Improving the Efficiency and Resiliency of Wireless Networks

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The design and deployment of mobile and wireless networks has undergone an extraordinary transformation. While this technology already forms the backbone of crucial systems such as health care, disaster recovery, public safety, manufacturing, and citywide broadband access, it has even greater potential. The flexibility inherent in cellular, sensor, mobile ad hoc, mesh, and wireless local area network technologies delivers an almost endless range of applications, including mobile banking, inter-vehicle communication, space exploration, and climate-change tracking.

Despite their promise, efficiently controlling wireless networks is a challenging task, due to interference between simultaneous transmissions, mobility of the nodes, limited capacity of the wireless channel, energy limitations of the devices, and lack of central control. Such distinct characteristics set wireless networks apart from other networking technologies and pose numerous challenging theoretical and practical problems.

To tackle these problems, Gil Zussman focuses on designing new wireless networking architectures and on improving the performance and resilience of existing networks. Due to the special characteristics of these networks, Zussman designs architectures and algorithms that are optimized across multiple layers of the networking protocol stack. For example, he has been working on energy-aware protocols that take into account energy consumption and battery status while making joint decisions regarding routing and scheduling. Zussman has been recently focusing on developing algorithms and prototypes for Energy Harvesting Active Networked Tags (EnHANTs). These tags harvest their energy from the environment and can be used in various tracking applications, and particularly, in disaster recovery applications.

Moreover, in order to enable the efficient operation of distributed algorithms which usually have inferior performance to centralized algorithms, Zussman has been working on identifying topologies in which distributed algorithms obtain maximum throughput. His results in this area enable the partitioning of networks to subnetworks in which distributed algorithms operate very well, thereby improving the overall network performance.

Other research projects of Zussman’s group focus on controlled mobility of wireless nodes, dynamic spectrum allocation and cognitive radio, interfaces between wireless and optical networks, and resilience of networks to geographically correlated failures. Results regarding the latter include identifying vulnerabilities of networks to large-scale attacks, such as Electromagnetic Pulse (EMP) attacks, and mechanisms to mitigate the effects of such attacks.

Zussman was a postdoctoral associate with the Massachusetts Institute of Technology as a Fulbright Fellow and Marie Curie Fellow. He is a senior member of the Institute of Electrical and Electronics Engineers.

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