Performance Analysis of Adhoc Networks by Varying Fragmentation Threshold

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Abstract: Adhoc Networks are a new emerging wireless networking paradigm for mobile hosts due to an edge gained over the traditional wired fixed infrastructure. Though the adhoc networks provide an advantage of mobility but then too certain limitations subject these network

Keywords: Adhoc Networks, Fragmentation Threshold

I. INTRODUCTION

Need of mobile computing devices by a growing segment of population has led to a tremendous rise in popularity. At the same time, a rapid growth is taking place in te markets of wireless telephones and communication devices. Mobile Ad-hoc Networks is an emerging technology over the old technology. Research is on in the fields of routing, media access control, multicasting and security. Technological innovations of engineers have drastically changed the day-to-day lifestyle of people. The prominent among these is the telecommunications networking, the most complex and that owns the largest market size, has enabled us to change our lifestyle by entering into the era of information technology. During the last several decades, the world has seen phenomenal changes in the telecommunication industry. Wireless communications between mobile users is becoming more popular than ever before. This is due to technological advances in laptop computers and wireless communication devices, such as wireless modems and wireless LANs. This has led to lower prices and higher data rates. Wireless networks are becoming popular because of their “3 Anys”- *any* person, *any* where, *any* time [43]. People can get on-line, be reached, and interact anywhere and anytime. Advances in wireless technology and portable computing along with demands for greater user mobility have provided a major impetus toward development of an emerging class of self-organizing, rapidly deployable network architectures referred to as ad-hoc networks. An ad-hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the aid of any established infrastructure or centralized administration. Ad-hoc networks are expected to play important role in future commercial and military settings where mobile access to a wired network is either ineffective or impossible. Potential applications for this class of network include instant network infrastructure to support collaborative computing in temporary or mobile environments, emergency rescue networks for disaster management, remote control of electrical appliance, communication systems such as IVC (Inter-Vehicle Communications), and mobile access to the global Internet.

Furthermore, ad-hoc networks have the potential to serve as a ubiquitous wireless infrastructure capable of interconnecting many thousands of devices with a wide range of capabilities and uses. In order to achieve this status, however, ad-hoc networks must evolve to support large numbers of heterogeneous systems with a wide range of application requirements. Ad-hoc networks are the key factor in the evaluation of wireless communication envisioned as corner stones of future generation wireless networking. They are infrastructure less networks formed on-the-fly (anytime, anywhere, for virtually any application) with limited life of existence [14]. Fig 1.1 shows a simple Ad hoc network of three nodes. The outermost nodes are not with in the transmission range of each other. However the middle nodes can be used to forward the packets between the outermost nodes. The middle node is acting as a router and three nodes have formed an ad hoc network. A fundamental problem in ad hoc networking is how to deliver data packets among MNs efficiently without predetermined topology or centralized control, which is the main objective of ad hoc routing protocols

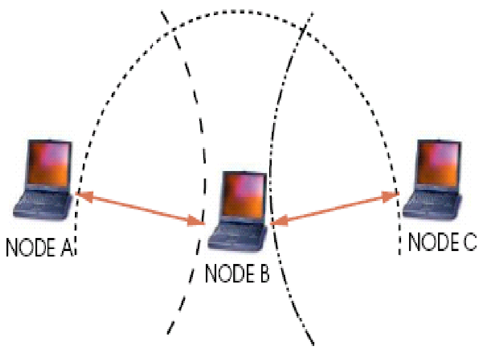

Figure 1: Example of simple Ad hoc network with three participating nodes

A fundamental problem in ad hoc networking is how to deliver data packets among MNs efficiently without predetermined topology or centralized control, which is the main objective of ad hoc routing protocols. Since mobile ad hoc networks change their topology frequently, routing in such networks is a challenging task. Moreover, bandwidth, energy and physical security are limited. With the increasing popularity of mobile devices and wireless networks over the past few years, wireless ad-hoc networks has now become one of the most vibrant and active fields of communication and networking research.

II. LITERATURE SURVEY

Mobile ad-hoc networking offers convenient infrastructure-less communication over the shared wireless channels. The major research efforts in the area of Mobile Ad-hoc Networks focus on developing efficient routing protocols. In this chapter, an overview of these works is undertaken so as to have better understanding of the work ahead. The problems with wireless network designed without the aid of any centralized administration or standard support services were discussed by ***Johnson et al [1994]*** who suggested a new approach based on separate route discovery and route maintenance protocols. The comprehensive review for routing features and techniques in wireless ad-hoc networks were discussed by ***Zou et al [2002]***. This work defined two categories of wireless networks cellular (one-hop) and wireless ad-hoc (multi-hop) networks and addressed different criteria for designing, classifying and comparisons of routing protocols for wireless ad-hoc networks. The protocols such as Link State Routing (LSR) and Distance Vector Routing (DVR), On-Demand Routing Protocol, Periodical Update and Event-Driven Update, Flat Structure and Hierarchical Structure, Decentralized Computation and Distributed Computation, Source Routing and Hop--by-Hop Routing, Single Path and Multiple paths were discussed. ***Ahmed et al [2006]***analyzed the performance differentials to compare the commonly used ad hoc network routing protocols. They also analyzed the performance over varying loads for each of these protocols using OPNET Modeler 10.5. Their findings show that for specific differentials, TORA shows better performance over the two on-demand protocols, that is, DSR and AODV. ***Zaballos et al [2006]*** evaluated four different protocols using OPNET and their results demonstrated that proactive protocols introduce a lower delay in the network, as they have routes before their demand. However, because they continuously search for routes to all possible destinations, routing overhead introduced is high. On the other side, reactive protocols do not maintain unused routes and search them when they are needed. This fact increases the delay suffered by packets, because they remain waiting at buffers before being transmitted. They generally generate less control traffic than proactive ones. ***Jayakumar et al [2007]*** categorized the routing protocols on the basis of structure straight information and scheduling and concluded the comparison of on-demand reactive protocols and proactive protocols of Mobile Ad-hoc Networks. ***Trung et al [2007]*** compared the performance of different protocols for ad hoc networks – Ad Hoc On-Demand Distance Vector Routing (AODV), Location-Aided Routing (LAR), Ad Hoc On- Demand Multipath Distant Vector (AOMDV) routing and Location-Aided Multipath Routing (LAMR). They analyzed the performance differential using varying network load and mobility. Simulations model with MAC and physical layer models demonstrated the performance benefits of their proposal i.e. LAMR over LAR and AODV in most movement scenarios. AOMDV has the best performance in terms of packet delivery, average end to end delay compared with the three others consistently, and LAMR does better than LAR in almost cases. We also observed that the simulation results shown AOMDV consistently performs better than LAMR in terms of overall packet delivery, but does more frequent flooding of control packets and thus higher bandwidth usage than LAMR. ***Jayakumar et al [2008]*** described thatAd hoc networks are characterized by multihop wireless connectivity, frequently changing network topology and the need for efficient dynamic routing protocols plays an important role. They compared the performance of two prominent on-demand routing protocols for mobile ad hoc networks: Dynamic Source Routing (DSR), Ad Hoc On-demand distance Vector Routing (AODV) and demonstrated that even though DSR and AODV share similar on-demand behavior, the differences in the protocol mechanisms can lead to significant performance differentials. ***Aziz et al [2009]*** investigated different performance aspects of three MANET routing protocols i.e. AODV, DSR and DYMO. The results indicated that all routing protocols perform well according to the performance metrics that have been selected. For packet delivery ratio metric, performance of AODV, DSR and DYMO routing protocols are quite similar to each other. The DSR performance is better compared to AODV and DYMO and has stable normalized routing overhead. In terms of throughput, DYMO routing protocol performs the best as compared to AODV and DSR. Finally, for average end to end delay, DYMO and AODV perform well in comparison with DSR. ***Huang et al [2009]*** introduced the feature and infrastructure of Ad Hoc. They analyzed ad hoc in aspects of objection, scheme design, environment setting and OTcl script writing. Their comparison of simulation results concluded that in the circumstance of non-active movement, the DSR protocol is available due to its low packet loss rate and low end-to-end time delay. While in the circumstance of active movement, AODV protocol is available due to its high packet delivery fraction and low end-to-end time delay, because it embodies the mixed features of DSR and DSDV protocol. Most of the work as surveyed in this chapter was evaluated through simulation based experiments using a maximum of 50 nodes and changing only one parameter. However, it is felt that these results must be enriched through real world experiments as well for better and more realistic results. In this chapter, various techniques as proposed by researchers from time to time were overviewed in a broader perspective.

III. PERFORMANCE ANALYSIS

In this paper the wireless Adhoc Networks has been discussed. The emphasis is laid on the effect of the fragmentation of data packets. Two case studies have been discussed. Case Study I deal with the simple Wireless Adhoc Network, wherein no fragmentation of data Packets is carried out. Case Study II involves the concept of fragmentation. The work involves two scenarios in which comparison has been done for the above discussed Case Studies. In the case studies the scenario has four

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wireless LAN-based workstations in a simple network configuration. The workstation discussed involves the following properties:

The wireless station node model represents an IEEE802.11 wireless LAN station. The node model consists of following processes:

1. **The MAC layer** which has a wireless LAN MAC process model with following attributes:
    a. MAC address -- station address
    b. Fragmentation Threshold --- based on this threshold station decides wether or not to send data packets in fragments.
    c. Rts threshold --- based on this threshold station decides wether Rts/Cts exchange is needed for every data transmission. The wireless LAN MAC layer has an interface with higher layer which receives packet from higher layer and generates random address for them.

2. **Wireless LAN interface**

This process model is an interface between MAC layer and higher layer. The function of this process is to accept packets from higher layer and generate random destination address for them. This information is then sent to the MAC layer.

3. **Wireless LAN receiver**

A wireless receiver accepts any incoming packets from the physical layer and passes it to the wireless MAC process.

4. **Wireless LAN transmitter**

This is a wireless transmitter which receives packet from MAC layer and transmits it to the physical medium.

Following are the two scenarios for which the statistics are compared:

1. Wireless Adhoc Network unfragmented
2. Wireless Adhoc Network fragmented

CASE STUDY I:

For a simple un-fragmented wireless Adhoc network

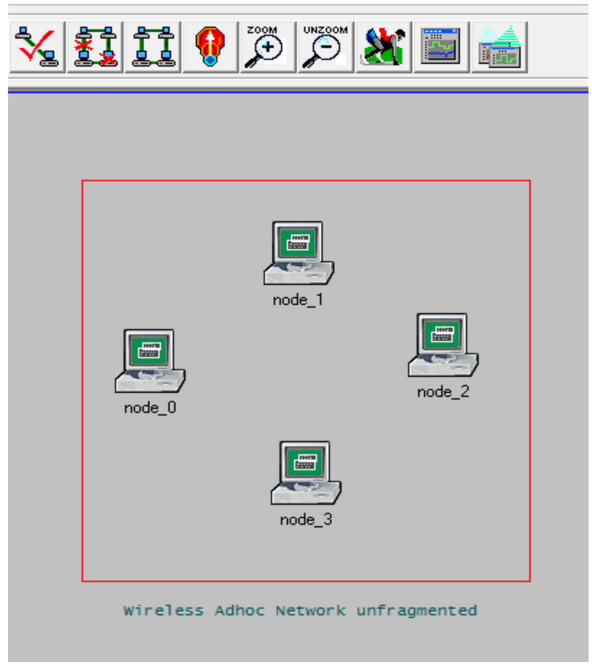

Figure 2 Scenarios for Case Study 1

Table 1 Simulation Parameters for case study 1

S.No.	Parameters Varied	Values
1	Start time (sec.)	6.0
2	ON state Time (sec)	90
3	OFF state time (sec)	2
4	Interval Time (Sec)	0.02
5	Packet Size	1024
6	Wireless MAC address	Auto Assigned
7	Data Rate	5.5 Mbps
8	Buffer Size	256000
9	Physical Characteristics	Frequency Hopping

CASE STUDY II

In the Second Scenario all the four workstations are configured so that data received from the higher layer is fragmented before transmission.

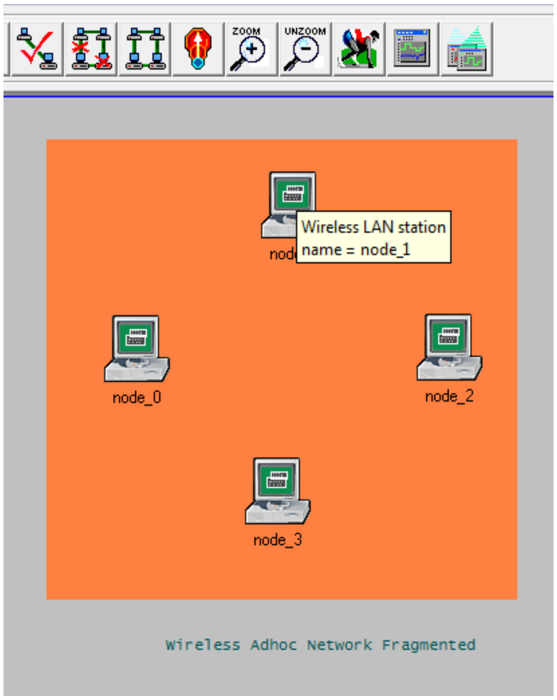

Figure 3 Scenarios for Case Study 2

Table 2 Simulation Parameters for case study 2

S.No.	Parameters Varied	Values
1	Start time (sec.)	6.0
2	ON state Time (sec)	90
3	OFF state time (sec)	2
4	Packet Interval Time	0.02
5	Packet Size	1024
6	Fragmentation Threshold	1024
7	Data Rate	1 Mbps
8	Buffer Size	256000
9	Physical Characteristics	Frequency Hopping

IV. RESULTS

The results obtained from the above case studies serve as a baseline for comparing the effects of different wireless-LAN parameter settings.

Statistics compared are:

1. Control Traffic Rcvd
2. Retransmission Attempts
3. Load
4. Media Access Delay
5. Channel Reservation
6. Throughput

1. Control Traffic Rcvd (bits/sec)

2.

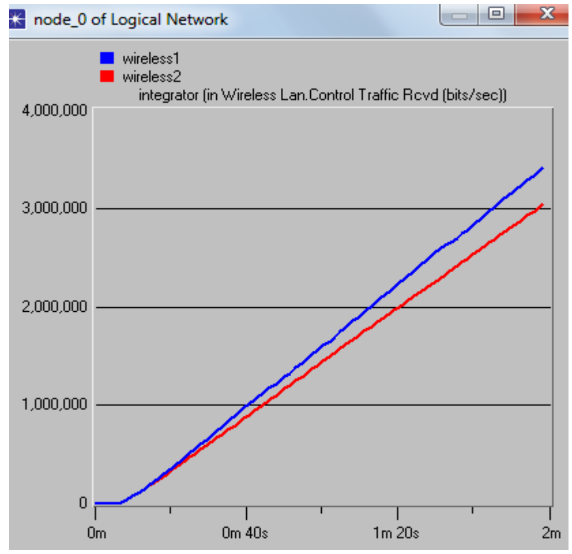

Figure 4 Comparison graph for Control Traffic Rcvd (bits/sec)

3. Retransmission Attempts (Packets)

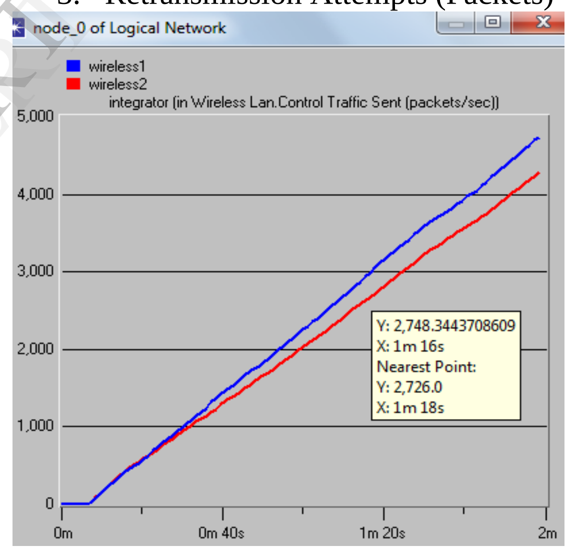

Figure 5 Comparison graph for Retransmission Attempts (Packets)

3. Load(bits/sec)

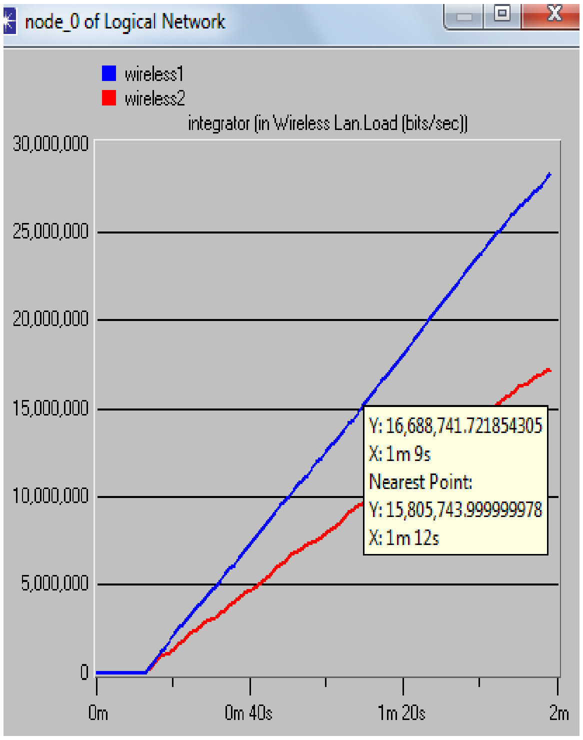

Figure 6 Comparison graph forLoad (bits/sec)

4. Media Access Delay (sec)

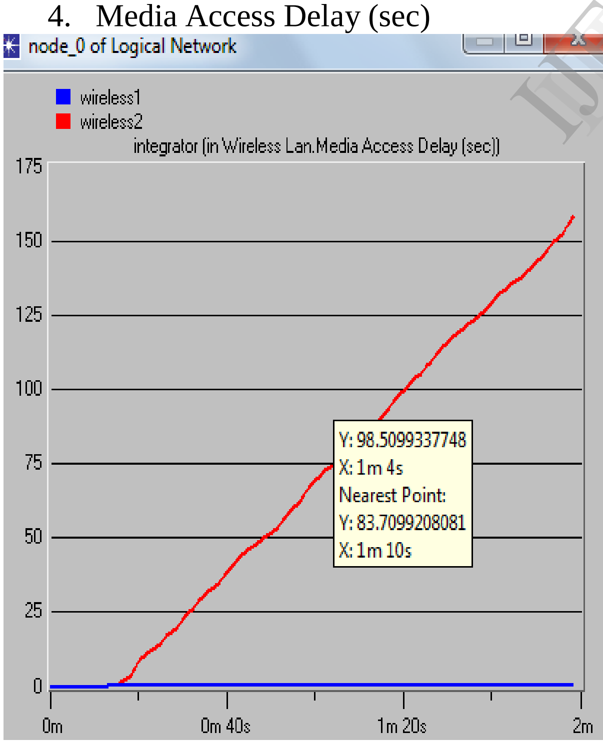

Figure 7 Comparison graph forMedia Access Delay (sec)

5. Channel Reservation (sec)

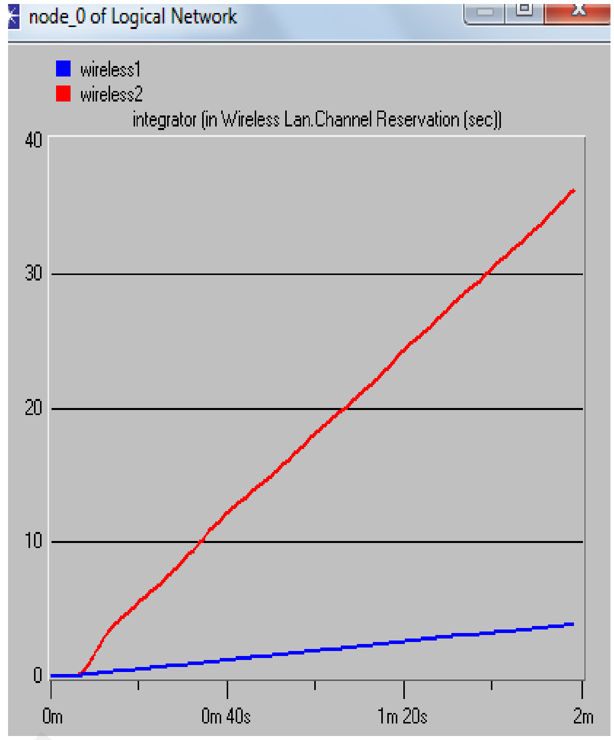

Figure 8 Comparison graph forChannel Reservation (sec)

6. Throughput (bits/sec)

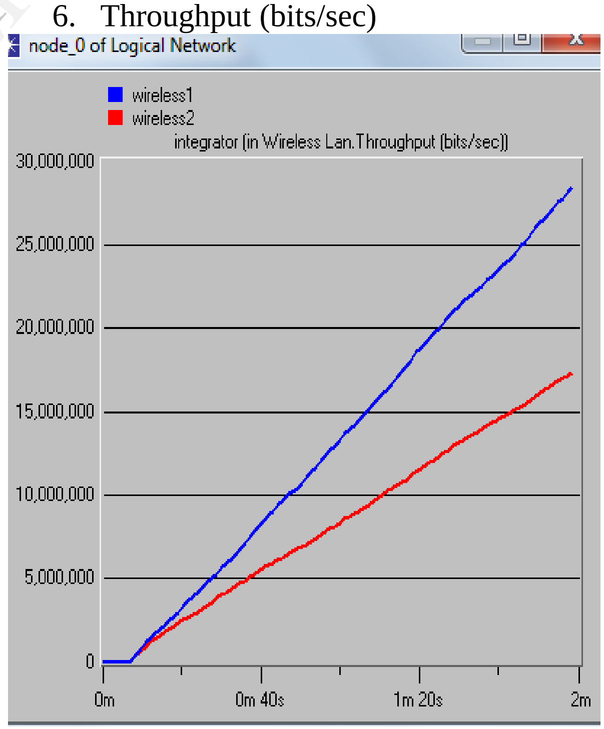

Figure 9 Comparison graph forThroughput (bits/sec)

Both the scenarios use the different data rates and network loads; as a result, The Media Access Delay, Control Traffic Rcvd , Retransmission Attempts ,Load and throughput vary. If data rate would have been same then media access delay and Throughput results do not change. In both the case studies Media Access Delay, Throughput, the Channel Reservation, Control Traffic Rcvd and load results are different for both scenarios; these differences illustrate the effects of different wireless-LAN parameter settings. Control Traffic Rcvd, Retransmission Attempts, Load, Throughput decreased in case study II, but Media Access Delay and Channel Reservation increased, where the fragmentation is done.

V. CONCLUSION

This study was conducted to evaluate the performance of the wireless Adhoc Networks using a scenario in which there is no fragmentation and another scenario in which there is fragmentation. Certain other simulation parameters as discussed in the previous chapter were also varied to study and compare the response. The response indicated that Control Traffic Rcvd, Retransmission Attempts, Load, Throughput decreased in case study II, but Media Access Delay and Channel Reservation increased, where the fragmentation is done. Mobile Adhoc network is an upcoming area that is taking shapes slowly but steadily. The above illustrated case studies emphasized the significance of fragmentation. Further areas of research may include the use of various protocols, variation in data rates etc

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