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An Efficient Modified AODV Routing Protocol for Cognitive Radio Network

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ABSTRACT

More spectrum is required for data transmission in the Internet of Things, mobility, and cloud computing. The spectrum is a limited resource that, unfortunately, is not utilized by licensed users while being overused by unauthorized users. Spectrum underutilization can now be addressed with cognitive radio technology, which is known to be effective. The purpose of this study is to use a modified AODV routing protocol to increase the success rate of unutilized band spectrum. This study makes proposals on how the issues impacting energy awareness can be addressed based on related work. The performance of the AODV helps increase energy awareness, and its effectiveness to improve spectrum efficiency is subsequently evaluated. An existing Q-AODV protocol is compared with the proposed scheme for modified AODV. NS 2 is used to perform simulations. In terms of throughput, packet delivery ratio, and delay, the proposed system outperforms the Q-AODV routing protocol.. The routing issue was solved by the scheme, which also gradually decreased the factors impacting energy awareness.

Keywords - Ad-hoc On-demand Distance Vector, Cognitive Radio Network, Network Simulator 2, Energy Awareness

I. INTRODUCTION

The cognitive radio network (CRN) is a network that has the ability to adapt and identify available channels automatically. In order to adjust to the dynamic environment, cognitive radios can change their configurations. The global system for mobile (GSM), television, wireless local area networks (WLAN), military, and long-term evolution (LTE) are a few examples of the different radio spectrums. While the free bands are overwhelmed, some of them are underutilized. Spectrum bands for TV and the military are typically underutilized. Cognitive radio network (CRN) has emerged as a promising solution to address the issue of the underutilized spectrum which can be used by the unlicensed users when the primary users (PUs) are idle. The cognitive if the PU wants to use its spectrum, the secondary users (SUs) should vacate the spectrum without interrupting the PUs activities quality of service in the routing of CRNs should be taken into consideration given the ever-increasing wireless devices PU's spectrum which results in spectrum congestion. The breakage of links and frequent need for route discovery to repair the routes or to discover-increasing number of is a challenge that affects spectrum performance of CRN. However, selecting relay nodes with higher residual power improves the quality of routing in multi-hop networks. Ad hoc networks are widely used in disasters, rescue, vehicular networks, combat, mountainous areas, fire outbreaks, earthquakes, and acoustic underwater networks. Ad hoc networks are frequently utilized in combat, disaster relief, vehicle networks, mountainous regions, fire outbreaks, earthquakes, and acoustic underwater networks.

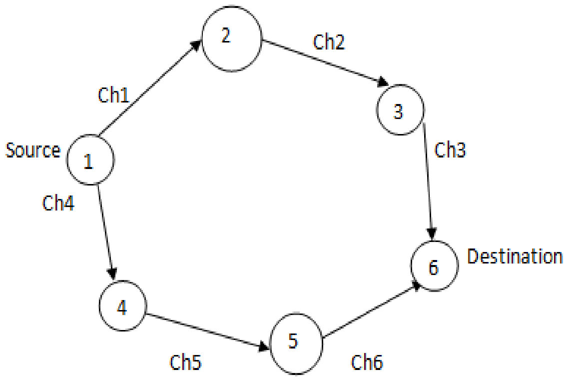

Figure 1: Cognitive Radio Network

II. LITERATURE REVIEW

In [1] The Internet of Things, cloud computing, and mobility require more spectrum for data transmission. However, licensed users use a small portion of the available spectrum, while unlicensed users share an overcrowded spectrum. This study aims to improve the AODV protocol using QoS constraints to reduce routing issues. The study assesses the effectiveness of QoS traffic in improving ADDV performance and compares CAODV with Q-AODV. Simulations are conducted using NS 2.

In [2] the quality of group communication in mobile ad-hoc networks relies on factors like channel fading, signal quality, path loss, transmission and reception power, mobility, link life, and battery backup. A cross-layer approach can extract critical information from multiple layers, enhancing network performance and Quality of Service (QoS). This paper introduces Cross-layer Multicast Routing (CLMR), a tree- based multicast routing protocol that optimizes tree operations and management costs. CLMR utilizes the PHY, Application, and Routing layers for QoS-oriented communication. The performance of CLMR is analyzed using the Multicast Ad-Hoc On- Demand Distance Vector (MAODV) routing protocol under various parameters, including throughput, delay, packet delivery ratio, link cost, and energy consumption.

In [3] the proposed Weight Decision Scheme (WDS) is an efficient spectrum decision mechanism for Cognitive Radio Networks (CRN) to find the best free channels for Secondary Users (SUs) without causing interference to Primary Users (PUs). The scheme is based on primary user activity, helping choose the best free channel for SUs while reducing interference for PUs. The improvements in channel utilization were 72.3%, 34.7%, and 53.8% compared to RD, BFC, and LITC schemes, while interference improvements were 73.8%, 35.6%, and 54.6%.

In [4] Cognitive radio-enabled VANET (CR- VANET) aims to improve the reliability of communication in vehicular ad-hoc networks (VANET) by detecting idle spectrum and assisting in timely broadcasting of safety messages. A novel prediction algorithm is proposed, utilizing spatiotemporal correlations and Bayesian inference to pick the channel with the greatest probability of availability. This algorithm significantly improves detection performance, avoids access conflicts with licensed users, and has a larger packet reception probability and lower transmission delay compared to conventional VANET broadcasting.

The literature illustrates that there are still defects in the routing protocol. Routing protocols that can fix the routing issue without affecting network performance are required. This study proposes and puts into practice the use of energy awareness to enhance performance in routing protocols.

III. ROUTING PROBLEM

The static spectrum allocation policy is responsible for the issue with spectrum availability. The demand for spectrum is increasing as a result of advancements in technology and an increase in mobile devices. Additionally, new routing methods need to be developed in order to overcome the routing issue and enhance network performance while properly utilizing the spectrum. Network performance is affected by the lack of network resources, reliable routes, and frequent link failures. The routing issue with CRNs has to be fixed. Routing protocols suffer from frequent breakdowns in links caused by node and spectrum mobility. Undeliverable packets build up in buffers for a long time when a route breaks down, which causes them to be dropped.

IV. ENERGY AWARENESS

In wireless ad hoc networks, a modified form of the AODV protocol incorporates energy awareness by taking node energy levels into account when selecting routes. This enables more efficient packet delivery rates and distributed energy consumption. The protocol also uses route update messages to update route information, with multiple backup routes built around active routes. The route discovery process is similar to the original AODV protocol, but with backup routes and updated route entries. This protocol is ideal for high mobility and a strong, reliable network where node energy is not a concern.

V. PATH DISCOVERY PROCESS

In the proposed modified AODV, the control packets are modified to be aware of the energy present in the mobile nodes. The hop count

is used to find the shortest route first. The RREP packet provides the destination node with details about several hops, the sequence number, and resources accessible on each path. The source node verifies the data after receiving the RREP packets. Before choosing the best route in terms of its capacity to meet energy awareness, take into consideration the shortest path, resource availability, and link stability. Other potential routes are considered in the event that a route does not satisfy energy awareness. The only route chosen is the one that complies with energy awareness.

VI. MULTI MODAL OPTIMIZATION

Multi model optimization have multiple optimum solutions for modifying nodes, which helps in aware energy presence in the nodes. Any optimization algorithm typically finds it challenging to find the overall optimum solutions when dealing with multi-modality in a search and optimization problem. Finding multiple global optimum locations in a single run and maintaining those locations until the end of the run are the goals of multimodal optimization. In order to find and follow multiple static optima in multimodal optimization, an adaptive multipopulation framework has been proposed. In real-world applications in dynamic environments, it is frequently necessary to optimize a series of events, i.e., optimization process may contain some changing characteristics.

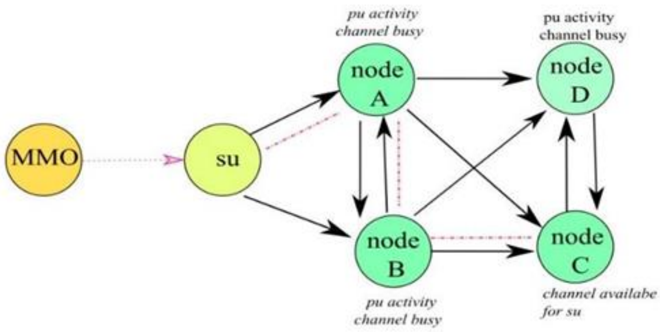

Figure 2 : Route setup

A node's localization from a source node to a destination or target node can be improved by using the MMO. To reduce localization errors, the MMO is played repeatedly, and the average localization error frequently drops. The optimal and final position for the secondary user to effectively use the spectrum is determined in the final iteration to be the optimal multi-modal position.

VII. SIMULATION MODEL

The study took into account a grid with an 800 x 800 m network topology. Modified AODV, the suggested scheme, was evaluated and compared with Q-AODV. The simulation parameters that were used to evaluate the protocols are shown in Table I. According to difficulties with energy awareness identified in the literature, the two routing protocols were evaluated. For buffer management, the maximum packet size was set to 100 and the transmission speed to run for 120 simulation seconds

TABLE I

Parameters	Values
Simulator	NS-2.31
Routing Protocols	Modified AODV,Q-AODV
Simulation time	120 seconds
Topology	800 m x 800 m
Number of nodes	10, 30, 50, 80, 100
Transmission range	400 m
Movements model	Random waypoint
Packet size	512 bytes
Channel Type	Channel/wireless channel
Queue	Queue/DropTail/Pri-Queue
Packet rate	4 packets/s
Traffic type	UDP

VIII. RESULT

In this project, we compare the existing with the proposed system Figure 3 presents the comparative average end-to-end delay results. The results show that the proposed scheme has a lower delay as compared to the Q-ADDV protocol.

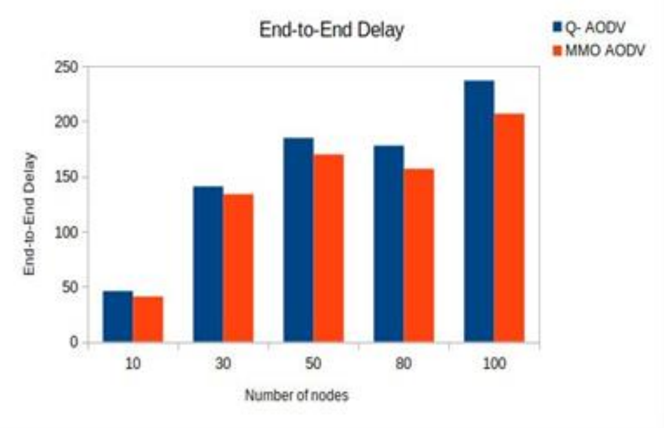

Figure 3 : End-End Delay

Figure 4 depicts the performance of the two routing protocols in terms of the number of dropped packets. The show that the proposed modified AODV scheme outperformed the QAODV protocol. However, in the scenario the performance of the two schemes is poor though the modified AODV was marginally better. Most packets are lost due to the increase in traffic and a need to buffer many packets for long periods which causes transmission delays. These delays may result in many packets being dropped.

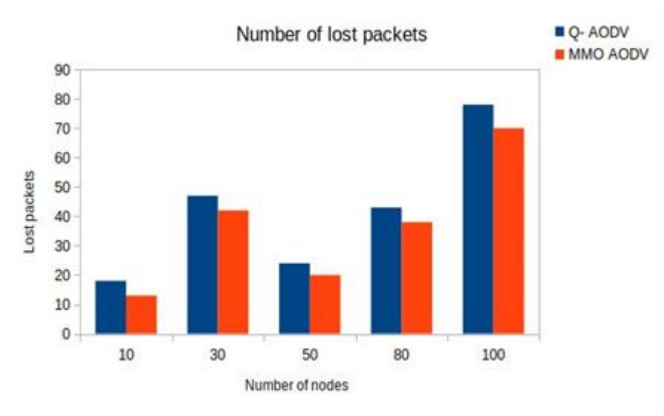

Figure 4 : Number of lost packets

In figure 5 the packet delivery ratio (PDR) results show that the modified AODV protocol outperformed the Q-AODV protocol.

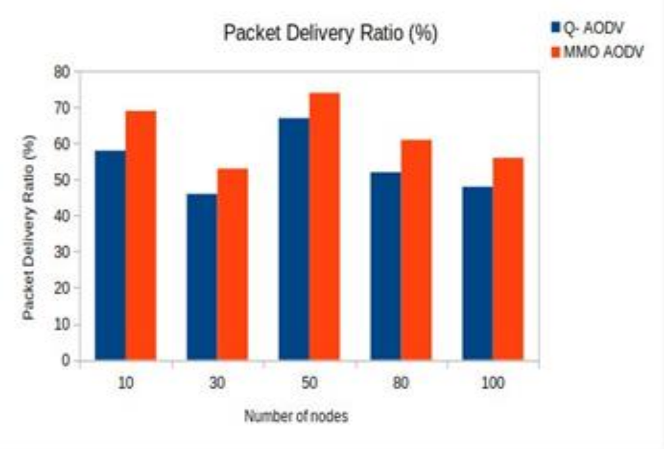

Figure 5: Packets Delivery Ratio (%)

Figure 6 Throughput was also considered as one of the evaluation metrics. The comparative results show that the achievable in the number of nodes. However, the performance of the modified AODV protocol was superior. The results prove that the modified AODV protocol is effective in selecting the desired path based on the energy awareness.

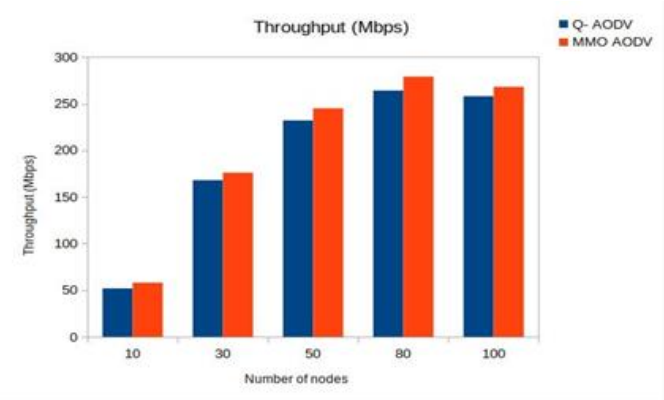

Figure 6 : Throughput (Mbps)

IX. CONCLUSION

Given the simulation results from this project, it is clearly demonstrated that the suggested scheme outperformed the Q-AODV routing protocol. The plan has been modified to find stable routes with enough battery life to satisfy the SUs' need for energy awareness. The scheme was able to address the routing challenge in CRNs, as shown by the simulation results. The Network Simulator (NS-2) was used to obtain the simulation results. Different graphs have been obtained for a number of parameters, including throughput, packet delivery ratio, and end-to-end delay. In this project, we suggested a novel way to make greater use of the underutilised band spectrum and reduce spectrum scarcity.

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