011. http://dx.doi.org/10.1109/TNET.2010.2091968.

[62] Konstantin Avrachenkov, Alexander Dudin, Valentina Klimenok, Philippe Nain, and Olga Semenova. Optimal threshold control by the robots of web search engines with obsolescence of documents. *Computer Networks*, 55(8):1880–1893, June 2011. http://dx.doi.org/10.1016/j.comnet.2011.01.013.

[63] Konstantin Avrachenkov and Jean B. Lasserre. Analytic perturbation of generalized inverses. *Linear Algebra and Its Applications*, published online Novembre 30, 2011. http://dx.doi.org/10.1016/j.laa.2011.10.037.

[64] Konstantin Avrachenkov, Alexey Piunovskiy, and Yi Zhang. Asymptotic fluid optimality and efficiency of the tracking policy for bandwidth-sharing networks. *Journal of Applied Probability*, 48:90–113, March 2011. http://dx.doi.org/10.1239/jap/1300198138.

[65] Amar Prakash Azad, Sara Alouf, and Eitan Altman. Analysis and optimization of sleeping mode in WiMAX via stochastic decomposition techniques. *IEEE Journal on Selected Areas in Communications*, 29(8):1630–1640, September 2011. Special Issue on Energy-Efficient Wireless Communications. http://dx.doi.org/10.1109/JSAC.2011.110912.

[66] Amar Prakash Azad, Sara Alouf, Eitan Altman, Vivek Borkar, and Georgios Stavrou Paschos. Optimal control of sleep periods for wireless terminals. *IEEE Journal on Selected Areas in Communications*, 29(8):1605–1617, September 2011. Special Issue on Energy-Efficient Wireless Communications. http://dx.doi.org/10.1109/JSAC.2011.110910.

[67] Damiano Carra, Giovanni Neglia, Pietro Michiardi, and Francesco Albanese. On the robustness of BitTorrent swarms to greedy peers. *IEEE Transactions on Parallel and Distributed Systems*, 22(12):2071–2078, December 2011. http://dx.doi.org/10.1109/TPDS.2011.94.

[68] Richard Combes, Zwi Altman, and Eitan Altman. Scheduling gain for frequency-selective Rayleigh-fading channels with application to self-organizing packet scheduling. *Performance Evaluation*, 68(8):690–709, February 2011. Special Issue: Modeling and Optimization in Mobile, Ad hoc, and Wireless Networks: selected papers from WiOpt 2010. http://dx.doi.org/10.1016/j.peva.2011.01.009.

[69] Jocelyne Elias, Fabio Martignon, Konstantin Avrachenkov, and Giovanni Neglia. A game theoretic analysis of network design with socially-aware users. *Computer Networks*, 55(1):106–118, January 2011. http://dx.doi.org/10.1016/j.comnet.2010.07.014.

[70] Jocelyne Elias, Fabio Martignon, Antonio Capone, and Eitan Altman. Non-cooperative spectrum access in cognitive radio networks: a game theoretical model. *Computer Networks*, 55(17):3832–3846, December 2011. ISSN 1389-1286. http://dx.doi.org/10.1016/j.comnet.2011.07.022.

[71] Katrin Erdlenbruch, Alain Jean-Marie, Michel Moreaux, and Mabel Tidball. Optimality of impulse harvesting policies. *Economic Theory*, pages 1–31, published online June 24, 2011. http://dx.doi.org/10.1007/s00199-011-0650-6.

[72] Majed Haddad, Salah-Eddine Elayoubi, Eitan Altman, and Zwi Altman. A hybrid approach for radio resource management in heterogeneous cognitive networks. *IEEE Journal on Selected Areas in Communications*, 29(4):831–842, April 2011. http://dx.doi.org/10.1109/JSAC.2011.110414.

[73] Yezekael Hayel, Hamidou Tembine, Eitan Altman, and Rachid El-Azouzi. A Markov decision evolutionary game for individual energy management. In *Advances in Dynamic Games*, volume 11 of *Annals of the International Society of Dynamic Games*, pages 313–335. Birkhäuser Boston, 2011. http://dx.doi.org/10.1007/978-0-8176-8089-3_16.

[74] Emmanuel Hyon and Alain Jean-Marie. Scheduling services in a queuing system with impatience and setup costs. *The Computer Journal*, published online January 5, 2011. http://dx.doi.org/10.1093/comjnl/bxq096.

[75] Hisao Kameda, Jie Li, and Eitan Altman. Optimal routing for multiclass networks. *Advances in Operations Research*, 2011, 2011. Article ID 645954, 21 pages. http://dx.doi.org/10.1155/2011/645954.

[76] Veeraruna Kavitha and Eitan Altman. Continuous polling models and application to ferry assisted WLAN. *Annals of Operations Research*, published online September 21, 2011. http://dx.doi.org/10.1007/s10479-011-0960-x.

[77] Veeraruna Kavitha, Sreenath Ramanath, and Eitan Altman. Spatial queuing analysis for design and dimensioning of picocell networks with mobile users. *Performance Evaluation*, 68(8):710–727, August 2011. Special Issue: Modeling and Optimization in Mobile, Ad hoc, and Wireless Networks: selected papers from WiOpt 2010. http://dx.doi.org/10.1016/j.peva.2011.03.002.

[78] Vincenzo Mancuso and Sara Alouf. Reducing costs and pollution in cellular networks. *IEEE Communications Magazine*, 49(8):63–71, August 2011. http://dx.doi.org/10.1109/MCOM.2011.5978417.

[79] Venkatesh Ramaiyan, Anurag Kumar, and Eitan Altman. Optimal hop distance and power control for a single cell, dense, ad hoc wireless network. *IEEE Transactions on Mobile Computing*, published online October 6, 2011. http://dx.doi.org/10.1109/TMC.2011.204.

[80] Hamidou Tembine, Eitan Altman, Rachid El-Azouzi, and Yezekael Hayel. Bio-inspired delayed evolutionary game dynamics with networking applications. *Telecommunication Systems*, 47(1-2):137–152, June 2011. Special Issue on Game Theory in Communications Networks Dedicated to Papers from GameComm'08 and GameComm'07. http://dx.doi.org/10.1007/s11235-010-9307-1.

[81] Ilenia Tinnirello, Laura Giarré, and Giovanni Neglia. MAC design for WiFi infrastructure networks: a game-theoretic approach. *IEEE Transactions on Wireless Communications*, 10(8):2510–2522, August 2011. http://dx.doi.org/10.1109/TWC.2011.062011.100193.

[82] Piotr Wiecek, Yezekael Hayel, and Eitan Altman. Stochastic state dependent population games in wireless communication. *IEEE Transactions on Automatic Control*, 56(3):492–505, March 2011. http://dx.doi.org/10.1109/TAC.2010.2054810.

[83] Sulan Wong, Eitan Altman, and Julio Rojas-Mora. Internet access: where law, economy, culture and technology meet. *Computer Networks*, 55(2):470–479, February 2011. Special Issue: Wireless for the Future Internet. http://dx.doi.org/10.1016/j.comnet.2010.09.004.

[84] Xiaolan Zhang, Giovanni Neglia, and Jim Kurose. Network coding in disruption tolerant networks. In Muriel Medard and Alex Sprintson, editors, *Network Coding: Fundamentals and Applications*, chapter 10, pages 267–308. Elsevier Science, 2011. http://dx.doi.org/10.1016/B978-0-12-380918-6.00010-X.

[85] Eitan Altman, Manjesh Kumar Hanawal, Rachid El-Azouzi, and Shlomo Shamai. Tradeoffs in green cellular networks. *ACM SIGMETRICS Performance Evaluation Review*, March 2012. Special Issue on GreenMetrics 2011 Workshop, San Jose, CA, USA, June 7, 2011. To appear.

[86] Eitan Altman and Tania Jiménez. NS simulator for beginners. *Synthesis Lectures on Communication Networks*, 5(1):1–184, January 2012. http://dx.doi.org/10.2200/S00397ED1V01Y201112CNT010.

[87] Konstantin Avrachenkov, Laura Cottatellucci, and Lorenzo Maggi. Algorithms for uniform optimal strategies in two-player zero-sum stochastic games

with perfect information. *Operations Research Letters*, 40(1):56–60, January 2012. http://dx.doi.org/10.1016/j.orl.2011.10.005.

[88] Eugenio Della Vecchia, Silvia Di Marco, and Alain Jean-Marie. Illustrated review of convergence conditions of the value iteration algorithm and the rolling horizon procedure for average-cost MDPs. *Annals of Operations Research*, published online February 2, 2012. http://dx.doi.org/10.1007/s10479-012-1070-0.

[89] Mohammad Hossein Rezaei Khouzani, Eitan Altman, and Saswati Sarkar. Optimal quarantining of wireless malware through reception gain control. *IEEE Transactions on Automatic Control*, 57(1):49–61, January 2012. http://dx.doi.org/10.1109/TAC.2011.2150350.

[90] Mohammad Hossein Rezaei Khouzani, Saswati Sarkar, and Eitan Altman. Saddle-point strategies in malware attack. *IEEE Journal on Selected Areas in Communications*, 30(1):31–43, January 2012. http://dx.doi.org/10.1109/JSAC.2012.120104.

6.3 Publications in Conferences and Workshops

[91] Ahmad Al Hanbali, Mouhamad Ibrahim, Vilmos Simon, Endre Varga, and Iacopo Carreras. A survey of message diffusion protocols in mobile ad hoc networks. In *Proc. of 3rd International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2008)*. Athens, Greece, October 20-24, 2008. Presented at 3rd Workshop on Interdisciplinary Systems Approach in Performance Evaluation and Design of Computer and Communication Systems (Inter-Perf 2008). http://dx.doi.org/10.4108/ICST.VALUETOOLS2008.4510.

[92] Sara Alouf, Eitan Altman, and Amar Azad. Analysis of an M/G/1 queue with repeated inhomogeneous vacations with application to IEEE 802.16e power saving mechanism. In *Proc. of 5th International Conference on the Quantitative Evaluation of SysTems (QEST 2008)*, pages 27–36. Saint-Malo, France, September 14-17, 2008. http://dx.doi.org/10.1109/QEST.2008.37.

[93] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Closed form solutions for symmetric water filling games. In *Proc. of IEEE INFOCOM 2008*, pages 673–681. Phoenix, AZ, USA, April 15-17, 2008. http://dx.doi.org/10.1109/INFOCOM.2008.117.

[94] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Fair resources allocation in wireless networks in the presence of a jammer. In *Proc. of 3rd International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2008)*. Athens, Greece, October 20-24, 2008. http://dx.doi.org/10.4108/ICST.VALUETOOLS2008.4416.

[95] Eitan Altman, Urtzi Ayesta, and Balakrishna J. Prabhu. Load balancing in processor sharing systems. In *Proc. of 3rd International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2008)*. Athens, Greece, October 20-24, 2008. Presented at 2nd International Workshop on Game Theory in Communication Networks (GameComm 2008). http://dx.doi.org/10.4108/ICST.VALUETOOLS2008.4462.

[96] Eitan Altman, Tamer Başar, and Francesco De Pellegrini. Optimal monotone forwarding policies in delay tolerant mobile ad hoc networks. In *Proc. of 3rd International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2008)*. Athens, Greece, October 20-24, 2008. Presented at 3rd Workshop on Interdisciplinary Systems Approach in Performance Evaluation and Design of Computer and Communication Systems (Inter-Perf 2008). http://dx.doi.org/10.4108/ICST.VALUETOOLS2008.4430.

[97] Eitan Altman, Pierre Bernhard, and Alonso Silva. The mathematics of routing in massively dense ad-hoc networks. In *Proc. of 7th International Conference on Ad-hoc, Mobile and Wireless Networks (ADHOC-NOW 2008)*, volume 5198 of *Lecture Notes in Computer Science*, pages 122–134. Sophia-Antipolis, France, September 10-12, 2008. http://dx.doi.org/10.1007/978-3-540-85209-4_10.

[98] Eitan Altman, Rachid El-Azouzi, Yezekael Hayel, and Hamidou Tembine. An evolutionary game approach for the design of congestion control protocols in wireless networks. In *Proc. of 6th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks and Workshops (WiOpt 2008)*, pages 547–552. Berlin, Germany, April 1-3, 2008. Presented at 1st Workshop on Physics-Inspired Paradigms in Wireless Communications and Networks (PHYSCOMNET 2008). http://dx.doi.org/10.1109/WIOPT.2008.4586129.

[99] Eitan Altman, Rachid El-Azouzi, Yezekael Hayel, and Hamidou Tembine. Evolutionary power control games in wireless networks. In *Proc. of IFIP Networking 2008*, volume 4982 of *Lecture Notes in Computer Science*, pages 930–942. Singapore, May 5-9, 2008. http://dx.doi.org/10.1007/978-3-540-79549-0_82.

[100] Eitan Altman and Yezekael Hayel. A stochastic evolutionary game of energy management in a distributed Aloha network. In *Proc. of IEEE INFOCOM 2008*, pages 1759–1767. Phoenix, AZ, USA, April 15-17, 2008. http://dx.doi.org/10.1109/INFOCOM.2008.238.

[101] Eitan Altman and Yezekael Hayel. Stochastic evolutionary games. In *Proc. of 13th International Symposium on Dynamic Games and Applications (ISDGA 2008)*. Wroclaw, Poland, June 30 - July 3, 2008.

[102] Eitan Altman, Yezekael Hayel, Hamidou Tembine, and Rachid El-Azouzi. Markov decision evolutionary games with time average expected fitness criterion. In *Proc. of 3rd International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2008)*. Athens, Greece, October 20-24, 2008. http://dx.doi.org/10.4108/ICST.VALUETOOLS2008.4268.

[103] Eitan Altman, Tania Jiménez, Nelson Vicuna, and Richard Marquez. Coordination games over collision channels. In *Proc. of 6th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks and Workshops (WiOpt 2008)*, pages 523–527. Berlin, Germany, April 1-3, 2008. Presented at 2nd International Workshop on Wireless Networks: Communication, Cooperation and Competition (WNC3). http://dx.doi.org/10.1109/WIOPT.2008.4586122.

[104] Eitan Altman, Vijay Kamble, and Hisao Kameda. A Braess type paradox in power control over interference channels. In *Proc. of 6th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks and*

Workshops (WiOpt 2008), pages 555–559. Berlin, Germany, April 1-3, 2008. Presented at 1st Workshop on Physics-Inspired Paradigms in Wireless Communications and Networks (PHYSCOMNET 2008). http://dx.doi.org/10.1109/WIOPT.2008.4586132.

[105] Konstantin Avrachenkov, Eitan Altman, and Andrey Garnaev. Generalized α-fair resource allocation in wireless networks. In *Proc. of 47th IEEE Conference on Decision and Control (CDC 2008)*, pages 2414–2419. Cancun, Mexico, December 9-11, 2008. http://dx.doi.org/10.1109/CDC.2008.4738709.

[106] Konstantin Avrachenkov, Vladimir Dobrynin, Danil Nemirovsky, Son Kim Pham, and Elena Smirnova. PageRank based clustering of hypertext document collections. In *Proc. of 31st Annual International ACM SIGIR conference on Research and development in information retrieval*, pages 873–874. Singapore, 2008. Presented at Workshop: Learning to Rank for Information Retrieval. http://dx.doi.org/10.1145/1390334.1390549.

[107] Anne-Elisabeth Baert, Vincent Boudet, and Alain Jean-Marie. Performance analysis of data replication in grid delivery networks. In *Proc. of 2nd International Conference on Complex, Intelligent and Software Intensive Systems (CISIS 2008)*, pages 369–374. Barcelona, Spain, March 4-7, 2008. http://dx.doi.org/10.1109/CISIS.2008.25.

[108] Anne-Elisabeth Baert, Vincent Boudet, Alain Jean-Marie, and Xavier Roche. Optimization of download times in a distributed VOD system. In *Proc. of 37th International Conference on Parallel Processing - Workshops (ICPP-W 2008)*, pages 173–180. Portland, Oregon, USA, September 8-12, 2008. http://dx.doi.org/10.1109/ICPP-W.2008.27.

[109] Damiano Carra, Giovanni Neglia, and Pietro Michiardi. On the impact of greedy strategies in BitTorrent networks: the case of BitTyrant. In *Proc. of 8th International Conference on Peer-to-Peer Computing (P2P 2008)*, pages 311–320. Aachen, Germany, September 8-11, 2008. http://dx.doi.org/10.1109/P2P.2008.45.

[110] Tijani Chahed, Salah-Eddine Elayoubi, and Eitan Altman. On design of TDD for joint uplink and downlink resource allocation in OFDMA-based WiMax. In *Proc. of 68th IEEE Vehicular Technology Conference (VTC 2008-Fall)*. Calgary, Canada, September 21-24, 2008. http://dx.doi.org/10.1109/VETECF.2008.305.

[111] Romain Couillet, Sebastian Wagner, Mérouane Debbah, and Alonso Silva. The space frontier: physical limits of multiple antenna information transfer. In *Proc. of 3rd International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2008)*. Athens, Greece, October 20-24, 2008. Presented at 3rd Workshop on Interdisciplinary Systems Approach in Performance Evaluation and Design of Computer and Communication Systems (Inter-Perf 2008). **Best Student Paper Award**. http://dx.doi.org/10.4108/ICST.VALUETOOLS2008.4574.

[112] Ralph El-Khoury, Rachid El-Azouzi, and Eitan Altman. Delay analysis for real-time streaming media in multi-hop ad hoc networks. In *Proc. of 6th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks and Workshops (WiOpt 2008)*, pages 419–428. Berlin, Germany, April 1-3, 2008. http://dx.doi.org/10.1109/WIOPT.2008.4586101.

[113] Gaoning He, Sophie Gault, Mérouane Debbah, and Eitan Altman. Distributed power allocation game for uplink OFDM systems. In *Proc. of 6th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks and Workshops (WiOpt 2008)*, pages 515–521. Berlin, Germany, April 1-3, 2008. Presented at 2nd International Workshop on Wireless Networks: Communication, Cooperation and Competition (WNC3). http://dx.doi.org/10.1109/WIOPT.2008.4586120.

[114] Gaoning He, Sophie Gault, Mérouane Debbah, and Eitan Altman. Iterative mercury/waterfilling for parallel multiple access channels. In *Proc. of IEEE International Conference on Communications (ICC 2008)*, pages 5018–5022. Beijing, China, May 19-23, 2008. http://dx.doi.org/10.1109/ICC.2008.941.

[115] Jean-Marc Kelif and Eitan Altman. Downlink macrodiversity in cellular networks – a fluid analysis. In *Proc. of 13th IFIP International Conference on Personal Wireless Communications (PWC 2008)*, pages 369–382. Toulouse, France, September 30 - October 2, 2008. http://dx.doi.org/10.1007/978-0-387-84839-6_29.

[116] Dinesh Kumar, Dhiman Barman, Eitan Altman, and Jean-Marc Kelif. New cross-layer channel switching policy for TCP transmission on 3G UMTS downlink. In *Proc. of 7th Wireless Telecommunications Symposium (WTS 2008)*, pages 169–176. Pomona, CA, USA, April 24-26, 2008. http://dx.doi.org/10.1109/WTS.2008.4547562.

[117] Nikolaos Laoutaris, Damiano Carra, and Pietro Michiardi. Uplink allocation beyond choke/unchoke or how to divide and conquer best. In *Proc. of 4th ACM International Conference on Emerging Networking Experiments and Technologies (CoNEXT 2008)*. Madrid, Spain, December 9-12, 2008. http://dx.doi.org/10.1145/1544012.1544030.

[118] Ishai Menache and Eitan Altman. Battery-state dependent power control as a dynamic game. In *Proc. of 6th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks and Workshops (WiOpt 2008)*, pages 242–250. Berlin, Germany, April 1-3, 2008. http://dx.doi.org/10.1109/WIOPT.2008.4586072.

[119] Daniele Miorandi, Iacopo Carreras, Eitan Altman, Lidia Yamamoto, and Imrich Chlamtac. Bio-inspired approaches for autonomic pervasive computing systems. In *Proc. of 1st Workshop on Bio-Inspired Design of Networks (BIOWIRE 2007), Cambridge, UK, April 2-5, 2007*, volume 5151 of *Lecture Notes in Computer Science*, pages 217–228. 2008. Invited paper. http://dx.doi.org/10.1007/978-3-540-92191-2_20.

[120] Natalia Osipova, Alberto Blanc, and Konstantin Avrachenkov. Improving TCP fairness with the MarkMax policy. In *Proc. of 15th International Conference on Telecommunications (ICT 2008)*. St. Petersburg, Russia, June 16-19, 2008. http://dx.doi.org/10.1109/ICTEL.2008.4652651.

[121] Saswati Sarkar, Eitan Altman, Rachid El-Azouzi, and Yezekael Hayel. Information concealing games. In *Proc. of IEEE INFOCOM 2008*, pages 2119–2127. Phoenix, AZ, USA, April 15-17, 2008. http://dx.doi.org/10.1109/INFOCOM.2008.278.

[122] Alonso Silva, Pierre Bernhard, and Eitan Altman. Numerical solutions of continuum equilibria for routing in dense ad hoc networks. In *Proc. of 3rd International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2008)*. Athens, Greece, October 20-24, 2008. Presented at 3rd Workshop on Interdisciplinary Systems Approach in Performance Evaluation and Design of Computer and Communication Systems (Inter-Perf 2008). http://dx.doi.org/10.4108/ICST.VALUETOOLS2008.4521.

[123] Hamidou Tembine, Eitan Altman, Rachid El-Azouzi, and Yezekael Hayel. Evolutionary games with random number of interacting players applied to access control. In *Proc. of 6th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks and Workshops (WiOpt 2008)*, pages 344–351. Berlin, Germany, April 1-3, 2008. http://dx.doi.org/10.1109/WIOPT.2008.4586088.

[124] Hamidou Tembine, Eitan Altman, Rachid El-Azouzi, and Yezekael Hayel. Stochastic population games with individual independent states and coupled constraints. In *Proc. of 3rd International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2008)*. Athens, Greece, October 20-24, 2008. Presented at 2nd International Workshop on Game Theory in Communication Networks (GameComm 2008). http://dx.doi.org/10.4108/ICST.VALUETOOLS2008.4359.

[125] Hamidou Tembine, Eitan Altman, Rachid El-Azouzi, and William H. Sandholm. Evolutionary game dynamics with migration for hybrid power control in wireless communications. In *Proc. of 47th IEEE Conference on Decision and Control (CDC 2008)*, pages 4479–4484. Cancun, Mexico, December 9-11, 2008. http://dx.doi.org/10.1109/CDC.2008.4739024.

[126] Sara Akbarzadeh, Laura Cottatellucci, Eitan Altman, and Christian Bonnet. Distributed communication control mechanisms for ad hoc networks. In *Proc. of IEEE International Conference on Communications (ICC 2009)*. Dresden, Germany, June 14-18, 2009. http://dx.doi.org/10.1109/ICC.2009.5198923.

[127] Eitan Altman. Competition and cooperation between nodes in delay tolerant networks with two hop routing. In *Proc. of 3rd Workshop on Network Control and Optimization (NET-COOP 2009)*, volume 5894 of *Lecture Notes in Computer Science*, pages 264–278. Eindhoven, The Netherlands, November 23-25, 2009. http://dx.doi.org/10.1007/978-3-642-10406-0_18.

[128] Eitan Altman, Konstantin Avrachenkov, Laura Cottatellucci, Mérouane Debbah, Gaoning He, and Alberto Suarez. Operating point selection in multiple access rate regions. In *Proc. of 21st International Teletraffic Congress (ITC 2009)*. Paris, France, September 15-17, 2009. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5300242.

[129] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Alpha-fair resource allocation under incomplete information and presence of a jammer. In *Proc. of 3rd Workshop on Network Control and Optimization (NET-COOP 2009)*, volume 5894 of *Lecture Notes in Computer Science*, pages 219–233. Eindhoven, The Netherlands, November 23-25, 2009. http://dx.doi.org/10.1007/978-3-642-10406-0_15.

[130] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Jamming game with incomplete information about the jammer. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. Presented at 3rd International Workshop on Game Theory in Communication Networks (GameComm 2009). http://dl.acm.org/citation.cfm?id=1698903.

[131] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Jamming in wireless networks: the case of several jammers. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 585–592. Istanbul, Turkey, May 13-15, 2009. http://dx.doi.org/10.1109/GAMENETS.2009.5137448.

[132] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Jamming in wireless networks under uncertainty. In *Proc. of 7th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2009)*. Seoul, Korea, June 23-27, 2009. http://dx.doi.org/10.1109/WIOPT.2009.5291638.

[133] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Transmission power control game with SINR as objective function. In *Proc. of 2nd Workshop on Network Control and Optimization (NET-COOP 2008), Paris, France, September 8-10, 2008*, volume 5425 of *Lecture Notes in Computer Science*, pages 112–120. February 2009. http://dx.doi.org/10.1007/978-3-642-00393-6_14.

[134] Eitan Altman, Tamer Başar, and Francesco De Pellegrini. Optimal control in two-hop relay routing. In *Proc. of 48th IEEE Conference on Decision and Control (CDC 2009)*, pages 2729–2735. Shanghai, China, December 15-18, 2009. http://dx.doi.org/10.1109/CDC.2009.5399870.

[135] Eitan Altman, Tamer Başar, Ishai Menache, and Hamidou Tembine. A dynamic random access game with energy constraints. In *Proc. of 7th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2009)*. Seoul, Korea, June 23-27, 2009. http://dx.doi.org/10.1109/WIOPT.2009.5291611.

[136] Eitan Altman and Francesco De Pellegrini. Forward correction and fountain codes in delay tolerant networks. In *Proc. of IEEE INFOCOM 2009*, pages 1899–1907. Rio de Janeiro, Brazil, April 19-25, 2009. http://dx.doi.org/10.1109/INFCOM.2009.5062111.

[137] Eitan Altman, Jocelyne Elias, and Fabio Martignon. A game theoretic framework for joint routing and pricing in networks with elastic demands. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. http://dl.acm.org/citation.cfm?id=1698894.

[138] Eitan Altman and Moshe Haviv. Broadcasting forever. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 484–487. Istanbul, Turkey, May 13-15, 2009. http://dx.doi.org/10.1109/GAMENETS.2009.5137436.

[139] Eitan Altman, Vijay Kamble, and Vivek Borkar. Convergence of population dynamics in symmetric routing games with a finite number of players. In *Proc. of*

1st International Conference on Game Theory for Networks (GameNets 2009), pages 668–672. Istanbul, Turkey, May 13-15, 2009. Invited paper. http://dx.doi.org/10.1109/GAMENETS.2009.5137459.

[140] Eitan Altman, Vijay Kamble, and Alonso Silva. Stochastic games with one step delay sharing information pattern with application to power control. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 124–129. Istanbul, Turkey, May 13-15, 2009. http://dx.doi.org/10.1109/GAMENETS.2009.5137393.

[141] Eitan Altman, Anurag Kumar, and Yezekael Hayel. A potential game approach for uplink resource allocation in a multichannel wireless access network. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. Presented at 3rd International Workshop on Game Theory in Communication Networks (GameComm 2009). http://dl.acm.org/citation.cfm?id=1698910.

[142] Eitan Altman, Anurag Kumar, Chandramani Singh, and Rajesh Sundaresan. Spatial SINR games combining base station placement and mobile association. In *Proc. of IEEE INFOCOM 2009*, pages 1629–1637. Rio de Janeiro, Brazil, April 19-25, 2009. http://dx.doi.org/10.1109/INFCOM.2009.5062081.

[143] Eitan Altman, Ishai Menache, and Asuman Ozdaglar. Noncooperative load balancing in the continuum limit of a dense network. In *Proc. of IEEE INFOCOM 2009*, pages 2636–2640. Rio de Janeiro, Brazil, April 19-25, 2009. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2009.5062202.

[144] Eitan Altman, Ishai Menache, and Alberto Suarez. Team and noncooperative solutions to access control with priorities. In *Proc. of IEEE INFOCOM 2009*, pages 1611–1619. Rio de Janeiro, Brazil, April 19-25, 2009. http://dx.doi.org/10.1109/INFCOM.2009.5062079.

[145] Eitan Altman, Philippe Nain, and Jean-Claude Bermond. Distributed storage management of evolving files in delay tolerant ad hoc networks. In *Proc. of IEEE INFOCOM 2009*, pages 1431–1439. Rio de Janeiro, Brazil, April 19-25, 2009. http://dx.doi.org/10.1109/INFCOM.2009.5062059.

[146] Eitan Altman, Giovanni Neglia, Francesco De Pellegrini, and Daniele Miorandi. Decentralized stochastic control of delay tolerant networks. In *Proc. of IEEE INFOCOM 2009*, pages 1134–1142. Rio de Janeiro, Brazil, April 19-25, 2009. http://dx.doi.org/10.1109/INFCOM.2009.5062026.

[147] Eitan Altman, Sulan Wong, and Julio Rojas-Mora. P2P business and legal models for increasing accessibility to popular culture. In *Proc. of International Conference on Digital Business (DIGIBIZ 2009)*, volume 21 of *LNICST*, pages 130–138. London, United Kingdom, June 17-19, 2009. http://dx.doi.org/10.1007/978-3-642-11532-5_15.

[148] Amar Prakash Azad, Sara Alouf, Eitan Altman, Vivek Borkar, and Georgios Paschos. Optimal sampling for state change detection with application to the control of sleep mode. In *Proc. of 48th IEEE Conference on Decision and Control (CDC 2009)*, pages 1645–1650. Shanghai, China, December 15-18, 2009. http://dx.doi.org/10.1109/CDC.2009.5400669.

[149] Amar Prakash Azad, Sara Alouf, Eitan Altman, Vivek Borkar, and Georgios Paschos. Vacation policy optimization with application to IEEE 802.16e power saving mechanism. In *Proc. of 2nd IFIP Wireless Days 2009*. Paris, France, December 15-17, 2009. **Best Paper Award**. http://dx.doi.org/10.1109/WD.2009.5449688.

[150] Amar Prakash Azad, Eitan Altman, and Rachid El-Azouzi. From altruism to non-cooperation in routing games. In *Proc. of Networking and Electronic Commerce Research Conference (NAEC)*. Riva del Garda, Italy, October 8-11, 2009.

[151] Anne-Elisabeth Baert, Vincent Boudet, and Alain Jean-Marie. Guaranteed download time in a distributed video on demand system. In *Proc. of 3rd International Conference on Complex, Intelligent and Software Intensive Systems (CISIS 2009)*, pages 421–426. Fukuoka, Japan, March 16-19, 2009. http://dx.doi.org/10.1109/CISIS.2009.96.

[152] Abdelghani Ben Tahar and Alain Jean-Marie. Population effects in multiclass processor sharing queues. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. http://dl.acm.org/citation.cfm?id=1698865.

[153] Alberto Blanc, Konstantin Avrachenkov, and Denis Collange. Comparing some high speed TCP versions under Bernoulli losses. In *Proc. of International Workshop on Protocols for Future, Large-Scale and Diverse Network Transports (PFLDNeT 2009)*, pages 435–440. Tokyo, Japan, May 21-22, 2009. http://www.hpcc.jp/pfldnet2009/Program_files/1569197811.pdf.

[154] Alberto Blanc, Konstantin Avrachenkov, Denis Collange, and Giovanni Neglia. Compound TCP with random losses. In *Proc. of IFIP Networking 2009*, volume 5550 of *Lecture Notes in Computer Science*, pages 482–494. Aachen, Germany, May 11-15, 2009. http://dx.doi.org/10.1007/978-3-642-01399-7_38.

[155] Alberto Blanc, Denis Collange, and Konstantin Avrachenkov. Modelling an isolated compound TCP connection. In *Proc. of 5th Advanced International Conference on Telecommunications (AICT 2009)*, pages 435–440. Venice/Mestre, Italy, May 24-28, 2009. http://dx.doi.org/10.1109/AICT.2009.78.

[156] Julien Champ, Vincent Boudet, and Anne-Elisabeth Baert. Dynamic localized broadcast incremental power protocol and lifetime in wireless ad hoc and sensor networks. In *Proc. of 2nd Joint IFIP Wireless and Mobile Networking Conference (WMNC 2009)*, pages 286–296. Gdańsk, Poland, September 9-11, 2009. http://hal-lirmm.ccsd.cnrs.fr/lirmm-00385340/en/.

[157] Julien Champ, Clément Saad, and Anne-Elisabeth Baert. Lifetime in wireless sensor networks. In *Proc. of 3rd International Conference on Complex, Intelligent and Software Intensive Systems (CISIS 2009)*, pages 293–298. Fukuoka, Japan, March 16-19, 2009. http://dx.doi.org/10.1109/CISIS.2009.106.

[158] Omer Czerniak, Eitan Altman, and Uri Yechiali. Analysis of a TCP system under polling-type reduction-signal procedures. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. http://dl.acm.org/citation.cfm?id=1698852.

[159] Abdulhalim Dandoush, Sara Alouf, and Philippe Nain. Performance analysis of centralized versus distributed recovery schemes in P2P storage systems. In *Proc. of IFIP Networking 2009*, volume 5550 of *Lecture Notes in Computer Science*, pages 676–689. Aachen, Germany, May 11-15, 2009. http://dx.doi.org/10.1007/978-3-642-01399-7_53.

[160] Abdulhalim Dandoush, Sara Alouf, and Philippe Nain. A realistic simulation model for peer-to-peer storage systems. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. Invited paper at International Workshop on Network Simulation Tools (NSTOOLS 2009). http://dl.acm.org/citation.cfm?id=1698822.1698830.

[161] Abdulhalim Dandoush, Sara Alouf, and Philippe Nain. Simulation analysis of download and recovery processes in P2P storage systems. In *Proc. of 21st International Teletraffic Congress (ITC 2009)*. Paris, France, September 15-17, 2009. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5300232.

[162] Dinil Mon Divakaran, Eitan Altman, Georg Post, Ludovic Noirie, and Pascale Vicat-Blanc Primet. Analysis of the effects of XLFrames in a network. In *Proc. of IFIP Networking 2009*, volume 5550 of *Lecture Notes in Computer Science*, pages 364–377. Aachen, Germany, May 11-15, 2009. http://dx.doi.org/10.1007/978-3-642-01399-7_29.

[163] Dinil Mon Divakaran, Eitan Altman, Georg Post, Ludovic Noirie, and Pascale Vicat-Blanc Primet. From packets to XLFrames: sand and rocks for transfer of mice and elephants. In *Proc. of IEEE INFOCOM Workshops 2009*. Rio de Janeiro, Brazil, April 19-25, 2009. http://dx.doi.org/10.1109/INFCOMW.2009.5072149.

[164] Laura Giarré, Giovanni Neglia, and Ilenia Tinnirello. Performance analysis of selfish access strategies on WiFi infrastructure networks. In *Proc. of 52nd IEEE Global Communications Conference (GLOBECOM 2009)*. Honolulu, HI, USA, November 30 - December 4, 2009. http://dx.doi.org/10.1109/GLOCOM.2009.5425511.

[165] Laura Giarré, Ilenia Tinnirello, and Giovanni Neglia. Resource sharing optimality in WiFi infrastructure networks. In *Proc. of 48th IEEE Conference on Decision and Control (CDC 2009)*, pages 5877–5882. Shanghai, China, December 15-18, 2009. http://dx.doi.org/10.1109/CDC.2009.5399621.

[166] Emmanuel Hyon and Alain Jean-Marie. Politiques à seuil dans un système stochastique discret avec pertes et set-up. In *Proc. of 10th congress of the French Society for Operations Research and Decision (ROADEF 2009)*, pages 214–215. Nancy, France, February 10-12, 2009. http://roadef2009.loria.fr/programme/Resumes.pdf.

[167] Mouhamad Ibrahim, Eitan Altman, Pascale Vicat-Blanc Primet, Giovanna Carofiglio, and Georg Post. A simulation study of passive inference of TCP rate and detection of congestion. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. Presented at International Workshop on Network Simulation Tools (NSTOOLS 2009). http://dl.acm.org/citation.cfm?id=1698831.

[168] Mouhamad Ibrahim, Philippe Nain, and Iacopo Carreras. Analysis of relay protocols for throwbox-equipped DTNs. In *Proc. of 7th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2009)*. Seoul, Korea, June 23-27, 2009. http://dx.doi.org/10.1109/WIOPT.2009.5291625.

[169] Hisao Kameda, Eitan Altman, Corinne Touati, and Arnaud Legrand. Nash equilibrium based fairness. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 533–539. Istanbul, Turkey, May 13-15, 2009. Invited paper. http://dx.doi.org/10.1109/GAMENETS.2009.5137442.

[170] Gaurav Kasbekar, Eitan Altman, and Saswati Sarkar. A hierarchical spatial game over licensed resources. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 70–79. Istanbul, Turkey, May 13-15, 2009. http://dx.doi.org/10.1109/GAMENETS.2009.5137385.

[171] Veeraruna Kavitha and Eitan Altman. Queueing in space: design of message ferry routes in static ad hoc networks. In *Proc. of 21st International Teletraffic Congress (ITC 2009)*. Paris, France, September 15-17, 2009. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5300246.

[172] Veeraruna Kavitha, Eitan Altman, Rachid El-Azouzi, and Rajesh Sundaresan. Opportunistic scheduling in cellular systems in the presence of non-cooperative mobiles. In *Proc. of 48th IEEE Conference on Decision and Control (CDC 2009)*, pages 8581–8587. Shanghai, China, December 15-18, 2009. http://dx.doi.org/10.1109/CDC.2009.5400039.

[173] Mohammad Hossein Rezaei Khouzani, Eitan Altman, and Saswati Sarkar. Optimal quarantining of wireless malware through power control. In *Proc. of 4th Information Theory and Applications Workshop*, pages 301–310. San Diego, California, February 8-13, 2009. Invited paper. http://dx.doi.org/10.1109/ITA.2009.5044961.

[174] Dinesh Kumar, Tijani Chahed, and Eitan Altman. Analysis of a fountain codes based transport in an 802.11 WLAN cell. In *Proc. of 21st International Teletraffic Congress (ITC 2009)*. Paris, France, September 15-17, 2009. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5300267.

[175] Daniel Sadoc Menasche, Giovanni Neglia, Don Towsley, and Shlomo Zilberstein. Strategic reasoning about bundling in swarming systems. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 611–620. Istanbul, Turkey, May 13-15, 2009. Invited paper. http://dx.doi.org/10.1109/GAMENETS.2009.5137451.

[176] Giovanni Neglia, Giuseppe Reina, and Sara Alouf. Distributed gradient optimization for epidemic routing: a preliminary evaluation. In *Proc. of 2nd IFIP Wireless Days 2009*. Paris, France, December 15-17, 2009. http://dx.doi.org/10.1109/WD.2009.5449659.

[177] Danil Nemirovsky and Konstantin Avrachenkov. Weighted PageRank: cluster-related weights. In *Proc. of 17th Text Retrieval Conference (TREC 2008), Gaithersburg, Maryland, USA, November 18-21, 2008*. February 2009. http://trec.nist.gov/pubs/trec17/papers/inria.ent.rev.pdf.

[178] Danil Nemirovsky and Vladimir Dobrynin. Word importance discrimination using context information. In *Proc. of 17th Text Retrieval Conference (TREC 2008), Gaithersburg, Maryland, USA, November 18-21, 2008*. February 2009. http://trec.nist.gov/pubs/trec17/papers/st.petersburg.ent.rev.pdf.

[179] Natalia Osipova, Urtzi Ayesta, and Konstantin Avrachenkov. Optimal policy for multi-class scheduling in a single server queue. In *Proc. of 21st International Teletraffic Congress (ITC 2009)*. Paris, France, September 15-17, 2009. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5300261.

[180] Sreenath Ramanath, Eitan Altman, Vinod Kumar, and Mérouane Debbah. Optimizing cell size in pico-cell networks. In *Proc. of 7th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2009)*. Seoul, Korea, June 23-27, 2009. Invited paper at 5th Workshop on Resource Allocation, Cooperation and Competition in Wireless Networks (RAWNET/WNC3 2009). http://dx.doi.org/10.1109/WIOPT.2009.5291586.

[181] Sreenath Ramanath, Eitan Altman, Vinod Kumar, Veeraruna Kavitha, and Laurent Thomas. Fair assignment of base stations in cellular networks. In *Proc. of 22nd World Wireless Research Forum Meeting (WWRF)*. Paris, France, May 5-7, 2009.

[182] Julio Rojas-Mora, Eitan Altman, and Tania Jiménez. Some considerations in simulating an M/M/1 queue. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. Presented at International Workshop on Network Simulation Tools (NSTOOLS 2009). http://dl.acm.org/citation.cfm?id=1698828.

[183] Essaid Sabir, Rachid El-Azouzi, Veeraruna Kavitha, Yezekael Hayel, and El-Houssine Bouyakhf. Stochastic learning solution for constrained Nash equilibrium throughput in non saturated wireless collision channels. In *Proc. of 4th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2009)*. Pisa, Italy, October 20-22, 2009. Presented at 3rd International Workshop on Game Theory in Communication Networks (GameComm 2009). http://dl.acm.org/citation.cfm?id=1698899.

[184] Alonso Silva, Patricio Reyes, and Mérouane Debbah. Congestion in randomly deployed wireless ad-hoc and sensor networks. In *Proc. of International Conference on Ultra Modern Telecommunications*. St. Petersburg, Russia, October 12-14, 2009. http://dx.doi.org/10.1109/ICUMT.2009.5345632.

[185] Gilles Simonin, Anne-Elisabeth Baert, Alain Jean-Marie, and Rodolphe Giroudeau. Problème d'acquisition de données par une torpille. In *Proc. of 10th congress of the French Society for Operations Research and Decision (ROADEF 2009)*, pages 161–162. Nancy, France, February 10-12, 2009. http://roadef2009.loria.fr/programme/Resumes.pdf.

[186] Sébastien Soudan, Dinil Mon Divakaran, Eitan Altman, and Pascale Vicat-Blanc Primet. Equilibrium in size-based scheduling systems. In *Proc. of 16th International Conference on Analytical and Stochastic Modeling Techniques and Applications (ASMTA 2009)*, volume 5513 of *Lecture Notes in Computer Science*, pages 234–248. Madrid, Spain, June 9-12, 2009. http://dx.doi.org/10.1007/978-3-642-02205-0_17.

[187] Hamidou Tembine, Eitan Altman, Rachid El-Azouzi, and Yezekael Hayel. Battery state-dependent access control in solar-powered broadband wireless networks. In *Proc. of 2nd Workshop on Network Control and Optimization (NET-COOP 2008), Paris, France, September 8-10, 2008*, volume 5425 of *Lecture Notes in Computer Science*, pages 121–129. February 2009. http://dx.doi.org/10.1007/978-3-642-00393-6_15.

[188] Hamidou Tembine, Eitan Altman, Rachid El-Azouzi, and Yezekael Hayel. Correlated evolutionarily stable strategies in random medium access control. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 212–221. Istanbul, Turkey, May 13-15, 2009. Invited paper. http://dx.doi.org/10.1109/GAMENETS.2009.5137404.

[189] Hamidou Tembine, Jean-Yves Le Boudec, Rachid El-Azouzi, and Eitan Altman. From mean field interactions to evolutionary game dynamics. In *Proc. of 7th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2009)*. Seoul, Korea, June 23-27, 2009. Presented at 2nd Workshop on Physics-Inspired Paradigms in Wireless Communications and Networks (PHYSCOMNET 2009). http://dx.doi.org/10.1109/WIOPT.2009.5291592.

[190] Hamidou Tembine, Jean-Yves Le Boudec, Rachid El-Azouzi, and Eitan Altman. Mean field asymptotics of Markov decision evolutionary games and teams. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 140–150. Istanbul, Turkey, May 13-15, 2009. http://dx.doi.org/10.1109/GAMENETS.2009.5137395.

[191] Ilenia Tinnirello, Laura Giarré, and Giovanni Neglia. The role of the access point in Wi-Fi networks with selfish nodes. In *Proc. of 1st International Conference on Game Theory for Networks (GameNets 2009)*, pages 631–637. Istanbul, Turkey, May 13-15, 2009. http://dx.doi.org/10.1109/GAMENETS.2009.5137453.

[192] Piotr Wiecek, Eitan Altman, and Yezekael Hayel. An anonymous sequential game approach for battery state dependent power control. In *Proc. of 3rd Workshop on Network Control and Optimization (NET-COOP 2009)*, volume 5894 of *Lecture Notes in Computer Science*, pages 121–136. Eindhoven, The Netherlands, November 23-25, 2009. http://dx.doi.org/10.1007/978-3-642-10406-0_9.

[193] Sulan Wong, Eitan Altman, and Mouhamad Ibrahim. P2P networks: the interplay between legislation and information technology. In *Proc. of Networking and Electronic Commerce Research Conference (NAEC)*. Riva del Garda, Italy, October 8-11, 2009.

[194] Utku Günay Acer, Petros Drineas, and Alhussein A. Abouzeid. Random walks in time-graphs. In *Proc. of 2nd International Workshop on Mobile Opportunistic Networking (MobiOpp 2010)*, pages 93–100. February 22-23, 2010. http://dx.doi.org/10.1145/1755743.1755761.

[195] Eitan Altman, Alireza Aram, Tamer Başar, Corinne Touati, and Saswati Sarkar. Robust control in sparse mobile ad hoc networks. In *Proc. of 1st Conference on Decision and Game Theory for Security (GameSec 2010)*, volume 6442 of *Lecture Notes in Computer Science*, pages 123–134. Berlin, Germany, November 22-23, 2010. http://dx.doi.org/10.1007/978-3-642-17197-0_8.

[196] Eitan Altman, Konstantin Avrachenkov, and Andrey Garnaev. Taxation for green communication. In *Proc. of 8th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2010)*, pages 108–112. Avignon, France, May 31 - June 4, 2010. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5518903.

[197] Eitan Altman, Amar Azad, Tamer Başar, and Francesco De Pellegrini. Optimal activation and transmission control in delay tolerant networks. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2010.5462264.

[198] Eitan Altman, Tamer Başar, and Veeraruna Kavitha. Adversarial control in a delay tolerant network. In *Proc. of 1st Conference on Decision and Game Theory for Security (GameSec 2010)*, volume 6442 of *Lecture Notes in Computer Science*, pages 87–106. Berlin, Germany, November 22-23, 2010. http://dx.doi.org/10.1007/978-3-642-17197-0_6.

[199] Eitan Altman, Pierre Bernhard, Stephane Caron, George Kesidis, Julio Rojas-Mora, and Sulan Wong. A study of non-neutral networks with usage-based prices. In *Proc. of 3rd Workshop on Economic Traffic Management (ETM 2010)*, volume 6236 of *Lecture Notes in Computer Science*, pages 76–84. Amsterdam, The Netherlands, September 6, 2010. http://dx.doi.org/10.1007/978-3-642-15485-0_8.

[200] Eitan Altman, Francesco De Pellegrini, and Lucile Sassatelli. Dynamic control of coding in delay tolerant networks. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2010.5462259.

[201] Eitan Altman, Manjesh Kumar Hanawal, and Rajesh Sundaresan. Non-neutral network and the role of bargaining power in side payments. In *Proc. of 4th Workshop on Network Control and Optimization (NET-COOP 2010)*. Ghent, Belgium, November 29 - December 1, 2010. http://hal.inria.fr/inria-00596225/en.

[202] Konstantin Avrachenkov, Alexander Dudin, and Valentina Klimenok. Retrial queueing model MMAP/M2/1 with two orbits. In *Proc. of 3rd International Workshop on Multiple Access Communications (MACOM 2010)*, volume 6235 of *Lecture Notes in Computer Science*, pages 107–118. Barcelona, Spain, September 13-14, 2010. http://dx.doi.org/10.1007/978-3-642-15428-7_12.

[203] Konstantin Avrachenkov, Bruno Ribeiro, and Don Towsley. Improving random walk estimation accuracy with uniform restarts. In *Proc. of 7th International Workshop on Algorithms and Models for the Web Graph (WAW 2010)*, volume 6516 of *Lecture Notes in Computer Science*, pages 98–109. Stanford University, CA, USA, December 13-14, 2010. http://dx.doi.org/10.1007/978-3-642-18009-5_10.

[204] Amar Azad, Eitan Altman, and Rachid El-Azouzi. Routing games: from egoism to altruism. In *Proc. of 8th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2010)*, pages 528–537. Avignon, France, May 31 - June 4, 2010. Presented at the International Workshop on Wireless Networks: Communication, Cooperation and Competition (WNC3 2010). http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5520227.

[205] Gaurav Bansal, Vinod Sharma, Neelesh Mehta, and Eitan Altman. Relay load balancing in queued cooperative wireless networks with rateless codes. In *Proc. of IEEE International Conference on Communications (ICC 2010)*. Cape Town, South Africa, May 23-27, 2010. http://dx.doi.org/10.1109/ICC.2010.5501935.

[206] Stephane Caron, George Kesidis, and Eitan Altman. Application neutrality and a paradox of side payments. In *Proc. of the Re-Architecting the Internet Workshop (ReARCH 2010)*. Philadelphia, PA, USA, November 30, 2010. http://dx.doi.org/10.1145/1921233.1921245.

[207] Damiano Carra, Konstantin Avrachenkov, Sara Alouf, Alberto Blanc, Philippe Nain, and Georg Post. Passive online RTT estimation for flow-aware routers using one-way traffic. In *Proc. of IFIP Networking 2010*, volume 6091 of *Lecture Notes in Computer Science*, pages 109–121. Chennai, India, May 10-14, 2010. http://dx.doi.org/10.1007/978-3-642-12963-6_9.

[208] Richard Combes, Zwi Altman, and Eitan Altman. On the use of packet scheduling in self-optimization processes: application to coverage-capacity optimization. In *Proc. of 8th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2010)*, pages 98–107. Avignon, France, May 31 - June 4, 2010. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5519534.

[209] Abdulhalim Dandoush and Alain Jean-Marie. Flow-level modeling of parallel download in distributed systems. In *Proc. of 3rd International Conference on Communication Theory, Reliability, and Quality of Service (CTRQ 2010)*, pages 92–97. Athens/Glyfada, Greece, June 13-19, 2010. **Best Paper Award**. http://dx.doi.org/10.1109/CTRQ.2010.23.

[210] Francesco De Pellegrini, Eitan Altman, and Tamer Başar. Optimal monotone forwarding policies in delay tolerant mobile ad hoc networks with multiple classes of nodes. In *Proc. of 8th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2010)*, pages 497–504. Avignon, France, May 31 - June 4, 2010. Presented at the International Workshop on Dynamic Networks (WDN 2010). http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5520232.

[211] Dinil Mon Divakaran, Fabienne Anhalt, Eitan Altman, and Pascale Vicat-Blanc Primet. Size-based flow scheduling in a CICQ switch. In *Proc. of 11th International Conference on High Performance Switching (HPSR 2010)*. Dallas, TX, USA, June 13-16, 2010. http://dx.doi.org/10.1109/HPSR.2010.5580275.

[212] Dinil Mon Divakaran, Giovanna Carofiglio, Eitan Altman, and Pascale Vicat-Blanc Primet. A flow scheduler architecture. In *Proc. of IFIP Networking 2010*, volume 6091 of *Lecture Notes in Computer Science*, pages 122–134. Chennai, India, May 10-14, 2010. http://dx.doi.org/10.1007/978-3-642-12963-6_10.

[213] Rachid El-Azouzi, Habib Sidi, Julio Rojas-Mora, and Amar Prakash Azad. Delay tolerant networks in partially overlapped networks: a non-cooperative game approach. In *Proc. of 4th International Conference on Bio-Inspired Models of Network, Information, and Computing Systems (BIONETICS 2009), Avignon, France, December 9-11, 2009*, volume 39 of *LNICST*, pages 195–202. 2010. Work-in-progress track. http://dx.doi.org/10.1007/978-3-642-12808-0_19.

[214] Salah Eddine Elayoubi, Eitan Altman, Majed Haddad, and Zwi Altman. A hybrid decision approach for the association problem in heterogeneous networks. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2010.5462204.

[215] Jocelyne Elias, Fabio Martignon, Konstantin Avrachenkov, and Giovanni Neglia. Socially-aware network design games. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2010.5462275.

[216] Jocelyne Elias, Fabio Martignon, Antonio Capone, and Eitan Altman. Competitive interference-aware spectrum access in cognitive radio networks. In *Proc. of 8th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2010)*, pages 85–90. Avignon, France, May 31 - June 4, 2010. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5519538.

[217] Dieter Fiems and Eitan Altman. Applying branching processes to delay-tolerant networks. In *Proc. of 4th International Conference on Bio-Inspired Models of Network, Information, and Computing Systems (BIONETICS 2009), Avignon, France, December 9-11, 2009*, volume 39 of *LNICST*, pages 117–125. 2010. Invited paper. http://dx.doi.org/10.1007/978-3-642-12808-0_11.

[218] Andrey Garnaev, Yezekael Hayel, Eitan Altman, and Konstantin Avrachenkov. Optimal hierarchical pricing schemes for wireless network usage and resource allocation. In *Proc. of 4th Workshop on Network Control and Optimization (NET-COOP 2010)*. Ghent, Belgium, November 29 - December 1, 2010. http://hal.inria.fr/inria-00596219/en.

[219] Paolo Giaccone, David Hay, Giovanni Neglia, and Leonardo Rocha. Routing in quasi-deterministic intermittently connected networks. In *Proc. of 4th International Conference on Bio-Inspired Models of Network, Information, and Computing Systems (BIONETICS 2009), Avignon, France, December 9-11, 2009*, volume 39 of *LNICST*, pages 126–129. 2010. Invited paper. http://dx.doi.org/10.1007/978-3-642-12808-0_12.

[220] Majed Haddad, Zwi Altman, Salah Eddine Elayoubi, and Eitan Altman. A Nash-Stackelberg fuzzy Q-learning decision approach in heterogeneous cognitive networks. In *Proc. of 53rd IEEE Global Communications Conference (GLOBECOM 2010)*. Miami, FL, USA, December 6-10, 2010. http://dx.doi.org/10.1109/GLOCOM.2010.5684318.

[221] Emmanuel Hyon and Alain Jean-Marie. Scheduling in a queuing system with impatience and setup costs. In *Proc. of 2010 MSOM Annual Conference*. Technion, Haifa, Israel, June 27-29, 2010. http://msom.technion.ac.il/conf_program/papers/MA/3/61.pdf.

[222] Alain Jean-Marie and Emmanuel Hyon. Scheduling services in a queuing system with impatience and setup costs. In *Proc. of 25th International Symposium on Computer and Information Sciences (ISCIS 2010)*, volume 62 of *Lecture Notes in Electrical Engineering*, pages 45–50. London, September 22-24, 2010. http://dx.doi.org/10.1007/978-90-481-9794-1_9.

[223] Vijay Kamble, Eitan Altman, Rachid El-Azouzi, and Vinod Sharma. Atomic hierarchical routing games in communication networks. In *Proc. of 5th*

International Conference on Cognitive Radio Oriented Wireless Networks and Communications (CROWNCOM 2010). Cannes, France, June 9-11, 2010. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5577696.

[224] Vijay Kamble, Eitan Altman, Rachid El-Azouzi, and Vinod Sharma. A theoretical framework for hierarchical routing games. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2010.5462222.

[225] Veeraruna Kavitha and Eitan Altman. Analysis and design of message ferry routes in sensor networks using polling models. In *Proc. of 8th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2010)*, pages 247–255. Avignon, France, May 31 - June 4, 2010. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5518803.

[226] Veeraruna Kavitha and Eitan Altman. Opportunistic scheduling of a message ferry in sensor networks. In *Proc. of 2nd International Workshop on Mobile Opportunistic Networking (MobiOpp 2010)*, pages 163–166. February 22-23, 2010. http://dx.doi.org/10.1145/1755743.1755774.

[227] Veeraruna Kavitha, Eitan Altman, Rachid El-Azouzi, and Rajesh Sundaresan. Fair scheduling in cellular systems in the presence of noncooperative mobiles. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. http://dx.doi.org/10.1109/INFCOM.2010.5462091.

[228] George Kesidis, Youngmi Jin, Amar Prakash Azad, and Eitan Altman. Stable Nash equilibria of ALOHA medium access games under symmetric, socially altruistic behavior. In *Proc. of 49th IEEE Conference on Decision and Control (CDC 2010)*, pages 1071–1075. Atlanta, GA, USA, December 15-17, 2010. http://dx.doi.org/10.1109/CDC.2010.5717121.

[229] Mohammad Hossein Rezaei Khouzani, Saswati Sarkar, and Eitan Altman. Dispatch then stop: optimal dissemination of security patches in mobile wireless networks. In *Proc. of 49th IEEE Conference on Decision and Control (CDC 2010)*, pages 2354–2359. Atlanta, GA, USA, December 15-17, 2010. http://dx.doi.org/10.1109/CDC.2010.5717273.

[230] Mohammad Hossein Rezaei Khouzani, Saswati Sarkar, and Eitan Altman. Maximum damage malware attack in mobile wireless networks. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. http://dx.doi.org/10.1109/INFCOM.2010.5462150.

[231] Mohammad Hossein Rezaei Khouzani, Saswati Sarkar, and Eitan Altman. Optimal killing of nodes in a wireless malware outbreak. In *Proc. of IEEE Information Theory Workshop (ITW 2010)*. Cairo, Egypt, January 6-8, 2010. http://dx.doi.org/10.1109/ITWKSPS.2010.5503225.

[232] Xiao Lei, Konstantin Avrachenkov, Laura Cottatellucci, and Andrey Garnaev. Competitive unlicensed spectrum sharing with partial information on slow fading channels. In *Proc. of 8th International Conference on Wired/Wireless Internet Communications (WWIC 2010)*, volume 6074 of *Lecture Notes in Computer Science*, pages 158–169. Lulea, Sweden, June 1-3, 2010. http://dx.doi.org/10.1007/978-3-642-13315-2_13.

[233] Vincenzo Mancuso, Omer Gurewitz, Ahmed Khattab, and Edward W. Knightly. Elastic rate limiting for spatially biased wireless mesh networks. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. http://dx.doi.org/10.1109/INFCOM.2010.5461991.

[234] Olivia Morad and Alain Jean-Marie. Optimisation en temps-réel du téléchargement de vidéos. In *Proc. of 11th Congress of the French Society for Operations Research and Decision (ROADEF 2010)*. Toulouse, February 24-26, 2010.

[235] Sreenath Ramanath, Mérouane Debbah, Eitan Altman, and Vinod Kumar. Asymptotic analysis of precoded small cell networks. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. http://dx.doi.org/10.1109/INFCOM.2010.5461990.

[236] Sreenath Ramanath, Veeraruna Kavitha, and Eitan Altman. Impact of mobility on call block, call drops and optimal cell size in small cell networks. In *Proc. of 21st IEEE International Symposium on Personal, Indoor and Mobile Radio Communications Workshops (PIMRC Workshops 2010)*, pages 157–162. Istanbul, Turkey, September 26-30, 2010. Presented at 2nd International Workshop on Indoor and Outdoor Femto Cells (IOFC 2010). http://dx.doi.org/10.1109/PIMRCW.2010.5670352.

[237] Sreenath Ramanath, Veeraruna Kavitha, and Eitan Altman. Spatial queueing analysis for mobility in pico cell networks. In *Proc. of 8th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2010)*, pages 152–159. Avignon, France, May 31 - June 4, 2010. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5518818.

[238] Alonso Silva, Eitan Altman, Mérouane Debbah, and Giuseppa Alfano. Magnetworks: how mobility impacts the design of mobile networks. In *Proc. of IEEE INFOCOM 2010*. San Diego, CA, USA, March 15-19, 2010. http://dx.doi.org/10.1109/INFCOM.2010.5461992.

[239] Alonso Silva, Hamidou Tembine, Eitan Altman, and Mérouane Debbah. Spatial games combining base station placement and mobile association: the downlink case. In *Proc. of 49th IEEE Conference on Decision and Control (CDC 2010)*, pages 966–972. Atlanta, GA, USA, December 15-17, 2010. http://dx.doi.org/10.1109/CDC.2010.5717550.

[240] Alonso Silva, Hamidou Tembine, Mérouane Debbah, and Eitan Altman. Uplink spatial games on cellular networks. In *Proc. of 48th Annual Allerton Conference on Communication, Control, and Computing 2010*, pages 800–804. Allerton, IL, USA, September 29 - October 1, 2010. http://dx.doi.org/10.1109/ALLERTON.2010.5706989.

[241] Elena Smirnova, Konstantin Avrachenkov, and Brigitte Trousse. Using web graph structure for person name disambiguation. In *Proc. of Conference on Multilingual and Multimodal Information Access Evaluation (CLEF 2010)*. Padua, Italy, September 20-23, 2010. Presented at the Web People Search Workshop (WePS-3). http://clef2010.org/resources/proceedings/clef2010labs_submission_62.pdf.

[242] Ilenia Tinnirello, Laura Giarré, and Giovanni Neglia. A game theoretic approach to MAC design for infrastructure networks. In *Proc. of 49th IEEE Conference on Decision and Control (CDC 2010)*, pages 1933–1938. Atlanta, GA, USA, December 15-17, 2010. http://dx.doi.org/10.1109/CDC.2010.5717759.

[243] Sulan Wong and Eitan Altman. Restricting Internet access: ideology and technology. In *Proc. of 2nd International Conference on COMmunication Systems and NETworkS (COMSNETS)*. Bangalore, India, January 5-9, 2010. http://dx.doi.org/10.1109/COMSNETS.2010.5431999.

[244] Sulan Wong, Julio Rojas-Mora, and Eitan Altman. Public consultations on net neutrality 2010. In *Proc. of 4th Workshop on Network Control and Optimization (NET-COOP 2010)*. Ghent, Belgium, November 29 - December 1, 2010. http://hal.inria.fr/inria-00597380/en.

[245] Utku Acer, Paolo Giaccone, David Hay, Giovanni Neglia, and Saed Tarapiah. Timely data delivery in a realistic bus network. In *Proc. of IEEE INFOCOM 2011*, pages 446–450. Shangai, China, April 10-15, 2011. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2011.5935201.

[246] Arshad Ali, Eitan Altman, Tijani Chahed, Manoj Panda, and Lucile Sassatelli. A new reliable transport scheme in delay tolerant networks based on acknowledgments and random linear coding. In *Proc. of 23rd International Teletraffic Congress (ITC 2011)*, pages 214–221. San Francisco, USA, September 6-8, 2011. http://dl.acm.org/citation.cfm?id=2043468.2043503.

[247] Arshad Ali, Tijani Chahed, Eitan Altman, Manoj Panda, and Lucile Sassatelli. A new proposal for reliable unicast and multicast transport in delay tolerant networks. In *Proc. of 22nd IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC 2011)*, pages 1129–1134. Toronto, Canada, September 11-14, 2011. Local and Personal Area Networks (LPAN) Track. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6139673.

[248] Eitan Altman, Zwi Altman, Richard Combes, and Sylvain Sorin. Routing games in the many players regime. In *Proc. of 5th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2011)*. Paris, France, May 16-20, 2011. Presented at 4th International Workshop on Game Theory in Communication Networks (GameComm 2011).

[249] Eitan Altman, Konstantin Avrachenkov, and Sreenath Ramanath. Multiscale fairness and its application to resource allocation in wireless networks. In *Proc. of IFIP Networking 2011*, volume 6641 of *Lecture Notes in Computer Science*, pages 225–237. Valencia, Spain, May 9-13, 2011. http://dx.doi.org/10.1007/978-3-642-20798-3_17.

[250] Eitan Altman, Alejandra Estanislao, and Manoj Panda. Routing games on a circle. In *Proc. of International Conference on NETwork Games, COntrol and OPtimization (NetGCooP 2011)*. Paris, France, October 12-14, 2011. http://hal.inria.fr/hal-00644364/en.

[251] Eitan Altman, Veeraruna Kavitha, Francesco De Pellegrini, Vijay Kamble, and Vivek Borkar. Risk sensitive optimal control framework applied to delay tolerant networks. In *Proc. of IEEE INFOCOM 2011*, pages 3146–3154.

Shanghai, China, April 10-15, 2011. http://dx.doi.org/10.1109/INFCOM.2011.5935161.

[252] Eitan Altman, Arnaud Legout, and Yuedong Xu. Network non-neutrality debate: an economic analysis. In *Proc. of IFIP Networking 2011*, volume 6641 of *Lecture Notes in Computer Science*, pages 68–81. Valencia, Spain, May 9-13, 2011. http://dx.doi.org/10.1007/978-3-642-20798-3_6.

[253] Eitan Altman, Philippe Nain, Adam Shwartz, and Yuedong Xu. Predicting the impact of measures against P2P networks on the transient behaviors. In *Proc. of IEEE INFOCOM 2011*, pages 1440–1448. Shanghai, China, April 10-15, 2011. http://dx.doi.org/10.1109/INFCOM.2011.5934931.

[254] Eitan Altman, Odile Pourtallier, Tania Jiménez, and Hisao Kameda. Symmetric games with networking applications. In *Proc. of International Conference on NETwork Games, COntrol and OPtimization (NetGCooP 2011)*. Paris, France, October 12-14, 2011. http://hal.inria.fr/hal-00644106/en.

[255] Eitan Altman, Julio Rojas-Mora, Sulan Wong, Manjesh Kumar Hanawal, and Yuedong Xu. Net neutrality and quality of service. In *Proc. of 2nd International Conference on Game Theory for Networks (GameNets 2011)*. Shanghai, China, April 16-18, 2011. Invited paper. http://arxiv.org/abs/1105.0283.

[256] Konstantin Avrachenkov, Mahmoud El Chamie, and Giovanni Neglia. A local average consensus algorithm for wireless sensor networks. In *Proc. of 7th IEEE International Conference on Distributed Computing in Sensor Systems and Workshops (DCOSS 2011)*. Barcelona, Spain, June 27-29, 2011. Presented at 5th International Workshop on Localized Algorithms and Protocols for Wireless Sensor Networks (LOCALGOS 2011). http://dx.doi.org/10.1109/DCOSS.2011.5982199.

[257] Konstantin Avrachenkov, Jocelyne Elias, Fabio Martignon, Giovanni Neglia, and Leon Petrosyan. A Nash bargaining solution for cooperative network formation games. In *Proc. of IFIP Networking 2011*, volume 6641 of *Lecture Notes in Computer Science*, pages 307–318. Valencia, Spain, May 9-13, 2011. http://dx.doi.org/10.1007/978-3-642-20757-0_24.

[258] Konstantin Avrachenkov, Ali Eshragh, and Jerzy Filar. Properties of Hamiltonian transition matrices. In *Proc. of 5th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2011)*. Paris, France, May 16-20, 2011.

[259] Konstantin Avrachenkov, Arnaud Legout, Paulo Gonçalves, and Marina Sokol. Graph based classification of content and users in BitTorrent. In *Proc. of NIPS Big Learning Workshop 2011*. Sierra Nevada, Spain, December 16-17, 2011. http://biglearn.org/files/papers/biglearn2011_submission_14.pdf.

[260] Konstantin Avrachenkov, Nelly Litvak, Danil Nemirovsky, Elena Smirnova, and Marina Sokol. Quick detection of top-k personalized PageRank lists. In *Proc. of 8th International Workshop on Algorithms and Models for the Web Graph (WAW 2011)*, volume 6732 of *Lecture Notes in Computer Science*, pages 50–61. Atlanta, GA, USA, May 27-29, 2011. http://dx.doi.org/10.1007/978-3-642-21286-4_5.

[261] Angelos Chatzipapas, Sara Alouf, and Vincenzo Mancuso. On the minimization of power consumption in base stations using on/off power amplifiers. In *Proc. of 2011 IEEE Online Conference on Green Communications*, pages 18–23. September 26-29, 2011. http://dx.doi.org/10.1109/GreenCom.2011.6082501.

[262] Richard Combes, Zwi Altman, and Eitan Altman. A self-optimization method for coverage-capacity optimization in OFDMA networks with MIMO. In *Proc. of 5th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2011)*. Paris, France, May 16-20, 2011.

[263] Richard Combes, Zwi Altman, and Eitan Altman. Self-organizing fractional power control for interference coordination in OFDMA networks. In *Proc. of IEEE International Conference on Communications (ICC 2011)*. Kyoto, Japan, June 5-9, 2011. http://dx.doi.org/10.1109/icc.2011.5963461.

[264] Richard Combes, Zwi Altman, and Eitan Altman. Self-organizing relays in LTE networks: queuing analysis and algorithms. In *Proc. of 7th International Conference on Network and Service Management (CNSM 2011)*. Paris, France, October 24-28, 2011. **Best Paper Award**. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6103951.

[265] Richard Combes, Zwi Altman, Majed Haddad, and Eitan Altman. Self-optimizing strategies for interference coordination in OFDMA networks. In *Proc. of IEEE International Conference on Communications Workshops (ICC 2011 Workshops)*. Kyoto, Japan, June 5-9, 2011. http://dx.doi.org/10.1109/iccw.2011.5963595.

[266] Eugenio Della Vecchia, Silvia C. Di Marco, and Alain Jean-Marie. On the rolling horizon procedure applied to zero-sum semi-Markov games with discounted payoff. In *Proc. of 8th International ISDG Workshop*. Padova, Italy, July 21-23 2011.

[267] Dinil Mon Divakaran, Eitan Altman, and Pascale Vicat-Blanc Primet. Size-based flow-scheduling using spike-detection. In *Proc. of 18th International Conference on Analytical and Stochastic Modeling Techniques and Applications (ASMTA 2011)*, volume 6751 of *Lecture Notes in Computer Science*, pages 331–345. Venice, Italy, June 20-22, 2011. http://dx.doi.org/10.1007/978-3-642-21713-5_24.

[268] Andrey Garnaev, Yezekael Hayel, Eitan Altman, and Konstantin Avrachenkov. Jamming game in a dynamic slotted ALOHA network. In *Proc. of 2nd International Conference on Game Theory for Networks (GameNets 2011)*. Shanghai, China, April 16-18, 2011.

[269] Andrey Garnaev, Yezekael Hayel, Konstantin Avrachenkov, and Eitan Altman. Throughput and QoS pricing in wireless communication. In *Proc. of 5th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2011)*. Paris, France, May 16-20, 2011.

[270] Majed Haddad, Eitan Altman, Rachid El-Azouzi, and Tania Jiménez. A survey on YouTube streaming service. In *Proc. of 5th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2011)*. Paris, France, May 16-20, 2011.

[271] Manjesh Kumar Hanawal, Eitan Altman, Rachid El-Azouzi, and Balakrishna Prabhu. Spatio-temporal control for dynamic routing games. In *Proc. of 2nd International Conference on Game Theory for Networks (GameNets 2011)*. Shanghai, China, April 16-18, 2011. http://www-sop.inria.fr/members/Manjesh_Kumar.Hanawal/GameNets2011.pdf.

[272] Cengis Hasan, Eitan Altman, and Jean-Marie Gorce. A coalition game approach to the association problem of mobiles in broadcast transmission. In *Proc. of 9th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2011)*, pages 236–240. Princeton, New Jersey, USA, May 9-13, 2011. http://dx.doi.org/10.1109/WIOPT.2011.5930021.

[273] Yezekael Hayel, Elena Veronica Belmega, and Eitan Altman. Hawks and doves in a dynamic framework. In *Proc. of International Conference on NETwork Games, COntrol and OPtimization (NetGCooP 2011)*. Paris, France, October 12-14, 2011. http://hal.inria.fr/hal-00643719/en.

[274] Mohammad Hossein Rezaei Khouzani, Saswati Sarkar, and Eitan Altman. A dynamic game solution to malware attack. In *Proc. of IEEE INFOCOM 2011*, pages 2138–2146. Shanghai, China, April 10-15, 2011. http://dx.doi.org/10.1109/INFCOM.2011.5935025.

[275] Mohammad Hossein Rezaei Khouzani, Saswati Sarkar, and Eitan Altman. Optimal control of epidemic evolution. In *Proc. of IEEE INFOCOM 2011*, pages 1683–1691. Shanghai, China, April 10-15, 2011. http://dx.doi.org/10.1109/INFCOM.2011.5934963.

[276] Imed Lassoued, Amir Krifa, Chadi Barakat, and Konstantin Avrachenkov. Network-wide monitoring through self-configuring adaptive system. In *Proc. of IEEE INFOCOM 2011*, pages 1826–1834. Shanghai, China, April 10-15, 2011. http://dx.doi.org/10.1109/INFCOM.2011.5934983.

[277] Xiao Lei, Laura Cottatellucci, and Konstantin Avrachenkov. Equilibriums in slow fading interfering channels with partial knowledge of the channels. In *Proc. of IEEE INFOCOM 2011*, pages 481–485. Shanghai, China, April 10-15, 2011. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2011.5935209.

[278] Lorenzo Maggi, Konstantin Avrachenkov, and Laura Cottatellucci. Stochastic games for cooperative network routing and epidemic spread. In *Proc. of IEEE International Conference on Communications Workshops (ICC 2011 Workshops)*. Kyoto, Japan, June 5-9, 2011. http://dx.doi.org/10.1109/iccw.2011.5963532.

[279] Vincenzo Mancuso and Sara Alouf. Power save analysis of cellular networks with continuous connectivity. In *Proc. of 12th IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM 2011)*. Lucca, Italy, June 20-24, 2011. http://dx.doi.org/10.1109/WoWMoM.2011.5986202.

[280] Riccardo Masiero and Giovanni Neglia. Distributed subgradient methods for delay tolerant networks. In *Proc. of IEEE INFOCOM 2011*, pages 261–265. Shangai, China, April 10-15, 2011. Presented at the Mini-Conference. http://dx.doi.org/10.1109/INFCOM.2011.5935089.

[281] Georgios Stavrou Paschos, Petteri Mannersalo, Slawomir Stanczak, Eitan Altman, and Leandros Tassiulas. Energy optimal algorithms for mobile Internet: stochastic modeling, performance analysis and optimal control. In *Proc. of 7th Conference on Next Generation Internet (EURO-NGI 2011)*, pages 1–2. Kaiserslautern, Germany, June 27-29, 2011. http://dx.doi.org/10.1109/NGI.2011.5985873.

[282] Sreenath Ramanath, Eitan Altman, and Konstantin Avrachenkov. A heterogeneous approach to fair resource allocation and its application in femtocell networks. In *Proc. of 9th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2011)*, pages 440–444. Princeton, New Jersey, USA, May 9-13, 2011. Presented at 3rd International Workshop on Indoor and Outdoor Femto Cells (IOFC 2011). http://dx.doi.org/10.1109/WIOPT.2011.5930060.

[283] Sreenath Ramanath, Veeraruna Kavitha, and Eitan Altman. Open loop optimal control of base station activation for green networks. In *Proc. of 9th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2011)*, pages 161–166. Princeton, New Jersey, USA, May 9-13, 2011. http://dx.doi.org/10.1109/WIOPT.2011.5930009.

[284] Sreenath Ramanath, Veeraruna Kavitha, and Mérouane Debbah. Satisfying demands in a multicellular network: a universal power allocation algorithm. In *Proc. of 9th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2011)*, pages 175–182. Princeton, New Jersey, USA, May 9-13, 2011. http://dx.doi.org/10.1109/WIOPT.2011.5930011.

[285] Julio Rojas-Mora, Tania Jiménez, and Eitan Altman. Simulating flow level bandwidth sharing with Pareto distributed file sizes. In *Proc. of 5th International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2011)*. Paris, France, May 16-20, 2011.

[286] Chandramani K. Singh and Eitan Altman. The wireless multicast coalition game and the non-cooperative association problem. In *Proc. of IEEE INFOCOM 2011*, pages 2705–2713. Shanghai, China, April 10-15, 2011. http://dx.doi.org/10.1109/INFCOM.2011.5935101.

[287] Chandramani K. Singh, Anurag Kumar, Rajesh Sundaresan, and Eitan Altman. Optimal forwarding in delay tolerant networks with multiple destinations. In *Proc. of 9th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks (WiOpt 2011)*, pages 228–235. Princeton, New Jersey, USA, May 9-13, 2011. http://dx.doi.org/10.1109/WIOPT.2011.5930020.

[288] Ilenia Tinnirello, Laura Giarré, and Giovanni Neglia. Achieving fair bandwidth distribution in WiFi networks: a game theoretical approach. In *Proc. of 18th IFAC World Congress*. Milano, Italy, August 28 - September 2, 2011. http://www.ifac-papersonline.net/Detailed/49337.html.

[289] Piotr Wiecek and Eitan Altman. Stationary anonymous sequential games with undiscounted rewards. In *Proc. of International Conference on NETwork Games, COntrol and OPtimization (NetGCooP 2011)*. Paris, France, October 12-14, 2011. http://hal.inria.fr/hal-00643737/en.

[290] Eitan Altman, Dieter Fiems, Majed Haddad, and Julien Gaillard. Semi-dynamic hawk and dove game applied to power control. In *Proc. of IEEE INFOCOM 2012*. Orlando, Florida, USA, March 25-30, 2012. To be presented at the Mini-Conference.

[291] Eitan Altman, Julien Gaillard, Majed Haddad, and Piotr Wiecek. Dynamic hawk and dove games within flocks of birds. In *Proc. of 6th International Conference on Bio-Inspired Models of Network, Information, and Computing Systems (BIONETICS 2011), York, UK, December 5-6, 2011*, LNICST. 2012. To appear.

[292] Richard Combes, Zwi Altman, and Eitan Altman. Self-organization in wireless networks: a flow-level perspective. In *Proc. of IEEE INFOCOM 2012*. Orlando, Florida, USA, March 25-30, 2012. To be presented at the Mini-Conference.

[293] Manjesh Kumar Hanawal and Eitan Altman. Stochastic geometry based jamming games in mobile ad hoc networks. In *Proc. of 9th International Conference on Wireless On-Demand Network Systems and Services (WONS 2012)*. Courmayeur, Italy, January 9-11, 2012. `http://www-sop.inria.fr/members/Manjesh_Kumar.Hanawal/SGJamming.pdf`.

[294] Manjesh Kumar Hanawal, Eitan Altman, and Francois Baccelli. Stochastic geometry based medium access games. In *Proc. of IEEE INFOCOM 2012*. Orlando, Florida, USA, March 25-30, 2012. To appear.

[295] Dinesh Kumar, Eitan Altman, and Tamer Başar. Exploring Wiener filter estimation of node population in a sensor network with generally distributed node lifetimes. In *Proc. of 9th International Conference on Wireless On-Demand Network Systems and Services (WONS 2012)*. Courmayeur, Italy, January 9-11, 2012.

[296] Yuedong Xu, Eitan Altman, Rachid El-Azouzi, Majed Haddad, Salah-Eddine Elayoubi, and Tania Jiménez. Probabilistic analysis of buffer starvation in Markovian queues. In *Proc. of IEEE INFOCOM 2012*. Orlando, Florida, USA, March 25-30, 2012. To appear.

6.4 Patents

[297] Damiano Carra, Konstantin Avrachenkov, Sara Alouf, Philippe Nain, and Georg Post. Method for estimating a round trip time of a packet flow. Filed EU Patent 09 305 207.4, Alcatel-Lucent and Inria, March 2009. `http://hal.inria.fr/hal-00641414/en`.

[298] Alberto Blanc, Sara Alouf, Konstantin Avrachenkov, and Georg Post. Binary search method and system for congestion avoidance. Filed EU Patent 10 290 432.3, Alcatel-Lucent and Inria, July 2010. `http://hal.inria.fr/hal-00641421/en`.

[299] Alberto Blanc, Sara Alouf, Konstantin Avrachenkov, and Georg Post. Flow aware congestion avoidance method and system. Filed EU Patent 10 290 431.5, Alcatel-Lucent and Inria, July 2010. `http://hal.inria.fr/hal-00641420/en`.

[300] Veronique Capdeville, Sreenath Ramanath, Eitan Altman, and Laurent Roullet. Stacking cells for seamless mobility management of high speed users in small cells networks. Filed EU Patent 809154-EP-EPA, Alcatel-Lucent and Inria, 2011.

6.5 Miscellaneous

[301] Sara Alouf, Eitan Altman, and Amar Azad. M/G/1 queue with repeated inhomogeneous vacations applied to IEEE 802.16e power saving. *ACM SIGMETRICS Performance Evaluation Review*, 36(1):451–452, June 2008. Poster at ACM SIGMETRICS 2008, Annapolis, Maryland, USA. http://dx.doi.org/10.1145/1384529.1375516.

[302] Sara Alouf and Olivier Dalle. Modèles et simulation de systèmes de stockage et de sauvegarde de données dans les réseaux P2P. LISA, Lettre de l'INRIA Sophia Antipolis - Méditerranée, n° 11, Mars 2008.

[303] Abdulhalim Dandoush. P2P storage systems: towards a more accurate model. In *Proc. of 9th Workshop on Performance Evaluation (AEP9)*. Aussois, France, June 1-4, 2008. http://aep9.imag.fr/papers/Dandoush_aep9.pdf.

[304] Natalia Osipova. Comparison of discriminatory processor sharing policies. In *Proc. of 9th Workshop on Performance Evaluation (AEP9)*. Aussois, France, June 1-4, 2008. http://aep9.imag.fr/papers/Osipova_aep9.pdf.

[305] Konstantin Avrachenkov. Quasi-stationary distributions as centrality measures for the giant strongly connected component of a reducible graph. In *15th INFORMS Applied Probability Society Conference*. Ithaca, NY, USA, July 12-15, 2009. http://appliedprob.society.informs.org/apsconf09/Abstracts.pdf.

[306] Jean-Claude Bermond, Dorian Mazauric, and Philippe Nain. Algorithmes distribués d'ordonnancement dans les réseaux sans-fil. In *10èmes Journées Doctorales en Informatique et Réseaux (JDIR 2009)*. Belfort, France, February 2-4, 2009. http://jdir.utbm.fr/presentations/mazauric.pdf.

[307] Alberto Blanc, Konstantin Avrachenkov, Sara Alouf, and Georg Post. Flow aware traffic management. In *EuroNF Workshop on Traffic Management and Traffic Engineering for the Future Internet*. Paris, France, December 7-8, 2009.

[308] Uri Yechiali and Konstantin Avrachenkov. On tandem blocking queues with a common retrial queue. In *15th INFORMS Applied Probability Society Conference*. Ithaca, NY, USA, July 12-15, 2009. http://appliedprob.society.informs.org/apsconf09/Abstracts.pdf.

[309] Eitan Altman, Philippe Nain, Adam Shwartz, and Yuedong Xu. Predicting the impact of measures against unauthorized downloads on the transient behaviors of P2P networks. In *Proc. of IFIP PERFORMANCE 2010*. Namur, Belgium, November 15-19, 2010. Poster. http://www-sop.inria.fr/members/Philippe.Nain/PAPERS/PERFORMANCE2010-POSTER/Perf2010-poster.pdf.

[310] Jean-Claude Bermond, Dorian Mazauric, Vishal Misra, and Philippe Nain. A distributed scheduling algorithm for wireless networks with constant overhead and arbitrary binary interference. *ACM SIGMETRICS Performance Evaluation Review*, 38(1):345–346, June 2010. Poster at ACM SIGMETRICS 2010, New York City, New York, USA. http://dx.doi.org/10.1145/1811039.1811079.

[311] Eugenio Della Vecchia, Silvia Di Marco, and Alain Jean-Marie. On the convergence of rolling horizon procedure and the average criterion. In *ALIO-INFORMS Joint International Meeting*. Buenos Aires, Argentina, June 6-9, 2010.

[312] Eitan Altman, Rachid El-Azouzi, Daniel Sadoc Menasche, and Yuedong Xu. Poster: aging control for smartphones in hybrid networks. *ACM SIGMETRICS Performance Evaluation Review*, 39(2):68, September 2011. Special Issue on IFIP PERFORMANCE 2011- 29th International Symposium on Computer Performance, Modeling, Measurement and Evaluation. Poster. http://dx.doi.org/10.1145/2034832.2034852.

[313] Eitan Altman, Cengis Hasan, Jean-Marie Gorce, and Laurent Roullet. Green networking: downlink considerations. In *Proc. of International conference on NETwork Games, COntrol and OPtimization (NetGCooP 2011)*. Paris, France, October 12-14, 2011. Poster. http://hal.inria.fr/hal-00644558/en.

[314] Eitan Altman, Hisao Kameda, and Yezekael Hayel. Revisiting collusion in routing games: a load balancing problem. In *Proc. of International conference on NETwork Games, COntrol and OPtimization (NetGCooP 2011)*. Paris, France, October 12-14, 2011. Poster. http://hal.inria.fr/hal-00644539/en.

[315] Eugenio Della Vecchia, Silvia C. Di Marco, and Alain Jean-Marie. Rolling horizon and state space truncation approximations for zero-sum semi-markov games with discounted payoff. In *16th INFORMS Applied Probability Society Conference*. Stockholm, Sweden, July 6-8, 2011. http://www.informs.org/content/download/232605/2206125/file/book.pdf.

[316] Majed Haddad and Eitan Altman. The interplay between caching and popularity. In *Proc. of International conference on NETwork Games, COntrol and OPtimization (NetGCooP 2011)*. Paris, France, October 12-14, 2011. Poster. http://hal.inria.fr/hal-00644545/en.

[317] Angelo Coluccia and Eitan Altman. SINR base station placement and mobile association games under cooperation. In *Proc. of 9th International Conference on Wireless On-Demand Network Systems and Services (WONS 2012)*. Courmayeur, Italy, January 9-11, 2012. Poster.

6.6 Journals Special Issues and Proceedings Editing

[318] Eitan Altman, Bruno Gaujal, and Jean Mairesse, editors. *Selected Papers from the First International Conference on Performance Evaluation Methodologies and Tools (VALUETOOLS 2006)*, volume 18, issue 4 of *Discrete Event Dynamic Systems*. December 2008. http://www.springerlink.com/content/0924-6703/18/4/.

[319] Eitan Altman and Augustin Chaintreau, editors. *Network Control and Optimization – Second Euro-NF Workshop, NET-COOP 2008 Paris, France, September 8-10, 2008. Revised Selected Papers*, volume 5425 of *Lecture Notes in Computer Science*. February 2009. http://dx.doi.org/10.1007/978-3-642-00393-6.

[320] Konstantin Avrachenkov, Debora Donato, and Nelly Litvak, editors. *Algorithms and Models for the Web-Graph. 6th International Workshop, WAW 2009 Barcelona, Spain, February 12-13, 2009, Proceedings*, volume 5427 of *Lecture Notes in Computer Science*. February 2009. http://dx.doi.org/10.1007/978-3-540-95995-3.

[321] Eitan Altman, Tamer Başar, Emma Hart, Daniele Miorandi, Aris L. Moustakas, and Stavros Toumpis, editors. *New Network Paradigms*, volume 54, issue 6 of *Computer Networks*. April 2010. http://www.sciencedirect.com/science/journal/13891286/54/6.

[322] Eitan Altman, Iacopo Carrera, Rachid El-Azouzi, Emma Hart, and Yezekael Hayel, editors. *Bioinspired Models of Network, Information, and Computing Systems – 4th International Conference, BIONETICS 2009, Avignon, France, December 9-11, 2009, Revised Selected Papers*, volume 39 of *LNICST*. 2010. http://dx.doi.org/10.1007/978-3-642-12808-0.

[323] Abderrahim Benslimane, Chadi Assi, Eitan Altman, and Hsiao-Hwa Chen, editors. *SM 85-Wireless and Mobile Computing, Networking and Communications*, volume 15, issue 2 of *Mobile Networks and Applications*. April 2010. http://www.springerlink.com/content/1383-469x/15/2/.

[324] Eitan Altman, Sajal K. Das, Luciano Lenzini, and Adam Wolisz, editors. *Wireless for the Future Internet*, volume 55, issue 2 of *Computer Networks*. February 2011. http://www.sciencedirect.com/science/journal/13891286/55/2.

[325] John S. Baras, Jonathan Katz, and Eitan Altman, editors. *Decision and Game Theory for Security – Second International Conference, GameSec 2011, College Park, MD, Maryland, USA, November 14-15, 2011. Proceedings*, volume 7037 of *Lecture Notes in Computer Science*. 2011. doi:10.1007/978-3-642-25280-8. http://dx.doi.org/10.1007/978-3-642-25280-8.

6.7 Internal Reports

[326] Sara Alouf, Eitan Altman, and Amar Prakash Azad. Analysis of an M/G/1 queue with repeated inhomogeneous vacations – application to IEEE 802.16e power saving. Research Report RR-6488, INRIA, March 2008. http://hal.inria.fr/inria-00266552/.

[327] Eitan Altman, Philippe Nain, and Jean-Claude Bermond. Distributed storage management of evolving files in delay tolerant ad hoc networks. Research Report RR-6645, INRIA, September 2008. http://hal.inria.fr/inria-00321641/.

[328] Eitan Altman, Giovanni Neglia, Francesco De Pellegrini, and Daniele Miorandi. Decentralized stochastic control of delay tolerant networks. Research Report RR-6654, INRIA, August 2008. http://hal.inria.fr/inria-00322443/.

[329] Damiano Carra, Giovanni Neglia, and Pietro Michiardi. Unveiling BitTyrant: when the devil is not so black as he is painted. Research Report RR-08-209, Eurecom, June 2008. http://www.eurecom.fr/util/popuppubli.en.htm?page=detail&id=2424.

[330] Abdulhalim Dandoush, Sara Alouf, and Philippe Nain. Performance analysis of centralized versus distributed recovery schemes in P2P storage systems. Research Report RR-6769, INRIA, December 2008. http://hal.inria.fr/inria-00346503/.

[331] Natalia Osipova. Comparison of the discriminatory processor sharing policies. Research Report RR-6475, INRIA, March 2008. http://hal.inria.fr/inria-00264111/.

[332] Eitan Altman. Competition and cooperation between nodes in delay tolerant networks with two hop routing. Research Report RR-6904, INRIA, May 2009. http://hal.inria.fr/inria-00381030/.

[333] Eitan Altman, Amar Prakash Azad, Tamer Başar, and Francesco De Pellegrini. Optimal activation and transmission control in delay tolerant networks. Technical report, INRIA, August 2009. http://hal.inria.fr/inria-00408520/en.

[334] Eitan Altman, Julio Rojas-Mora, and Tania Jiménez. Simulating bandwidth sharing with Pareto distributed file sizes. Research Report RR-6926, INRIA, May 2009. http://hal.inria.fr/inria-00383079/.

[335] Amar Prakash Azad, Sara Alouf, Eitan Altman, Vivek Borkar, and Georgios Paschos. Optimal sampling for state change detection with application to the control of sleep mode. Research Report RR-7026, INRIA, September 2009. http://hal.inria.fr/inria-00420542/.

[336] Amar Prakash Azad, Sara Alouf, Eitan Altman, Vivek Borkar, and Georgios Paschos. Vacation policy optimization with application to IEEE 802.16e power saving mechanism. Research Report RR-7017, INRIA, August 2009. http://hal.inria.fr/inria-00410117/.

[337] Amar Prakash Azad, Eitan Altman, and Rachid El-Azouzi. Routing games: from egoism to altruism. Research Report RR-7059, INRIA, October 2009. http://hal.inria.fr/inria-00423475/.

[338] Abdelghani Ben Tahar and Alain Jean-Marie. The fluid limit of the multiclass processor sharing queue. Research Report RR-6867, INRIA, April 2009. http://hal.inria.fr/inria-00368246/.

[339] Jean-Claude Bermond, Dorian Mazauric, Vishal Misra, and Philippe Nain. Distributed call scheduling in wireless networks. Research Report RR-6763, INRIA, October 2009. Version 3. http://hal.inria.fr/docs/00/43/42/51/PDF/RR-6763.pdf.

[340] Alberto Blanc, Konstantin Avrachenkov, and Denis Collange. Modelling an isolated compound TCP connection. Research Report RR-6778, INRIA, January 2009. http://hal.inria.fr/inria-00349845/.

[341] Alberto Blanc, Konstantin Avrachenkov, Denis Collange, and Giovanni Neglia. Compound TCP with random losses. Research Report RR-6736, INRIA, January 2009. http://hal.inria.fr/inria-00346050/.

[342] Damiano Carra, Konstantin Avrachenkov, Sara Alouf, Alberto Blanc, Philippe Nain, and Georg Post. Passive online RTT estimation for flow-aware routers using one-way traffic. Research Report RR-7124, INRIA, November 2009. http://hal.inria.fr/inria-00436444/.

[343] Abdulhalim Dandoush, Sara Alouf, and Philippe Nain. Simulation analysis of download and recovery processes in P2P storage systems. Research Report RR-6858, INRIA, February 2009. http://hal.inria.fr/inria-00363966/.

[344] Abdulhalim Dandoush and Alain Jean-Marie. Download process in distributed systems, flow-level algorithm vs. packet-level simulation model. Research Report RR-7159, INRIA, December 2009. http://hal.inria.fr/inria-00442030/en.

[345] Dinil Mon Divakaran, Giovanna Carofiglio, Eitan Altman, and Pascale Primet. A flow scheduler architecture. Research Report RR-7133, INRIA, December 2009. http://hal.inria.fr/inria-00438594/.

[346] Dinil Mon Divakaran, Sébastien Soudan, Pascale Primet, and Eitan Altman. A survey on core switch designs and algorithms. Research Report RR-6942, INRIA, May 2009. http://hal.inria.fr/inria-00388943/.

[347] Jocelyne Elias, Fabio Martignon, Konstantin Avrachenkov, and Giovanni Neglia. Socially-aware network design games. Research Report RR-7141, INRIA, December 2009. http://hal.inria.fr/inria-00439687/.

[348] Dieter Fiems and Eitan Altman. Markov-modulated stochastic recursive equations with applications to delay-tolerant networks. Research Report RR-6872, INRIA, March 2009. http://hal.inria.fr/inria-00366541/.

[349] Laura Giarré, Giovanni Neglia, and Ilenia Tinnirello. The role of the access point in Wi-Fi networks with selfish nodes. Research Report RR-6737, INRIA, January 2009. http://hal.inria.fr/inria-00350047/.

[350] Alain Jean-Marie and Emmanuel Hyon. Scheduling in a queuing system with impatience and setup costs. Research Report RR-6881, INRIA, March 2009. http://hal.inria.fr/inria-00369382/.

[351] Alain Jean-Marie, Xavier Roche, Vincent Boudet, and Anne-Elisabeth Baert. Combinatorial designs and availability. Research Report RR-7119, INRIA, November 2009. http://hal.inria.fr/inria-00441624/.

[352] Giovanni Neglia, Giuseppe Reina, and Sara Alouf. Distributed gradient optimization for epidemic routing: a preliminary evaluation. Research Report RR-7016, INRIA, November 2009. http://hal.inria.fr/inria-00435184/.

[353] Danil Nemirovsky. Tensor approach to mixed high-order moments of absorbing Markov chains. Research Report RR-7072, INRIA, November 2009. http://hal.inria.fr/inria-00426763/.

[354] Natalia Osipova, Urtzi Ayesta, and Konstantin Avratchenkov. Optimal policy for multi-class scheduling in a single server queue. Research report, INRIA, March 2009. http://hal.inria.fr/inria-00371944/en.

[355] Alonso Silva, Patricio Reyes, and Mérouane Debbah. Congestion in randomly deployed wireless ad-hoc and sensor networks. Research Report RR-6854, INRIA, February 2009. http://hal.inria.fr/inria-00364370/.

[356] Sébastien Soudan, Dinil Mon Divakaran, Eitan Altman, and Pascale Primet. Extending routing games to flows over time. Research Report RR-6931, INRIA, May 2009. http://hal.inria.fr/inria-00383573/.

[357] Sébastien Soudan, Dinil Mon Divakaran, Eitan Altman, and Pascale Vicat-Blanc Primet. Equilibrium in size-based scheduling systems. Research Report RR-6888, INRIA, March 2009. http://hal.inria.fr/inria-00371391/.

[358] Sulan Wong, Eitan Altman, and Mouhamad Ibrahim. P2P networks: the interplay between legislation and information technology. Research Report RR-6889, INRIA, June 2009. http://hal.inria.fr/inria-00371507/.

[359] Utku Acer, Paolo Giaccone, David Hay, Giovanni Neglia, and Saed Tarapiah. Timely data delivery in a realistic bus network. Research Report RR-7344, INRIA, August 2010. http://hal.archives-ouvertes.fr/hal-00510746.

[360] Eitan Altman, Konstantin Avrachenkov, and Sreenath Ramanath. Multiscale fairness and its application to dynamic resource allocation in wireless networks. Technical Report RR-7382, INRIA Research Report, September 2010. http://hal.inria.fr/inria-00515430/en/.

[361] Eitan Altman, Pierre Bernhard, George Kesidis, Julio Rojas-Mora, and Sulan Wong. A study of non-neutral networks. Research report, INRIA, May 2010. http://hal.inria.fr/inria-00481702/en.

[362] Konstantin Avrachenkov, Laura Cottatellucci, and Lorenzo Maggi. Algorithms for uniform optimal strategies in two-player zero-sum stochastic games with perfect information. Research Report RR-7355, INRIA, July 2010. http://hal.inria.fr/inria-00506390/en.

[363] Konstantin Avrachenkov, Jocelyne Elias, Fabio Martignon, Giovanni Neglia, and Leon Petrosyan. A Nash bargaining solution for cooperative network formation games. Research Report RR-7480, INRIA, December 2010. http://hal.archives-ouvertes.fr/inria-00544527/en/.

[364] Konstantin Avrachenkov, Nelly Litvak, Danil Nemirovsky, Elena Smirnova, and Marina Sokol. Monte Carlo methods for top-k personalized PageRank lists and name disambiguation. Research Report RR-7367, INRIA, September 2010. http://hal.inria.fr/inria-00510991/en.

[365] Konstantin Avrachenkov and Evsey Morozov. Stability analysis of GI/G/c/K retrial queue with constant retrial rate. Research Report RR-7335, INRIA, July 2010. http://hal.inria.fr/inria-00499261/en.

[366] Konstantin Avrachenkov, Bruno Ribeiro, and Don Towsley. Improving random walk estimation accuracy with uniform restarts. Research Report RR-7394, INRIA, September 2010. http://hal.inria.fr/inria-00520350/en.

[367] Abdulhalim Dandoush, Sara Alouf, and Philippe Nain. Lifetime and availability of data stored on a P2P system: evaluation of recovery schemes. Technical Report RR-7170, INRIA Sophia Antipolis, January 2010. http://hal.inria.fr/inria-00448100/en.

[368] Dinil Mon Divakaran, Fabienne Anhalt, Eitan Altman, and Pascale Primet. Size-based flow scheduling in a CICQ switch. Research Report RR-7183, INRIA, January 2010. http://hal.inria.fr/inria-00450054/en.

[369] Riccardo Masiero and Giovanni Neglia. Distributed sub-gradient method for delay tolerant networks. Research Report RR-7345, INRIA, August 2010. http://hal.archives-ouvertes.fr/inria-00506485/en/.

[370] Xiaolan Zhang, Giovanni Neglia, Jim Kurose, and Don Towsley. Benefits of network coding in disruption tolerant networks. Research Report RR-7277, INRIA, June 2010. http://hal.inria.fr/inria-00494473/.

[371] Konstantin Avrachenkov, Laura Cottatellucci, and Lorenzo Maggi. Cooperative Markov decision processes: time consistency, greedy players satisfaction, and cooperation maintenance. Research Report RR-11-248, Eurecom, June 2011. http://www.eurecom.fr/util/popuppubli.en.htm?page=detail&id=3326.

[372] Konstantin Avrachenkov, Paulo Gonçalves, Alexey Mishenin, and Marina Sokol. Generalized optimization framework for graph-based semi-supervised learning. Research Report RR-7774, INRIA, October 2011. http://hal.inria.fr/inria-00633818/en.

[373] Amar Prakash Azad, Sara Alouf, Eitan Altman, Vivek Borkar, and Georgios Stavrou Paschos. Optimal control of sleep periods for wireless terminals. Research report, INRIA, May 2011. http://hal.inria.fr/inria-00591761/en.

[374] Jean-Claude Bermond, Alain Jean-Marie, Dorian Mazauric, and Joseph Yu. Well balanced designs for data placement. Research Report RR-7725, INRIA, September 2011. http://hal.inria.fr/inria-00618656/en.

[375] Eugenio Della Vecchia, Silvia C. Di Marco, and Alain Jean-Marie. Illustrated review of convergence conditions of the value iteration algorithm and the rolling horizon procedure for average-cost MDPs. Research Report RR-7710, INRIA, August 2011. http://hal.inria.fr/inria-00617271/en.

[376] Fedor Fomin, Frédéric Giroire, Alain Jean-Marie, Dorian Mazauric, and Nicolas Nisse. To satisfy impatient Web surfers is hard. Research Report RR-7740, INRIA, September 2011. http://hal.inria.fr/inria-00625703/en.

[377] Nicaise Choungmo Fofack, Philippe Nain, Giovanni Neglia, and Don Towsley. Analysis of TTL-based cache networks. Research Report RR-7883, INRIA, February 2012.