ABSTRACT

This dissertation contains a collection of analytical and numerical results which provide supportive evidence about the effectiveness of the establishment of local distributed gateways in three-dimensional wireless ad hoc networks for specific applications such as disaster management, rescue operations, tactical units, etc. In said applications, small teams of two, three or four persons in close proximity to each other would allow the effective operation of cooperative wireless units interconnected in local topologies resembling corresponding dipole, triangle, rectangle, or tetrahedron. Assuming a holistic approach in creating a synergy within small discrete sets of cooperative nodes, it is shown that the local performance in relaying packet flows can be improved gradually in terms of reduced delays and optimal throughput. The rate equalization for non-real time applications is considered first. Then the rate-delay equalization for real-time applications is performed with M/M1 queues for MICMOC (multiple-input channels and multiple-output channels) communication model as well as with GI/G/1 queues for MICSOC (multiple-input channels and single-output channel) communication model. A novel topology control algorithm for interconnection of distributed gateways for indoor wireless ad hoc networks is also presented. The algorithm relies on two-hop control information to split the connected nodes into discrete sets and spontaneously form distributed gateways. The dissertation attempts to highlight the importance of performance evaluation of local routing and its relation to fundamental philosophical concepts.