A Real-Time, Distributed, Directional TDMA MAC Protocol for QoS-aware Communication in Multi-Hop Wireless Networks

Time division multiple access (TDMA) based medium access control (MAC) schemes are widely used for communication among directional nodes since they can provide a conflict-free transmission schedule. However, the existing directional TDMA schemes introduce significant overhead and delay, and cannot adapt to topology changes in real-time in a directional multi-hop network. These schemes also incur considerable overhead and delay in order to support the QoS (quality of service) traffic.

Here, a novel, real-time, distributed, directional TDMA MAC scheme is presented for directional multi-hop wireless networks. This scheme adapts to the topology changes and/or flow requirements in real-time, and facilitates QoS-aware communication with no notification overhead. In the proposed scheme, the 1-hop neighborhood of every node is divided into fully connected 1-hop neighborhoods, which allows the node to intelligently serve multiple routes without requiring a globally converged scheduling solution. This feature allows the use of a low-complexity rank-based mechanism to obtain a distributed, real-time transmission schedule for a directional multi-hop network.

The following new features are also added in the proposed scheme: (i) REQ period which reduces slot wastages, (ii) throughput scaling which ensures fairness, and (iii) piggyback reservation period which increases the spatial reuse and adapts to the dynamic requirements of multiple flows in real-time. The control-period overhead in our scheme is low and linearly changes with the number of nodes. Simulation results show that our scheme provides high throughput for real-time traffic.

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