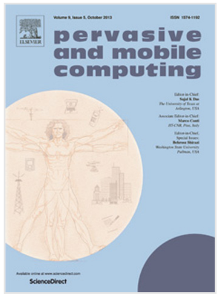

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On the Effect of Human Mobility to the Design of Metropolitan Mobile Opportunistic Networks of Sensors

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Abstract

We live in a world where demand for monitoring natural and artificial phenomena is growing. The practical importance of Sensor Networks is continuously increasing in our society due to their broad applicability to tasks such as traffic and air-pollution monitoring, forest-fire detection, agriculture, and battlefield communication. Furthermore, we have seen the emergence of sensor technology being integrated in everyday objects such as cars, traffic lights, bicycles, phones, and even being attached to living beings such as dolphins, trees, and humans. The consequence of this widespread use of sensors is that new sensor network infrastructures may be built out of static (e.g., traffic lights) and mobile nodes (e.g., mobile phones, cars). The use of smart devices carried by people in sensor network infrastructures creates a new paradigm we refer to as *Social Networks of Sensors* (SNoS). This kind of opportunistic network may be fruitful and economically advantageous where the connectivity, the performance, of the scalability provided by cellular networks fail to provide an adequate quality of service. This paper delves into the issue of understanding the impact of human mobility patterns to the performance of sensor network infrastructures with respect to four different metrics, namely: detection time, report time, data delivery rate, and network coverage area ratio. Moreover, we evaluate the impact of several other mobility patterns (in addition to human mobility) to the performance of these sensor networks on the four metrics above. Finally, we propose possible improvements to the design of sensor network infrastructures.

Keywords: Wireless Sensor Networks (WSNs), Human Mobility, Opportunistic Networks, Social Networks of Sensors (SNoS), Mobile Ad-Hoc Networks (MANETs)

1. Introduction

Since their introduction in the 1950s as a US military application to track Soviet submarines (known as the Sound Surveillance System, SOSUS) [1], sensor networks have taken on an increasing practical relevance [2] and the number of deployed sensor network infrastructures is now difficult to quantify [3]. Further, the recently-introduced paradigm of the Internet of Things (IoT) shows that we are moving toward a world where "smart" physical objects augmented with computing and sensing capabilities will be seamlessly integrated to many aspects of our lives [4]. When connected and mobile, these sensors form a mobile opportunistic network of sensors; while static sensors are attached to the physical infrastructure, mobile sensors are carried by *social entities* (such as humans). In this work, we refer to such a network as a "Social Network of Sensors" (SNoS). The "Social" aspect arises due to the patterns of interactions originated by the movements of the actors carrying the "objects" endowed with sensing capability (sensors) [5]. In fact, people's movements are far from random and inherently embed the social aspects related to human interactions [6, 7].

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