



ABCDE



## Scientific Report

First name / Family name

Dimitrios Vergados

Nationality

Greek and US

Name of the *Host Organisation*

Norwegian University of Science and  
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First Name / family name  
of the *Scientific Coordinator*  
Period of the fellowship

Yuming Jiang

01/10/2012 to 30/09/2013



## I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

The research activity during the fellowship period, in line with the ABCDE Research Training Program, was the following:

- Participated in a performance evaluation experiment on the effect of different TCP variants over various queue management schemes. Executed the simulation and produced the figures
- Participated in a study of adaptation schemes for improving the Quality of Experience in MPEG video transmissions over LTE. Implemented the client and server in ns3, executed the simulations, and produced the results.
- Participated in the composition of a survey of TDMA scheduling schemes in wireless multihop networks.
- Participated in a literature survey on sensing networks for arctic exploration (under preparation).
- Designed a distributed traffic dependent, topology dependent scheduling algorithm for wireless networks. Developed an event-driven object-oriented simulation tool for wireless scheduling algorithms. Simulated a comparison of the proposed mechanism, with other schemes from the literature.
- Participated in a study about optimizing message delivery in social networks through collective intelligence. Designed and implemented a simulation platform. Performed simulation for the performance evaluation of the scheme.
- Participated in a study about Guided Crowdsourcing in Corporate Environments. Designed and implemented a simulation platform. Performed simulation for the evaluation of the scheme.
- Participated in a study about resource scheduling for wiki crowds. Designed and implemented a simulation platform. Performed simulation for the performance evaluation of the scheme.

## II – PUBLICATION(S) DURING YOUR FELLOWSHIP

### Published Papers:

1. Dimitrios J. Vergados, Aggeliki Sgora, Angelos Michalas, Dimitrios D. Vergados, J-P. Laulajainen, and Yuming Jiang. "A QoE-Driven Adaptation Scheme for Video Content Delivery in LTE Networks." Tenth International Symposium on Wireless Communication Systems (ISWCS 2013), August 27 – 30, 2013 – Ilmenau, Germany.

The Long-Term Evolution (LTE) standard is a promising solution to mobile connectivity. It provides high data rates at a relatively low cost. At the same time, video traffic has so far outpaced other traffic types in growth, making it the dominant traffic type in current wireless networks. In this paper we study the concept of Quality of Experience (QoE) for video traffic in LTE systems. Since video users are more annoyed by unpredictable disruptions than overall reduced video fidelity, we developed an adaptive video coding scheme that aims to improve QoE in LTE networks. In the proposed model users of the same quality class are classified into a number of service levels providing different QoE satisfaction thresholds to their members. The QoE driven adaptation scheme adapts the rate of the transmitted video, so that the QoE experienced by the users remains in satisfactory levels. Two different policies for transmission rate adaptation are studied, namely the adaptive and the coordinated approach. The level of the transmission rate for both policies is regulated by the linear slow start and/or the exponential increase. Simulation results showed that the proposed algorithm for the both transmission rate adaptation policies succeeds in minimizing packet loss and delay in the video transmission, by adjusting the video resolution.

2. Ioanna Lykourantzou, Dimitrios J. Vergados, Katerina Papadaki, and Yannick Naudet, "Guided Crowdsourcing for Collective Work Coordination in Corporate Environments", 5th International Conference on Computational Collective Intelligence Technologies and Application (ICCCI 2013), Sept 11-13, 2013, Craiova, Romania.

Crowdsourcing is increasingly gaining attention as one of the most promising forms of large-scale dynamic collective work. However current crowdsourcing approaches do not offer guarantees often demanded by consumers, for example regarding minimum quality, maximum cost or job accomplishment time. The problem appears to have a greater impact in corporate environments because in this case the above-mentioned performance guarantees directly affect its viability against competition. Guided crowdsourcing can be an alternative to overcome these issues. Guided crowdsourcing refers to the use of Artificial Intelligence methods to coordinate workers in crowdsourcing settings, in order to ensure collective performance goals such as quality, cost or time. In this paper, we investigate its potential and examine it on an evaluation setting tailored for intra and inter-corporate environments.

3. Ioanna Lykourantzou, Wassila Aggoune-Mtalaa, Dimitrios J. Vergados and Yannick Naudet, "Guiding wiki crowds through resource scheduling", Multidisciplinary International Scheduling Conference



(MISTA 2013), August 27-30, 2013, Ghent, Belgium.

Wikis are among the most popular technologies for collaborative knowledge production. In brief, a wiki is a collaborative content creation system, where users contribute knowledge content in the form of articles, while they can also edit and even delete the contributions of others. Wikis have received significant interest in the past few years and they are increasingly being used to support knowledge development in many domains, from education, to scientific research, and from activities of the public sector to enterprise environments. Last, one of the most well-known and studied wikis, the popular Wikipedia, is an ever-growing source of information with millions active users and articles. The rapid expansion and success of wikis is based on the open form of user collaboration that they are based on. That is, wiki users are free to edit any article they wish, with almost no restrictions on their access and edit rights. This open collaboration enables the massive production of wiki articles, which cover a broad spectrum of topics and expertise backgrounds. However, this same self-coordination poses significant limitations in terms of content quality. Take as an example Wikipedia: although it features a number of qualitative articles, it has also a very long tail of low-quality ones. This inability to guarantee quality lowers the reliability of wikis and hinders their adoption. To guide the wiki crowd, systematize contributions and help them utilize their knowledge competencies more efficiently, we propose a coordination scheme that can be viewed as a scheduling problem. The wiki is seen as a system with resources, which are the users and their expertise, and tasks, which are the wiki articles that need quality improvement. The objective is to match users to articles, in such a way as to maximize the average quality of the articles inside the wiki, regarding specific constraints such as user workload.

4. I. Lykourantzou and D. J. Vergados, "Optimizing Crowd Performance through Collective Intelligence-Based System Design: An Application on Social Network Information Diffusion", Seventh International Workshop on Semantic and Social Media Adaptation and Personalization (SMAP), December 3-4, 2012, Luxembourg, Luxembourg.

In this paper we propose a novel system design approach to improve the performance of large-scale user communities interacting towards a collective goal. The proposed approach has been applied on the example case of social network information diffusion and results show that it helped the participating community achieve less spam and improved information coverage.

5. D. J. Vergados, A. Michalas, A. Sgora, and D. D. Vergados, "An Adaptive Video Transmission Algorithm to improve Quality of Experience over LTE Access Networks", 16th Panhellenic Conference on Informatics (PCI), October 5- 7, 2012, Piraeus, Greece.

The LTE standard is a promising solution to wireless connectivity. It promises high data rates at a low cost. At the same time, video traffic has so far outpaced other traffic types in growth, making it now the dominant traffic type in wireless networks. In this paper we study the concept of Quality of Experience for video traffic in LTE systems, since video users are more annoyed by unpredictable packet loss, rather than reduced video fidelity, we developed an adaptive video coding scheme that aims to improve QoE in LTE networks, by continuously adapting the video fidelity, in order to keep the packet loss at acceptable levels.

#### Papers Under Review:

6. Addisu Eshete, Yuming Jian, Dimitrios J. Vergados, "Fairness among TCP Variants under Different Queue Management Mechanisms", Submitted to ACM SIGCOMM Computer Communication Review

The Internet is no longer controlled by a single TCP congestion control algorithm. Since 1988 [16], a plethora of TCP congestion control algorithms have been proposed and deployed. Having no standards to follow, these algorithms are ad hoc fixes and some of them have been adopted by various operating system vendors. This begs the question of whether these heterogeneous TCP algorithms are fair or compatible both to each other. Our simulation study shows that most of the considered TCP variants are, surprisingly, highly throughput-unfair to each other under several well-known queue management (QM) schemes. To understand whether QM at all has important impact on the coexistence of heterogeneous TCP variants, a recently proposed QM scheme, AFpFT, is included in the study. Promisingly, AFpFT helps battle the TCP heterogeneity and enforce throughput fairness among the various considered TCP variants. We believe this sheds new lights on TCP and QM designs.

7. Aggeliki Sgora, Dimitrios J. Vergados, Dimitrios D. Vergados, "A Survey of TDMA Scheduling Schemes in Wireless Multihop Networks", Submitted to ACM Computing Surveys

One of the major problems in wireless multihop networks is the scheduling of transmissions in a fair and efficient manner. Time Division Multiple Access (TDMA) seems to be one of the dominant solutions to achieve this goal, since it is a simple scheme and can prolong the devices lifetime, by allowing them to transmit only portion of the time during conversation. For that reasons several TDMA scheduling



algorithms may be found in the literature. The scope of this paper is to classify the existing TDMA scheduling algorithms based on several factors, i.e. the entity that is scheduled, the network topology information that is needed in order to produce or maintain the schedule and the entity/entities that perform the computing for producing and maintaining the schedules, and to discuss the advantages and disadvantages of each category.

8. Dimitrios J. Vergados, Natalia Amelina, Yuming Jiang, “New Insights on the Effect of Scheduling in Stochastic Wireless Multihop Networks”, Submitted to INFOCOM 2013

One of the challenges in wireless multihop networks is the problem of scheduling transmissions in an efficient and fair manner. The performance of a scheduling algorithm is closely related to its ability to adapt to the changing traffic conditions. Although theoretical results have been obtained regarding the capacity of wireless multihop networks, analytic results on the interaction of load balancing and scheduling algorithms have yet to be derived. In this paper we consider a stochastic wireless multihop network of nonlinear nodes with switching topology, noisy and delayed measurements. The problem of wireless scheduling was modeled as a load balancing problem and the consensus protocol was suggested to solve it. Conditions for an approximate consensus that gives an almost optimal behavior of the system were provided. Through analysis and simulation, we evaluate the performance of various scheduling algorithms. We show that load balancing improves the delay and fairness of the system.

9. Ameen Chilwan, Natalia Amelina, Zhifei Mao, Yuming Jiang, Dimitrios J. Vergados, “Consensus Based Approach for Improving the Network Lifetime in Stochastic Underwater Sensor Networks”, Submitted to INFOCOM 2013

Among the main objectives of wireless sensor network design is to prolong the network lifetime. In underwater sensor networks, this problem is even more critical due to the difficulty in battery replacement and/or recharging. In this paper, we study the problem of extending the network lifetime for stochastic underwater sensor networks. We consider a clustered network, where sensors are divided into two groups: the clusterheads (“super nodes”) that send the information to sink, and the ordinary sensors that collect information about the environment. The sensors are considered to have nonlinear dynamics with switching topology, and noisy and delayed measurements. Two consensus based protocols are introduced for determining the workload distribution throughout the network. To analyze the original stochastic system, an averaged deterministic model is introduced. In addition simulations are performed to cater the stochastic behaviour which show that the proposed protocols increase the network lifetime without compromising energy efficiency.

10. Natalia Amelina, Alexander Fradkov, Yuming Jiang, Dimitrios J. Vergados, “Approximate Consensus in Stochastic Networks with Application to Load Balancing”, Submitted to IEEE Transactions on Information Theory

This paper is devoted to the approximate consensus problem for stochastic networks of nonlinear agents with switching topology, noisy and delayed information about agent states. A local voting protocol with nonvanishing step size is examined. Nonvanishing (e.g., constant) step size protocols give the opportunity to achieve better convergence rate (by choosing proper step sizes) in coping with time-varying information of loads and agent states. The price to pay is replacement of the mean square convergence with an approximate one. To analyze dynamics of the closed loop system, the so-called method of averaged models is used. It allows to reduce analysis complexity of the closed loop system. In this paper, upper bounds for mean square distance between the initial system and its approximate averaged model are proposed. The proposed upper bounds are used to obtain conditions for approximate consensus achievement. The analysis is applied to the load balancing problem in stochastic dynamic networks with incomplete information about the current states of agents and with changing set of communication links. The conditions to achieve the optimal level of load balancing are obtained. The performance of the system is evaluated both analytically and by simulation.

### III – ATTENDED SEMINARS, WORKSHOPS, CONFERENCES

1. 7<sup>th</sup> International Workshop on Semantic and Social Media Adaptation and Personalization (SMAP 2012), December 3-4, 2012 – Luxembourg

### IV – RESEARCH EXCHANGE PROGRAMME (REP)

1. VTT, Finland, Quality of Service Technologies, Converging Networks Laboratory, Jukka-Pekka Laulajainen, 11-15 March, 2013
2. CWI, Netherlands, Stochastics Group, Bert Zwart, 9-13 September, 2013