International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 4, April - 2014

Performance Analysis of MultiHop Relay Networks in IEEE 802.11

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Abstract—Due to the packet-fairness property of the 802.11 WLANs, the clients take longer time to transmit a packet and would reduce the overall throughput of the network. The Distributed Coordination Function (DCF) in the IEEE 802.11 standard provides fairness for all clients at the frame level. That is, all clients would achieve the same throughput (in terms of numbers of packets transmitted or received) in the long run regardless of their data rates. As a result, it will take much longer time for a low data rate client to transmit / receive a packet than clients with higher data rates, which leads to the low throughput of clients and a poor performance of the whole system. So am proposing a relay node selection algorithm for packet transmission in AODV protocol, which allows source to send packet to destination . Then implemented normal packet transmission using AODV protocol. Then this two are compared based on various parameters and output is shown using NS2 simulator. It is proved that the proposed algorithm is better for packet transmission.

Index Terms-Performance Anomaly Problem,Client Relay,Relay Network

I. INTRODUCTION

Wireless multi-hop networks play a important role in future communications world. The demand for higher data rates in wireless networks increases with increasing user needs. Hence, throughput, the amount of data transfered successfully to the destination nodes is a major issue in the design of wireless networks.Simultaneous transmissions cause interference to each other .It may degrade the performance severely compared to wired networks. In wireless networks ,throughput and packet delivery ratio are the important factors in order to provide the required quality of service,

Applications that run on large wireless networks have some limitations due to limited range of the network.It can be rectified by multi-hopping functionality, which is the act of transferring data through multiple hops via intermediate nodes. Multi-hopping is used in wireless networks to extend the coverage when transmit power of the source station is not enough to reach the destination.

Multihop wireless networks are used to convey information from a source to a destination. There are many applications of multi-hop communication, with variety of applications.They are mobile adhoc networks and multihop cellular systems. Cellular systems employ single hops between mobile units and the base station. Throughput is becoming a significant concern. This problem can be in systems with higher carrier frequencies and larger bandwidth. A solution to the problem of improving coverage and throughput is the use of relays. Different relay technologies are under investigation including fixed relays, mobile relays (other users opportunistically agree to relay each others' packets), as well as mobile fixed relays . The use of relays affects almost every aspect of optimization and cellular system design .It include scheduling, handoff, adaptive modulation, ARQ. These topics are under intense investigation. A mobile ad hoc network consists of a group of mobile nodes that communicate without requiring a fixed wireless infrastructure.

II. BACKGROUND

A. Performance Anomaly Problem

The Distributed Coordination Function (DCF) in the IEEE 802.11 standard provides fairness for all clients at the frame level. That is, all clients would achieve the same throughput (in terms of numbers of packets transmitted or received) in the long run regardless of their data rates. As a consequence, it will take much longer time for a low data rate client to transmit / receive a frame than clients with higher data rates. It leads to the low throughput of fast clients and a poor performance of the whole system. This is regarded as the performance anomaly problem in IEEE 802.11 DCF protocols[2].While analyzing the performance of the IEEE 802.11b wireless local area networks it is observed that when some mobile hosts use a lower bit rate.So the performance of all hosts is considerably decreased. Such a situation is a common case in wireless local area networks.A host far away from an Access Point experiences signal fading and interference

Wireless local area networks such as IEEE 802.11 that have become famous as access networks to the wireless mobile Internet.The performance anomaly problem was first analyzed in by Heusse et al in 2003. There are two types of methods for solving the problem. One of the method is to change the longterm access fairness property of the IEEE 802.11 MAC .It will help to reduce the access probabilities of low data rate clients. The other method is to use intermediate clients to help relay the traffic for low data rate clients . Although the first method can be implemented by IEEE 802.11e enhanced distributed channel access (EDCA) protocols it is not recommended , because this method further degrades the performance of low data rate stations.The other method is the concept of client Relay. We believe service providers have the responsibility to provide the same level of service to all users in the coverage area, and it is not a good policy to penalize those people who are just far away from the access point. Thus, this paper is based on the client relay (second) method. The concept of client relay (client repeaters) was introduced to relieve the performance anomaly problem in [4]. By using client relays, some intermediate clients are selected to relay the traffic for low data rate clients.An important issue of client relay is to decide when a clients traffic should be relayed and who relays it, which requires rigorous and accurate performance analysis.

As this work uses the IEEE 802.11 standard MAC layer to support traffic relay, the relay nodes[1] do not have special priority in transmitting the relay traffic in the MAC layer, and they need to compete for the wireless medium at each transmission. However, existing analytical models either neglect the DCF contention overhead or simply use a rough performance estimation in their algorithms.

B. Relaying in 802.11-based networks

Relaying, or multi-hopping[5], is a method to increase capacity, extend coverage and improve energy efficiency in wireless networks.Relay nodes are introduced to transfer data from source to Destination. It can be used in networks with varying degrees of infrastructure relaying nodes. Also, relaying can be used for routing and medium access, either in a distributed or centralized fashion . Relay nodes can be used for transfering packets from source to the destination.

C. Who Relays

Relaying can be done by relay nodes or by the users themselves. When the traffic is heavier, dedicated nodes makes it possible to have some sort of cell-planning. It is possible to put up more relay nodes . It is also possible to increase the coverage of the cell. Relaying done by nodes is a simple approach; nodes themselves forward packets on behalf of others and no extra processing is needed. Disadvantages with this solution are that the nodes need to use battery power for transmissions other than their own

III. System Analysis And Design

For simulating multihop relay network we need to simulate a network that comprises of many nodes. Mainly there are three modules.First module deals with finding a relay node in a network. For finding a relay node , here I am proposing an algorithm for finding a relay node in a network. This network is simulated by AODV protocol for packet transmision. Second module deals with simulation of normal aodv protocol for packet transmission .Third module deals with performance comparison of AODV that implements relay node selection algorithm and aodv protocol.

First module deals with algorithm for finding a relay nodes in a network.For this various studies have been made and identifies requirements that are needed to implement this Algorithm.Finding the neighbours in the network is the first procedure.Then we are setting upload and downlink traffic for each and every nodes.Now the channel is experiencing heterogenous traffic. Although extensive works have been reported on performance analysis of the standard IEEE 802.11 DCF protocol, most of these works assume all nodes have the same channel access probability (i.e., homogeneous traffic). However, in client relay networks, the network traffic of the nodes are heterogeneous[6], because the nodes would have different traffic loads due to traffic relay. As a result, existing techniques of performance analysis of the IEEE 802.11 standard cannot be directly applied to the system with client relays. Next is the calculation of traffic.Nodes that are having low upload and download traffic are identified.Then packet is forwarded to that node and that node acts as next relay node. Same procedure is applied to that node and the simulation ends when the neighbour node of relay node becomes destination. Earlier analysis is mainly based on two way hand shaking mechanism.But here RTS/CTS Mechanism is used for analysis.

A. Module Division

1) Module 1 :Algorithm for finding a relay nodes: First module deals with algorithm for finding a relay nodes in a network.For this various studies have been made and identifies requirements that are needed to implement this Algorithm.Finding the neighbours in the network is the first procedure.Then we are setting upload and downlink traffic for each and every nodes.Now the channel is experiencing heterogeneous traffic. Although extensive works have been reported on performance analysis of the standard IEEE 802.11 DCF protocol, most of these works assume all nodes have the same channel access probability (i.e., homogeneous traffic). However, in client relay networks, the network traffic of the nodes are heterogeneous, because the nodes would have different traffic loads due to traffic relay. As a result, existing techniques of performance analysis of the IEEE 802.11 standard cannot be directly applied to the system with client relays. Next is the calculation of traffic.Nodes that are having low upload and download traffic are identified and then packet is forwarded to that node.That node acts as next relay node. Same procedure is applied to that node and the simulation ends when the neighbour node of relay node becomes destination. Earlier analysis is mainly based on two way hand shaking mechanism.But here RTS/CTS Mechanism is used for analysis.

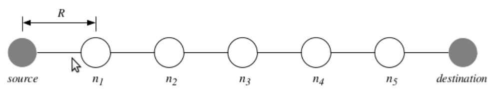

Fig 1.Multi-hop Relay Network

2) Module 2 :Packet transmision using normal AODV protocol: In the second module packet transmission is done using normal AODV protocol.It forwards the packet through any intermediate nodes.There is no relay node concept in AODV protocol. The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol mainly used for ad hoc mobile networks. AODV can be used for both unicast and multicast routing.It is an on demand algorithm, meaning that it finds routes between nodes only as desired by source nodes. It follows these routes as long as they are required by the sources. AODV forms trees which is used for multicast group members. The trees consists of group members

and the nodes are needed to connect the group members. AODV uses sequence numbers to ensure freshness of routes.

AODV builds routes using a route request / route reply mechanism. It is self-starting, and scales to large numbers of mobile nodes.When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network.

Nodes receiving packets update their information .It maintains a backward pointers to the source node in the route tables. In addition to the source nodes IP address, current sequence number, and broadcast ID, the RREQ also includes the most recent sequence number for the destination of which the source node is aware. A node receiving the Route Request packet will send a route reply if it is destination. If it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ it will send route reply packet. If this happens, it unicasts a RREP back to the source. Otherwise, it again broadcasts the RREQ. Nodes keep track of the RREQs source IP address and broadcast ID. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it.

3) Module 3:Performance comparison: Performance analysis of above two modules are made on the basis of throughput [3],packet delivery ratio and energy spent.Throughput is the ratio of successful message delivered at the destination. PDR is the proportion to the total amount of packets reached at the receiver and amount of packet sent by source. If the amount of malicious node increases, PDR decreases. The higher mobility of nodes causes PDR to decrease. Energy spent is defined as the utilization of node energy for selecting relaying node.Throughput of proposed system is compared with AODV is increased with increase of time.Results are analysed based on the number of nodes in the network.It is tested for the scenario of different number of nodes.(40,50,60) As the number of nodes increases throughput of the system increases.Throughput of Proposed algorithm(t.tr) is higher than that of AODV(ta.tr). AODV protocol randomly selects the intermediate nodes. So it contains low bandwidth stations and the hence station having low data rate delivers the packets to destination.This is the reason for increase in throughput of proposed system. Proposed system includes more parameters to select the forwarding node.Hence the energy consumed by the proposed work is higher than normal AODV.The Packet Delivery Ratio of proposed method (pdr.tr) is increased with increase of time.It is tested for the scenario of different number of nodes(40,50).Packet Delivery Ratio of proposed system (pdr.tr)is higher than that of AODV(pdra.tr). In proposed system , the data is transferred only through highly bandwidth station and the nodes having sufficient bandwidth to deliver the packets to destination.This is the reason for increase in packet delivery ratio.

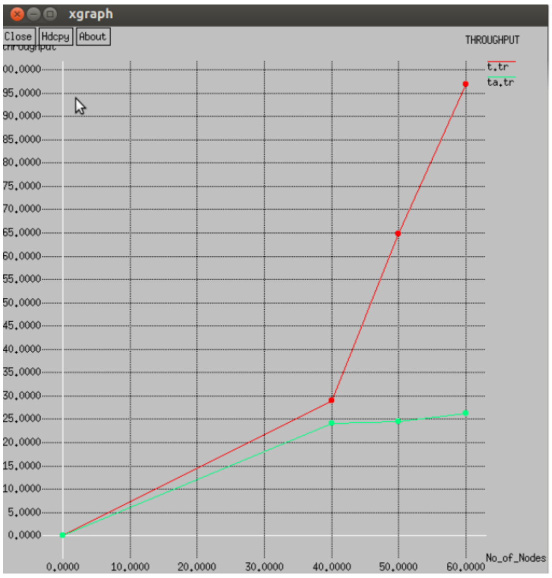

Fig 2. Throughput

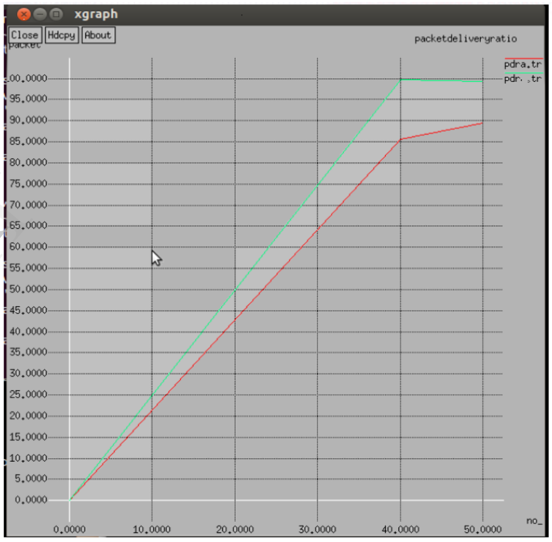

Fig 3.Packet Delivery Ratio

IV. CONCLUSION

The system performance of multi-hop relay networks in IEEE 802.11 DCF mode has analyzed. By modeling the heterogeneous traffic for relay networks, with the process of relay node selection one can accurately analyze the system throughput for any relay network nodes. Based on analytical model, an algorithm for selecting the relay node is proposed. We did simulations in NS-2 simulator to calculate the accuracy of our performance analytical model and proposed an algorithm for relay node selection. Simulation results show the protocol based on our algorithm surpasses the other existing relay algorithm in performance, and does not produce any wrong relay selections.

REFERENCES

[1] Bo Zhang, Student Member, IEEE, and Xiaohua Jia, Senior Member IEEE "MultiHop Relay Networks with Consideration of Contention Overhead of Relay Nodes in IEEE 802.11 DCF" in IEEE Transactions on Communications, February 2013.

[2] M. Heusse, F. Rousseau, G. Berger-Sabbatel, and A. Duda " Performance anomaly of 802.11b" in Proc. 2003 IEEE INFOCOM, vol. 2, pp. 836843.

[3] M. Heusse, F. Rousseau, R. Guillier, and A. Duda, " Idle sense: an optimal access method for high throughput and fairness in rate diverse wireless LANs" in ACM SIGCOMM, vol. 35, no. 4, pp. 121132, 2005.

[4] Victor Bahl, Ranveer Chandra, Patrick P. C. Lee, Vishal Misra, Jitendra Padhye, Dan Rubenstein, Yan Yu "Opportunistic Use of Client Repeaters to Improve Performance of WLANs" in International Journal of Computer Science Engineering Technology

[5] S. Lee, S. Banerjee, and B. Bhattacharjee, "The case for a multi-hop wireless local area network" , in Proc. 2004 IEEE INFOCOM, vol. 2, pp. 894905.

[6] X. Ling, L. X. Cai, J. W. Mark, and X. Shen, "Performance analysis of IEEE 802.11 DCF with heterogeneous traffic" in Proc. 2007 IEEE CCNC, pp. 4953.

[7] Qiang Ni1, Imad Aad, Chadi Barakat, and Thierry Turletti, "Modeling and Analysis of Slow CW Decrease for IEEE 802.11 WLAN" in Proc. 2007 IEEE CCNC, pp. 4953.