Integrating Heterogeneous Wireless Technologies: Cellular-aided Mobile Ad Hoc Networks

Project Summary

Integrating ad hoc and cellular networks can enhance wireless communication and support for services. Mobile ad hoc networks have limited wireless bandwidth, low throughput, large delays, and poor authentication and security.

This research proposes a cellular-aided mobile ad hoc network (CAMA) architecture. A mobile ad hoc agent (a CAMA agent) in the cellular network manages the control signaling for the ad hoc network, and the data traffic is via the ad hoc network. Mobile ad hoc users exchange routing and security information with the agent through cellular radio channels.

We plan to investigate the CAMA architecture and its implications, such as, how to overcome the shortcomings of the pure ad hoc networks. Research includes identifying strategies for routing with global positioning knowledge, security, and radio resource allocation for data transmission. Research problems in moving from an integrated networks with a "flat" ad hoc network component to integrated networks with a"hierarchical" ad hoc network component are included.

The basic idea of building cellular-assisted ad hoc networks to improve upon pure ad hoc networks, uses "out-of-band signaling" for an ad hoc network to increase the quality of network control and management. It utilizes global information related to an ad hoc network, and incorporates anti-jamming solutions based on filter design with smart antenna technology.

Intellectual Merit The proposed research is expected to contribute to the areas of mobile wireless networks, communications theory, and signal processing by providing insights into both theoretical and practical aspects of integrating ad hoc and cellular networks. We will develop a new architecture, with its associated schemes, protocols, and algorithms. The proposed architecture has a significant potential for extending the applicability of ad hoc networks. It can provide a complimentary service for cellular networks by providing high-speed and low-cost mobile wireless data services.

Broader Impacts This work has a potential for emerging services in the mobile applications. We are already working with Motorola Inc. We will conduct series of experiments and find new services in mobile communicaiton, so that cellular providers can enter the ad hoc network domain. We regularly offer a graduate course related to wireless networks. This research will enhance the course by adding integrated network issues and experiments in the curriculum. We will contribute to the outreach program through preparation of education material and organizing workshops. The PIs will involve many minorities in the Raid laboratory, including women Ph.D. students, and other undergraduate and graduate minority students. PIs will upport women through the the NSF REU (Research Experiences for Undergraduates) program. Prof. Bhargava serves as member of the science minority affairs committee and of a program to mentor bright minority students. He will involve minorities in this research program. The proposed research will develop new simulation and experimentation infrastructure, to be used not only for research, but also for teaching and industry. The platform for simulation and experiments will be made available to other universities.