Comparison between AODV and CDMA Protocol

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Abstract- **CDMA is most widely used standard for multiuser system in wireless adhoc network. CDMA standards present set of protocols for power control, BER control and multiuser detection system in adhoc networks. Therefore behaviour of MANET depends upon the modelling of CDMA based MAC layer, which also attributes to the performance of the network. We can summarize the section in short by claiming that in ADHOC network selecting the nodes is difficult due to hidden terminal and collision problems. Hence CDMA based technique is best to find out the suitable nodes in transmission. Further selecting those nodes which can be reached with minimum power loss is the best solution for such a problem. Hence we propose a CDMA based MAC protocol for MANET and select the closest geographical nodes with minimum power loss for routing. In this paper we present a means of improving the performance of the network by adopting a CDMA based scheduling algorithm.**

Keywords - MANET, CDMA, AODV

I. INTRODUCTION

Mobile ad hoc networks (MANETs) have recently been the topic of extensive research. The interest in such networks stems from their ability to provide a temporary wireless networking capability in scenarios where fixed infrastructures are lacking and are expensive or infeasible to deploy (e.g., disaster relief efforts, battlefields, etc.). One of the fundamental challenges in MANETs research is how to increase the overall network throughput while maintaining low energy consumption for packet processing and communications. The low throughput is attributed to the harsh characteristics of the radio channel combined with the contention-based nature of medium access control (MAC) protocols commonly used in MANETs. The focus of this paper is on improving the network throughput of a MANET by means of a CDMA-based design of the MAC protocol compared to the AODV Protocol.

II. AODV PROTOCOL

Ad hoc On-Demand Distance Vector (AODV) routing is a routing protocol for mobile adhoc networks and other wireless ad-hoc networks. The AODV routing protocol is a reactive routing protocol; therefore, routes are determined only when needed. Hello messages may be used to detect and monitor links to neighbours. If Hello messages are used, each active node periodically broadcasts a Hello message that all its neighbours receive. Because nodes periodically send Hello messages, if a node fails to receive several Hello messages from a neighbour, a link break is
detected. It is jointly developed in Nokia Research Centre of University of California, Santa Barbara and University of Cincinnati by C. Perkins and S. Das. It is an on demand and distance-vector routing protocol, meaning that a route is established by AODV from a destination only on demand [3].AODV is capable of both unicast and multicast routing. It keeps these routes as long as they are desirable by the sources. Additionally, AODV creates trees which connect multicast group members. The trees are composed of the group members and the nodes needed to connect the members. The sequence numbers are used by AODV to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes [2] [3]. AODV defines three types of control messages for route maintenance.

A. RREQ-

A route request message is transmitted by a node requiring a route to a node. As an optimization AODV uses an expanding ring technique when flooding these messages. Every RREQ carries a time to live (TTL) value that states for how many hops this message should be forwarded. This value is set to a predefined value at the first transmission and increased at retransmissions. Retransmissions occur if no replies are received. Data packets waiting to be transmitted (i.e. the packets that initiated the RREQ). Every node maintains two separate counters: a node sequence number and broadcast_id. The RREQ contains the following fields.

B. RREP-

A route reply message is unicasted back to the originator of a RREQ if the receiver is either the node using the requested address, or it has a valid route to the requested address. The reason one can unicast the message back, is that every route forwarding a RREQ caches a route back to the originator.

C. RERR-

Nodes monitor the link status of next hops in active routes. When a link breakage in an active route is detected, a RERR message is used to notify other nodes of the loss of the link. In order to enable this reporting

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mechanism, each node keeps a ―precursor list containing the IP address for each its neighbours that are likely to use it as a next hop towards each destination.

D. Advantages and Disadvantages

The main advantage of AODV protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination. The connection setup delay is less. The HELLO messages supporting the routes maintenance are range-limited, so they do not cause unnecessary overhead in the network. One of the disadvantages of this protocol is that intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries. Also multiple RouteReply packets in response to a single RouteRequest packet can lead to heavy control overhead [3]. Another disadvantage of AODV is that the periodic beaconing leads to unnecessary bandwidth consumption. AODV performs very well and acceptably when the node mobility is moderate and the load offered to the network is minimum. When the network is flooded with more packets and there are more number of nodes in the close proximity and the nodes moves fast, AODV tends to fail to produce best results. This is primarily due to the routing overhead or the overhead of control packets which are increased for route maintenance under constant route failures. Hence many different techniques are proposed over the years to improve the performance of AODV.

III. CDMA PROTOCOL

Code Division Multiple Access is based on spread spectrum (SS) techniques, in which each user occupies the entire available bandwidth. At the transmitter, a digital signal of bandwidth, say *B*1 bits/sec, is *spread* using (i.e., multiplied by) a pseudo-random noise (PN) code of bandwidth, say *B*2 bits/sec (*B*2/*B*1 _ 1 is called the *processing gain*). The PN code is a binary sequence that statistically satisfies the requirement of a random sequence, but that can be exactly reproduced at the intended receiver through precise mathematical rules. Using a locally generated PN code, the receiver *de-Spreads* the received signal, recovering from it the original information. The enhancement in performance obtained from spreading the signal makes it possible for several, independently coded signals to occupy the same channel bandwidth, provided that each signal has a distinct PN code. This type of communication in which each transmitter-receiver pair has a distinct PN code for transmitting over a common channel is called CDMA . Due to its superior characteristics, CDMA has been the 153 access technology of choice in cellular systems, including the recently adopted 3G systems. In such systems, CDMA has been shown to provide up to six times the capacity of
TDMA- or FDMA-based solutions. This throughput gain comes along with other desirable features, including graceful signal degradation, multipath resistance, inherent frequency diversity, and interference rejection. It is, therefore, of no surprise that CDMA is being considered for adhoc networks.[1] Interestingly, the IEEE 802.11 standard uses SS techniques at the physical layer1, but only to mitigate the impact of the harsh wireless channel. More specifically, in the 802.11 protocol all transmitted signals are spread using a *common* PN code, precluding the possibility of multiple concurrent transmissions in the a vicinity of a receiver.

A. Basic service set in CDMA

The Basic Service Set (BSS) is the basic building block of 802.11 networks. It is composed of several stations which could communication with each other. The area in which they can communicate is called the basic service area. There are basically two configuration modes provided by IEEE 802.11 for the BSS. They are independent BSS and infrastructure BSS (Figure 3.1). In the independent BSS, stations can communicate directly with each other when they are in each other's transmission range. It is always called ad hoc networks. This kind of network is used when there is need for wireless network between stations temporarily. The example of use could be the tanks or soldiers in the wars. Each tank could have one station and when they are in each other's transmission range, they could communicate directly. Besides the usage in military, the usage of ad hoc networks is also considered in emergency, earthquakes. The advantage of using ad hoc networks is that there is no need of infrastructure during the set up of the network. In the infrastructure BSS, there is an access point in each BSS. Stations communicate with each other through the access point. That is, mobile station should first transmit the frames to the access point, and it is the responsibility of the access point to transmit those frames to the destination station. The transmission range of the access point is the radius 8 of the service area of this wireless network. Because of this, the destination station does not need to be in the transmission range of the source station, but only need to be in the transmission range of the access point. There is no restriction to the distance between the source and destination station.

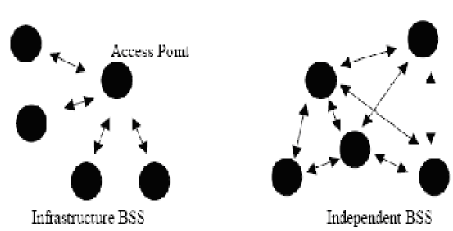


Fig 3.1: Representations of BSS

B. Contention Window

The contention window (CW) size is a value chosen from the range between the minimum contention window (CWmin) and the maximum contention window (CWmax). CWmin and CWmax are PHY dependent value, e.g. in 802.11b, the Cwmin and CWmax are 15 and

1023 respectively. The initial value of CW is CWmin. The size of contention window should be chosen very carefully. If the CW is too small, the random value (back off time) chosen between the range of zero and contention window will be close together and there will be higher probability that the random value chosen has the same value. With the same CW, nodes will transmit at the same time after waiting for the same CW period of time. Collision will happen in this situation. On the other hand, if the size of CW is too big, there might be some unnecessary high delay. For each retransmission, CW size will be increased to the value twice of the previous used CW.

C. Back off Time

Back off time is the used in order to reduce the probability of collision. The back off time is composed of a few slots. It is calculated as the slot time multiplied by a random number which is uniformly distributed between zero and the CW size. The slot time is a PHY dependent value. When the medium is sensed to be idle for a period of one complete slot, the back off time is decremented by a slot time. When the medium becomes busy, the back off time suspends and waits until the channel is sensed to be idle again. When the channel is again sensed to be idle for duration of DIFS, the back off time will start decreasing accordingly.

D. ACK

ACK is sent by the receiver for acknowledgement, when the receiver successfully receives a frame. Only receiving the ACK from the receiver makes the sender know that the frame has been successfully transmitted to the receiver Channel reservation schemes. When sender is sending a frame, the neighbours in its carrier sensing area should keep silence to prevent the interference. Thus, reservation schemes are needed by the sender when it intends to send a frame. There are two carrier sense mechanisms to reserve the channel, one is physical carrier sensing, and the other one is to use the Network Allocation Vector (NAV). In physical carrier sensing mechanism, physical layer will tell the MAC layer the channel is occupied when frames are detected on the channel. Because of the effect of fading caused by reflection, diffraction and so on, frames transmitted may not be detected by nodes in its carrier sensing range. As a result, another method called network allocation vector is used. In virtual carrier sensing mechanism, NAV values are set in all stations which indicate the earliest time that the channel will become idle again after this transmission. This time information is carried at the header of the transmission frame if RTS/CTS (Request To Send /Clear To Send) is not used. All stations that could hear the transmission frames have to monitor the header of the received frame and store the NAV value. The information from virtual carrier sensing is stored in the RTS and CTS frames if RTS/CTS is used.

E. Hidden terminal problem

Hidden terminal problem and RTS/CTS mechanism there is a famous problem called hidden terminals problem existing in DCF, which is contention, based. This problem is caused by the incomplete topology information of the node in wireless network. For example, two nodes, which are not in each other's transmission range, are going to transmit frames to the same terminal. This will result in the collision at the receiving node. To prevent hidden node phenomena, neighbours of receivers should be told that the channel is busy when the receiver is already has one transmission on the way. RTS/CTS are used to solve this problem. A sender will sent RTS frame when it wants to send traffic. This packet includes the information of the receiver and the expected duration of the whole data transmission. All the stations in the transmission range should hear the packet. Stations detecting this RTS frame will set their own NAV accordingly. NAV is used to store the earliest time that stations are permitted to access the shared channel. After receiving RTS of period SIFS, receiver will send CTS packet if it is ready to received data. CTS will also contain the duration that station will take up. Stations hearing this CTS will set NAV. After this process, both the neighbour in the transmission range of sender and receiver will keep silence during the transmission. The disadvantage of using RTS/CTS is that it increases the MAC header dramatically and this increase will decrease the throughput. As a result, to increase the effective transmission, RTS/CTS cannot always be used. A RTS threshold is set for the frame size. Only when frame size is larger than this RTS threshold, RTS/CTS will be used.

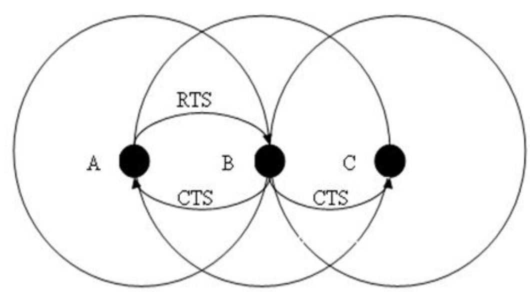


Fig 3.2: RTS/CTS Problems

Example of the effect of RTS/CTS. RTS send from A to B, and B reply with CTS to A. A simple example of RTS/CTS mechanism is described in Figure 4-3. With RTS/CTS, before Node A send message to Node B, RTS/CTS are exchanged and Node C will be told by CTS of Node B and will not transmit to Node B at the same time as Node A transmit.

F. Advantages and Disadvantages

By increasing the number of successful receptions at the link-layer, the capacity of ad hoc networks is enhanced. CDMA improves parallelism, thus decreases the possible delay a node must go through when waiting for grabbing the channel. This helps to decrease idle listening. On the other hand, predetermined schedules result in collision avoidance, which helps in reducing energy consumption. It is easy to implement multi-path routing in CDMA ad hoc networks, which reduces the overhead significantly. However, CDMA ad hoc networks still face quite a few challenges like Near-Far problem. When cross-correlations between different CDMA codes are non-zero, the induced multi-access interference results in collisions at the receiver. This problem can cause a significant reduction in network throughput, thus it must be carefully considered. When combined with power control issues, things become even more complex. Since each terminal can communicate with several other nodes simultaneously in ad hoc networks, the transmit power must be controlled to avoid overhearing in near-far situations. Distinct codes are required for different communication parties. Thus a spreading-code protocol is needed to decide which code to use for packet transmission and which to use for monitoring the channel in anticipation of packet reception. Such problem is usually formulated as Graph Colouring, a well-known NP-complete problem. Due to the topology dynamism of ad hoc networks, recoding is necessary. Otherwise collisions may happen. However, recoding brings about additional overhead on channel acquisition at the receiver side and synchronization between the sender and the receiver. Such process is expensive and must be minimized as well. One of the main advantages of CDMA is that dropouts occur only when the phone is at least twice as far from the base station. Thus it is used in the rural areas where GSM cannot cover. Another advantage is its capacity; it has a very high spectral capacity that it can accommodate more users per MHz of bandwidth.

IV. PROPOSED SCHEME

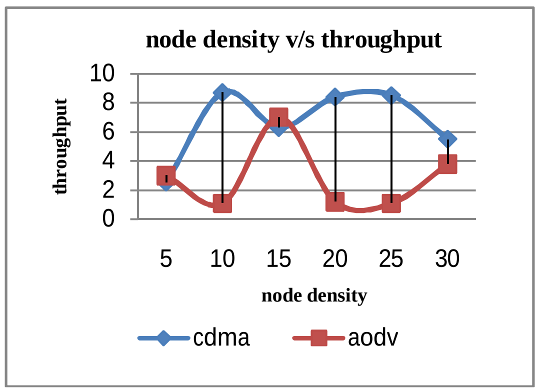
The objective of this work is to evaluate two routing protocols based on scheduling behaviour, namely, Ad hoc Demand Distance vector (AODV) and Code Division Multiple Access (CDMA), for Mobile ad hoc networks based on performance in terms of throughput, latency and pause time. This evaluation is to be carried out through exhaustive literature review and simulation.

V. SIMULATION

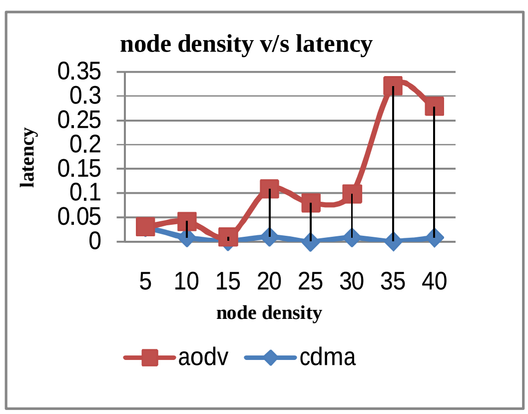
We simulated the proposed system with OMNeT++. It is an object-oriented modular discrete event network simulator. This software provides a simulation for Mobile wireless communication with detailed propagation. OMNeT++ simulations can feature varying user interfaces for different purposes: debugging, demonstration and batch execution. Advanced user interfaces make the inside of the model visible to the user; allow control over simulation execution and to intervene by changing variables/objects inside the model, table describes the detailed setup for our simulation.

Table1.Simulation Settings for AODV and CDMA

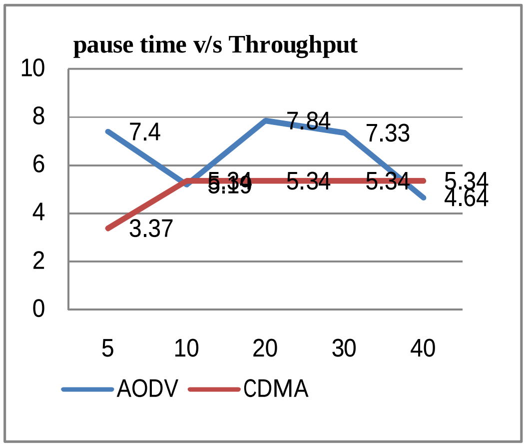
Routing	AODV, CDMA Based Power Aware AODV
Channel Bandwidth	11Mb/s (IEEE 802.11b)
Channel Delay	0.0001 sec
Channel Error rate	0.000001
Channel data rate	11.04858e+6 bits/sec
Node placement	Random
Mobility Model	RWP, Rwalk
Message packet size	512 bytes(4096bits)
Number of Nodes	5,10,15,20,25,30
Burst Interval	Normally Distributed(2,1,0)
Control Message Size	512 bytes(4096bits)
Input Buffer Size	8.38864e6 bits



Graph 1 suggests that performance of CDMA based technique is better than that of AODV based technique. CDMA throughput is maintained at a good level.



Graph 2 suggests that performance of CDMA based technique is better than that of AODV based technique.



Graph 3 suggests that performance of CDMA based technique is better than that of AODV based technique when the pause time is moderate. This is because under high pause time, link losses are significant.

VI. CONCLUSION

A comparison of two routing protocols, namely, Ad hoc On-Demand Distance Vector Routing (AODV) and Code Division Multiple Access (CDMA). It is observed that the packet loss is very less in case of AODV, initially but it Increases substantially as the simulation time increases. In case of CDMA simulation the packet loss is very high initially but it decreases substantially on the simulation time increases. Hence it is quite clear that CDMA based technique is adopted to support resolving the channel amongst undetermined number of fighting nodes. Therefore we propose a mechanism which achieves a performance improvement over AODV by estimating channel conditions through estimating the signal power. Result shows that significant improvement is observed in performance with comparison to AODV. Increasing the power at every intermediate node balances the power load. Therefore no particular node will run out of energy faster. The work does not independently consider noise contributed by independent channel entities; rather it gives an overall estimation of channel.

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