AD HOC AND SENSOR NETWORKS



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We live in exciting times! As we develop into a society increasingly becoming more technology-dependent, much closer to Mark Weiser's vision of the computer disappearing into the fabric of everyday life [1], we develop technologies to support novel ways to communicate. With the miniaturization of computer technology, we expect today technology-driven ordinary objects to behave "intelligently," to communicate between themselves and with large data centers privately holding our "digital life," and running smart algorithms against our data, all designed to improve our life. This large-scale ubiquitous computing vision embraces a model in which users, services, and resources discover other users, services, and resources, and integrate them into a useful experience [2]. This ubiquitous society is similar to what Manuel Castells defines as the "network society" [3], where, similar to how the Internet has become a pervasive utility, we reach a phase when networking logic becomes applicable in every realm of daily activity, in every location and every context. In such a ubiquitous society, billions of miniature, ubiquitous inter-communication devices will be spread worldwide, "like pigment in the wall paint" [3]. This is the time when computing is expected to be available for us anywhere anytime, at the reach of a button. And many times that button is made available by a smartphone, a portable or wearable device, or a miniaturized wireless sensor. And, of course, communication has to cope with the high demand of the mobile world, to exchange more data much more reliably and faster than before!

This issue explores recent advances in ad hoc communication to support this vision. It includes technology efforts toward scaling communication by leveraging everyday mobile devices, using social information to make smart relaying decisions. It includes advances in the field of wireless sensor networks. And it includes a study of the realization of a concrete video-related application. The issue presents communication paradigms that contribute to the emergence of the pervasive and ubiquitous computing vision, based on the proliferation of sensor-rich portable devices. Until now, such sensor-rich devices were used mostly standalone, but when combined or as a complement to an infrastructure-based computation substrate, such as the cloud, they leverage the mobility of end users, and the processing power of these end devices, to enhance users' ability to communicate, sense, and compute in the absence of reliable end-to-end connectivity.

Toward this vision, one development in the field of ad hoc networks is that of opportunistic networks (OppNets). OppNets are related to delay-tolerant networks (DTNs) in that connectivity is expected to be intermittent. One main feature of OppNets is that they are networks among devices carried by individuals for a variety of purposes, but mostly to support mobile communication for the individual. OppNets use short-range communications such as WiFi or Bluetooth, and are infrastructure-free by design. The purpose of OppNets is to disseminate content rather than (as in DTNs) to connect devices. As in DTNs, communication may be enabled by the physical motion of the devices.

In the first article, "A Decade of Research in Opportunistic Networks: Challenges, Relevance, and Future Directions," Trifunovic *et al.* give a good overview of this field before analyzing the challenges and future research directions possible with OppNets. Unlike a typical survey of the up-to-date results obtained by authors working in this field, the authors make an analysis of today's challenges that still forbid us from seeing real-world implementations of such technology, from the lack of support at the mobile operating system level to the existence of alternative technologies (Google's Project Loon, Internet.org by Facebook) that can lead to the realization of the typical use cases advertised as the killer applications for OppNets. Finally, the authors review the oft-stated motivations for having OppNets become reality, identifying the technical areas in which they fit applications and examining the economic drivers for their development.

In the second article, Zhang *et al.* discuss similar scenarios, but refer to the network as smartphone ad hoc networks, or SPANs. Rather than providing an overview, the focus of this article is to leverage smartphone users' social connections to improve routing in the lower layers. As in the previous article, the focus is on content dissemination rather than node connectivity. As an example, content sharing is more likely between friends than between people who are not socially connected. Protocols that take advantage of this are found to provide higher delivery ratios under otherwise comparable circumstances.

The third article, by Mate and Curcio, also focuses on content, but this time on automatic remixing of video content from several sources. The crucial insight of this article is that information from sensors available in many modern handheld devices, particularly accelerometers, GPS, compass, and gyroscope, can be used to automatically choose among several available video streams of the same event uploaded over high-speed wireless networks by different users using different devices.

The final article, by Iova, Theoleyre, and Noel, returns to the topic of ad hoc networks, in particular networks serving the Internet of Things (IoT). Many devices in the IoT are power-constrained and use potentially lossy network links, placing them in the world of low-power and lossy networks (LLNs). IEEE 802.15.4-2006 has defined a protocol, IPv6 Routing Protocol for LLNs (RPL), which effectively ignores information from the medium access control (MAC) layer such as the number of MAC-layer packet retransmissions. Ignoring MAC-layer information also leads to redundant routes that may have undesirable sharing of wireless link characteristics. This article provides a survey of interesting questions and conclusions on this general topic.

In short, these articles provide a range of answers to questions about the continuing evolution of the field of wireless ad hoc networks, in supporting both different applications and different technologies used to solve specific issues.

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BIOGRAPHIES

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