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RESEARCH ARTICLE

EVALUATING PERFORMANCE OF DSDV & DSR ROUTING PROTOCOLS IN MANET THROUGH QoS PARAMETERS

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Abstract- ***Ad hoc is a network connection method which is often associated with wireless devices. The connection is established for the duration of one session and requires no base station. Instead, devices discover others within range to form a network for those computers. Devices may search for target nodes that are out of range by flooding the network with broadcasts that are forwarded by each node. Connections are possible over multiple nodes known as multi hop ad hoc network. For this ad hoc network I have tested the quality of service parameters like throughput, packet loss and delay for protocols DSDV and DSR with different number of nodes for various counts of agents and sinks. The comparisons have shown that DSR perform better than DSDV on all Quality of Service Parameters when the number of nodes increases, for various numbers of agents and sinks. Network simulators enable us to study the performance and behavior of these protocols on various network topologies. The performance of the network is validated with an NS2 for DSR and DSDV routing protocols.***

Keywords: ***Ad Hoc, DSDV, DSR, NS2, Agents, Sinks, Packet loss, Throughout, Delay***

I. INTRODUCTION

An ad hoc network can be formed on-the-fly andspontaneously without the required intervention of acentralized access point or an existing infrastructure.An ad hoc network provides a cost effective means ofcommunication among many mobile hosts.Applicationsof an ad hoc network include battlefield communicationswhere soldier need to decide for a defend or offend, riotcontrol and law enforcement where only law enforcingpersonnel need to communicate while others are notallowed to do so to prevent spreading of rumors,emergency rescue missions and disaster recovery wherethe communication infrastructure is abolished. Further,people may communicate forming an ad hoc networking convention centres and online conferences andclassrooms without routing their calls to the availableinfrastructure. Thus, an ad-hoc network may providea cost-effective and cheaper way to share informationamong many mobile hosts.The unique characteristics of an ad hoc networkdifferentiate it from other classes of networks. Themobile devices are connected through wireless links thatmay have several effects such as fading, environmental,obstacles, etc. The devices used to form an ad hocnetwork possess limited transmission range; therefore,the routes between a source and a destination are often multihop. As there are no separate routers, nodes thatare part of the network need to cooperate with eachother for relaying packets of one another towards theirultimate destinations. The devices are often operatedthrough batteries; the depletion of battery power maycause failure of nodes and associated links. The devicesmay move about randomly, and therefore, the topologyof the network varies dynamically.

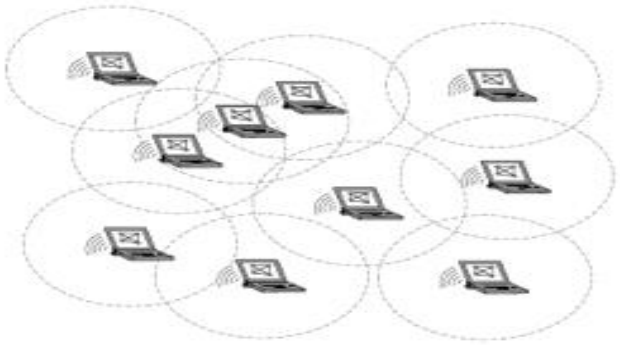

Figure 1.1 Mobile Ad-hoc Network

Quality of Service (QoS) means that the networkshould provide some kind of guarantee or assuranceabout the level or grade of service provided to anapplication. The actual form of QoS and the QoSparameter to be considered depends upon specificrequirements of an application. For example, anapplication that is delay sensitive may require the QoSin terms of delay guarantees. Some applications mayrequire that the packets should flow at certain minimumbandwidth. In that case, the bandwidth will be a QoSparameter. Certain application may require a guaranteethat the packets are delivered from a given source todestination reliably, then, reliability will be a parameterfor QoS.
As more and more applications are added on topof an ad hoc network, it is desirable that the networkshould provide QoS in some form or the other. However,the characteristics of an ad hoc network pose severalchallenges in the provision of QoS.
Some of thesechallenges are as follows.

- The topology of the network varies dynamically. Therefore, it is difficult to design a scheme or aprotocol that is able to provide hard guaranteesabout the QoS desired by an application.
- The resources of the devices used are limited; therefore, any such scheme or a protocol should be a light-weight scheme. In other words, the protocol should not consume a significant amount of energy or should not incur a large amount of computational or communication overheads.

Due to the above mentioned challenges, one may notexpect hard guarantees about the QoS. However, onewould rather be interested in QoS with soft guarantees.Owing to its importance, a lot of research is directedto the provision of QoS in ad hoc networks. A survey of QoS support inTime Division Multiple Access (TDMA) based ad hocnetworks is presented in Jawhar and Wu (2005). Anothersurvey about the issues and solutions pertaining to QoSin a mobile ad hoc network is presented in Reddy et al.(2006). However, a large part of the survey contains thedescription of routing protocols and QoS architecturalframeworks. Surveys of QoS routing solutions formobile ad hoc networks are presented in Zhang and Mouftah (2005) and Hanzo and Tafazolli (2007).The survey presented in Zhang and Mouftah (2005)contains discussion on basic problems encountered inQoS provisioning together with solutions reported in theliterature. The survey presented in Hanzo and Tafazolli(2007) brings out various factors related to the QoSprovisioning at the level of routing such as designconsiderations and trade-offs. However, there is needfor a comprehensive survey on the provision of QoSin mobile ad hoc networks. Further, we believe that alot of research has carried out since the times of thesurveys that appeared in Perkins and Hughes (2002),Reddy et al. (2006), Zhang and Mouftah (2005) and Hanzo and Tafazolli (2007), and a lot more issueshave emerged. Therefore, there is a need to revisit themethodologies presented in the literature with differentissues and perspectives.

In this paper, Ifirst describe about the various routing protocols, the quality of service parameters like packet loss, throughput, denial of service, delay etc. I start fromthe theoretical background about provision of QoS anddiscuss state-of-the-art research carried out in differentdirections that address different issues.

A. *Routing*

It may necessary for the packets to traverse various hops before reaching the destination so the need to use the routing protocols arises. There are 2 main jobs of routing protocols. First the selection of routes for various source and destinations pairs and second the delivery of the messages to the correct destination.

*Conventional Protocols:*If we need to use a routing protocol why do not we use a conventional routing protocol like link state and distance vector routing. The main problem with these protocols is that they are designed to work for static routes and so they would not be able to adjust for dynamic topology in an ad hoc network.

Link state and distance vector protocols can very well for ad hoc networks with low mobility. Problem still holds, as these protocols are dependent on periodic control messages. As in an ad hoc network the number of network nodes can be large and the number of potential destinations will also be large. This is contradicting as all the updates in wireless interconnected ad hoc network are transmitted by air and hence can be a costly affair in terms of resources like bandwidth, CPU and battery power.

Also conventional protocols assume bi-directional links e.g. the transmission between two hosts work equally well in both directions while this may not be the case always in a wireless network.
Nevertheless the ad hoc routing protocols have the same underlying algorithms hence we have a look at what the link state and distance vector routing protocols are.

Link State: In link state routing [1], each node maintains a view of the complete topology with a cost for each link. To keep these costs consistent each node periodically broadcasts the link costs of its outgoing links to all the other nodes using flooding. As each node receives this information, it updates its view of the network and applies a shortest path algorithm to choose the next hop for each destination. Some link costs in a node view can be incorrect because of long propagation delays, portioned network etc. Such inconsistent network topology views can lead to formation of routing loops.

Distance Vector: In Distance vector routing [1] each node monitors only the cost of its outgoing links, but instead of broadcasting this information to all the nodes, it periodically broadcasts to each of its neighbors an estimate of the shortest distance to every other node in the network. The receiving nodes then use this information to recalculate the routing table, by using the shortest path algorithm.
This is more efficient than the link state routing in terms of computational speed. It also requires less storage space and is more computational efficient.

Source Routing: Source Routing [1] means that each packet must carry the complete path that the packet should take through the network. The routing decision is thus made at the source. This approach helps avoiding routing loops and the disadvantage is that each node has to bear the extra overhead.

Flooding: Many routing protocols use broadcast to distribute control information, which is send control information from the origin node to the final destination. The widely used form of broadcasting is flooding [1] and is used as follows: The origin node sends its information to its neighbors. The neighbors rely this to its neighbors and so on, until the packet has reached all the nodes in the network. A node will only relay a packet once and to ensure this some sort of sequence number can be used. This sequence number is increased for each new packet a node sends.

B. *Classification Of Routing Protocols*

Routing protocols can be classified [2] into different categories depending on their properties.
Centralized vs. Distributed

- Static vs. Adaptive
- Reactive vs. Proactive

In Centralized algorithms all route choices are made at the central node, while in distributed algorithms the computation of routes is shared among the network nodes.

In static algorithm the route used by source destination pairs is fixed regardless of traffic conditions. It can only change in response to a node or link failure. While in an adaptive algorithm the routes used to route between sources – destination pairs may change in response to congestion.

The final classification is more related to ad-hoc networks. Proactive protocols continuously evaluate the routes within the network so that when a packet needs to be forwarded the route is already known and can be immediately used. e.g. Distance vector protocols. Reactive protocols on the other hand invoke a route determination procedure on demand only. Thus when a route is needed some sort of global search procedure is applied e.g. classical flooding.

II. ADHOC ROUTING PROTOCOLS

A. Destination Sequenced Distance Vector – DSDV

DSDV is a proactive protocol. Each node maintains its own routing table for the entire network. Consider a node S. Suppose; S needs to send a message to node D.
S can look up the best route to D from its routing table and forward the message to the neighbor along the best route. The neighbor in turn checks the best route from its own table and forwards the message to its appropriate neighbor. The routing progresses this way.
There are two issues in this protocol:

- How to maintain the local routing tables
- How to collect enough information for maintaining the local routing tables.

DSDV is basically distance vector with few adjustments to make it better suited for ad hoc networks. These changes consist of triggered updates to that will take care of topology changes in the time between broadcasts. To reduce the amount of information in these packets there are two types of update messages defined: full and incremental dump.The full dump carries all available routing information while the incremental jump only carries the information that has changed since the last dump.

*Properties:*Because DSDV is based on periodic broadcasts it needs some time to converge before a route can be used. This converge time can probably be considered negligible in a static wired network where the topology is not changing very frequently.

B. Dynamic Source Routing – DSR

Dynamic source routing DSR [3] [4] also belongs to the class of reactive protocols and allows nodes to dynamically discover a route across multiple network hops to any destination. Source routing means that each packet in the header carries the complete ordered lists of nodes through which the packet must pass. DSR uses no periodic routing messages thereby reducing network bandwidth overhead, conserving battery power and avoiding large routing updates throughout the ad hoc network. Instead DSR relies on support from the MAC layer. The DSR protocol has two important mechanisms through which the protocol operates.

- *Route Discovery*: A node S wishing to send a packet to node D obtains a route to D
- *Route Maintenance*: When S is using a discovered route to D, S may detect that the route is broken. In such cases, S may use an alternate route to D (if it is known), or start another route discovery phase to D.

Route discovery and route maintenance operate entirely on-demand. There is no need to broadcast periodically to update routing information in individual nodes. DSDV requires such periodic broadcasts. The number of overhead packets is much smaller in DSR. The number of overhead packets drops to zero when the nodes are static and all routes has been discovered. It is necessary to discover new routes in these situations and hence the new route discovery packets are the overhead packets. Note that, a node may receive multiple routes to a destination in response to a route discovery request. A node may store multiple routes to a destination in its route cache. A node can react to changes in network topology much more rapidly by taking advantage of cached routes. For example, if one route to a destination is broken, the source node can choose another route to the destination from its route cache.
Consider the case when a source node S wants to send a packet to a destination node D. In a 'good situation', S already knows a route to D from its route cache. In this case, S will add the sequence of hops to D in the header of the packet. Then S will send the packet to the first node in this sequence.
In the 'bad case' S will not find any route to D in its route cache. S will initiate the route discovery protocol. In this case, we call S the initiator and D the target of this protocol. Node S is trying to discover a route to node D.S broadcasts a route request message to its neighbours. All nodes within the transmission range of S receive this message. Each route request message contains the initiator and target of the route discovery. Also, each route request is stamped with a unique ID assigned by the initiator.

Properties: DSR uses the key advantage of source routing. Intermediate nodes do not need to maintain up to date routing information in order to route the packets they forward. There is also no need for periodic routing advertisement messages, which will lead to reduce network bandwidth overhead, particularly during periods when little or no significant host movement is taking place. Battery power is also conserved on the mobile hosts, both by not sending the advertisements and by not needing to receive them; a host could go down to sleep instead.

DSR is a simple and an efficient routing protocol with low overhead of control messages.
However, DSR has relatively high latency in finding routes. DSR is not very scalable since packet size increases with increasing hop numbers in a route.

III. SIMULATION AND ANALYSIS METHOD

The simulations were performed using Network Simulator (Ns-2), which is popularly used for ad hoc networking community.
Ns2, a widely used network simulator in the research community has the extended features to simulate Sensor Networks. It uses object-oriented design for the implementation of various modules of a sensor network [6]. There are modules for energy model, wireless channel, sensor channel which models dynamic inter-action between the physical environment and the sensor nodes. It also has implementations of few protocols that are under development for sensor networks. These include S-MAC, a Sensor MAC protocol at the MAC layer in a Sensor Node protocol stack, Directed Diffusion routing protocol with Geographic Routing. The object-oriented design of ns2 introduces unnecessary interdependence between modules and makes the addition of new protocols very difficult as it can be mastered only by experts in ns2 [7].

From the user's perspective, NS−2 is an OTcl interpreter that takes an OTcl script as input and produces a trace file as output.

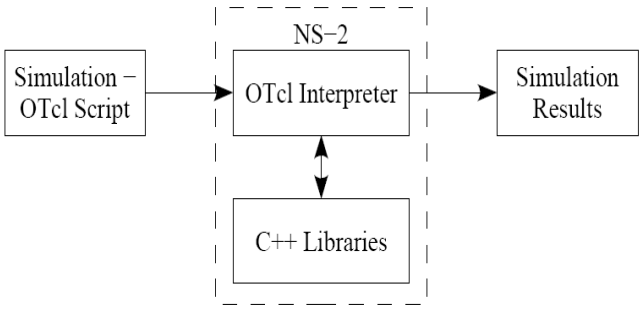

Figure 3.1 NS2 Architecture

The routing protocols were compared based on the following 3 performance metrics:

- *Packet Delivery Fraction (PDF):* The ratio of data packets delivered to those generated by the sources.
- *End to Enddelay*: The delay in delivering a packet to the destination which is inclusive of all kinds of delay.
- *Routing Load:* This is the routing packets sent perdelivered packet at the destination.

A. Simulation Results For DSR

Here I have presented all the graphs for various set of parameters like delay, packet loss and throughput for DSR protocol. The below graphs are showing that how the various QoS parameters are varying with increase in number of nodes.

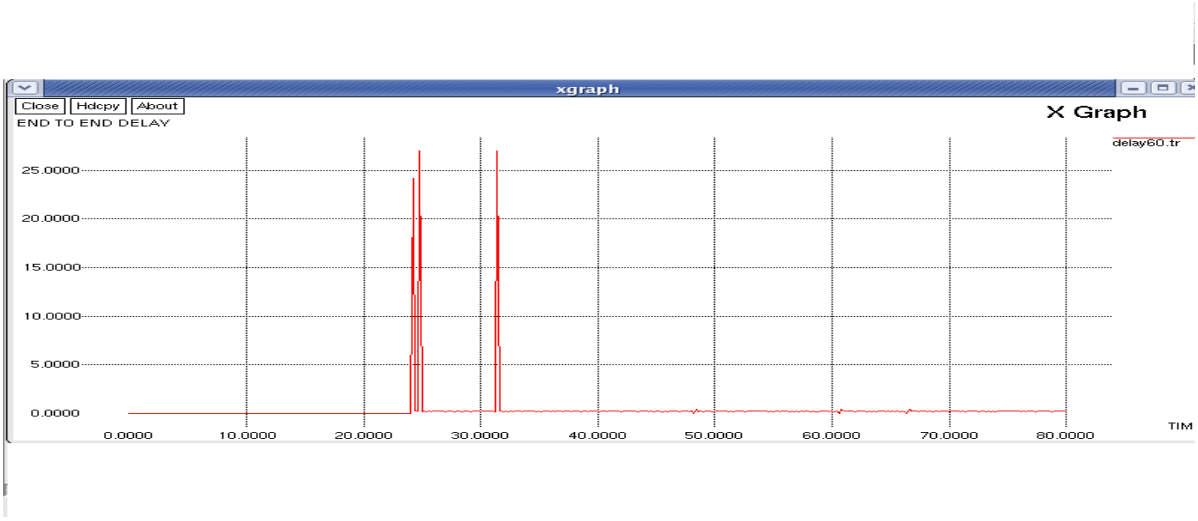

Figure 3.2 Packet Loss, 3 agents and 3 sinks (For 20 Nodes)

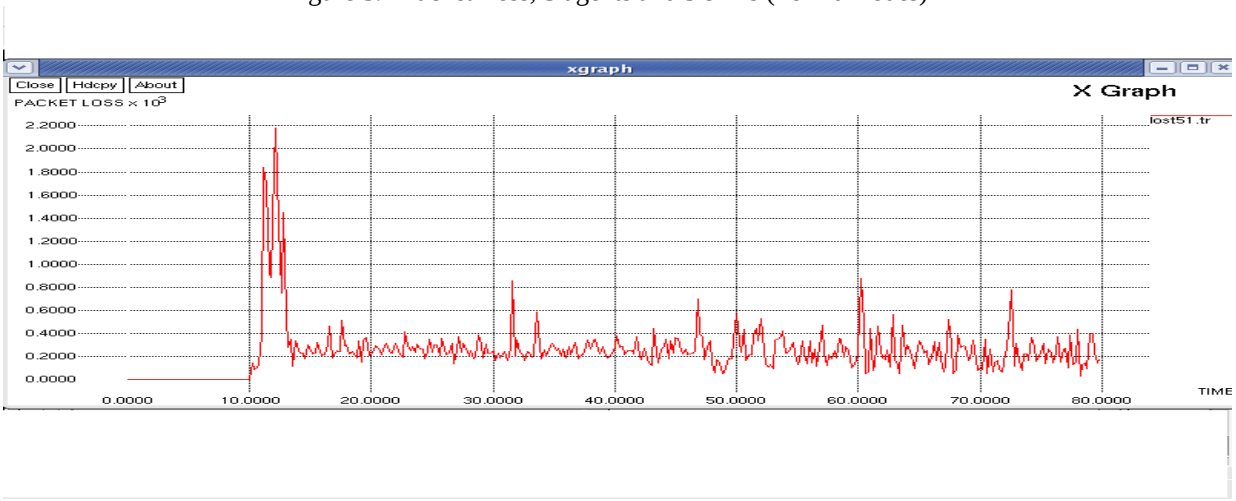

Figure 3.3 Packet Loss, 3 agents and 3 sinks
For 30 Nodes

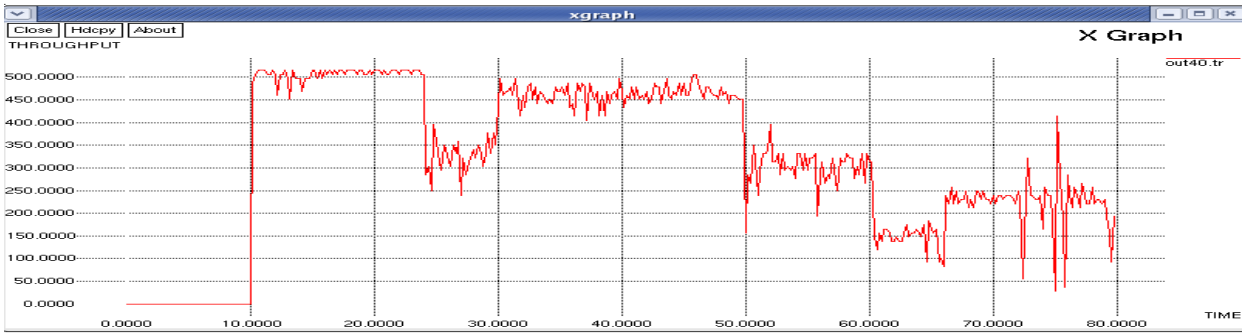

Figure 3.4 Throughput, 3 agents and 3 sinks
For 20 Nodes

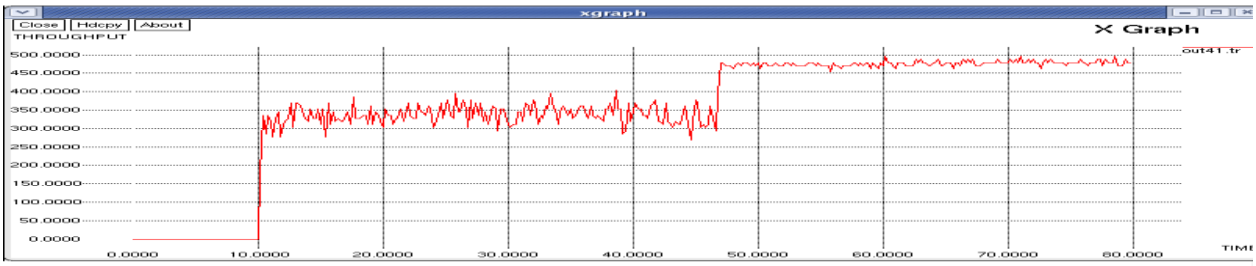

Figure 3.5 Throughput, 3 agents and 3 sinks
For 30 Nodes

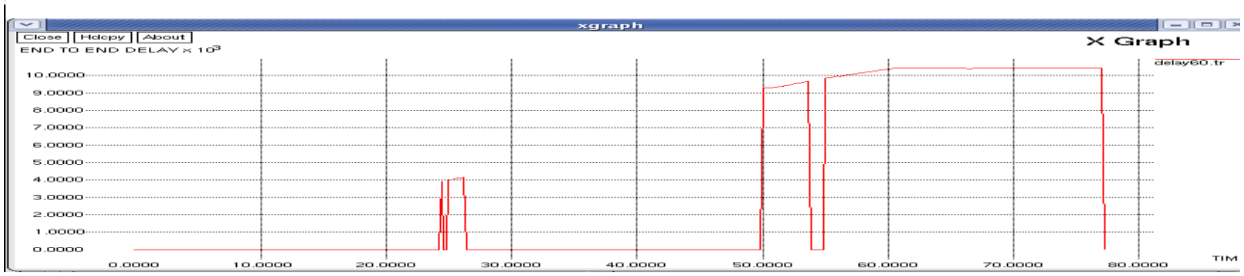

Figure 3.6 Delay, 3 agents and 3 sinks (For 20 Nodes)

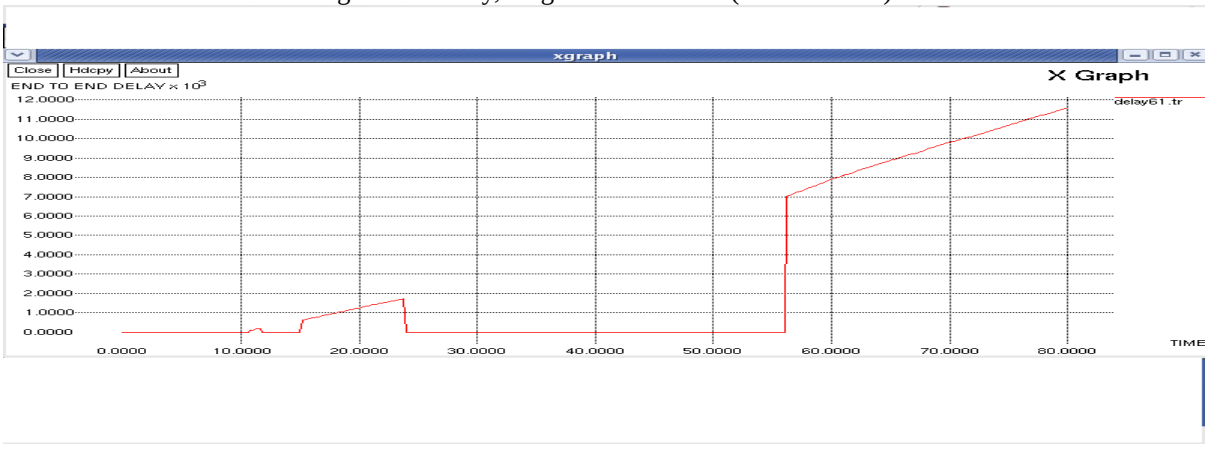

Figure 3.7 Delay, 3 agents and 3 sinks
(For 30 Nodes)

B. Simulation Results For DSDV

The below graphs are showing that how the various QoS parameters are varying with increase in number of nodes.

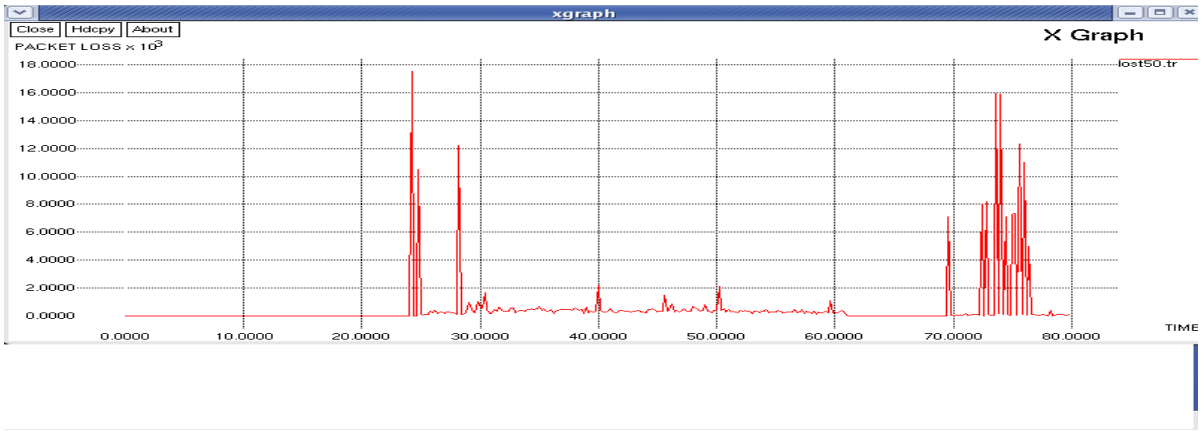

Figure 3.8 Packet Loss, 3 agents and 3 sinks
(For 20 Nodes)

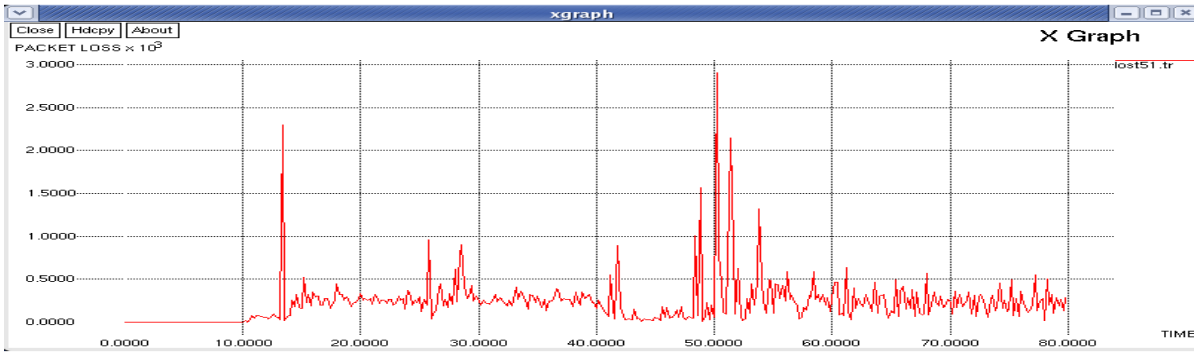

Figure 3.9 Packet Loss, 3 agents and 3 sinks
(For 30 Nodes)

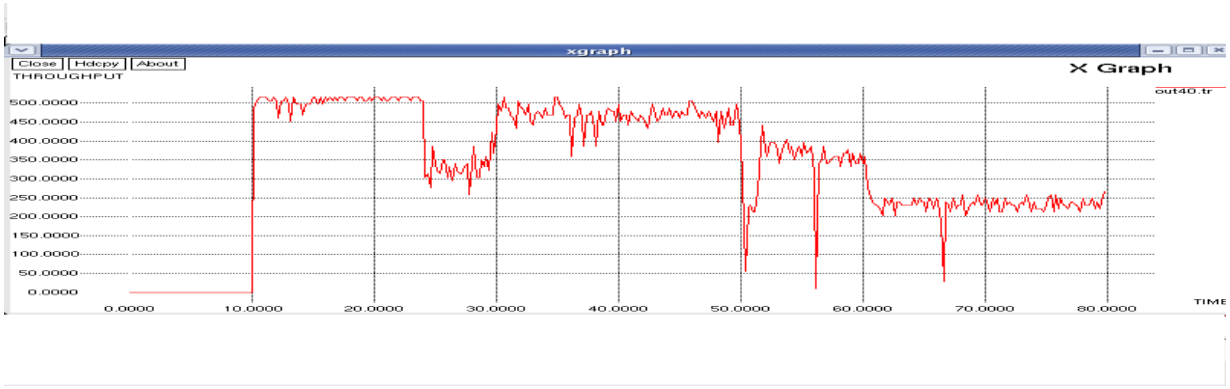

Figure 3.10 Throughput, 3 agents and 3 sinks
(For 20 Nodes)

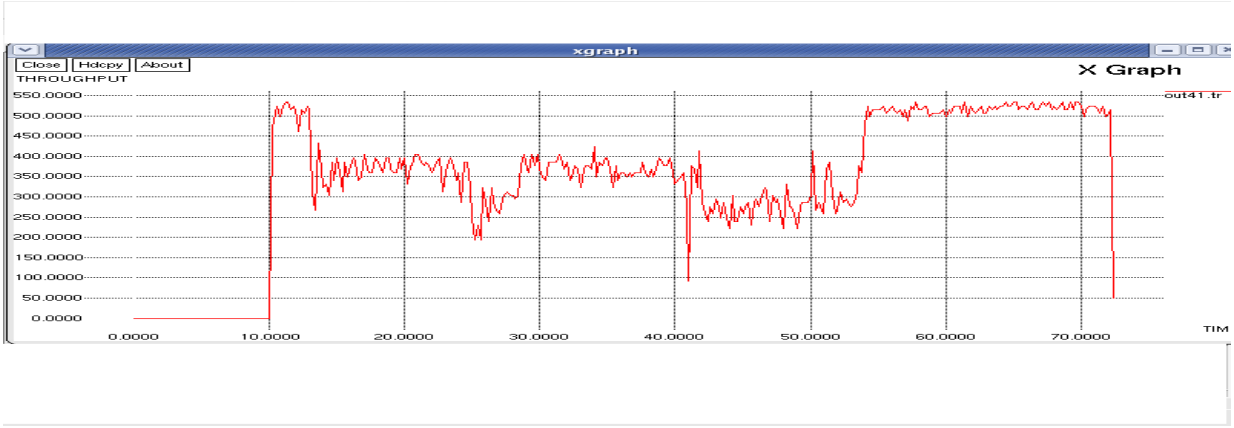

Figure 3.11 Throughput, 3 agents and 3 sinks
(For 30 Nodes)

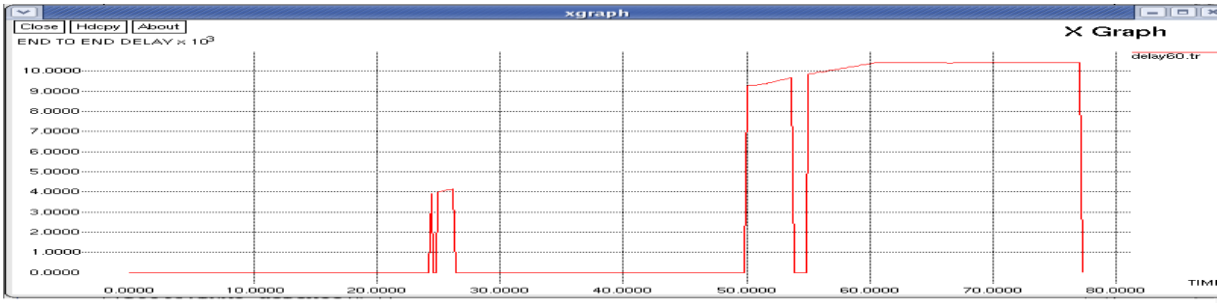

Figure 3.12 Delay, 3 agents and 3 sinks
(For 20 Nodes)

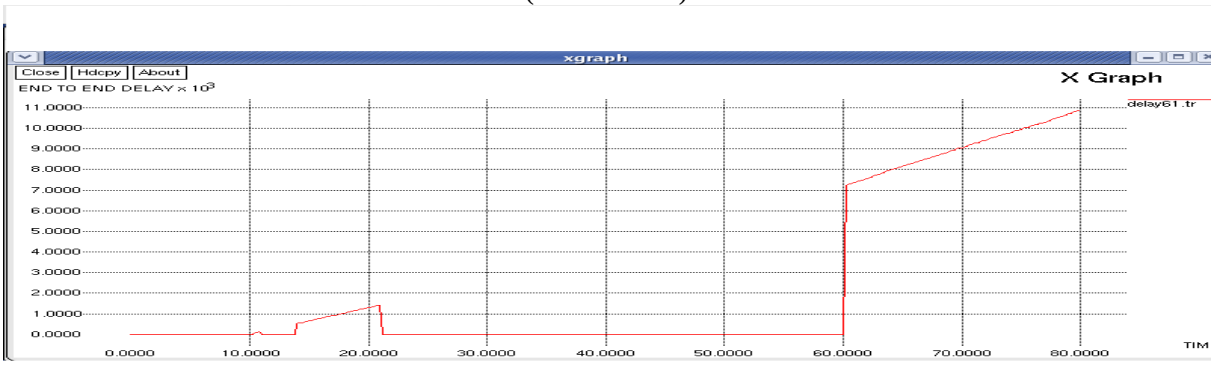

Figure 3.13 Delay, 3 agents and 3 sinks
(For 30 Nodes)

IV. FUTURE WORK

Ad hoc networking is a rather hot concept in computer communications. This means that there is much research going on and many issues that remain to be solved. Due to the limited time I have only focused on the routing protocols. However there are many issues that can be subject to further studies.

- Simulation Environment can be improved.
- More routing protocols like AODV, TORA, and ZRP are included.
- Measuring computational complexity
- Simulations which take unidirectional links into consideration.

- Some sort of analysis of whether many small control messages are most costly to send in terms of resources than fewer large control messages.
- Integration of mobile IP into ad hoc networks.
- Hand-over of real-time traffic between nodes.

V. CONCLUSION

The simulations have shown that there is certainly a need for a special ad hoc routing protocol when the number of nodes in a network increases, with conditions like the constant packet size, data rate and different number of mobile nodes present with different mobility rates. The simulations have shown that the more conventional routing protocols like DSDV have less delay which comes from effect from the large fraction of packet drops that DSDV has in both cases for 20 and 30 nodes. The throughput for DSDV tends to be on higher side than DSR when the size of the network is 30 nodes with packet size of 512 bytes and data rate of 600Kbps with area of the network limited to 500 x 500.
Also the simulations have shown that the protocol like DSR has high delay for 20 and 30 nodes sized network while the packet loss is less. The throughput for DSR is higher for network with 20 nodes with packet size of 512 bytes and data rate of 600Kbps with area of network limited to 500 x 500.
DSR which is based on source routing , which means that the byte overhead in each packet can affect the total byte overhead in the network quite drastically when the offered load to the network and size of the network increases.

A combination of DSR and DSDR thus would result in a protocol with better performance than DSR and DSDV.

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