CSMA/CA BASED AD-HOC NETWORK USING MAC PROTOCOL

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Abstract - With the extensive rapid progress of computers and the wireless communication, the mobile computing becomes the field of computer communications in high profile link. In wireless networks, the data is transmitted over the channel. Adhoc network is infrastructure less type of network in which nodes are moving. Due to movement of nodes the frequent changes are made in topology. CSMA/CA protocol is collision avoidance protocol and used for wireless networks. The problem arises when two transmitters transmit at the same time. To overcome the collision problem binary backoff algorithm is used. This algorithm reduces the chances of collision. With increasing the number of nodes the success rate, response time and hop count increases. So CSMA/CA is best used for hidden node problem. It increases the throughput and decrease the collision. In this paper we studied adhocnetwork,MAC protocol ,design isssues in MAC protocol and CSMA/CD mechanism.

Keywords –CSMA/CD, MAC, PCF, DCF, BSS.

INTRODUCTION

1.1 Adhoc network

With the extensive rapid progress of computers and the wireless communication, the mobile computing becomes the field of computer communications in high profile link. To exchange information from one point to another communication is important. Wireless networks consist of nodes which communicate with each other over a wireless channel. Wireless communications networks are generally implemented and administered using radio communication. These wireless networks have various types like adhoc networks, sensor networks, cellular networks, satellite networks. The main focus is on adhoc networks. Adhoc network is a combination of wireless mobile nodes forming a wireless network. Adhoc network is infrastructure less type of network. Nodes in adhoc network act as routers that transmit data to desired destinations. Due to node mobility frequent changes are made in topology. Mobility of nodes in adhoc networks decreases the fair management of bandwidth and collision occurs when two nodes simultaneously transmit the data. In this type of network, nodes collision problem increases because all nodes are mobile and chances of collision are more. The network is said to be adhoc because it does not depend on a preexisting infrastructure, such as routers in wired networks or access point in infrastructure wireless networks[3].Network connectivity decides that which node forward data.

Figure1.1 Adhoc network

Wireless networks are different from wired networks. Adhoc wireless networks have specific properties such as node mobility[1], power constraints. For controlling access to the physical medium, new protocols are needed. The specific challenges of the adhoc networks make the design of media access control (MAC) more challenging.

1.1 **Medium Access Control (MAC) Protocol**

The medium access control layer is the lower sublayer of the data link layer of the seven layer OSI model. The main function of MAC[4] protocol is to control the usage of the medium and this is done through a channel access mechanism. Channel access mechanism tells each node when it can transmit and when it is expected to receive data. The channel access mechanism is the main principle of the MAC protocol. MAC protocol defines multiple access protocols. Multiple access protocols are called random access protocols.

The MAC layer defined by IEEE 802.11standard is the lower part of the link layer and is placed between the dependent sublayer of the physical layer and LLC sublayer of the link layer. MAC architecture[3] includes two basic coordination functions: Point Coordination Function (PCF) and Distributed Coordination Function (DCF). These functions define an operation mode for the stations that want to access the wireless medium. Coordination Function determines within a Basic Service Set (BSS), when a station is enabled to transmit and/or receive protocol data units at MAC level through the wireless channel.

DCF is auncomplicated and necessary mode for all stations and is located at lower part of MAC architecture. The DCF functionality is based on random techniques and is used by asynchronous traffic that does not require a severe bounded time. The IEEE 802.11 standard stipulates the CSMA/CA access algorithm for this level. PCF[9] is located over DCF and the access algorithm forthis level is based on circular polling from an access point, that is, deterministic access. This device allows broadcast of traffic that does not tolerate random and unbounded delays or contention free asynchronous traffic.

1.2 Design Issues in MAC Protocol

When designing a MAC protocol following are the main issues that are to be considered:

1. Bandwidth efficiency: The radio spectrum is limited so the bandwidth available for communication is also very limited. Bandwidth efficiency can be defined as the ratio of the bandwidth used for actual data transmission to the total available bandwidth. The MAC protocol must be designed in such a way that the scarce bandwidth is utilized in an efficient manner. The MAC protocol must try to maximize this bandwidth efficiency.

2. Quality of service support: Due to the implicit nature of the adhoc wireless network, where nodes are usually mobile most of the time, providing quality of service (QOS) support to data sessions in such networks is very difficult. Due to node[6] mobility in adhoc networks, bandwidth reservation made at one point of time may become invalid. QOS support is essential for supporting time-critical traffic sessions such as in military communications.

3. Mobility of nodes: Nodes in an adhoc network are mobile. If the node mobility is very high, the bandwidth reservation made or the control information exchanged may end up being of no use.

4. Synchronization: Synchronization is very important for bandwidth reservation by nodes[8]. The synchronization between nodes in the network must be considered. Exchange of control packets may be required for achieving time synchronization between nodes. The control packets must not consume too much of network bandwidth[HYPERLINK \l "CSi04" 3].

II.CSMA/CA Mechanism

CSMA/CA protocol uses listen before talk mechanism and due to this mechanism [10]collision is decreased and throughput is increased. The IEEE 802.11 standard determines DCF (Distributed Coordination Function) which is used for infrastructure less network. DCF is based on CSMA/CA protocol. It is variation of CSMA protocol. CSMA/CA uses RTS/CTS frames to avoid collisions.

RTS: Request to send frame, used by a node to transmit a frame.

CTS: Control to send frame indicated that the destination station is ready to receive data.

III.Purposed Work:

In this work, CSMA/CA protocol is used in two simulation environments. CSMA/CA minimizes collision but increases the overhead of retransmissions. If a node wants to transmit the data, first assemble the frame for transmission. Then two simulation environments are used. One is for network size and second is for mobility. Network size defines the number of nodes that are involved in the network. These nodes (network size) can be increased or decreased it depends on the mobility of nodes. So mobility simulation is considered. Transmitting node first senses the channel, if channel is sensed to idle then transmitting node sends RTS frame. In wireless network, the node that wants to involve in the transmission sends a CTS frame in reply to the RTS frame. The RTS/CTS frames are used to inform to another nodes that the transmission is going on. After receiving CTS, the transmitting node sends the data to receiving node. In case if CTS is not received then transmitting node waits for random backoff time. After receiving the data, an acknowledgement is sent to the transmitting node and transmission finished.

3.1**Advantages**

- CSMA/CA avoids data collisions.
- When data is large it minimizes the cost of collision.
- Intent signals are sent until the cable is clear so that data will travel and reach its destination carefully.
- RTS/CTS provide virtual carrier sense which protects against hidden terminal collisions.

3.2 CSMA/CA Algorithm

1. CW=CWmin
2. Choose random backoff counter b uniformly for (0,CW]
3. Sense the channel
4. If idle
5. Transmit the frame
6. Else
   Wait for IFS time
7. Transmit RTS
8. If CTS received
   Then goto step 5.
9. Else Backoff counter
10. Goto step 3
11. If collision
    Then
    Backoff time
    Backoff_count>=16
12. Goto step 3.

3.3 CSMA/CA Flowchart

The flowchart of CSMA/CA describes about the sequence of operations that are to be performed during CSMA/CA protocol.

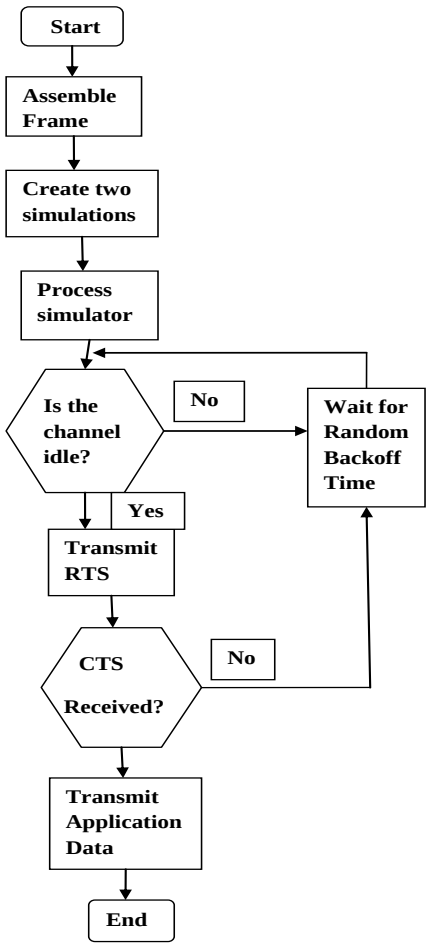

Figure 3.1 Flowchart of CSMA/CA Protocol

IV..Result Analysis

4.1Experimental Setup

First we installed MATLAB software. Then we designed the simulation of CSMA/CA with RTS/CTS frames. Two simulation environments are used. First is network size and second is mobility of nodes.

4.2 Working Procedure

Matlab software, here we used bin folder. In bin folder three coding folders are there or network size, mobility and to connect the both simulations. First we run the simulation 1 and then simulation 2. When we run simulation 1 then the following output is shown:

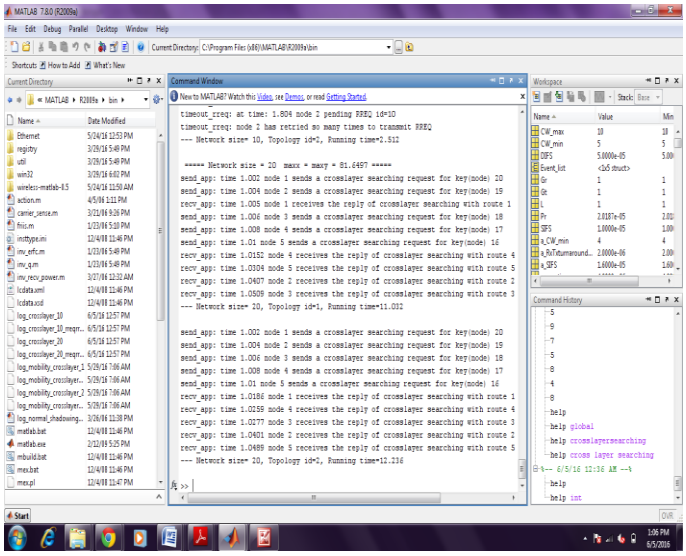

Figure 4.1 Simulation for network size

And when we run simulation 2 then following output is shown:

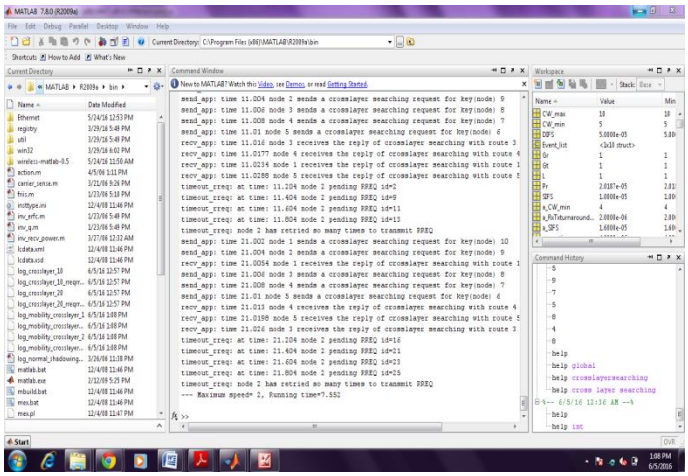

Figure 4.2 Simulation for mobility

To analyse the CSMA/CA protocol we have created two simulation environments considering the transmission of different nodes. And when we have simulated the protocol, in this simulation we have varied different variables. The variables are:

1.Success rate
2. Response time
3. Hop count

We would like to explain the results with graphical representation. The proposed CSMA/CA with RTS/CTS is proposed in Matlab and three parameters are considered to increase the throughput and decrease collision. Two simulation environments are created for performance. First is for network size and second is for mobility of nodes. The results are given in the graphs.
Success rate when number of nodes are 10

Here is the graph when number of nodes are 10.

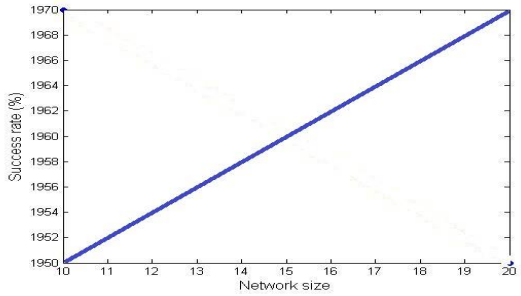

Figure 4.3 Success rate v/s network size with 10 nodes

Here X- axis denotes the network size and Y- axis denote the success rate. The graph shows that with increasing the number of nodes the success rate also increased.

Response time when number of nodes are 10

Here is the graph when number of nodes are 10.

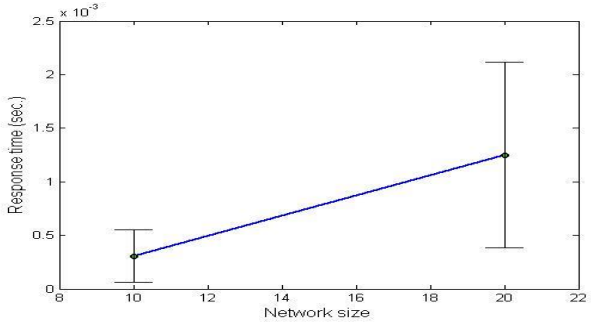

Figure 4.4 Response time v/s network size with nodes 10

Here X-axis denotes the network size and Y-axis denote the response time. The graph shows that with increasing the number of nodes the hop count also increases.

Hop count when number of nodes are 10

Here is the graph when number of nodes are 10.

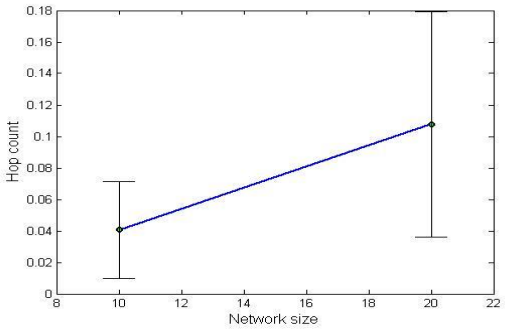

Figure 4.5 Hop count v/s network size with nodes 10

Here X-axis denotes the network size and Y-axis denote the hop count. Graph shows that with increasing the number of nodes the hop count also increased.

4.3 Simulation Parameters

Data transmission parameters are given below in table 5.1:

Table 4.1 Simulation 1 and simulation 2

Simulation 1			Simulation 2	
Network Size	Topology Id	Running Time	Maximum Speed	Running Time
10	1	3.663	1	5.802
10	2	2.705		
20	1	11.54	2	7.561
20	2	12.056		

In simulation 1, three parameters are used: network size, topology id, running time. Network nodes are 10 and 20. In simulation 2, maximum speed and running time two parameters are used. .

5. Conclusion& Future Scope

Conclusion

With the widespread rapid development of computers and the wireless communication, the mobile computing becomes the field of computer communications in high profile link. In wireless networks, the data is transmitted over the channel. Adhoc network is infrastructure less type of network in which nodes are moving. Due to movement of nodes the frequent changes are made in topology. CSMA/CA protocol is collision avoidance protocol and used for wireless networks. The problem arises when two transmitters transmit at the same time. To overcome the collision problem binary backoff algorithm is used. This algorithm reduces the chances of collision. With increasing the number of nodes the success rate, response time and hop count increases. So CSMA/CA is best used for hidden node problem. It increases the throughput and decrease the collision.

Future Scope

When RTS and CTS are used in CSMA/CA protocol, then huge number of frame or data is saved and collision can be avoided. So, we will try to better solution in future that will decrease data or packet loss and achieve highly motivated the carrier sense multiple access with collision avoidance.

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