International Journal of Technology Research and Management
ISSN (Online): 2348-9006
Vol 3 Issue 9 September 2016

Performance Enhancement of Cognative Radio Network Using AODV Routing Protocol

Swati Shah[1], Prof. Pratibha Nagaich[2]
Research Scholar M. Tech, Sagar Group of Institution, Indore[1]
Assistant Professor, Sagar Group of Institution, Indore[2]
swatishah03@gmail.com[1], pratibhanagi@yahoo.co.in[2]

Abstract: *Cognitive Radio Networks are a promising technology likely to be deployed in the very near future as a viable solution to the spectrum shortage problems faced by traditional wireless systems. Technological breakthroughs in the field of Software Defined Radios enabled the development of flexible cognitive radio transceivers capable of dynamically changing their transmission parameters in order to efficiently exploit the available wireless resources. This increased capability of cognitive radios to self adapt based on interactions with the surrounding environment makes them the perfect candidates for opportunistic spectrum access in those bands that are assigned to primary users. While these primary users are allowed to access their licensed spectrum resources anytime and anywhere, within the contractual limits imposed by spectrum management authorities, cognitive radios have to scan and identify any unused spectrum in the licensed bands. Most importantly, in order not to interfere with primary users, they have to rapidly vacate the licensed spectrum as soon as the primary user begins to use its legitimate spectrum resources. The coexistence of cognitive radios with such primary users is very challenging. When considering the natural evolution of cognitive radio networks to more complex systems, the challenges and problems to be faced increase substantially***.**

1. INTRODUCTION

TRADITIONALLY wireless networks have been operating based on fixed spectrum assignment policies. According to these policies, licensees are granted the rights for exclusive use of frequency bands on a long term basis over vast geographical areas. Because of this static allocation of the available spectrum resources, several portions of the licensed bands are unused or underused at many times and/or locations [1]. On the other hand, several recent technologies - such as IEEE 802.11, Bluetooth, ZigBee, andto some extent WiMAX - that operate in the Industrial, Scientific and Medical (ISM) unlicensed bands, have experienced a huge success and proliferation. As a consequence, the wireless spectrum they are accessing - especially the 2.4 GHz ISM band - has become overcrowded. In an effort to provide further spectrum resources for these technologies, as well as to allow potential development of alternative and innovative ones, it has recently been proposed to allow unlicensed devices, called secondary users, to access those licensed spectrum resources that are unused or sporadically used by their legitimate owners, called primary users. This approach is normally referred to as Dynamic Spectrum Access and the technology hat enables secondary users to find and opportunistically exploit unused or under used spectrum bands is called Cognitive Radio [2].

2. COGNITIVE RADIO NETWORK

Cognitive Radio Networks have consequently emerged as viable architectural solutions to alleviate the spectrum shortage problem faced by traditional wireless networks [4, 5] by exploiting the existing wireless spectrum opportunistically. However, when designing such solutions it is necessary to consider that, besides the strict requirements imposed by the opportunistic coexistence with Primary Users, Cognitive Radios may also have to deal with other malicious/selfish (adversary) Cognitive Radios that aim at denying/gaining access to the available spectrum resources with no regard to fairness or other behavioral etiquettes. This is possible because the same Software Defined Radio technology can enable adversary Cognitive Radios to significantly modify the perception that legacy Cognitive Radios have of the surrounding environment, resulting in suboptimal or interruption of operation for Cognitive Radio Networks.

In this work UDP agent with CBR traffic is used with 40 packet size and 10kbps rate used for the transmission. The simulation configuration for static nodes consists of many network components and simulation parameters that are shown in the table in detail.

3. ARCHITECTURAL SOLUTION

To tackle these issues we propose an architectural solution for Cognitive Radio Networks which uses network coding techniques for reliable control information exchange and enables Cognitive Radios to maintain up-to-date information regarding the network status and promptly react to wireless environmental changes. Its main features are: 1) a robust neighbor discovery algorithm able to guarantee fast and reliable network deployment; 2)a robust control channel for prompt control information exchange; 3) efficient cooperative detection of Primary Users' activity; 4) distributed allocation of the spectrum resources to Cognitive Radios for both single hop and multi hop Cognitive Radio Networks; 5) a spectrum aware cluster formation protocol that allows spectrum reuse and network scalability.

4. MOTIVATION

The cognitive radio presents a very lucrative area of the research field. Inefficient spectrum utilization is the driving force behind cognitive radio and adopting it can lead to a reduction of spectrum scarcity and better utilization of the spectrum resources. Spectrum Sensing i.e. checking the frequency spectrum for empty bands forms the foremost part of the cognitive radio. There are number of schemes for spectrum sensing like energy detector and matched filter. But the former functions properly for higher signal to noise ratio (SNR) value whereas the latter's complexity is very high. These constraints led to implementing a detector which performed well under low SNR conditions as well and with complexity not as high as the matched filter. Cyclo-stationary detector turned out to be the choice for such specifications.

5. SOLUTION DOMAIN

The proposed routing technique is based on a modification of the widely adopted Ad-hoc On-demand Distance Vector (AODV) protocol. Unlike most of the previous works, our proposal avoids regions of PU activity during both route formation and packet discovery without requiring any dedicated control channel. Moreover, it assesses the qualities of any available channel, minimizing the route cost by performing a joint path and channel selection at each forwarder. Finally, it exploits the presence of multiple available channels to improve the overall performances. To perform different tasks when any node has data and it wants to send the data to the destination node. These tasks are route discovery, route maintenance and other management tasks. Algorithm for these tasks are given below.

A multi-metric route selection algorithm, which considers the availability of frequency band in addition to traditional metric like switching delay and queuing delay.

A Combined opportunistic routing (OR) with transmit power control (TPC) schemes, which simplifies the selection of CFNs, improving the delivery ratios of CFNs and achieving service differentiation to traffic flows with different priorities.

Initiate route discovery:

```
Begin

if (no valid route found on cache) then

    1. Create RREQ packet;
```

```
    2. Initialize route record in RREQ packet to empty, initialize delay to 0, initialize MEATT to 0;

    3. Broadcast RREQ packet on common control channel.

Else Perform Route Decision.

endif

End
```

Propagate RREQ and route reply:

```
Begin

if (receive RREQ packet) then

    1. Determine if its address is on the list of route record;

    2.if (it is on the list of route record) then
        Discard RREQ packet.

else

    1. Append own address and frequency channel to route record in RREQ packet;

    2. Set switching delay dswitch = td ms if the receiving frequency is fixed to the same channel as the previous hop node’s transmitting frequency. Otherwise, theswitching delay is set to dswitch = 0 ms;

    3. Add dswitch to the delay field;

    4. Add average queuing delay to the delay field where dqueue 1⁄4 n t nsend À t nreceiv e =n, where tnsend and tnreceive are the send and receive time of the previous n packets;

    5. Update MEATT field.

    6. if (receiving node is destination) then

        1. Creates RREP packet;

        2. Send RREP packet.

    7. else

    Rebroadcasts the RREQ packet on the common control channel.

    Endif

endif

endif

End
```

6. REIVEW OF LITERATURE

Ibrahim Amadou et, all gave good summery of the work in high congestion wireless networks with evaluation the performance and characterize these solutions when they are used to reserve the wireless channel through broadcasting message for reader-to-tag communication. If the most important criteria for the application is to give equal access time to readers, SIFT should be chosen none of the MANETs CSMA approaches improves all criteria at the same time.

Chris Barrett et. all proposed three basic mobility models: Grid mobility model, Random way point model, and Exponential correlated Random model. The performance of protocols is measured in terms of quality of service measures including throughput, number of packets received and , long term decency.

MojtabaRazfaret. allpresented the performance of IEEE 802.11 MAC protocol under various mobility patterns for different network topologies. illustrated that the performance of the network improves as the traffic decreases when a sufficient transmission ranges of nodes is provided, The RTS/CTS handshaking method demonstrated its efficiency on the mobile nodes when the number of collisions becomes more and more.

Michele Garetto and TheodorosSalonidis, "Modeling Per-flow Throughput and Capturing Starvation in CSMA Multi-hop

Wireless Networks "Department of Electrical and Computer Engineering Rice University, Houston, TX 77005 1996. [12]This paper shows that the fundamental cause is not merely differences in the number of contending neighbors, but a generic coordination problem of CSMA-based random access in a multi-hop environment they develop a new analytical model that incorporates this lack of coordination, identifies dominating and starving flows and accurately predicts per-flow throughput in a large-scale network.

7. SIMULATION ENVIRONMENT

Simulation Tool	NS-2.35
Simulation Area in (meter)	1000 x 1000 meter
Number of nodes	20, 40, 60, 80, 100 nodes
Propagation Model	Two-Ray Ground Propagation
Node Mobility	Random
MAC Type	CSMA, MACA
Routing Protocol	Dynamic Source Routing Protocol
Traffic Type	TCP
Data Packet Size	512 byte
Queue type	CMU Priqueue
Channel	Wireless
TCP Variant	New RENO
Queue Limit	50 Packets
Speed of Nodes	10m/sec
Packet size	512 byte
Antenna	Omnidirectional antenna
Simulation Time	300 sec

8. EVALUATION OF RESULTS

Packet Delivery Fraction:

Packet delivery fraction is calculated by dividing the number of packets received by the destination through the number of packet originated by the application layer of the source. This is the fraction of the data packets generated by the TCP sources to those delivered to the destination. This evaluates the capability of the protocol to discover routes. The better the delivery ratio, the more complete and correct the protocol.

Figure shows the Packet Delivery Fraction under various aodv protocol.

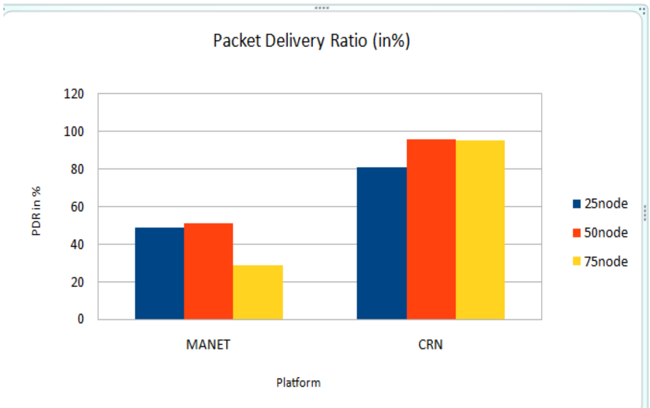

Figure 1 Packet Delivery ratio VS Platform

Throughput:

Throughput is define as the number of packet flowing through the channel at a particular instant of time. this performance metric signifies that the average rate at which the data packet is delivered successfully from source node to destination node over a communication network is known as throughput.

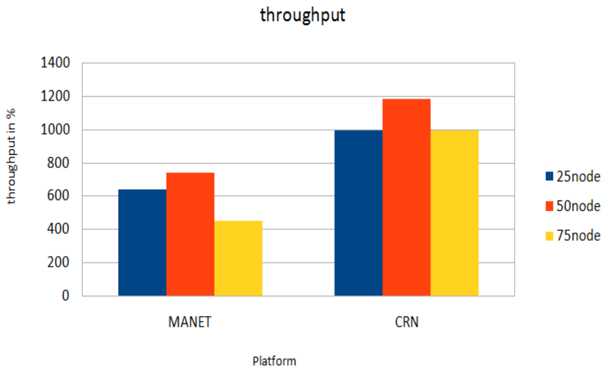

Figure 2 Throughput VS Platform

End to End Delay:

This is the average delay between the sending of the data packet by the source and its receipt at the corresponding receiver.This includes all the delays caused during route acquisition, buffering and processing at intermediate nodes.

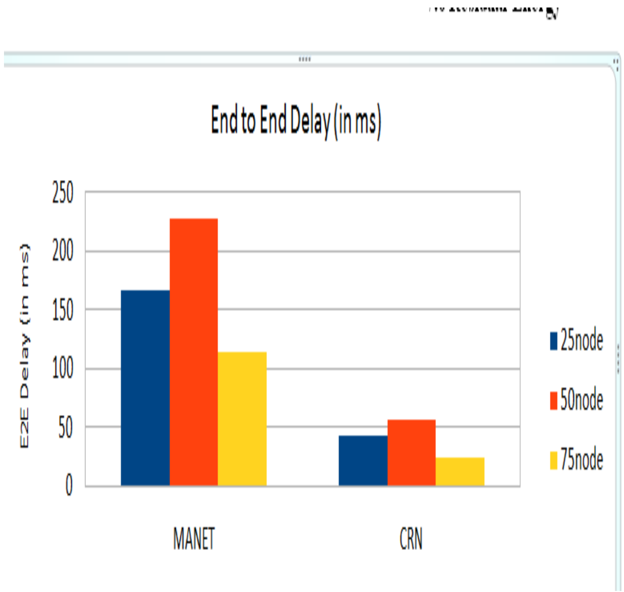

Figure 3 End to End DelayVS Platform

Residual Energy:

It is the total amount of remaining energy by the nodes after the completion of Communication or simulation. If a node is having 100% energy initially and having 70% energy after the simulation than the energy consumption by that node is 30%.The unit of it will be in Joules.

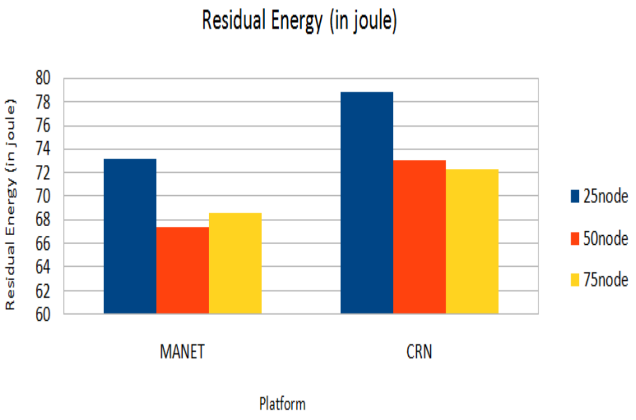

Figure 4 Residual Energy VS Platform

9. CONCLUSION

This work carried out the detailed analysis of Cognitive radio network routing protocols theoretically and through simulation by NS-2 for AODV on the basis of different performance metrics viz. packet delivery ratio, end to end delay, residual energy and average throughput. These performance metrics are analyzed for the AODV routing protocols by varying the node density. Simulation of routing protocols provides the facility to select a good environment for routing and gives the knowledge how to use routing schemes in static network. Simulation results show that, as the density of nodes increases in the network, the performance of the routing protocols decreases. Nodes density affects the performance of routing protocols most as frequent path break increases with the density. According to simulation results as the density of nodes increases, the packet drop and end to end delay of routing protocol increases whereas throughput and packet delivery ratio decreases. In the analyzed scenario, it is found that the CRN have the best all round performance than MANET. CRN is suitable for network with high, low and moderate node density.

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