

## *Abstract*

With the proliferation of innovative wireless devices and applications, the last two decades has witnessed a growing demand for the wireless radio spectrum. However, the fixed spectrum assignment policy coordinated by national regulatory bodies becomes a bottleneck for more efficient spectrum utilization. The concept of Cognitive Radio (CR) technology is proposed to address the issue of spectrum efficiency. Cognitive Radio technology is significantly promising solution to the problem of radio spectrum underutilization by enabling the coexistence of licensed (Primary) and unlicensed (Secondary) users equipped with CR's. Cognitive Radio is capable of sensing the environmental conditions and utilizes environmental observations such as spectrum or network conditions for adapting its operating parameters in order to achieve efficient use of the frequency resource by maintaining the licensed user Quality-of-Service (QoS).

The existing wireless legacy network protocols don't support the coexistence of primary users (PU) and secondary users (SU) and productive utilization of the spectrum holes by the SU's. In this project report, we focus on MAC and Routing protocols for Multi-hop Ad-hoc Cognitive Radio Networks (CRN). Accordingly, we have proposed a cross-layer based Location Aided Routing protocol using a distributed TDMA MAC for Ad-hoc CRN. The distributed TDMA based MAC protocol constructs a TDMA schedule by exchanging three rounds of control messages over the common control channel (CCC) in a distributed manner to avoid collisions among SU's as a fundamental goal. The MAC protocol also uses the service of network layer, which classifies the available channels based on primary user un-occupancy and the number of neighboring SU's having the channel in their available channel list. The network layer selects the best ranked channel and passes it to the MAC sub-layer for transmission or reception. The routing protocol constructs the request zones using four different approaches for making routing decisions with highest end to end message reachability by confining the flooding of routing packets as a key objective. We have studied the performance of the proposed cross-layered protocol through an extensive simulation using NS-2. Simulation results show that the proposed Distributed TDMA MAC is able to avoid collisions among the contending SU's and reduces possibility of interference to primary users by selecting the finest channels for effective communication. Furthermore, we observed that the proposed adaptive request zone based approach outperforms the other three request zone selection approaches in terms of end-to-end message reachability and routing overhead in the network.

**Keywords:** Cognitive Radio (CR), Cognitive Radio Network (CRN), Cross-Layer Design, Medium Access Control (MAC), Location-Aided Routing (LAR), Distributed TDMA.