

Research plan for Tricha Anjali

Multi-hop wireless networks continue to be the focus of research of the wireless networking community. More specifically, wireless mesh networks are an active area of research. A mesh network is reliable and offers redundancy. When one node can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate nodes. Wireless mesh networks were originally proposed for connecting WLANs in residential or metropolitan areas to provide pervasive wireless access and share Internet connections. In the future, mesh networks will surely go far beyond the above application scenarios. My research aims to push mesh networks into the arena of real-time services such as Voice over IP and multimedia. Supporting real-time data delivery in wireless mesh networks is much more difficult than its counterpart in the wired networks due to resource constraints, shared wireless channels, lossy communication, and highly dynamic traffic. Thus efficient systems require support from the bottom to the top of the network protocol stack.

The objective of my research is to develop new technologies at the MAC and network layers to support end-to-end, real-time data transport in wireless mesh networks. The research includes the following: 1) real-time MAC protocols with bounded media access delay and minimized channel idle time, 2) routing protocols with increased capacity, fairness, efficiency and quality of service, 3) end-to-end security of the application data with encryption and authentication of the network elements, 4) capability to support client mobility while providing the above, and 5) using cooperative communication to improve the throughput.

The project includes the development of architecture for the management of wireless mesh networks and provisioning of real-time services. This architecture includes algorithms for medium access, route computation, mobility support and security. The protocols and algorithms will utilize various mathematical tools like optimization theory, dynamic programming, game theory etc. This architecture can be useful for military, first responder and mining applications to enable communication between the personnel and also to create secure connections to remotely located resources such as command centers, satellite or microwave connections, or network operation centers. The research results are expected to have significant intellectual and practical impact. Not only will the new technologies provide solutions to an array of fundamental problems in real-time mesh networks, but also they will expand the application scope of mesh networks from access networks to distributed real-time systems in diverse domains such as transportation, battlefield surveillance/command/control, and wireless multimedia communications. The research on mesh networks potentially facilitates the communication among different emergency management divisions in disaster rescue operations.