Performance Comparison of Two On-demand Routing Protocols for Ad-hoc Networks based on Random Way Point Mobility Model

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Abstract:

Ad hoc networks are characterized by multihop wireless connectivity, frequently changing network topology and the need for efficient dynamic routing protocols plays an important role. We compare 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). A detailed simulation model with MAC and physical layer models is used to study the interlayer interactions and their performance implications. We demonstrate that even though DSR and AODV share similar on-demand behavior, the differences in the protocol mechanisms can lead to significant performance differentials. In this paper we examine two on demand routing protocols AODV and DSR based on packet delivery ratio, normalized routing load, normalized MAC load, average end to end delay by varying the number of sources, speed and pause time.

Keywords: *MANET, Routing Protocol, on-demand, DSR, AODV, Random way point model*

1. Introduction

A network is a collection of two or more computing devices, which is connected by a communication medium. There are two types of network wired network and wireless network. Figure 1 below shows a simple wired network with three computing devices. When a node wishes to send information to the destination, it may do so by transmitting the information along a shared communication medium. In this paper any device actively participating in the network is called a node. Nodes are connected by communication medium or link. The nodes exchange information over links in discrete blocks called packets. If nodes do not have a direct link, then the packets have to traverse the path through the intermediate nodes. Whenever packet is transmitted from one node to another, it is said to have a hop. The various nodes within the network must cooperate with each other to make the information exchange successful. This cooperation process is called routing.

Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two types:

- Infrastructured networks.
- Infrastructureless (Ad hoc) networks [Stalling, 1996]

Infrastructured network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the network (called base station) within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. This is called handoff. In this approach the base stations are fixed.

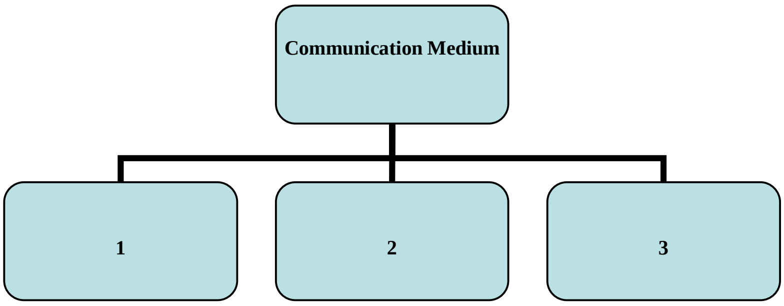


Figure 1. Simple network with three nodes

An ad hoc networks or infrastructureless networks is a collection of mobile nodes which forms a temporary network without the aid of centralized administration or standard support devices regularly available in conventional networks. In this paper, it is assumed that the mobile hosts uses wireless RF transceivers as their network interface. Routing protocol plays an important role if two hosts wishes to exchange packets which may not be able to communicate directly. All nodes are mobile and can be connected dynamically in an arbitrary manner. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network. Figure 2 below illustrates ad-hoc networks with three mobile hosts. Node C is not within the range of node A wireless transmitter. If node A wishes to exchange packets with node C, then it make use of node B to forward packets, since node B is an overlap between node A and node C. This situation becomes more complicated if more nodes are added within the network. An Ad-Hoc routing protocol must be able to decide the best path between the nodes, minimize the bandwidth overhead to enable proper routing, minimize the time required to converge after the topology changes. Ad hoc networks are very useful in emergency search-and-rescue operations, meetings or conventions in which persons wish to quickly share information, and data acquisition operations in inhospitable terrain.

This ad-hoc routing protocols can be divided into two categories:

i. *Table-driven routing protocols:* In table driven routing protocols, consistent and up-to-date routing information to all nodes is maintained at each node.

ii. *On-Demand routing protocols:* In On-Demand routing protocols, the routes are created as and when required. When a source wants to send to a destination, it invokes the route discovery mechanisms to find the path to the destination. Once a Route has been established, it is maintained until either the destination becomes inaccessible (along every path from the source), or until the route is no longer used, or expired [Elizabeth, 2003].

In recent years, a variety of new routing protocols targeted specifically at this environment have been developed. We consider two wirelesses on demand ad hoc network routing protocols that cover a range of design choices:

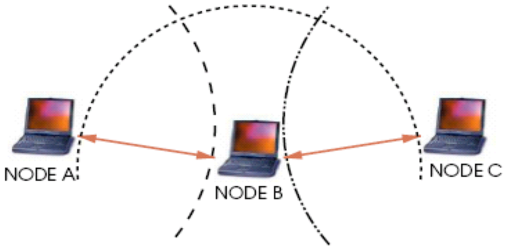


Figure 2 Ad-hoc Networks of three mobile hosts

Dynamic Source Routing (DSR) and Ad Hoc On-Demand Distance Vector Routing (AODV) are the two protocols that fall under the On-demand routing protocols category. Both these two protocols initiate routing activities on an on-demand basis. This reactive nature of these protocols is a significant departure from more traditional proactive protocols, which find routes between all source-destination pairs regardless of the use or need for such routes. The key motivation behind the design of on-demand routing protocols is the reduction of the routing load. High routing load usually has a significant performance impact in low-bandwidth wireless links.

Dynamic Source Routing (DSR): The key distinguishing feature of DSR [Broch, Johnson & Maltz, 1999], [Johnson & Maltz 1996] is the use of source routing. Dynamic Source Routing (DSR) [Jonhson, Maltz & Hu 2004] is a reactive protocol i.e. it doesn't use periodic advertisements. It computes the routes when necessary and then maintains them. Source routing is a routing technique in which the sender of a packet determines the complete sequence of nodes through which the packet has to pass, the sender explicitly lists this route in the packet's header, identifying each forwarding "hop" by the address of the next node to which to transmit the packet on its way to the destination host.

There are two significant stages in working of DSR: Route Discovery and Route Maintenance. A host initiating a route discovery broadcasts a *route request* packet which may be received by those hosts within wireless transmission range of it. The route request packet identifies the host, referred to as the *target* of the route discovery, for which the route is requested. If the route discovery is successful the initiating host receives a *route reply* packet listing a sequence of network hops through which it may reach the target. In addition to the address of the original initiator of the request and the target of the request, each route request packet contains a *route recor*d, in which is accumulated a record of the sequence of hops taken by the route request packet as it is propagated through the network during this route discovery. While a host is using any source route, it monitors the continued correct operation of that route. This monitoring of the correct operation of a route in use is called *route maintenanc*e. When route maintenance detects a problem with a route in use, route discovery may be used again to discover a new, correct route to the destination.

To optimize route discovery process, DSR uses cache memory efficiently. Suppose a host receives a route request packet for which it is not the target and is not already listed in the route record in the packet, and for which the pair (initiator address, request id) is not found in its list of recently seen requests; if the host has a route cache [Hu & Johnson, 200] entry for the target of the request, it may append this cached route to the accumulated route record in the packet, and may return this route in a route reply packet to the initiator without propagating (re-broadcasting) the route request. The delay for route discovery and the total number of packets transmitted can be reduced by allowing data to be piggybacked on route request packets. DSR uses no periodic routing advertisement messages, thereby reducing network bandwidth overhead, particularly during periods when little or no significant host movement is taking place. DSR has a unique advantage by virtue of source routing. As the route is part of the packet itself, routing loops, either short-lived or long-lived, cannot be formed as they can be immediately detected and eliminated.

Ad Hoc On-Demand Distance Vector Routing (AODV): Ad hoc On-demand Distance Vector (AODV) [Perkins, Elizabeth, and Das 2003] is essentially a combination of both DSR and DSDV. It borrows the basic on-demand mechanism of Route Discovery and Route Maintenance from DSR, plus the use of hop-by-hop routing, sequence numbers, and periodic beacons from DSDV. It uses destination sequence numbers to ensure loop freedom at all times and by avoiding the Bellman-Ford "count-to-infinity" problem offers quick convergence when the ad hoc network topology changes.

Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV. These message types are received via UDP, and normal IP header processing applies.

As long as the end points of a communication connection have valid routes to each other, AODV does not play any role. When a route to a new destination is needed, the node broadcasts a

RREQ to find a route to the destination. A route can be determined when the RREQ reaches either the destination itself, or an intermediate node with a 'fresh enough' route to the destination. A 'fresh enough' route is a valid route entry for the destination whose associated sequence number is at least as great as that contained in the RREQ. The route is made available by unicasting a RREP back to the origination of the RREQ. Each node receiving the request caches a route back to the originator of the request, so that the RREP can be unicast from the destination along a path to that originator, or likewise from any intermediate node that is able to satisfy the request.

If intermediate nodes reply to every transmission of a given RREQ, the destination does not receive any copies of it. In this situation, the destination does not learn of a route to the originating node. This could cause the destination to initiate a route discovery (for example, if the originator is attempting to establish a CBR session). In order that the destinations learn of routes to the originating node, the originating node SHOULD set the “gratuitous RREP” ('G') flag in the RREQ if for any reason the destination is likely to need a route to the originating node. If in response to a RREQ with the 'G' flag set, an intermediate node returns a RREP, it MUST also unicast a gratuitous RREP to the destination node.

Nodes monitor the link status of next hops in active routes. In order to maintain routes, AODV normally requires that each node periodically transmit a HELLO message, with a default rate of once per every second. Failure to receive three consecutive HELLO messages from a neighbour is taken as an indication that the link to the neighbour in question is down. When a link break in an active route is detected, a RERR message is used to notify other nodes that the loss of that link has occurred. The RERR message indicates those destinations which are now unreachable due to the loss of the link. In order to enable this reporting mechanism, each node keeps a “precursor list”, containing the IP address for each of its neighbours that are likely to use it as a next hop towards the destination that is now unreachable.

In this research paper we attempted to present an overview of two main categories of mobile ad-hoc routing protocols and performance comparison of both the protocols based on Random way point model and the simulation of two routing protocols focussing on their differences in their dynamic behaviours that can lead to performance differences.

2. Simulation Model

A detailed simulation model based on *ns-2* [Fall & Vardhan, 1999] is used in the evaluation. The Distributed Coordination Function (DCF) of IEEE 802.11 [IEEE, 1997] for wireless LANs is used as the MAC layer protocol. An unslotted carrier sense multiple access (CSMA) technique with collision avoidance (CSMA/CA) is used to transmit the data packets. The radio model uses characteristics similar to a commercial radio interface, Lucent’s WaveLAN. WaveLAN [Echkardt & Steekiste 1996] [Tuch, 1993] is modeled as a shared-media radio with a nominal bit rate of 2 Mb/s and a nominal radio range of 250 m [Anastasi, Borgia, Conti & Gregori, 2003], [Anastasi, Borgia, Conti & Gregori, 2003a].

The protocols maintain a *send buffer* of 64 packets. It contains all data packets waiting for a route, such as packets for which route discovery has started, but no reply has arrived yet. To prevent buffering of packets indefinitely, packets are dropped if they wait in the send buffer for more than 30 s. All packets (both data and routing) sent by the routing layer are queued at the *interface queue* until the MAC layer can transmit them. The interface queue has a maximum size of 50 packets and is maintained as a priority queue with two priori-ties each served in FIFO order. Routing packets get higher priority than data packets.

Traffic and Mobility models: In this paper we are using traffic and mobility model based on Continuous bit rate (CBR) traffic sources are used. The source-destination pairs are spread randomly over the network. Only 512-byte data packets are used. The number of source-destination pairs and the packet sending rate in each pair is varied to change the offered load in the network.

The mobility model uses the *random waypoint* model [Broch 1998] in a rectangular field. The field configurations used is: 500 m x 500 m field with 50 nodes and this simulation is also carried out for configuration 670mx670m filed with 20 nodes. Here, each packet starts its journey from a random location to a random destination with a randomly chosen speed (uniformly distributed between 0–20 m/s). Once the destination is reached, another random destination is targeted after a pause. The pause time, which affects the relative speeds of the mobiles, is also varied. Simulations are run for 100 simulated seconds and also it is run for 200 seconds. Identical mobility and traffic scenarios are used across protocols to gather fair results.

3. Performance Metrics

The following four important performance metrics are considered for evaluation of these two on demand routing protocols:

Packet delivery fraction: The ratio of the data packets delivered to the destinations to those generated by the CBR sources.

Average end-to-end delay of data packets: 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.

Normalized routing load: The number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one transmission

Normalized MAC load: The number of routing, Address resolution protocol (ARP), and control (e.g., RTS, CTS, ACK) packets transmitted by the MAC layer for each delivered data packet. Essentially, it considers both routing overhead and the MAC control overhead. Like normalized routing load, this metric also accounts for transmission at every hop.

The first two metrics are the most important for best effort traffic. The routing load metric evaluates the efficiency of the routing protocol. Finally the MAC load is a measure of effective utilization of the wireless medium by data traffic.

4. Implementation

Installing Cygwin in windows is done so that NS-2 software can be installed and this installation of Cygwin for windows can be done from the website http://www.cygwin.com

The network simulator NS-2 (ns-allinone-2.28) can be installed from the website http://www.isi.edu/nsnam/ns/. Installation of ns-2 could be a bit lengthy and a time-consuming process. It involved downloading and setting up a 250 MB package. However, getting the simulator to work was the first step involved in carrying out the simulations.

To understand the basics involved in ns-2 simulations a good tutorial is available at the website:

http://www.isi.edu/nsnam/ns/tutorial/index.html

The wireless extension to ns-2 (incorporated in the current release ns-2.28 under cygwin) provides the implementation of the DSR, AODV routing protocols. Nam is the basic visualization tool used for ns-2 simulations. Using the perl script analyze the trace file which are generated and using MSExcel we draw the graph to do the performance comparison of two on-demand routing protocols. To Generate traffic and mobility models for different on-demand routing protocols we use the following commands.

Traffic models: Random traffic connections of TCP and CBR can be setup between mobile nodes using a traffic-scenario generator script. This traffic generator script is available under ~ns/indep-utils/cmu-scen-gen and is called cbrgen.tcl. It can be used to create CBR and TCP traffics connections between wireless mobile nodes. So the command line to implement looks like the following:

```
ns cbrgen.tcl [-type cbr|tcp] [-nn
nodes] [-seed seed] [-mc connections][-
rate rate]
```

For the simulations to be carried out in this paper, we use traffic models for 50 nodes with cbr traffic sources, with maximum connections of 10,20,30,40 at a rate of 4 packets/sec. For the second set of simulations to be carried out, we use traffic models for 20 nodes with cbr traffic sources, with maximum connections of 10 at a rate of 10 packets/sec and the mobility can also be varied.

Mobility models: The node-movement generator is available under ~ns/indep-utils/cmu-scen-gen/setdest directory and consists of setdest{.cc,.h} and Makefile. The command to implement would look like

```
./setdest [-n num_of_nodes] [-p
pausetime] [-s maxspeed] [-t simtime] \  [-x
maxx] [-y maxy] > [outdir/movement-file]
```

Random Mobility models were created for the simulations using 50 nodes, with pause times of 0,10,20,40,100 seconds, maximum speed of 20m/s, topology boundary of 500x500 and simulation time of 100secs. Random mobility models were also created for the simulations using 20 nodes with different speeds 5,10,15,20 m/s, pause time of 2 seconds, topology boundary of 670x670 and simulation of 200secs.

To simulate we write the Tcl code to set up the wireless simulation components includes: network components types, parameters like the type of antenna, the radio-propagation model, the type of ad-hoc routing protocol, traffic models and node movement models [Christain de Waal & Gerharz, 2007] used by mobile nodes etc. To parse the Simulation trace files after each simulation is done the trace files recording the traffic and node movements are generated. These files need to be parsed in order to extract the information needed to measure the performance metrics. The old trace format was used for parsing [Odl and New Trace Format for NS2, 2007]. To evaluate the performance metrics of the two on-demand routing protocols we consider the following metrics.

Evaluating Packet delivery fraction (pdf):

$$\text{packet delivery fraction (pdf \%)} = (\text{received packets/ sent packets}) * 100$$

Evaluating Average End-End packet delivery time: For each packet with id (Ii) of trace level (AGT) and type (cbr), calculate the send(s) time (t) and the receive (r) time (t) and average it.

Evaluating Normalized routing load:

normalized routing load = (routing packets sent) / receives.

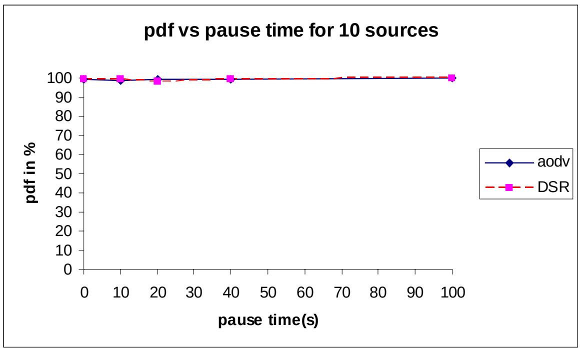
5. Results and Discussions

The simulation parameters which have been considered for doing the performance comparison of two on-demand routing protocols is given below.

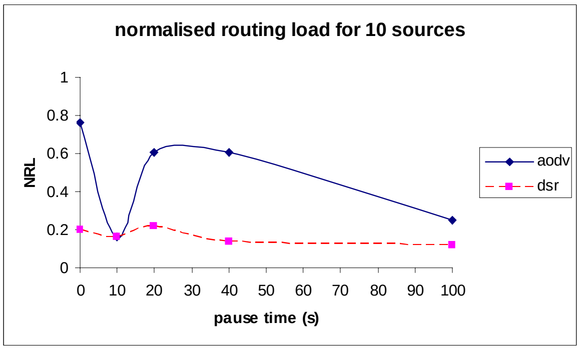
Protocols	**AODV, DSR**
Simulation time	100 seconds
#of nodes	50
Map size	500mx500m
Max speed	20m/s
Mobility model	Random way point
Traffic Type	Constant bit rate (CBR)
Packet Size	512 bytes
Connection rate	4pkts/sec
Pause time	0,10,20,40,100
#of connections	10,20,30,40

This simulation analysis is made from the graph 1. First we analyze the first parameter Packet delivery ratio with respect varied pause times. The graph shows that the packet delivery ratio for the two on-demand routing protocol is similar. The second parameter Normalized routing load with varied pause times is analyzed and it is found that for DSR it is less when compared to AODV and we see that it is fairly stable even with increase number of sources. A relatively stable normalizes routing load is a desirable property for scalability of the protocols. We find that major contribution to AODV routing overhead is from route requests, while route replies constitute a large fraction of DSR routing overhead. By virtue of aggressive caching, DSR is more likely to find the route in the cache and hence the route discovery process occurs less frequently than AODV and hence the routing overhead for DSR is less when compared to AODV. The third parameter Normalized MAC load is analyzed with respect to different pause times and it is found that for AODV it is less when compared to DSR for lower pause times. This is because RERRs are handled different in each protocol. RERR are unicast in DSR, and therefore contribute to additional MAC overhead like RREPs. In AODV, RERRs are broadcast like RREQs and hence are less expensive. Consequently when the MAC overhead is factored DSR is found to generate higher overall network load than AODV in all scenarios despite having less routing overhead. With respect to fourth parameter when analyzed the delay AODV and DSR have identical delays for 10 sources.

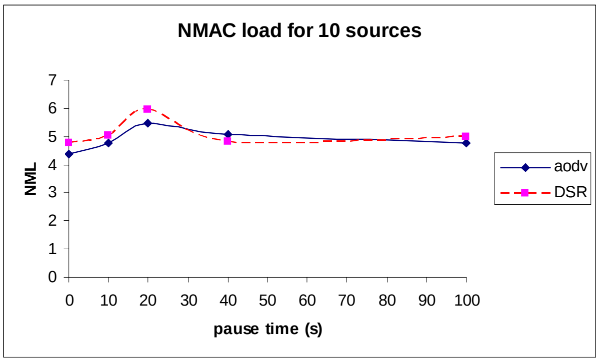
Graph 1-A



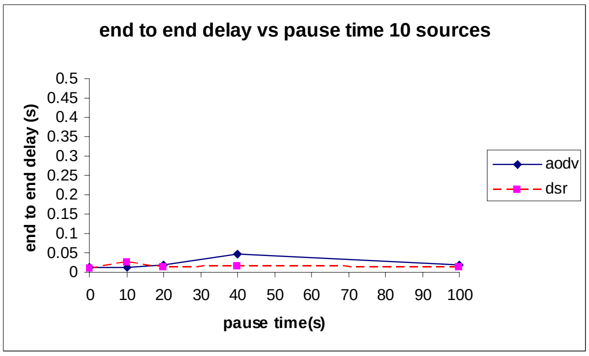
Graph 1-B



Graph 1-C



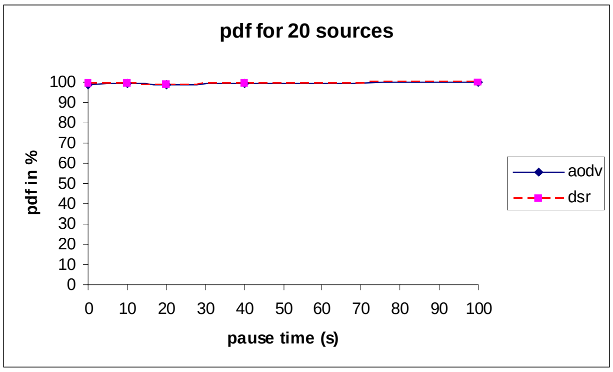
Graph 1-D



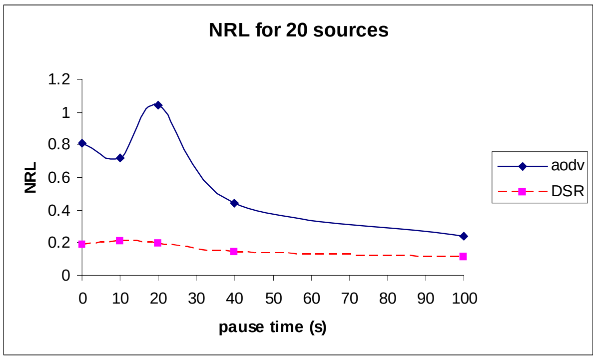
Graph 1: This graph is drawn considering 10 sources

The simulation analysis for the graph 2 shows that the packet delivery ratio with respect to varied pause times for both the protocols looks similar. The Normalized routing load for DSR is found to be less when compared to AODV because of DSR aggressive caching technique. The Normalized MAC load for AODV is slightly lesser when compared to DSR. The end to end delays for both the protocols looks identical.

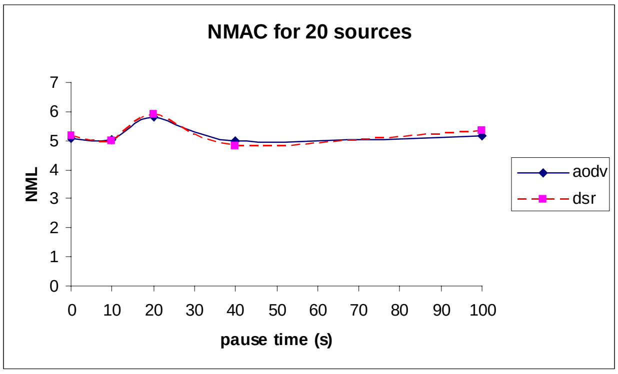
Graph 2-A



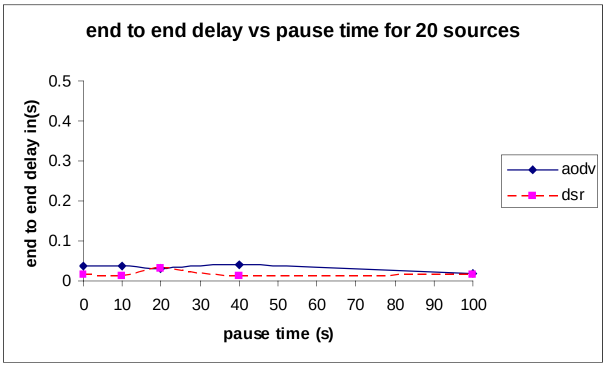
Graph 2-B



Graph 2-C



Graph 2-D



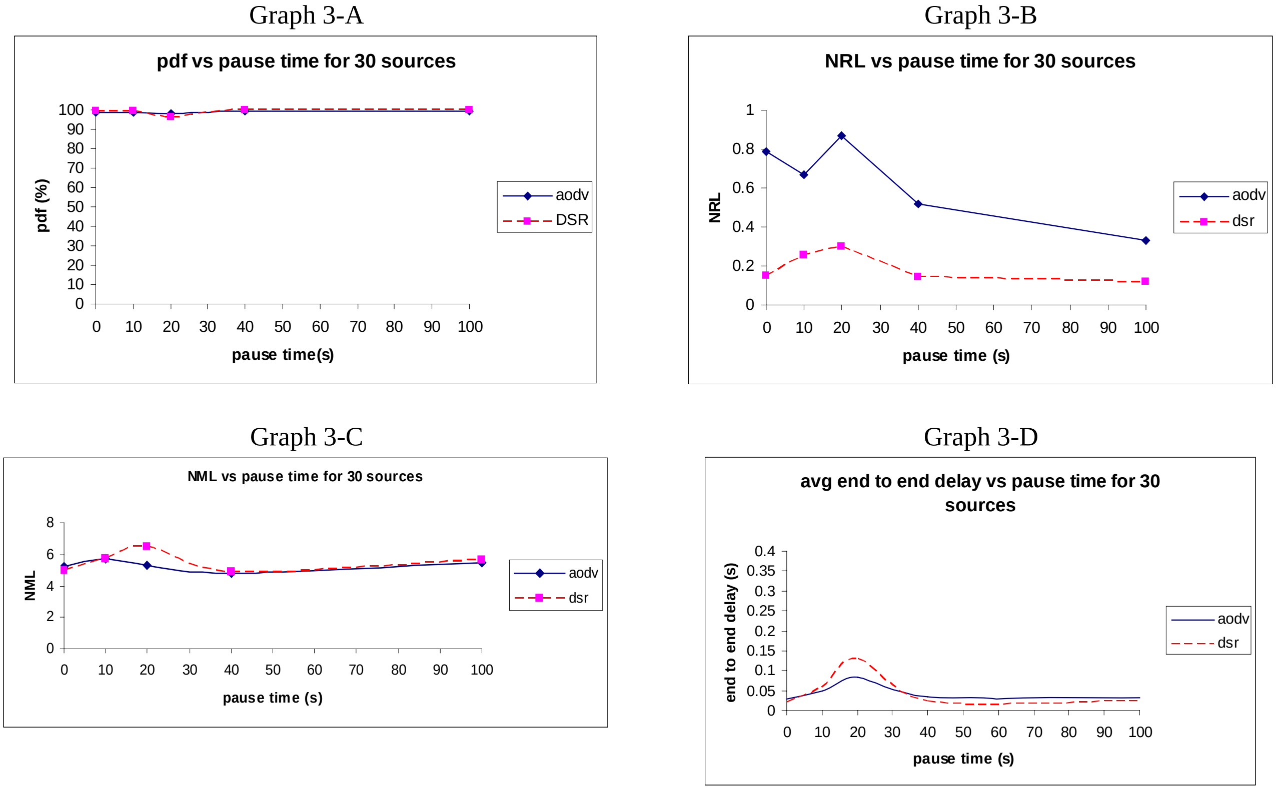
Graph 2: This graph is drawn considering 20 sources

The simulation analysis for the graph 3 shows that the packet delivery ratio with respect to varied pause times for both the protocols looks similar. The Normalized routing load with respect to varied pause times for DSR is found to be very less when compared to AODV because of DSR aggressive caching technique. The Normalized MAC load for AODV is slightly lesser when compared to DSR. With respect to end to end delays in the case of 30 sources AODV has less delay than DSR for lower pause times. But for higher pause times DSR has less delay when compared to AODV.

The simulation analysis for the graph 4 shows that the packet delivery ratio with respect to varied pause times for both the protocols looks similar. The Normalized routing load with respect to varied pause times for DSR is found to be very less when compared to AODV because of DSR aggressive caching technique. The Normalized MAC load for AODV is slightly lesser when compared to DSR. With respect to end to end delays in the case of 40 sources AODV has less delay than DSR for lower pause times. But for higher pause times DSR has less delay when compared to AODV.

To draw the graph 5 the set of simulation parameters considered to do the performance comparison of two on-demand routing protocols is given below:

Protocols	**AODV,DSR**
Simulation time	200s
#of nodes	20
Map size	670mx670m
Speed	5-10-15-20-25m/sec
Mobility model	Random Way point
Traffic type	Constant bit Rate(CBR)
Packet Size	512 bytes
Connection Rate	10 pkts/sec
Pause time	2s
#of connections	10

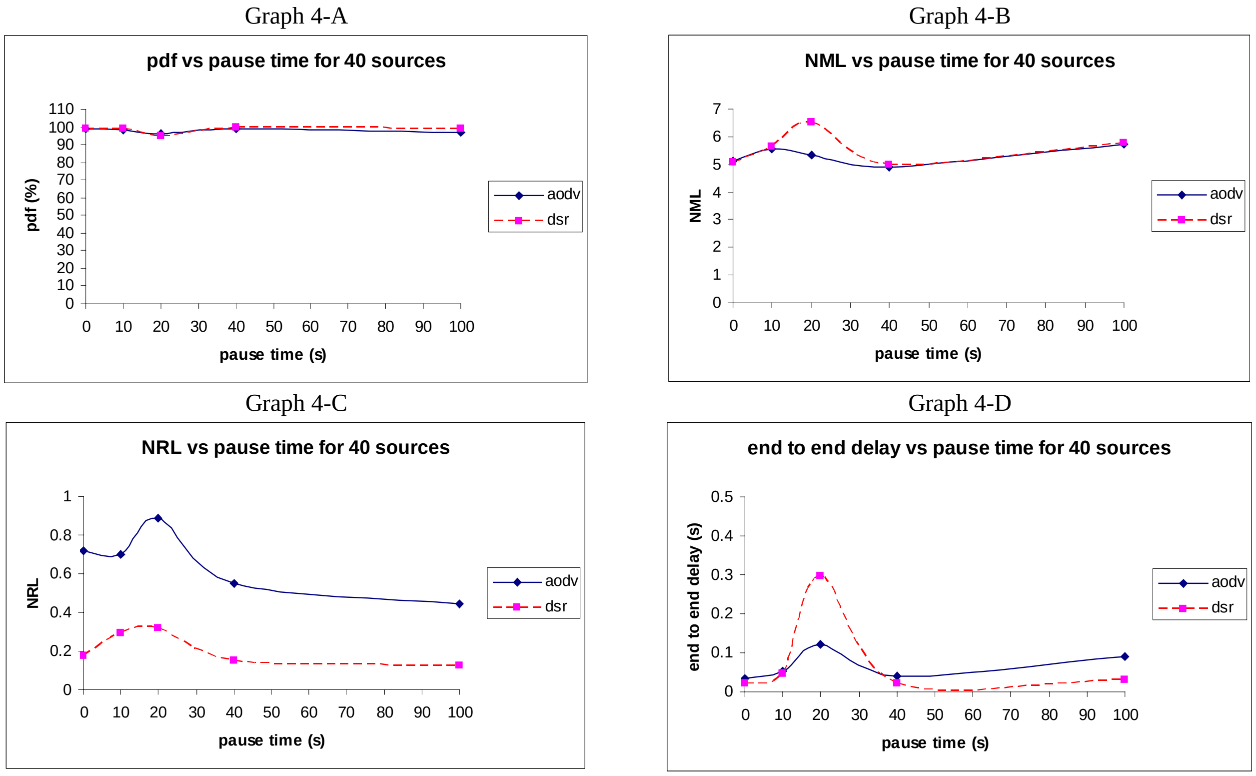

Graph 3-A

Graph 3-B

Graph 3-C

Graph 3-D

Graph 3: This graph is drawn considering 30 sources


Graph 4-A

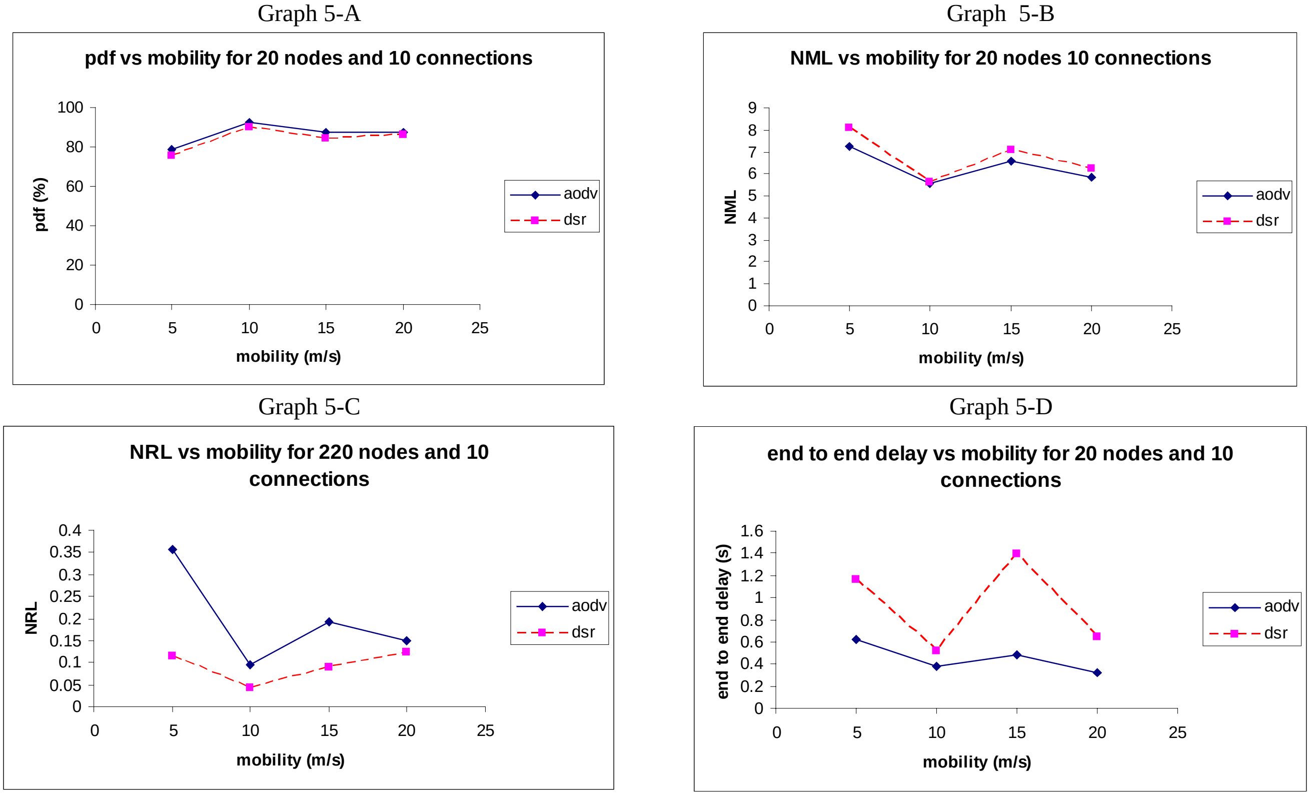
Graph 4-B

Graph 4-C

Graph 4-D

Graph 4: This graph is drawn considering 40 sources

The simulation analysis of graph 5 shows that the packet delivery ratio with respect to varied mobility for both the protocols looks similar. The Normalized routing load with respect to varied mobility for DSR is found to be very less when compared to AODV because of DSR aggressive caching technique. DSR almost have a lower routing load than AODV. This can be attributed to the caching strategy used by DSR. By virtue of aggressive caching, DSR is more likely to find a route in the cache, and hence resorts to route discovery less frequently than AODV. The Normalized MAC load for AODV is slightly lesser when compared to DSR. With respect to end to end delays AODV has less delay than DSR.


Graph 5-A

Graph 5-B

Graph 5-C

Graph 5-D

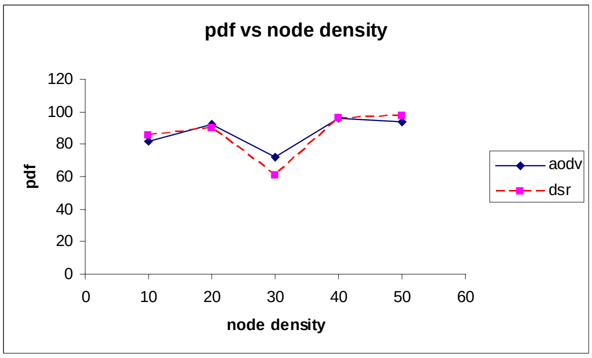
Graph 5:

To draw the graph 6 the simulation parameters considered to do the performance comparison of two on-demand routing protocols is given below.

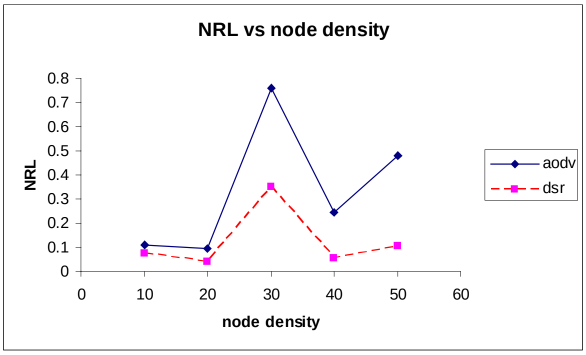
Protocols	**AODV,DSR**
Simulation time	200s
#of nodes	10-20-30-40-50
Map size	670mx670m
Speed	10m/s
Mobility model	Random way point
Traffic type	Constant bit rate
Packet size	512 bytes
Connection rate	10pkts/sec
Pause time	2s
#of connections	10

The simulation analysis of graph 6 shows that the packet delivery ratio with respect to varied node density for both the protocols looks similar. The Normalized routing load with respect to varied node density for DSR is found to be very less when compared to AODV because of DSR aggressive caching technique. DSR almost have a lower routing load than AODV. This can be attributed to the caching strategy used by DSR. By virtue of aggressive caching, DSR is more likely to find a route in the cache, and hence resorts to route discovery less frequently than AODV. The Normalized MAC load for AODV is slightly lesser when compared to DSR. With respect to end to end delays AODV has less delay than DSR

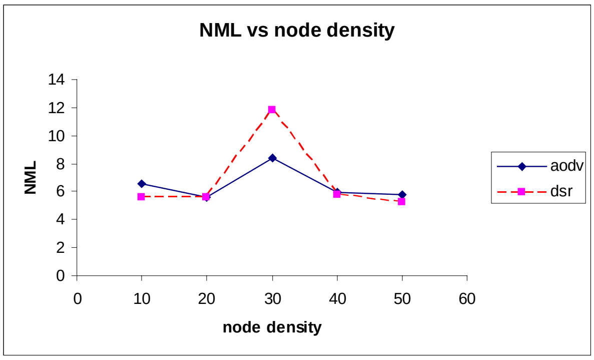
Graph 6-A



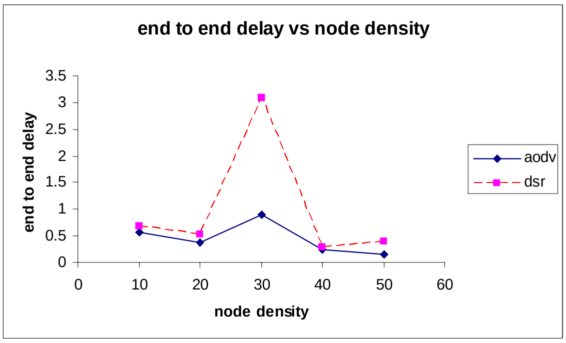
Graph 6-B



Graph 6-C



Graph 6-D

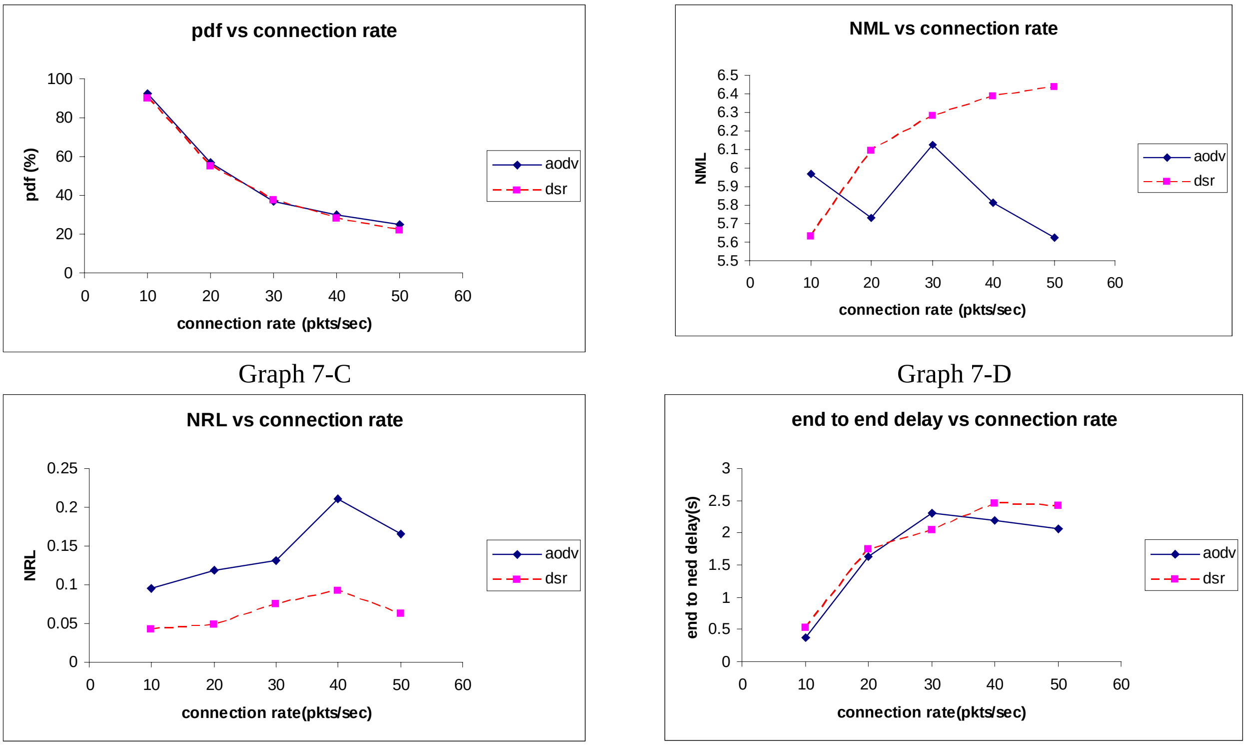


Graph 6:

The simulation parameters considered to draw Graph7 to do the performance comparison of two on-demand routing protocols is given below**:**

Protocols	**AODV,DSR**
Simulation time	200s
#of nodes	20

Map size	670mx670m
Speed	10m/s
Mobility model	Random way point
Traffic type	CBR
Packet size	512 bytes
Connection rate	10-20-30-40-50pkts/sec
Pause time	2s
#of connections	10


Graph 7-A

Graph 7-B

Graph 7-C

Graph 7-D

Graph 7:

The simulation analysis of graph 7 shows that the packet delivery ratio with respect to varied connection rate density for both the protocols looks similar. The Normalized routing load with respect to varied node density for DSR is found to be very less when compared to AODV because of DSR aggressive caching technique. DSR almost have a lower routing load than AODV. This can be attributed to the caching strategy used by DSR. By virtue of aggressive caching, DSR is more likely to find a route in the cache, and hence resorts to route discovery less frequently than AODV. The Normalized MAC load for AODV is lesser when compared to DSR. With respect to end to end delays AODV has less delay than DSR

6. Observations

The simulation results bring out some important characteristic of differences between the two on demand routing protocols. The presence of high mobility implies frequent link failures and each routing protocol reacts differently during link failures. The different basic working mechanism of these protocols leads to the differences in their performances.

For DSR and AODV, packet delivery ratio is independent of offered traffic load, with both protocols delivering between 85% and 100% of the packets in all cases. In contrast, the lazy approach used by the on-demand protocols, AODV and DSR to build the routing information as and when they are created make them more adaptive and result in better performance (high packet delivery fraction and lower average end-to-end packet delays).

Next the simulation results compare the performances of AODV and DSR lead us to the following conclusions.

Effect of Mobility: In the presence of high mobility, link failures can happen very frequently. Link failures trigger new route discoveries in AODV since it has at most one route per destination in its routing table. Thus, the frequency of route discoveries in AODV is directly proportional to the number of route breaks. The reaction of DSR to link failures in comparison is mild and causes route discovery less often. The reason is the abundance of cached routes at each node. Thus, the route discovery is delayed in DSR until all cached routes fail. But with high mobility, the chance of the caches being stale is quite high in DSR. Eventually when a route discovery is initiated, the large number of replies received in response is associated with high MAC overhead and cause increased interference to data traffic. Hence, the cache staleness and high MAC overhead together result in significant degradation in performance for DSR in high mobility scenarios.

In lower mobility scenarios, DSR often performs better than AODV, because the chances of find the route in one of the caches is much higher. However, due to the constrained simulation environment (lesser simulation time and lesser mobility models), the better performance of DSR over AODV couldn’t be observed.

Routing Load Effect: DSR almost always has a lower routing load than AODV. This can be attributed to the caching strategy used by DSR. By virtue of aggressive caching, DSR is more likely to find a route in the cache, and hence resorts to route discovery less frequently than AODV.

7. Conclusions

In this paper we have compared the performance of AODV and DSR routing protocols for ad hoc networks using ns-2 simulations. Unfortunately, TORA simulations couldn’t be successfully carried out.

AODV and DSR use the reactive On-demand routing strategy. Both AODV and DSR perform better under high mobility simulations. High mobility results in frequent link failures and the overhead involved in updating all the nodes with the new routing information as in DSDV is much more than that involved AODV and DSR, where the routes are created as and when required.

DSR and AODV both use on-demand route discovery, but with different routing mechanics. In particular, DSR uses source routing and route caches, and does not depend on any periodic or timer-based activities. DSR exploits caching aggressively and maintains multiple routes per destination. AODV, on the other hand, uses routing tables, one route per destination, and destination sequence numbers, a mechanism to prevent loops and to determine freshness of routes. The general observation from the simulation is that for application-oriented metrics such as packet delivery fraction and delay. AODV, outperforms DSR in more “stressful” situations (i.e., smaller number of nodes and lower load and/or mobility), with widening performance gaps with increasing stress (e.g., more load, higher mobility). DSR, however, consistently generates less routing load than AODV. The poor performances of DSR are mainly attributed to aggressive use of caching, and lack of any mechanism to expire stale routes or determine the freshness of routes when multiple choices are available. Aggressive caching, however, seems to help DSR at low loads and also keeps its routing load down. If there could be any mechanisms to expire routes and or determine the freshness of routes in the route cache could benefit DSR performance significantly. It is found that for lower loads DSR is more effective while AODV is more effective for higher loads.

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Article received: 2007-08-18