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Throughput Gain of Wireless Mesh Networks Using CSMA-CA Technique

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Abstract: ***WMN Integrated numeral, access points, and protocols. The working nodes in the mesh networks built distributed system that create interconnect networking and exchange the data over MAC Layers. The active node participates in the communication that able to transmit and receive the payload data but congestion relatedproblem is not permanent. These congestion related problem solved by CSMA-CA technique. We use CSMA-CA technique along RTS-CTS technique; these techniques use two layer communication. One is for communication node to nodes and other is for communication between the access point and node.The multi-hop transmission in both the communication layer follows RTS-CTS mechanism and the node has the shortest distance to the access point will be transmitting data. The traffic profiling is used in routing protocol to provide the quality of service (QOS).To minimize delay for packet transmission at sender and receiver end, a RTS-CTS mechanism is implemented in the grid-based scenario for effectively assignment of channels. The proposed CSMA-CA can improve the throughput and performance utilization to a large extent. The simulation result shows that the proposed approach attains the high throughput and minimum delay at the client ends as compared to the previous approach.***

Keywords: CSMA-CA, WMNs, IP, RTS-CTS, ACK, Throughput, Delay, Access points.

I. WIRELESS MESH NETWORKS

Wireless mesh networks provides seamless connectivity between number of end devices such as access point, laptop etc. that make up the ad-hoc networks and also affect the cost of IEEE 802.11 based networks. This mesh topology was support of interoperability. The 802.11 based mesh networks support any number of vendor based device to communicate with another vendor based device. Even though the majority of these commercial systems implement proprietary mesh protocols for routing and network configuration, all these networks use the network layer that interoperablethe mesh nodes. The example of such mesh based topology shown in fig.1 [9].

1.1 Mesh Architecture:

As Discussed in the previous section,the wireless provides seamless support intermediary wireless local area networks. The popularity of this wireless based network is to provide free of cost service to unlimited clients. The architecture of this network divided into three parts: Infrastructure, user and hybrid based mesh based networks [9].

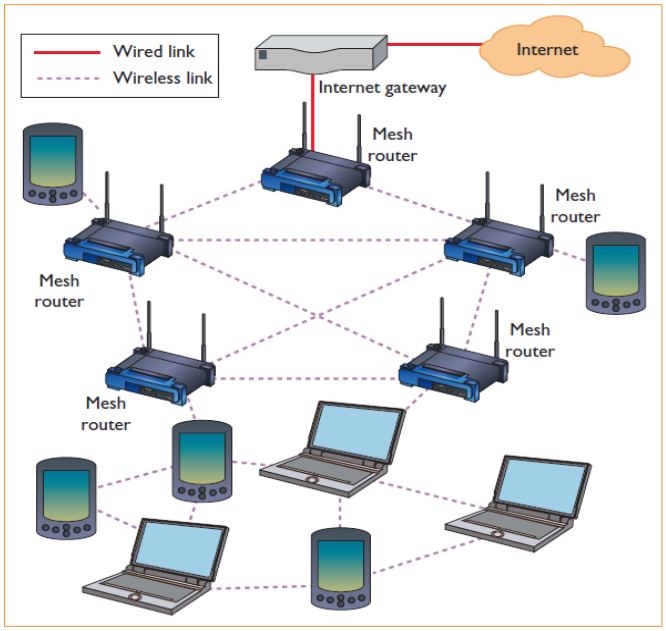

Fig1: 802.11 Mesh based topology

The Infrastructure sustains the connectivity between end user devices and access points that shown in the fig.1. These end user devices sometimes called 'user' or 'client' that passes the information to avail the resources. The number of users or client tied together and rake-off information betweenaccess points, client to client and access points to clients. The infrastructure divides into two parts i.e. infrastructure mode and distributed system. Each client communicates with single access points; but in the distributed sharing, one access point link togethernumber of access point that communicates with number of clients.

II. CARRIER SENSE MULTIPLE ACCESS WITH COLLISION AVOIDANCE (CSMA/CA)

The CSMA is a Carrier Sense Multiple Access that employs collision avoidance (CA) to improve the performance of the wireless networks. When any 'node' or 'client' connected with access point wish to communicate with another 'node' or 'client' the following steps has used:

1. The node sense the wireless medium or path which the node wants to communicates.
2. If the node senses 'idle' signal then it transfer the data to another node.
3. When the node senses the 'busy' signal then it waits the particular time (random time: set default timer, 2 milliseconds).

Once the transmission open then it transfers the whole data after it "Tear-down" the connection. The CSMA-CA does not sense the hidden node; therefore, in this paper we will import the features of RTS-CTS mechanism to solve the hidden node problems.

III. RELATED WORK

The analytical models [2] of wireless networks had classified on different control access mediums. Several access mechanisms are known for example Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA) and Code Division Multiple Access (CDMA).The proposed model explained the basic interaction between the PHY and the MAC. The channel occupation as seen by a node can be regarded as a renewal process of sum of failed attempts from the total attempts with one sink node receiving data and all other device nodes with connecting with each other [6]. This paper[20] presented a new continuous time model for CSMA wireless networks computationally tractable for large networks with minimal loss of accuracy. The model can be used for both single and multi-hop wireless networks and takes into account non-saturated queues, backoff-stage dependence of collision probabilities, and the correlation between departure processes and arrival processes ofadjacent nodes. Further number of nodes in a zone [5] is proportional to the area of the disk in homogeneous networks. A long link and a short link are neighbors to each other if either one of the transmitter is in the other receiver's guard zone. The paper [9] had focused on estimating aggregate flow statistics on wired backbone links with reduced packet sampling but most of this paper highlights simple technique for estimating the weight of nodes using the sending rates of leaf nodes. The author [11] proposed a routing protocol AODV LBIARM(Load Balancing Interference Aware Routing Metric). LBIARM is the metric in AODV protocol. This protocol finds best route discovery. It selects the route which has minimum interference, high throughput and low end to end delay. In this paper [12] derive the characteristic equation of network throughput and obtain the stable throughput and bounded delay regions with respect to the retransmission factor. Recently there has been studied [16] influence of the number of forwarding intermediate and gateway nodes in the system delay performance, including average end to end delay in the backbone and the average service time at the gateway nodes.

IV. PROPOSED MODEL AND SCENARIO

Since this paper is based on theimproved CSMA-CA protocol, herein is theprotocol introduction. The fundamental requirement for successful WMNs is to sufficient nodesin order to maintain connectivity across all nodesthat want to be part of the network. There mustbe enough channels in the network so that a nodecan reach any node that it desires. Channel quality and selection are responsibility on both side, since the channel quality experienced by thereceiver actually determines whether a packet can be successfully received. The earlier work [18] solves the problem related to congestion and hidden node. The single path routing model proposed by the authors but still the discussed results doesn't solve the interference problem. The CSMA/CA approach deployed on the network but it loss the accuracy due large network deployment [20]. We solve the problem of congestion and interference by propping the model and discuss given below section.

A. Proposed model

This paper improves the interference in between the communicating nodes. The interference influences the electromagnetic waves on physical layer. It affects the bit alteration that causes packet drops. We define the orthogonal channels in the proposed scenario therefore; calculate the channel interference in the Medium access layer. The proposed equation of interfering signals is:

$$ET_X = 1/ d_f \times d_r \qquad (1)$$

The d_f and d_r related to reverse delay ratio that finds from the expected transmission time. The expected transmission calculates from the source node when delivered/forward the packets to the destination node. Whereas we calculate the expected transmission time from the expected transmission rate that is defined as the ratio of number of packets sent with the transmission rate. The transmission rate expected the rate at which the number of packets delivered on the link. if you have an 1024 bytes packets with transmission rate is 2 then the outcome will be multiplies with the expected

transmission. The proposed method also measured the path loss (Pa) with distance of two nodes (i.e. d). Whereas we declare the value of transmitter power is constant.

$$Pa= Cd^{-\eta} \qquad (2)$$

The η specifies delay that measures the difference between the packet time receiving and transmission against two nodes. This equation solves the power level of two nodes. From the equation 2, the interference will be higher than the radius of the total network.

Proposed Scenario

Access Points are used primarily for routing of data. Generally, the Access Points relay traffic to and from the Clients and it also forms ad hoc network connectivity among themselves. The effectiveness of forwarding the packet in the network is to maintaining the connection between the networkstowards clients within its coverage area. If two clients are within hearing range of each other, then there exists a virtual link. The primary focus of channel assignment for multi-radio WMN is to maintaining topological connectivity. The supported traffic types are FTP and CBR. The topology of all networks in the simulations is a 25-node square grid. The simulated network has been configuring as square gridaccess Points and all the 13 nodes as mesh clients. The bandwidth from client to access point is 11 Mbps and 54 Mbps provided to access points that means in the 802.11 b standard configured on the client side nodes and 802.11 a standard configured on the access points. The ratio between communication and interference range is 2 and all nodes in multi-channel networks are equipped with 2 radios. At first, we randomly choose 4 pair of nodes from the 13 nodes and assign each pair with a different CBR UDP flow. The flow rate is selected as a 2Mbps. The packet size is 1024 bytes and flows run for 70 seconds with distance of 20 meter.

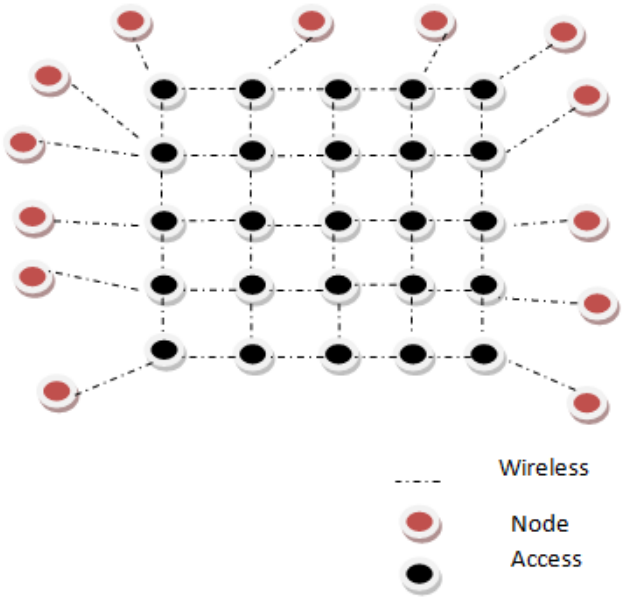

Fig.2: Square Grid based scenario

V. RESULTS AND DISCUSSION

The Medium Access Control (MAC) protocol plays the role of moderating access to reduce collisions while maintaining fairness. The objective is to maximizing the overall network throughput and reduces the end-to-end delay or even in terms of fairness.

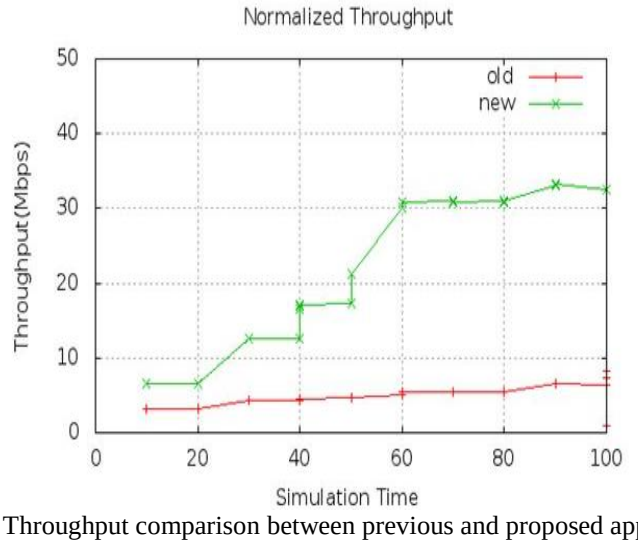

Fig.3: Throughput comparison between previous and proposed approach

The collision-free environment allows for higher throughput and improves the error performance of the system. The number of independent channels usedin the wireless systems.Each client initializes the data and forwarded data to another client. The achieved throughput of the network for each communicating client in the network scenario is 31 Mbps.

The multi radio multichannel applies on different client and access points to achieve the higher throughput with minimum of delay. If you are using one channel then the achieved throughput is less and propagating more delay per channel. So in the experimental scenario we are using 13 clients with 5x5 matrices of access points. The dynamic reassignment of channel is randomly assigned channels to each client. This way the delay corresponding of each client is less. The estimated average delay per client is 1milliseconds.

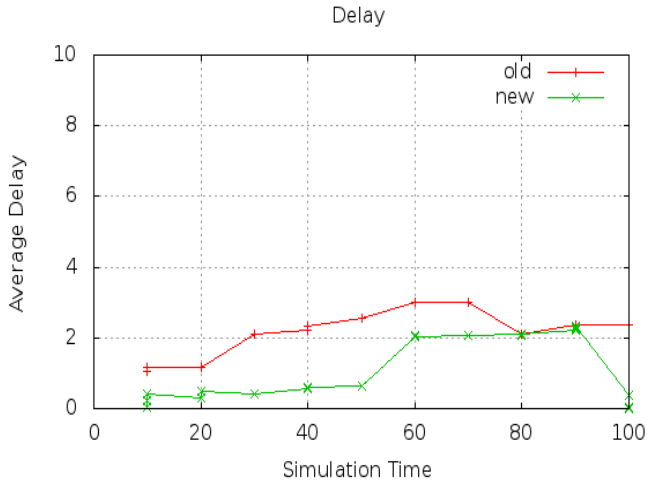

Fig.4: Delay comparison between previous and proposed approach

VI. CONCLUSION

Ad Hoc on demand distance vector routing (AODV) protocol has very low routing overhead and is able to correctly deliver almost all originated data packets in the local network. As the client communicates with another client on the same link and somewhat communication pattern change and increases routing packet overhead, CSMA-CA automatically scales the routes that currently used for transmitting data. We also presented in detail the routing mechanism used to evaluate the nodes using the CSMA-CA technique. CSMA-CA provides advance solution for network and optimizes network efficiency and operational integrity. The simulation results have been presented in this paper to improve the mobility and association towards the access point and client. The results show that this technique is trusted for improving throughput of the wireless networks.

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