Abstract

Information and Communication Technology (ICT) proliferation has revolutionized the way of human life. However, lack of ICT infrastructures in rural areas has created a *digital divide* with the urban areas. To solve this issue of digital divide, WiFi-based Long Distance (WiLD) network has turned out to be an interesting alternative over the other low cost solutions such as WiMAX, cellular networks, and satellite links. To fit in long distance operation, a lot of software level adjustments are required in the existing WiFi technology. The standard CSMA/CA MAC protocol is not suitable in multi-radio configuration as it causes radios to back off hearing each others transmission. Hence TDMA-based MAC protocols are recommended for better performance in such networks.

With the rapid advancement of communication technologies, real-time services are becoming integral parts of communication systems. In general, real-time applications make different performance demands from the network. To make multi-hop WiLD networks a reality, QoS related issues such as interference-aware scheduling, avoidance of congestion around the gateway node, and QoS-aware routing must be addressed. Multiple radios employed at the nodes and multi-hop nature of network topology make QoS provisioning in such resource-constrained networks a challenging task. In this research, network traffic is divided into a few categories based on their QoS requirements and priorities are assigned accordingly. We consider minimum throughput and maximum delay as QoS constraints as these two are the most prominent requirements of real-time traffic. This dissertation makes contributions towards the development of protocols and schemes for multi-hop WiLD networks concerning frequency reuse, congestion problem, packet scheduling and QoS-aware routing.

In the first contribution, we have addressed the issue of frequency reuse in multi-hop networks. A 2-colour ($2C$) node synchronization and transmission scheduling scheme is designed to optimize network throughput and delay performance.

In gateway-based multi-hop WiLD networks, congestion occurs around the gateway node. A dynamic QoS-aware bandwidth allocation scheme, called $DQBA$,