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Implementation of IEEE 802.11 MAC Protocol in AD-HOC Network through Various Parameters

Sameeksha Verma, Arpita Singh

Department of Electronics and Communication, RGPV, Bansal Institute of Science and Technology, Bhopal, Madhya Pradesh, India

ABSTRACT

IEEE 802.11 MAC protocol is standard for wireless local area networks (LANs), and has also been implemented in many network simulations for wireless multichannel ad hoc networks. However, it is well known that, as the number of active channel increases, the performance of IEEE 802.11 MAC in terms of delay and throughput is decreased especially when each station load approaches its saturation state. Since delay and throughput are important Quality of Service parameters in many wireless applications, we study the performance of different multi-channel Media Access Control (MAC) protocols in ad hoc networks by considering various parameters. This paper presents a new approach for performance evaluation of IEEE 802.11 medium access control MAC protocol for ad-hoc wireless network. The approach based on implementation of IEEE 802.11 MAC protocol in various parameters are calculated such as throughput and minimum access delay on varying number of nodes of IEEE 802.11 protocol which is a standard MAC protocol. The accuracy of the analytical result is verified by NS-2 software tool.

Keywords: Wireless Sensor Network (WSN), IEEE 802.11 standards, NS-2

I. INTRODUCTION

Mobile ad hoc network are formed dynamically by an autonomous system of mobile nodes that are connected via wireless links. Ad hoc network is a network formed without any fixed infrastructure or centralized administration which consists of mobile nodes that are connected via wireless links to send packet data and mobile nodes are free to move randomly in which each node work as a router. Ad-hoc networks mainly for military applications, where a decentralized network configuration is a necessity. Commercial ad hoc networks used where no infrastructure is available. Examples include rescue operations in remote areas.

An access point is the main part of the infrastructure to support a wireless LAN. It is connected to a router, which in turn is connected to the rest of the network and the Internet. One or more access points may be connected to the same router or different access points may be connected to different routers. The access points as well as user computers are equipped with an identical radio interface commonly known as the IEEE 802.11 standard interface. The IEEE 802.11 standard specifies both the PHY (physical) and the MAC layers for constructing a wireless LAN. The PHY layer defines the air interface between two IEEE 802.11 equipped devices and the MAC layer defines the medium access control protocols to access the shared medium.

II. METHODS AND MATERIAL

According to IEEE 802.11, stations access the channel using a basic access method or four-way handshaking access method with an additional Request-To-Send/Clear-To-Send (RTS/CTS) message exchange.

The basic access method, called Distributed Coordination Function (DCF), is basically a Carrier Sense Multiple Access with Collision Avoidance mechanism (usually known as CSMA/CA). Under this method, a station desires to transmit a new data frame, when there is no

other station transmitting. If another station is sending a frame, station are polite and wait until the Chanel is free. After the channel is detected to be idle for a specified period of time called the distributed interframe space (DIFS) period, the station (with packets to transmit) start transmitting after random number as a backoff timer. Note that the time immediately after the DIFS period is slotted. As shown in Figure 2.1, the timeslot duration is at least the time required for a station to detect an idle channel plus the time required switching from listening to transmitting mode. The backoff timer is decremented by one during each idle time slot within the contention periods, it stopped if the channel is sensed busy, and then reactivated if the channel is idle again and remains idle for more than a DIFS period. Station starts transmitting when the back-off timer reaches zero. The random number for the backoff timer is based on the binary exponential backoff algorithm, where a station chooses any of the numbers between 0 and CW-1 randomly with equal probability. The Contention Window (CW) is set to be CWmin for every new data frame transmission. CW is double when the transmission is unsuccessful, until it reaches CWmax, then it remains at CWmax. When the data transmission is successful, a positive acknowledgement (ACK) is transmitted by the receiver.

ACK is transmitted after a short interframe space (SIFS) period when successfully receiving the entire data frame. If ACK is not detected within a SIFS period after the completion of the data frame transmission, the transmission is assumed to be unsuccessful, and a retransmission is required. When the maximum number of retransmission is reached the packet is discarded.

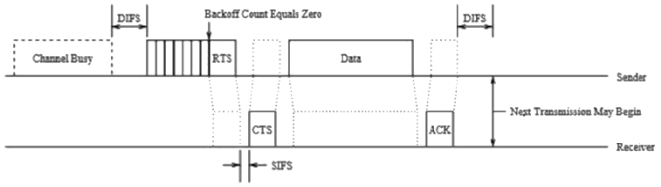

Figure 2.1 IEEE 802.11

In the four-way handshaking access method, an additional operation is introduced on top of the basic access method before a data frame transmission is taken place. When the back-off timer of a station reaches zero, instead of transmitting the data frame as in the basic access method, the sending station wants to transmit data it first sends (through contention) an RTS (request to send) frame and waits for the destination to reply with a CTS (clear to send) frame after a SIFS period. If CTS is detected, then data is transmitted and destination sends an ACK if the data was received completely and correctly. Once the RTS/CTS are exchanged successfully, the sender then transmits its data frame.

III. RESULTS AND DISCUSSION

We have implemented IEEE 802.11 protocol for WSN. Here we have simulated different networks according to the varying number of sensor nodes such as 10, 20, 30, 40 and 50. We have got delay and throughput in our simulation study.

3.a. Throughput analysis

The Throughput is the measure of how fast we can actually send data through the network. It is the measurement of number of packets that are transmitted through the network in a unit of time.

The maximum load that the system can carry in stable conditions is defined as the saturation throughput.

$$\text{Throughput} = \frac{\text{Number of bits received}}{\text{Time in milliseconds}}$$

3.b. Delay analysis

The transmission delay is the amount of time required to push all of the packets bits into the network, this delay caused by the data-rate of the link. It is the measurement of number of bits that are transmitted through the network.

$$\text{Delay} = \frac{\text{Number of bits}}{\text{Rate of Transmission}}$$

Simulation result is obtained in this section through the graph of 802.11 which is referring to original 802.11. Single channel MAC protocol through the simulation result performs for wireless LAN. Figure3.1 shows the aggregate throughput of different network size i.e. 10,30,40,50 is shown as network load increases.

Simulation performed in wireless LAN the bit rate for each node is 2 bit. Transmission range of each node is 250m. Each simulation was performed for the duration of 40sec. Packet size is 512 bytes. The parameters are varied; number of nodes i.e. 10,30,40,50. The aggregate

throughput of different protocol as network load is shown in figure 3.1

When number of nodes are low the value of throughput is also low, its value increases with the increase in number of nodes upto the saturation interval. As number of nodes in network increase the throughput gain of protocol also increases.

Based on the simulation result, graph of delay versus time and throughput versus time has been generated. The graphs are shown in figure 3.1 and figure 3.2

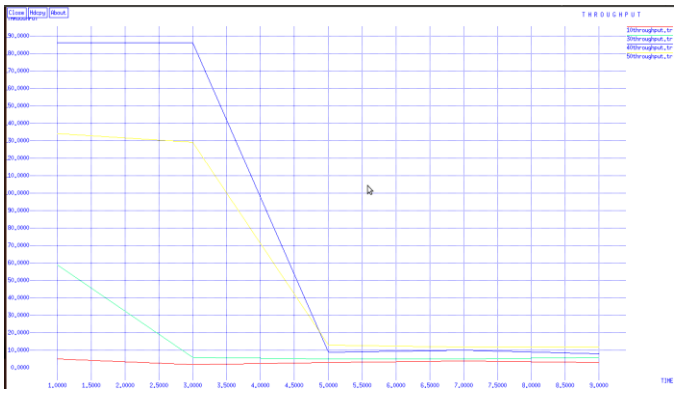

Figure 3.1 Throughput vs. Time

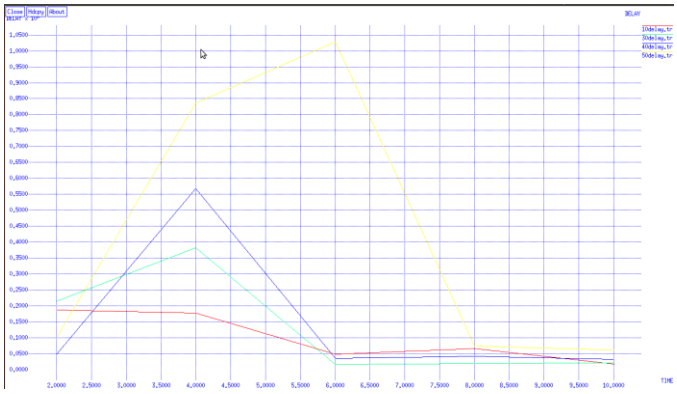

Figure 3.2 Delay vs. Time

IV. CONCLUSION

In this paper, we have implemented 802.11 MAC protocol in Ad-hoc network through various parameters. The approach based on throughput and minimum access delay on varying number of nodes of IEEE 802.11 MAC protocol. From the simulation result we obtained that value of throughput is increases with the increase in number of nodes up to the saturation interval. And in the case of delay, as the number of nodes increases the access delay also increases because of collision.

In the future scope, we compare multichannel MAC protocol with IEEE 802.11 MAC protocol through various parameters such as throughput and minimum access delay on varying number of nodes. And result can be exploited to another approach as total energy consumption by each node is to be calculated.

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