Cellular-Assisted Mobile Ad Hoc Networks

Project Summary

Mobile ad hoc networks have inefficient bandwidth utilization, low throughput, large delays, and poor authentication and security/privacy. Integrating heterogeneous wireless technologies can enhance communication and support for services. This research proposes a Cellular-Assisted Mobile Ad hoc network (CAMA) architecture to improve ad hoc networks. A CAMA agent in the cellular network manages ad hoc routing and security through the cellular channel, while the data traffic is exchanged via the ad hoc network. The architecture enhances cellular services by providing high-speed and low-cost mobile data services.

The proposed research investigates the design of routing algorithms that use global information such as positions and network traffic. Mechanisms to reduce cellular signaling overhead for scalability of the architecture will be studied. Mechanisms for authentication, intrusion detection, and intruder identification will be investigated. Privacy preservation for ad hoc nodes will be studied.

Intellectual Merits

- **Research on capacity in ad hoc networks** The network capacity will be studied when optimizing the utilization of link adaptation and route selection. Methods for improving end-to-end throughput in multi-hop wireless connections will be developed.

- **Hierarchical architecture for network scalability** Solutions for scalability will be provided. The cellular signaling overhead can be reduced by cluster head ad hoc routing. The cellular system will help in solving the problem of cluster management in the ad hoc network.

- **Cross layer design for network security** Smart antenna based signal processing will be implemented in the network physical layer. The corresponding upper layer protocols will be designed. The cross layer scheme will be applied to defend against jamming and eavesdropping.

- **Intruder identification scheme using trust model** A trust-adjusted quorum voting algorithms will be designed. The impact of trust on intruder identification will be studied in terms of accuracy and the convergence time.

- **Private communication in ad hoc networks** Anonymous communication algorithms will be designed for ad hoc network privacy. A private routing algorithm that uses node position instead of ID will be developed and analyzed.

- **Prototype of cellular-assisted mobile ad hoc network** An experimental test bed will be designed to evaluate routing schemes, intruder identification scheme, security improvement due to smart antenna, and overhead for privacy.

Broader Impacts

This research will result in developing graduate courses in wireless networks. Security and privacy will be significant parts of the PIs’ planned graduate course on Pervasive Systems. The PI will involve undergraduate minority and woman students in the research through the EPICS Program (Engineering Projects in Community Service). Research results will be presented in the seminars held by the Center of Wireless Systems and Applications (CWSA). An enhanced simulator based on ns-2 will be developed to mimic wireless environment. Students will be trained to conduct experiments using the simulator in the research lab. The platform for simulation and experimentation will be made available to other universities. The research will contribute to the e-stadium program at CWSA. It can extend the coverage of stadium-based wireless services that provide real-time game statistics, biographies of players and coaches, information on seating, and updates of local traffic and weather forecasts to sports fans. The research will contribute to wireless security and dissemination of security education via Center of Center for Education and Research in Information Assurance and Security (CERIAS).