Maximum Throughput in a Lined Up MANET

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Abstract
MANET (Mobile Ad hoc Network) does not rely on fixed infrastructure. Mobile units form a multi-hop wireless network with no fixed routers and no centralized administration. Thus, the Medium Access Control protocol through which mobile stations can share a common broadcast channel is essential in ad hoc networks. Due to the existence of hidden and exposed terminal problem, partially connected network topology and lack of central administration, in the existing popular MAC Layer in a wireless multi-hop network using simulation, we provide new insights into the interaction between TCP and various MAC layer protocols, including CSMA,FAMA and 802.11.These MAC protocols were chosen because they provide an evolving to the utilization MAC protocols and finally progressing to collision avoidance and acknowledgments. Our simulation results show that for a lined up ad hoc network best throughput results are achieved for a window size of four. For windows of size less than four are greater than four the throughput of the ad hoc network degrades.

Keywords: - Multi-hop, Broadcast channel, Hidden, Expose, Throughput, Window size.

1. Introduction

In recent years [5], the use of the Internet and of wireless communications has risen dramatically. Surfing the World Wide Web and chatting on a cellular phone have become common place activities. With the advent of wireless networks and the availability of portable computers such as laptops and hand held devices, the day is coming in the not too distant future when applications that require networking can be used anytime, anywhere. Wireless networks have been adapted to enable mobility, leading to their increasing popularity. The most common type of wireless network consists of mobile devices, which communicate with base stations that are the gateways to a fixed network infrastructure in the last decade. As a mobile unit moves about, its link to the wired portion of the network is handed off from one base station to another, thus providing seamless connectivity throughout the network. Another type of wireless network, called a mobile ad hoc network.
A MANET is defined as a collection of mobile platforms or nodes where each node is free to move about arbitrarily. Each node logically consist of a router that may have multiple hosts and that also may have multiple wireless communications

devices, Nodes [9] may be connected to other networks, the nodes in the network can be highly mobile, thus rapidly changing the node constellation and the presence or absence of links. Originally developed by the military for use in battlefield situations. A MANET network cloud is composed of autonomous, potentially mobile, wireless nodes that may be connected at the edges to the fixed, wired Internet. But the concept of mobile packet radio networks where every node in the network is mobile and where multi hop store and forward routing wirelesses is utilized.

Routing algorithms [8] for wired networks are designed to operate in a largely unchanging topology and over high bandwidth links. They are unsuitable for ad hoc networks because of the node mobility, which may lead to link failure and link repair .The rate of link failure and link repair may be high when nodes move fast. Hence specialized routing strategies are required to maintain route stability despite mobility. An additional limitation in ad hoc networks is limited battery power, which needs to be conserved by allowing sleep modes, and minimizing broadcasts.

However these protocols continuously waste network capacity to keep routing information current, even though most of this information becomes state even before it is used, due to node mobility. Another disadvantage is that in these protocols, local topological changes affect the entire network. Reactive or on-demand schemes, on the other hand, evaluate routes only when they are needed.

2. Problem Definition

As described in the earlier section, MANET does not rely on fixed infrastructure. In actual case, mobile units form a multi-hop wireless network with no fixed routers and no centralized administration. Each node in the network functions as routers, which creates and maintains routes to other nodes in the network. My problem is physically to create nodes to connect each other's in a linear manner. In this network packets are routed through intermediate nodes. Each intermediate node stores and forwards the packet. An amount of data that a receiver is willing to accept at any time is called window size. Window size can be measured in packets or in bytes. So many problems occur in a MANET; these are Network size, Traffic Pattern, Battery power, Mobility rate, Bandwidth.

Whenever a packet goes through intermediate nodes from source to destination, the performance of different window size will be evaluated. The following are the parameters for evaluation; End-to-End Delay, Delivery Rate, Throughput**.**

TCP is uses a window mechanism to control the flow of data. When a connection is established each end of the connection of the allocates a buffer to hold incoming data and sends the size of the buffer to the other end .As data arrives, the receiver sends acknowledgments, which also specify the remaining buffer size.

3 Motivation

Wireless ad hoc networks are required, [6] where a fixed communication infrastructure wired or wireless. In a multi hop ad-hoc network nodes communicated with each other using multi hop wireless links and there is no stationary infrastructure. The Carrier Sense Multiple Access (CSMA), to the radio environment is limited by the following two interference mechanisms: the hidden terminal and the exposed terminal problems. The hidden terminal problem occurs because the radio network, as opposed to other networks, such as a LAN, for instance, does not guarantee high degree of connectivity. Thus, two nodes, which maintain connectivity to a third node, do not, necessarily, can hear each other.

Each node in the network also acts as a router. The MAC protocol covers the MAC and physical layers. The standard a single MAC that interacts with three PHYs (all of them running at 1 and 2 Mbps) as follows: Frequency Hopping Spread Spectrum in the 2.4 GHz Band, Direct Sequence Spread Spectrum in the 2.4 GHz Band, and Infrared. The router forwarding data packets for other nodes. Each node a queue for packets awaiting transmission by the network interface that holds up to 50 packets and is managed in a drop tail method. A station wanting to transmit senses the medium, if the medium is free for a specified time called the distributed interference space (DIFS).

The DCF is basically a carrier sense multiple access with collision avoidance (CSMA/CA). One of the major challenges of the [4] wireless mobile Internet is to provide Quality of Service (QoS) guarantees over IP-based wireless access networks. Wireless access may be considered just another hop in the communication path for the whole Internet. Therefore, it is desirable that the architecture supporting quality assurances follows the same principles in the wireless networks as in the wire line Internet, assuring compatibility between the wireless and wire line parts. A good example for such a wireless technology is the IEEE 802.11 Distributed Coordination Function (DCF) standard, compatible with the current best-effort service model of the Internet.

Distributed Coordination Function (DCF) supports delay-insensitive data transmissions, and the optional Point Coordination Function (PCF) to support delay-sensitive transmissions. The DCF works as a listen-before-talk scheme, based on CSMA. Moreover, a Collision Avoidance (CA) mechanism is defined to reduce the probability of collisions. We use TCP traffic to show the problems exiting in the MAC Layer .We assume this TCP [8] connections carry these file transfers .TCP is the prevalent reliable transport protocol, It can adapt to the network condition and do congestion control therefore it can use almost all the available bandwidth without causing congestion. It is a window-based ACK-clocked flow control protocol. Window means, an amount of data that a receiver is willing to accept at any time .TCP uses a window mechanism to control the flow of data. When a connection is established each end of the connection allocates a buffer to hold incoming data and sends the size of the buffer to the other end .As data arrives the receiver sends acknowledgments, which also specify the remaining buffer size, other way we express, the amount of buffer space available at any time is called window and a notification that specifies the size is called a window size. If the receiving application can read data as quickly as it arrives, a receiver will send a (+ve) window advertisement along with each acknowledgment. Sending side operates faster than the receiving side .If a sender receives a zero window advertisement must stop sending until the receiver again advertises a (+ve) window. The window size is always measured beyond the data being acknowledged. If the window is increased exponentially by one packet for every non-duplicate ACK until the resource estimate of network capacity is reached. Window increase will stop when it reaches the maximum TCP window size.

A CSMA protocol works as follows: a station desiring to transmit senses the medium. If the medium is busy (i.e. some other station is transmitting) then the station defers its transmission to a later time. If the medium is sensed as free then the station is allowed to transmit. These kinds of protocols are very effective when the medium is not heavily loaded since it allows stations to transmit with minimum delay. But there is always a chance of stations simultaneously sensing the medium as free and transmitting at the same time, causing a collision. These collision situations must be identified so the packets can be retransmitted by the MAC layer, rather than by the upper layers. The later case will cause significant delay. In order to overcome the collision problem, the 802.11 uses a Collision Avoidance (CA) mechanism coupled with a Positive Acknowledge scheme, as follows:

1. A station wanting to transmit senses the medium. If the medium is busy then it defers. If the medium is free for a specified time (called Distributed Inter Frame Space [DIFS] in the standard), then the station is allowed to transmit.

2. The receiving station checks the CRC of the received packet and sends an acknowledgment packet. To distinguish this MAC layer ACK to upper layer acknowledgments, we symbolize it as M-ACK. Receipt of the M-ACK [3] indicates to the transmitter that no collision occurred. If the sender does not receive the MACK then it retransmits the frame until it receives M-ACK or is thrown away after a given number of retransmissions. According to the standard, a maximum of seven retransmissions are allowed before the frame drops. In order to reduce the probability of two stations colliding due to not hearing each other, which is well-known as the "hidden node problem", the standard defines a Virtual Carrier Sense mechanism: a station wanting to transmit a packet first transmits a short control packet called RTS (Request To Send), which includes the source, destination, and the duration of the intended packet and ACK transaction. The destination station responds (if the medium is free) with a response control Packet called CTS (Clear to Send), which includes the same duration information. All other stations receiving either the RTS and/or the CTS, set their Virtual Carrier Sense indicator (called NAV, for Network Allocation Vector), for the given duration, and use this information together with the Physical Carrier Sense when sensing the medium. The physical layer carrier sensing function is called Clear Channel Assessment (CCA). The NAV State is combined with CCA to indicate the busy state of the medium. This mechanism reduces the probability of the receiver area collision caused by a station that is ``hidden" from the transmitter during RTS transmission, because the station overhears the CTS and ``reserves" the medium as busy until the end of the transaction. The duration information on the RTS also protects the transmitter area from collisions during the

MACK (from stations that are out of range of the acknowledging station). It should also be noted that, due to the fact that the RTS and CTS are short frames, the mechanism also reduces the overhead of collisions, since these short transmissions allow faster recognition of collisions than would be possible for the transmission of an entire packet.

As we know, besides the hidden node problem, the wireless packet networks also face the exposed node problem. A hidden node is one, which is within the interfering range of the intended destination but out of the sensing range of the sender. Hidden nodes can cause collisions on data transmission. Exposed nodes are complementary to hidden nodes. An exposed node is one that is within the sensing range of the sender but out of the interfering range of the destination. If the exposed nodes are not minimized the available bandwidth is underutilized.

4. Simulation tool environment and Methodology

In this paper work to study of Maximum window size in a lined up Manet. For this purpose, a network simulator should provide the MAC protocol features to stimulate the networks like ad hoc networks, which is dynamic topology in which nodes may enter or leave the network (just like the store and forward method). The Network Simulator, Glomosim is the one that is the result of an effort of research and development that is administrated by researches at University of California, Department of computer science.

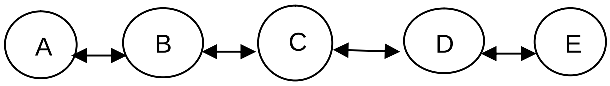
The node aggregation technique is introduced [1] into GloMoSim to give significant benefits to the simulation performance. Initializing each node as a separate entity inherently limits the scalability because the memory requirements increase dramatically for a model with large number of nodes. With node aggregation, a single entity can simulate several network nodes in the system. Node aggregation technique implies that the number of nodes in the system can be increased while maintaining the same number of entities in the simulation .In Glomosim; each entity represents a geographical area of the simulation. Hence the network nodes, which a particular entity represents, are determined by the physical position of the nodes.

The CONFIG.IN file contains the configuration parameters for the simulation and the main function in driver.pc is run the program. This is the C main function [2], where GloMoSim starts .The main function calls parsec_main ( ) to start the Parsec Simulation engine, initialize the simulation runtime variables and create the driver entity. Under the BIN directory to run the program file, in 10ms interval of time. /glomosim config.in. A file called GLOMO.STAT is produced at the end of the simulation and contains all the statistics generated, Directory main contains the basic framework to execute glomosim, which includes driver.pc file that defines the driver. Entity (to create nodes). Every Parsec program must include an entity called driver, which serves a purpose to the main function of a C program. When the simulation ends, parsec _main ( ) returns and the rest of the main function is executed.

4.1 Methodology

The results reported in this paper are based on simulation using the glomosim network simulator. The link layer of the simulator implement implements the complete CSMA standard MAC protocol DCF in order to accurately model of the contention of nodes for the wireless medium.

Figure 1 String topology



All nodes communicate with identical half duplex. We chose to keep most of the parameters of the simulations used in [1]. And our simulation set up, we take five nodes, these are A, B, C, D, E and A is source node and E is destination node. Number of nodes is fixed and the distance between any two neighboring is equal to 30m, which allow nodes to connect only to its neighboring nodes. In other words only those nodes between which line exists can directly communicate .The same distances between neighboring nodes ensure that the nodes ace equally in the simulation. Nodes are linear, no mobility. Packet size is fixed supported by glomosim simulator; time taken to each neighbor nodes for packets transfer from one node to other node is equal to 10ms (ms stand for mili second). We execute the program every 10ms and result will be occurring total simulation time period. Every 10ms time interval calculate the how many packet sent and how many received after completing the simulation time period (end of simulation time is 120s) to calculate the through put, also give a how many time delay. I mention the window size, CSMA.PC file in a Mac layer protocol. Glomosim simulator to avoid the hidden and exposed terminal problem. Number of nodes sending message is random, destination node is fixed. Each node has a queue called IFO for packets awaiting transmission by the network interface that hold up to 50 packets and is managed in a drop tail method. DSR routing protocol was used. . My target network is a wireless multi hop network, which is the basis of wireless mobile ad hoc network is used.

We use TCP traffic to show the problems exiting in the MAC Layer .We assume this TCP connections carry these file transfers .TCP is the prevalent reliable transport protocol, It can adapt to the network condition and do congestion control therefore it can use almost all the available bandwidth without causing congestion. It is a window-based ACK-clocked flow control protocol .If the window is increased exponentially by one packet for every non-duplicate ACK until the resource estimate of network capacity is reached. Window increase will stop when it reaches the maximum TCP window size. In a multi hop ad hoc network are contained two problems.

4.2 TCP instability problem

The TCP is the only traffic in that network, No background traffic exists. Hence there are no network condition changes in the whole lifetime of each experiment; TCP can adaptively adjust its transmission rate according to the network condition. If the network condition does not vary, the TCP throughput should stay stable within some range. It is a fast recovery algorithm, should achieve more stable throughput .The throughput are measured over 10ms intervals. We count the successively received TCP packets in each 10ms interval up to total simulation time period 120s and transfer it into the throughput in that interval. We see instability of TCP for the maximum window size has an effect on this problem. Since bigger data packet sizes and sending back-to-back packets both increase the chance of the intermediated node failing to obtain the channel. The node has to back to back of a random time and try again. This will increase the delay of ACKS if it finally succeeds. We experiment the different window sizes, the maximum number for possible back-to-back sending is window = 4. This greatly reduce the chance that other nodes the channel in seven tires. Thus no route failure occurs. The result is those nodes B cannot send back CTS even if it receives the RTS from node A correctly. After failing to receive CTS from node B seven times node a quits and reports a link breakage to its upper layer then route failure event occurs.

4.3 Unfairness problem

In a MAC Layer simultaneous TCP traffic may suffer from severe unfairness, even between connections with the same number of hops. This is caused by the difference of TCP round – trip time. The issue is rooted in MAC layer problems in multi-hop wireless links. In our experiment, one TCP connection might be completely shut down even if it starts much earlier than the competing TCP traffic.

5 Experimentation and Results

In methodology have described to forming simulation and discussed the basis steps involved in the processing of simulating the network, under the network simulator environment .I have mention the simulation result. I put some out put result after one interval time period. This result for window size –1 and simulation time is 30ms.

Node: 0, Layer: MacCSMA, Number of packets from network: 0

Node: 0, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0

Node: 0, Layer: MacCSMA, Number of UNICAST packets output to the channel: 0

Node: 0, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 10

Node: 0, Layer: MacCSMA, Number of UNICAST packets received clearly: 0

Node: 0, Layer: MacCSMA, Number of BROADCAST packets received clearly: 1
Node: 1, Layer: MacCSMA, Number of packets from network: 0
Node: 1, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 1, Layer: MacCSMA, Number of UNICAST packets output to the channel: 51
Node: 1, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 6
Node: 1, Layer: MacCSMA, Number of UNICAST packets received clearly: 0
Node: 1, Layer: MacCSMA, Number of BROADCAST packets received clearly: 1
Node: 2, Layer: MacCSMA, Number of packets from network: 0
Node: 2, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 2, Layer: MacCSMA, Number of UNICAST packets output to the channel: 1
Node: 2, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 10
Node: 2, Layer: MacCSMA, Number of UNICAST packets received clearly: 90
Node: 2, Layer: MacCSMA, Number of BROADCAST packets received clearly: 1
Node: 3, Layer: MacCSMA, Number of packets from network: 0
Node: 3, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 3, Layer: MacCSMA, Number of UNICAST packets output to the channel: 39
Node: 3, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 1
Node: 3, Layer: MacCSMA, Number of UNICAST packets received clearly: 1
Node: 3, Layer: MacCSMA, Number of BROADCAST packets received clearly: 0

Similarly for window size –1 and simulation time period is 60ms.
Node: 0, Layer: MacCSMA, Number of packets from network: 0
Node: 0, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 0, Layer: MacCSMA, Number of UNICAST packets output to the channel: 0

Node: 0, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 14
Node: 0, Layer: MacCSMA, Number of UNICAST packets received clearly: 0
Node: 0, Layer: MacCSMA, Number of BROADCAST packets received clearly: 1
Node: 1, Layer: MacCSMA, Number of packets from network: 0
Node: 1, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 1, Layer: MacCSMA, Number of UNICAST packets output to the channel: 111
Node: 1, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 6
Node: 1, Layer: MacCSMA, Number of UNICAST packets received clearly: 0
Node: 1, Layer: MacCSMA, Number of BROADCAST packets received clearly: 1
Node: 2, Layer: MacCSMA, Number of packets from network: 0
Node: 2, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 2, Layer: MacCSMA, Number of UNICAST packets output to the channel: 1
Node: 2, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 14
Node: 2, Layer: MacCSMA, Number of UNICAST packets received clearly: 193
Node: 2, Layer: MacCSMA, Number of BROADCAST packets received clearly: 1
Node: 3, Layer: MacCSMA, Number of packets from network: 0
Node: 3, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 3, Layer: MacCSMA, Number of UNICAST packets output to the channel: 84
Node: 3, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 1
Node: 3, Layer: MacCSMA, Number of UNICAST packets received clearly: 1
Node: 3, Layer: MacCSMA, Number of BROADCAST packets received clearly: 0
This out put result for window size –4 and simulation time period is 30
Node: 0, Layer: MacCSMA, Number of packets from network: 0
Node: 0, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0

Node: 0, Layer: MacCSMA, Number of UNICAST packets output to the channel: 0
Node: 0, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 2
Node: 0, Layer: MacCSMA, Number of UNICAST packets received clearly: 0
Node: 0, Layer: MacCSMA, Number of BROADCAST packets received clearly: 1
Node: 1, Layer: MacCSMA, Number of packets from network: 0
Node: 1, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 1, Layer: MacCSMA, Number of UNICAST packets output to the channel: 0
Node: 1, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 1
Node: 1, Layer: MacCSMA, Number of UNICAST packets received clearly: 0
Node: 1, Layer: MacCSMA, Number of BROADCAST packets received clearly: 2
Node: 2, Layer: MacCSMA, Number of packets from network: 0
Node: 2, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 2, Layer: MacCSMA, Number of UNICAST packets output to the channel: 0
Node: 2, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 1
Node: 2, Layer: MacCSMA, Number of UNICAST packets received clearly: 0
Node: 2, Layer: MacCSMA, Number of BROADCAST packets received clearly: 2
Node: 3, Layer: MacCSMA, Number of packets from network: 0
Node: 3, Layer: MacCSMA, Number of packets lost due to buffer overflow: 0
Node: 3, Layer: MacCSMA, Number of UNICAST packets output to the channel: 0
Node: 3, Layer: MacCSMA, Number of BROADCAST packets output to the channel: 1
Node: 3, Layer: MacCSMA, Number of UNICAST packets received clearly: 0
Node: 3, Layer: MacCSMA, Number of BROADCAST packets received clearly: 1

6 Simulation Results

Simulating different window size in every 10ms interval time period, I take end of simulation time period is 120ms. So we get 12 intervals, every interval to count how many packets sent and received after those calculate the throughput.

Figure 2 Window size-1

For Window size: 1

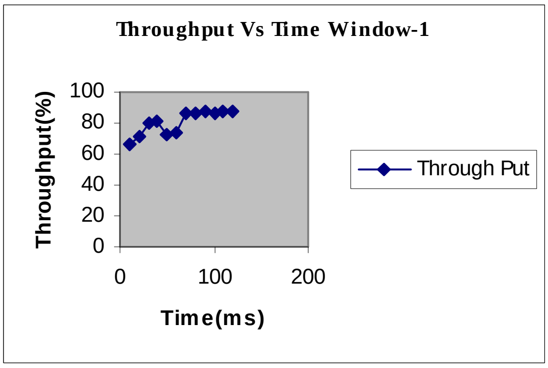


Figure 3 Window size-2

For Window size: 2

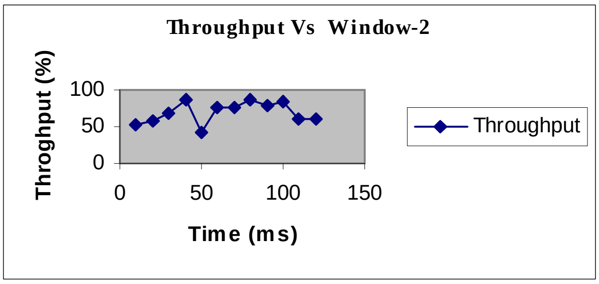


Figure 4 Window size-4

For Window size 4

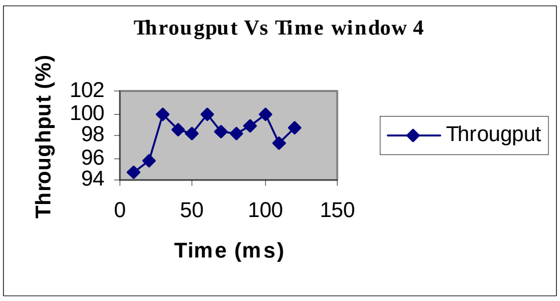


Figure 5 Window size-8

For Window size 8

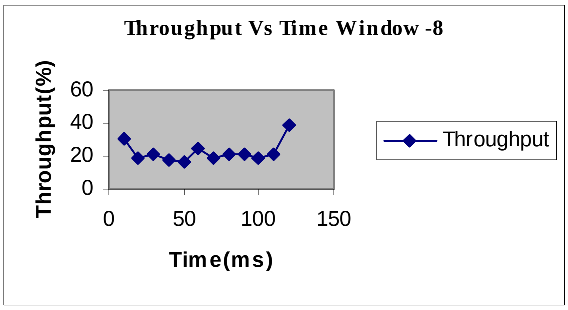


Figure 6 Window size-16

For Window size 16

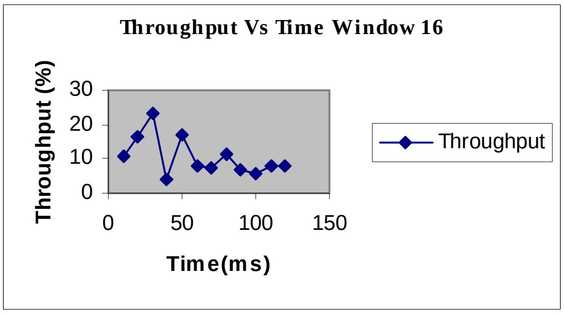
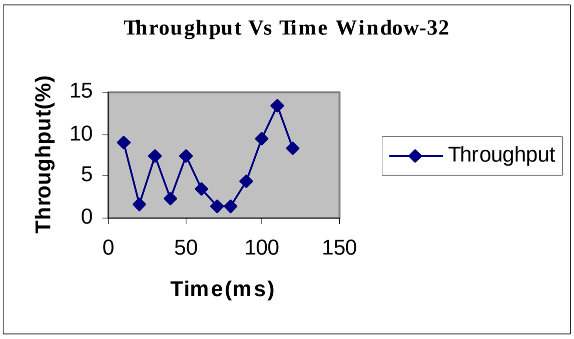


Figure 7 Window size-32

Window size 32



We compare different window size results, to determine, window size four is better performance the other windows size. Thus for windows size less than four and greater than four the throughput of the ad hoc network degrade.

7 Conclusions

In the present work attempts have been made to simulate different window sizes in a lined up mobile ad hoc network. In the context of end-to-end delay, throughput, traffic pattern and delivery rate have been evaluated. We use CSMA protocol in a MAC layer has shown the performance of different window size throughput results. The sender switches to a slow rate of increase in the window by one packet for every window's worth of ACKs, window increase will be stop, when it reaches the maximum TCP window size. As we have shown, in this paper The MAC layer problem cause the routing protocol failing and more efforts on MAC layer are needed to design a usable wireless mobile network.

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