Broadcasting in Multihop Cognitive Radio Ad Hoc Networks using NCPR under Blind Information

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Abstract— In wireless ad hoc networks broadcasting is a fundamental operation where control information is usually propagated as broadcasts for the realization of most networking protocols. In traditional ad hoc networks, since the spectrum availability is uniform, broadcasts are delivered via a common channel which can be heard by all users in a network. However, in cognitive radio (CR) ad hoc networks, unlicensed users may observe spectrum availability, which is unknown to other unlicensed user before the control information was broadcast. Thus it is extremely challenging that broadcasts can be successfully conducted without knowing the spectrum availability information in advance. In this paper, the performance of a neighbour coverage based broadcast protocol is proposed using different QoS metrics such as packet delivery ratio, end -to-end delay, packet loss probability and network control overhead.

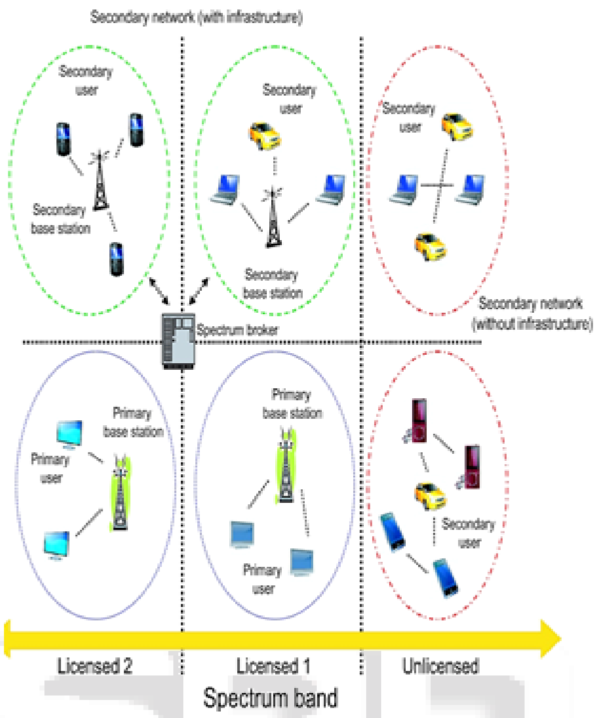
Key words: Blind information, broadcast protocol, cognitive radio (CR), multihop communications, quality-of-service (QoS)

I. INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring network of mobile routers and associated hosts connected by wireless links - the union of which forms a random topology. Cognitive Radio (CR) is considered to be the future of wireless communication. Recent studies have indicated that up to 85% of the assigned spectrum is underutilized due to the current fixed spectrum-allocation policy. Cognitive radios (CRs) are regarded as a promising solution for alleviating this spectrum underutilization problem by enabling an unlicensed user or a secondary user (SU) to adaptively adjust its operating parameters and exploit the spectrum that is unused by licensed users or primary users (PUs) in an opportunistic manner.

Primary Network is referred to as an existing network, where the primary users (PUs) have a license to operate in a certain spectrum band. If primary networks have an infrastructure support, the operations of the PUs are controlled through primary base stations. Due to their priority in spectrum access, the PUs should not be affected by unlicensed users.

Secondary Network does not have a license to operate in a desired band. Hence, additional functionality is required for CR users (or secondary user) to share the licensed spectrum band. Also, CR users are mobile, and can communicate with each other in a multi-hop manner on both licensed and unlicensed spectrum bands. However, they do not have direct communication channels with the primary networks and rely on their local observations during their operation.



II. RELATED WORKS

I. Chlamtac (1) proposes a graph-oriented model for dealing with broadcasting in radio networks. Using this model, optimality in broadcasting protocols is defined, and it is shown that the problem of finding an optimal protocol is NP-hard. A polynomial time algorithm is proposed under which a channel is assigned to nodes from global, multiple-source broadcasting considerations. In particular, nodes participating in the broadcast do not interfere with each other's transmissions, but otherwise simultaneous channel reuse is permitted. Protocol implementations of this approach by frequency division and by time division are given. It is shown that, using these protocols, bounded delay for broadcasted messages can be guaranteed.

R. Chen (2) proposes a systematic approach, based on quorum systems, for designing and analyzing channel hopping protocols for the purpose of control channel establishment. The proposed approach, called Quorum-based Channel Hopping (QCH) system, can be used for implementing rendezvous protocols in CR networks that are robust against link breakage caused by the appearance of incum bentuser signals. We describe two synchronous QCH systems under the assumption of global clock synchronization, and two asynchronous channel hopping systems that do not require global clock synchronization. Our analytical and simulation results show that the proposed channel hopping schemes outperform existing schemes under various network condition. It minimize the MTTR of the CH system and Guarantees the even distribution of the rendezvous points in terms of both time and frequency and also decrease channel access delay.

X. Wang (3) proposes a novel unified analytical model is proposed to address these challenges. Our proposed analytical model can be applied to any broadcast protocol with any CR network topology. We propose to decompose an intricate network into several simple networks which are tractable for analysis. We also propose systematic methodologies for such decomposition. Results from both the hardware implementation and software simulation validate the analysis well. In this scheme, all SU nodes in the network intelligently select a subset of available channels from the original available channel set for broadcasting. The size of the downsized available channel set is denoted as w. The value of w needs to be carefully designed to ensure that at least one common channel exists between the downsized available channel sets of the SU sender and each of its neighboring nodes.

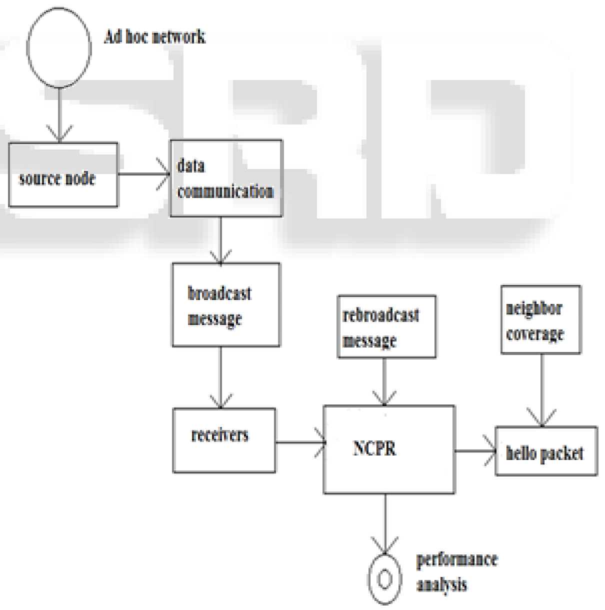
P. Sheu (4) proposes a technique for identify this problem by showing how serious it is through analyses and simulations. We propose several schemes to reduce redundant rebroadcasts and differentiate timing of rebroadcasts to alleviate this problem. A mechanism to reduce redundancy, contention, and Collision .One approach to alleviating the broadcast storm problem is to inhibit some hosts from rebroadcasting to reduce the redundancy, contention and collision. In the following, we present five schemes to do so. These schemes differ in how a mobile host estimates redundancy and how it accumulates knowledge to assist in making its decision.

Jiang Xie (5) proposes a technique with the aim of having a high success rate and short broadcast delay. In our design, we do not assume that unlicensed users are aware of the network topology, the spectrum availability information, and time synchronization information. They use two broadcast scheme. The first broadcast scheme is called the random broadcast scheme. Since an SU is unaware of the channel availability information on other SUs before the broadcasts are executed, a straightforward action for an SU sender is to randomly select a channel from its available channel set and to broadcast a message on that channel in a time slot. In addition, as stated in each SU sender needs to broadcast the message for multiple time slots. The second broadcast scheme is called the full broadcast scheme under which each SU visits all the available channels in the spectrum. Unlike the random broadcast scheme where the channel in each time slot is randomly selected by an SU, in the full broadcast scheme, an SU sender broadcasts on all its available channels sequentially. Similarly, an SU receiver listens to its available channels sequentially.

III. PROPOSED APPROACH

The proposed algorithm is Neighbor coverage based broadcast protocol (NCPR) it overcomes the problem of packet loss in cognitive radio ad hoc networks under blind information. In MANET the primary user having license to operate in the desired band but secondary user does not have a license to operate in the desired band. However, in CR ad hoc networks, since SUs can only use the channels that are not occupied by PUs, different SUs may acquire different sets of available channels. Thus, the availability of such a common channel for all nodes may not exist. More importantly, before control information is sent, an SU is unaware of the available channels of its neighboring nodes. As a result, although a global or local common channel may exist, SUs are unaware of its existence. Therefore, broadcasting control messages on a common channel is often not feasible in CR ad hoc networks under blind information.

Reliable group communication is a challenging issue for most Mobile Ad hoc Networks (MANETs) due to dynamic nature of wireless mobile nodes, group key establishment and management, ensuring secure information exchange and Quality of Service (QoS) in data transfer. Recently multicast and broadcast routing protocols are emerging for supporting QoS aware group communication. In MANETs QoS requirements can be quantified by a set of measurable pre specified service attributes such as packet delivery ratio, end -to-end delay, packet loss probability, network control overhead, throughput, bandwidth, power consumption, service coverage area etc. In this paper, the performance of a neighbor coverage based broadcast protocol is analyzed using different QoS metrics (packet delivery ratio, end -to-end delay, packet loss probability and network control overhead). BCAST is used as broadcast protocol. The performance differentials are analyzed using NS-2 network simulator for varying number of data senders (multicast group size) and data sending rate (offered traffic to the network) over QoS aware group communication.



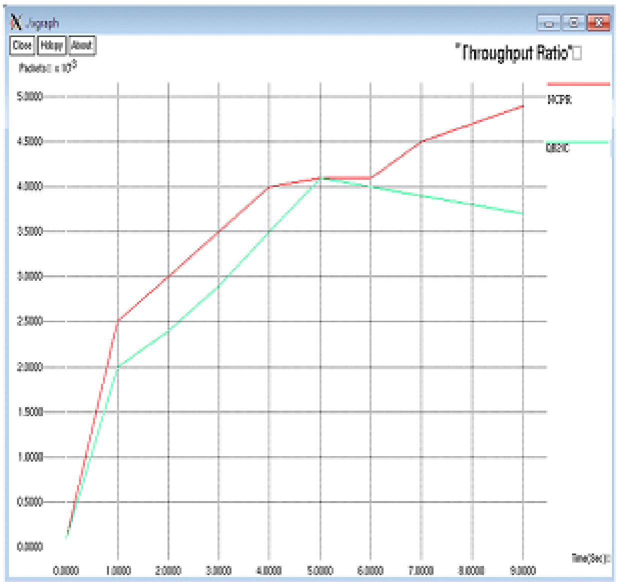
So we use NCPR protocol to overcomes the problem of performance metrics such as through put, packet delivery ratio, end to end delay, network control overhead and also reduce packet loss by using rebroadcasting scheme**.**

IV. PERFORMANCE ANALYSIS

Using NCPR protocol the performance metrics differences between existing and proposed systems are analyzed.

A. Throughput

Throughput is the rate of successful message delivery over a communication channel. It improves the performance of cognitive radio ad hoc networks. It minimize packet delay (i.e.) average rate at which the amount of packet is successfully delivered between destination node (receiver) and source node (sender) in a given amount of time.

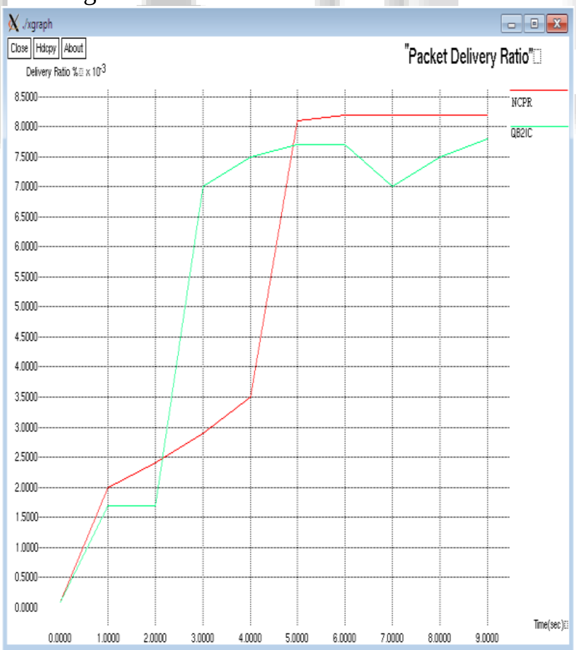


B. *Packet Delivery Ratio*

The ratio of the number of delivered data packet to the destination. The packets are delivered from source to destination on their network. It is calculated by dividing the number of data received by ending state through the quantity package originated from starting point on network.

PDF = (Pr/Ps)*100

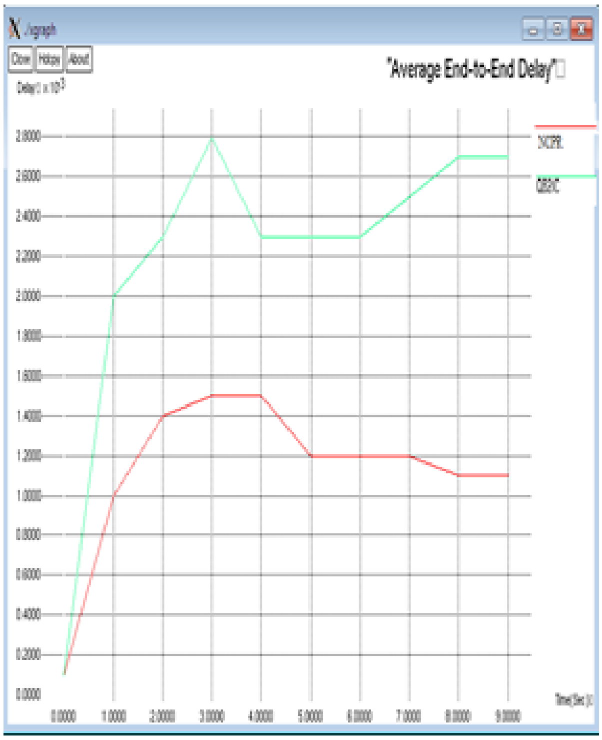
Where Pr is total Data received & Ps is the total data sending on their network



C. *End To End Delay*

The average time taken by a data packet to arrive in the destination. It is calculated by

∑(arrive time-send time)/∑number of connections



D. *Packet Loss*

The total number of packets dropped during the simulation and it is calculated by

$$P_L = P_s - P_r$$

Packet Loss = Total Data Packets Dropped(P_{dr}) Where, P_L = Packet Loss

P_s = Total Data Packets Sent

V. CONCLUSION AND FUTURE WORK

The broadcast issue in multihop CR ad hoc networks has been investigated. By utilizing the diversity of channels, broadcast collisions can be mitigated in multihop scenarios under our proposed NCPR protocol. In addition, based on the analysis of the channel availability, an enhanced scheme of the NCPR protocol is proposed to reduce the average broadcast delay and to improve packet delivery ratio. Simulation results show our proposed NCPR protocol to improve the network performance in terms of higher success rate and shorter average broadcast delay. In our future work, we extend to improve the throughput ratio and network control overhead.

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