Low Power Wireless Communications and the Internet of Things

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Abstract: The IEEE 802.15.4 standard offers the basis upon which a number of wireless data communications technologies are built. Characterised by key features such as high energy efficiency, low latency, high accuracy and low cost, these technologies play a significant role in the rapid development of new technological ecosystems that help shaping the emerging Internet of Things. The standard sets specifications for the RF, PHY and MAC layers. Augmented with higher layer ad hoc protocols and applications these specifications allow single chip complete radio controllers to create cost effective self-healing mesh networks of both sensors and actuators. Under the umbrella of Internet of Things, these devices allow people and objects in the physical world as well as data and virtual environments to interact with each other, thus enabling smart digital environments in important domains of human activity such as home, transport, health or energy. Mathematical modeling and performance assessment of the basic IEEE 802.15.4 technologies has been the focus of many studies in order to help understanding better the fundamental factors affecting their efficiency. Despite its complexity, the joint evaluation of communications mechanisms at both PHY and MAC layers is expected to lead to more realistic results and to help developing more efficient systems. At the MAC layer, efficiency is mainly determined by the foreseen multiple access mechanism CSMA/CA and its ability to resolve collisions of packets that originate from various network nodes. However, this efficiency is further affected by the path loss, multi path fading, shadowing, noise and interference exhibited in the underlying wireless channel. The presentation will review a number of approaches developed in the past for joint modeling of PHY and MAC layers in IEEE 802.15.4 wireless networks and present an analytical model based on the M/M/1 and M/G/1 queuing systems with service interruptions or vacations in an attempt to capture the stochastic behavior of signal propagation particularly in low power wireless networks. Simulation as well as experimental results will be discussed in the light of real life implementations for urban traffic management and public transport optimisation currently under development in a framework of smart cities applications.

Brief Bio: Dimitris Mitrakos is an Associate Professor at the Department of Electrical Engineering, School of Engineering, Aristotle University of Thessaloniki, Greece. His research interests include internet computing, multimedia communications, sensor and digital telemetry networks and distributed control and teleoperations systems. Dimitris has a Diploma in Electrical Engineering from Aristotle University of Thessaloniki, an MSc in Communications Engineering from University of Manchester Institute of Science and Technology, a DIC in Signal Processing and a PhD in Electrical Engineering from University of London Imperial College of Science and Technology. In the recent past, he has been Vice-Chairman of the Electrical Engineering Department and Director of the Electronics and Computer Section of the Electrical Engineering Department of

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