Load Balanced Routing Protocols for Ad Hoc Mobile Wireless Networks

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Abstract— the collections of mobile nodes which can form randomly and dynamically for temporary basis network without need preexisting network infrastructure or any centralized controlled administration that nodes can be arbitrarily located and can move freely called Mobile ad hoc network. Because of some limitation at wireless link capacities can be excessive loads on the nodes. There are two major aspects for this –traffic and power consumption. So, unbalanced traffic may cause of more delay, packet dropping, and reducing packet delivery ratio. The work is the idea on view of balancing nodes on traffic in different routing protocol DSR, DSDV and AODV in a mobile ad hoc network. This analysis of this result obtained from a NS2 particular scenario.

Index Terms— Ad hoc Networks, AODV, DSR, DSDV, load balancing, NS2, Routing Protocols.

I. INTRODUCTION

There are two versions of mobile wireless networks, typical infrastructure and infrastructure less networks. Typical infrastructure networks are cellular mobile networks, which have fixed base stations, which are connected with other base stations through a wired backbone. The other type of network, infrastructure-less network, is known as ad hoc networks .Mobile ad hoc networks (MANETs) are collections of mobile nodes that have desirable features such as fast deployment and the ability to communicate while on the move [1]. Nodes on the shortest path will get heavier loaded than others since they are frequently chosen as the routing path. Having a heavy load can exhaust a node's resources such as bandwidth, processing power, battery energy, and memory storage. Furthermore, if one of the heavily loaded nodes is congested, it can cause to packet loss and buffer overflow, resulting in longer end-to-end delay, degradation in throughput, and loss of transport connections. Hence, it is important that some form of load balancing is present in the network. [1] The requirement of balancing the nodes for sending the packets to the destination is a vital factor of network overhead. By balancing the node it could less the traffic of the network which is desired by one and all. The next section of this paper contains the analysis of the related parameter- Node failure's or drop packets and average end-to-end packet delay which could be optimized for a particular mobile ad-hoc protocol in the specific area. Load balanced routing aims to move the traffic from the optimal and busy load area to less loaded areas, so that entire network achieves better performance. Depending on situation of design some nodes are busy and some are idle.

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We worked with three routing protocols Ad hoc on-demand Distance Vector (AODV), Destination-Sequenced Distance-Vector Routing protocol (DSDV), Dynamic Source Routing Protocol (DSR), Only DSDV is proactive protocol and rest of two is reactive protocols.

II. RELATED WORKS

Over the years, several load balanced ad hoc routing protocols have been proposed. Most of the approaches are on-demand-based protocols; that is, they combine load balancing strategies with route discovery. A route with the least load among multiple possible routes from source to destination is usually chosen [1]. A critical challenge in the design of ad hoc networks is the development of efficient routing protocols that can provide high-quality communication between two mobile nodes. Numerous routing protocols have been developed for ad hoc mobile networks [2]. The most popular ones are Ad hoc on-demand Distance Vector (AODV), Destination-Sequenced Distance-Vector Routing protocol (DSDV), Dynamic Source Routing Protocol (DSR) [2]. Destination Sequence Distance Vector (DSDV) [5] is a proactive routing protocol and is based on the distance vector algorithm. In proactive or table-driven routing protocols, each node continuously maintains up-to-date routes to every other node in the network. Routing information is periodically transmitted throughout the network in order to maintain routing table consistency. The routing table is updated at each node by finding the change in routing information about all the available destinations with the number of nodes to that particular destination. Also, to provide loop freedom DSDV uses sequence numbers, which is provided, by the destination node [4][5]. Dynamic Source Routing DSR [6] is a reactive protocol. This protocol is one of the example of an on-demand routing protocol that is based on the concept of source routing. It is designed for use in multi hop ad hoc networks of mobile nodes. It allows the network to be completely self-organizing and self-configuring and does not need any existing network infrastructure or administration. DSR uses no periodic routing messages like AODV, thereby reduces network bandwidth overhead, conserves battery power and avoids large routing updates. However, it needs support from the MAC layer to identify link failure [4][6]

The AODV algorithm is an improvement of DSDV protocol described above. It reduces number of broadcast by creating routes on demand basis, as against DSDV that maintains mutes to each known destination [8]. When source requires sending data to a destination and if route to that destination is not known then it initiates route discovery. AODV allows nodes to respond to link breakages and changes in network topology in a timely manner [4] [7].

III. METHODOLOGY

In this case I tried to compare the load balancing parameters of DSDV, DSR and AODV in same scenario with same parameters [table A]. A simple scenario was created at ns2 and run. The NS-2 is a discrete event driven simulator developed at UC Berkeley [9] [10]. The version I use is NS-2.34-allinone that is well spurted tool for network research and education. It is an object oriented simulation written in C++, with an OTcl interpreter as a frontend. NS uses two languages because simulator got to deal with two things: i) detailed simulation of protocols which require a system programming language which can efficiently manipulate bytes, packet headers and implement algorithms, ii) research involving slightly varying parameters or quickly exploring a number of scenarios [9]. It also produced two file that we mentioned at TCL file – Nam and Trace file. I used AWK programming language, Perl script and Microsoft Excel for analysis the trace file.

Simulation parameters are shown in table 1.

Channel	Wireless Channel
radio-propagation	Two Ray Ground
network interface	Wireless Physical
MAC type	802_11
interface queue type	Drop Tail/ Pri Queue
link layer type	LL
antenna model	Omni Antenna
Number of nodes	6
Routing protocol	AODV/DSDV/DSR
Simulation time	100 ms
Area	1000mx1000m

Table 1: Simulation parameters in used for simulation

Performance matrix

To analysis the performance of MANET we use packet drop, node movement and distance covered by the node from start point to end point.

a. **Data loss**: Packet loss is a measure of the number of packets dropped by the routers due to various reasons.

b. **Throughput**: It gives the fraction of the channel capacity used for useful transmission (Data packets correctly delivered to the destination) and is defined as the total number of packets received by the destination. It is in fact a measure of the effectiveness of a routing protocol.

c. **Average end-to-end delay**: This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times.

All these metrics are most widely used for representing performance of routing protocols because higher data delivery, lower control overhead and lower delay are always desirable. The essential parameters, which we have varied in our simulations, are mobility, network size and node connectivity.

IV. SIMULATION RESULT AND OBSERVATIONS

In this case to increase the accuracy and reliability of the results we run multiple simulations, runs with different seed numbers (1-10) as I got confidence of simulation results. We are looking to measure which routing protocol will be good load balanced routing protocol.

We got average of data after simulation for DSR vs AODV vs DSDV which is shown in below in table 2.

Protocol	Dropped	Throughput	End to end delay
DSR	11.2	99.407	129.6143
AODV	12.4	99.469	131.4521
DSDV	13	98.785	125.3474

Table 2: Average comparison

a. Data loss

Between data transmitting within two nodes can interrupted for two reasons, i) nod's failure and ii) link breakage [12]. Link breakage mainly depends on energy consumption of the mobile ad hoc nodes for a particular protocol. So, which protocol can balance in energy consumptions can reducing the data failure in network. This particular simulations shows that in table 2 , DSR is got better result than other two routing protocols. The reason behind it DSR always have more than one paths for destination but on the other hand DSDV requires a regular update routing tables which use battery and small amount of bandwidth. DSR not send HELLO message which reduce packet losses. The comparison between these three routing protocols is shown in figure 1.

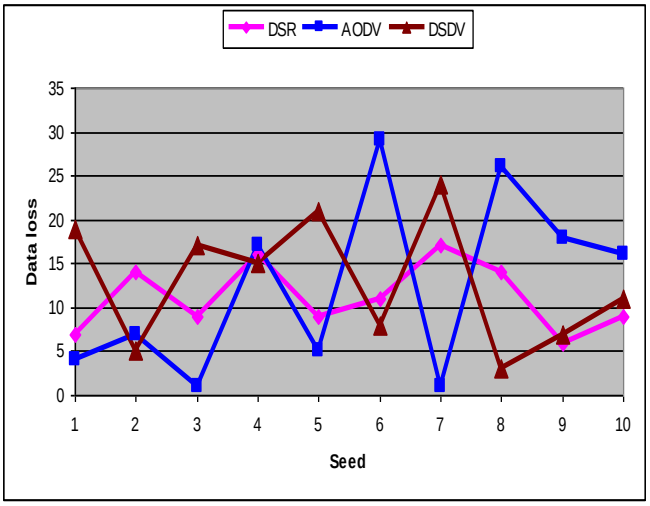

Figure 1 : Packet Drop DSR vs AODV vs DSDV

In the graph, figure 1 and Table 2 shows DSR is more stable than others two routing protocols.

b. Throughput

Throughput is the average rate of successful message delivery over a communication. Throughput of the routing protocol means that in certain time the total size of useful packets that received at all the destination nodes [4], the throughput values against 10 seeds on the table and graph shown in Figure 2. I got almost same output for two reactive routing protocols –DSR and AODV and less for DSDV. Because of DSR has multiple paths for destination its causes for less packet drops and storing neighbors nodes in the own node's database, so it produce more throughput. In comparisons three protocol DSR is better in this particular considerations.

Throughput	DSR	AODV	DSDV
Seed 1	99.4132	99.468	98.8179
Seed 2	99.4145	99.469	98.8163
Seed 3	99.4134	99.4683	98.8179
Seed 4	99.397	99.4691	98.7824
Seed 5	99.4144	99.4686	98.7342
Seed 6	99.3971	99.4698	98.7817
Seed 7	99.3969	99.4687	98.835
Seed 8	99.4138	99.4696	98.7985
Seed 9	99.4133	99.4692	98.7498
Seed 10	99.3964	99.4692	98.7155

Table 3: Throughput DSR vs AODV vs DSDV

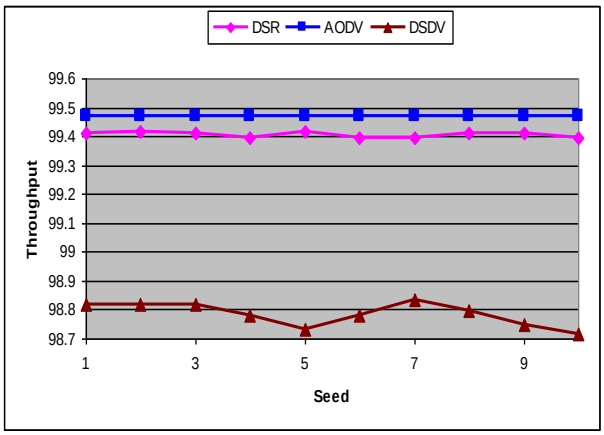

Figure 2 : Throughput DSR vs AODV vs DSDV

In the figure 2 and Table 2, it shown AODV has better perform then other two protocols and DSR and AODV has same throughput which is better than DSDV.

c. Average end-to-end delay

The packet end-to-end delay is the average time that packets take to traverse the network. This is the time from the generation of the packet by the sender up to their reception at the destination's application layer and is expressed in seconds. It therefore includes all the delays in the network such as buffer queues, transmission time and delays induced by routing activities and MAC control exchanges. The delay is also affected by high rate of CBR packets. The buffers become full much quicker, so the packets have to stay in the buffers a much longer period of time before they are sent.. [13].

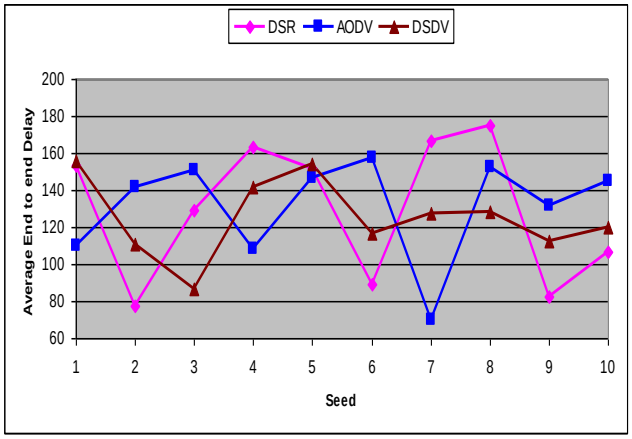

Figure 3: End to End Delay DSR vs AODV vs DSDV

In this figure 3 and Table 2 I got DSDV has lowest delay from all of them and DSR has much lower than AODV, which is as expected.

Summary of Comparison result

The results are in given below in a tabular for so that easy to look on it.

	Data loss	throughput	End to End delay
DSR	Stable	More consistence	Maximum delay introduced
AODV	Less stable	Least packet drop	Delay within acceptable time
DSDV	Not stable	highest packet drop	minimum delay introduced

Table 4: Comparison DSR vs AODV vs DSDV

This shown in this case DSR is and AODV is better than DSDV.

V. CONCLUSION

AODV is a reactive protocol (routes are only generated on demand, in order to reduce routing loads), and DSDV is a proactive protocol (with frequent updates of routing tables regardless of need). But DSR has multi paths for destinations that allow it's to do perform better. I have presented a detailed performance of mobile ad hoc networks routing protocols of DSR and AODV as reactive protocols and DSDV as proactive protocol. Both reactive protocols have shown better performance than proactive protocols in high mobility scenario [table 4]. Though both are reactive protocols they DSR and AODV have used different mechanism that is DSR use routing source and AODV use routing table.

By optimizing the parameters I used for the protocols could be used for balancing the load more efficiently for transferring packets in mobile ad-hoc network. For wireless power and energy is one of the most important things. So, Energy-constraint model can also be beneficial to the performance analysis of energy-aware protocols. Furthermore, when such an energy constraint exists, research can be devoted to a fair-queuing mechanism that balances between the node's own packets and the packets that need to be forwarded. In this work, I used three ad hoc routing protocols and that have been implemented and analyzed and compared. However there are other protocols also in MANETs such as TORA, ZRP, INSIGNIA etc. The future scope is the comparisons between these protocols. Also we can have different and every possible way to fine how maximize of performance in future. Maybe for the future we would be able to focus more on security issue. Because this is area we really should concentrate.

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