Scientific Research and Essays Vol. 6(6), pp. 1256-1274, 18 March, 2011
Available online at http://www.academicjournals.org/SRE
DOI: 10.5897/SRE10.763
ISSN 1992-2248 ©2011 Academic Journals

Full Length Research Paper

Comparative study between the performance of proactive and reactive mobile ad-hoc networks (MANET) routing protocols with varying mobility

Samir M. Said[1], Ibrahiem M. M. El Emary[2]* and Shatha Kadim[3]

[1]Ahliyya Amman University, Amman, Jordan.
[2]King Abdulaziz University, Jeddah, KSA, Saudi Arabia.
[3]Al Balqa Applied University, Al Salt, Jordan.

Accepted 3 February, 2011

Mobile ad-hoc networks (MANET) are collections of wireless mobile nodes dynamically forming a temporary network without the use of any pre-defined network infrastructure or centralized administration. In this paper, performance evaluation of both proactive wireless routing protocol destination sequenced distance vector (DSDV) and reactive protocols ad-hoc on demand distance vector (AODV) with continuous bit rate (CBR) traffic is executed using NS-2 simulator. The research work mainly focuses on the protocols behaviour on different mobility. The performance differentials are analyzed with varying network load and mobility. Random waypoint model is used to create mobility model for this research work. Two types of simulation work on mobility are done under same simulation environment, which make it more closely to evaluate the performance of routing protocols. In total five performance metrics are measured to conclude this paper. It demonstrates that even though both protocols share distance vector characteristics, the individuality of protocol's mechanism draw considerable performance differentials with mobility. Finally, according to results of practical works, we can clearly say that the routing protocols AODV gives less fluctuation results and better performance as compare with DSDV, with respect to some identified parameters of routing protocol such as , routing over head, throughput and average end- to- end delay.

Key words: Index terms– ad-hoc on demand distance vector, destination sequenced distance vector, mobile ad-hoc networks, NS-2.

INTRODUCTION

Mobile ad-hoc network (MANET) is a collection of self-directed mobile nodes that communicate with each other through wireless links in absence of any centralized backbone. Each node in the network generates both application and data traffic to control network. Nodes can be changed randomly both unidirectional and bidirectional link. Due to multiple node, noise and packet overhead, throughput is much more reduced than a radio's maximum transmission rate. Since the mobile node changes location randomly, it depends on their battery energy. It suffers a lack of security (Corson and Macker, 1999).

Recently, there has been a lot of interest in the field of wireless networks. The fast moving world demands seamless communication facilities, so former types of connectivity like wired networks, radio waves are swiftly becoming obsolete. One of the recent developments in the world of wireless technology is the use of mobile ad-hoc networks which was initially developed for military applications but now has expanded to include many commercial applications. The rapid use of MANET has resulted in the identification of several problems.

Earlier, MANET protocols did not focus on the quality of service but recently applications like multimedia have

---

*Corresponding author. E-mail: omary57@hotmail.com.

impressed the importance of quality of service in MANET and this has become the area of potential interest.

In MANET network, nodes can move dynamically. Due to this mobility, the number of control messages increase dramatically to maintain connectivity information. Increasing the number of control messages make extra load on bandwidth of the network. In return, ad-hoc network protocols are configured as much as possible to reduce control messages and increase scalability. Traditional routing protocols like link state routing protocol, for example: OSPF is used to collect information of source and destination nodes of ad-hoc network. This type of routing protocols is not suitable for highly dynamic, changeable network topology.

A general distance vector algorithm for example: Distributed Bellman-Ford algorithm is usually used in dynamic network topology. It has advantages as it consumes less memory, which is updated locally and with less overhead on packets. Other routing protocols like source routing and link reversal algorithms are also developed in ad-hoc networks. As a consequence, a MANET working group (Corson and Macker, 1999) has also been formed within the Internet Engineering Task Force (IETF) to develop a routing framework for IP-based protocols in ad-hoc networks (Charles et al., 2001; Geetha et al., 2006).

Johnson et al. (2002) defined a new mobility metric, which measures mobility in terms of relative speeds of the nodes rather than absolute speeds and pause times. This metric is intended to capture and quantify the kind of node motion relevant for an ad-hoc routing protocol. Throughput, delay and routing load were examined for 50-node network for three routing protocols namely ad-hoc on demand distance vector (AODV), destination sequenced distance vector (DSDV) and DSR. They used NS-2 based simulation environment. Their findings reveal that DSR was more effective at low load while AODV was more effective at higher loads. They kept small packet size (64bytes).

Broch et al. (1998) performed experiments for performance comparison of both proactive and reactive routing protocols (AODV, DSR, DSDV and TORA). In their simulation, a network size of 50 nodes, 10 to 30 traffic sources, seven different pause times and various movement patterns were chosen. They used NS-2 discrete event simulator. Through simulation, they reached the conclusion that performance of DSR was good at all mobility rates and speeds. AODV produces more routing overhead than DSR at high rates of node mobility.

Das et al. (2001) presented a detailed performance comparison of two on demand routing protocols namely, AODV and DSR. They carried out simulation using the NS-2 simulator. This simulator supports an IEEE 802.11 MAC layer, a radio model similar to Lucent’s Wave LAN radio interface and a random waypoint mobility model in which pause time was varied from 0 to 900 s. Two different scenarios were considered. Different performance metrics were computed for both the protocol.

Jorg (2003) computer science project studied the behavior of different routing protocols on network topology changes resulting from link breaks, node movement, etc. In his paper performance of routing protocols was evaluated by varying network sizes, number of nodes etc. But he did not investigate the performance of protocols under heavy loads (high mobility + large number of traffic sources + larger number of nodes in the network), which may lead to congestion situations. In his simulation, packets of small sizes and one source node were only considered.

The main objective of this paper is to compare between the performance of proactive and reactive routing protocols in MANET with varying mobility. This objective has been achieved through some analysis and simulation studies on two types of wireless routing protocols, proactive DSDV and reactive AODV.

RELATED WORKS

Josh et al. (1998), Das et al. (1998), Mahdipour et al. (2009), Chenna et al. (2006), Talooki and Ziarati (2006) and Lakshmikanth et al. (2008) have been done to evaluate the performance of proposed routing protocols. Josh et al. (1998) and Chenna et al. (2006) presented a detailed simulation of four protocols DSDV, AODV, DSR and TORA with 50 wireless nodes forming ad-hoc in 900 s (Josh et al., 1998) and 200 s (Chenna et al., 2006) of simulated time. The papers concluded that DSDV and TORA show good performance in a less mobility network situation where as, AODV and DSR maintains comparatively better performance in all mobility situations. Mahdipour et al. (2009) evaluated the performance of AODV and DSDV routing protocols in MANETs under CBR traffic with NS-2 simulator. It evaluated drop ratio and end-to-end delay of these protocols.

Some variations of performance metrics found in the paper (Talooki and Ziarati, 2006). Performance comparison of routing protocols for mobile ad-hoc networks. APCC '06: 1–5) with respect to Josh et al. (1998), Das et al. (1998), Chenna et al. (2006) and Lakshmikanth et al. (2008), though the authors used same routing protocols like Josh et al. (1998), Das et al. (1998), Mbarushimana and Shahrabi (2007) and Mahdipour et al. (2009). The paper consequences on analyzing of jitter that recently became important in ad-hoc networks (Talooki and Ziarati, 2006). It showed that DSDV has the best performance in terms of delay and jitter. Lakshmikanth et al. (2008) concen-trated on three key ad-hoc routing protocols DSDV, AODV and DSR performance in four different scenarios with varying number of nodes, max speed, pause time and transmission power. It demonstrated that both AODV and DSR showed better performance in all scenarios compare to DSDV.

MANET STRUCTURE AND PROTOCOL DESCRIPTION

Infrastructure elements support communication systems in many mobile technology applications. Examples of these elements are mobile phone cells antennas, Wi-Fi or Bluetooth access points, radio signal boosters and amplifiers. However, there are many scenarios where such infrastructure dependence is not possible, due to the high cost of the hardware elements or set-up processes, or the unfavorable users' movements to and from remote places, far away from wireless signal ranges. Another situation in which the infrastructure dependence is impossible occurs when the system collapses under massive connectivity events. On the other hand, the independent wireless signal range of every mobile device allows the set-up of a MANET (Talooki and Ziarati, 2006). This alternative may be convenient to use in the scenarios mentioned above.

A MANET is an autonomous peer to peer communication mesh supporting mobile group collaboration. It can be formed by different types of mobile devices which are also free to move (e.g. installed in land vehicles, ships, or transported by people). These devices are equipped with wireless network signal transmitters and receivers, usually Wi-Fi or Bluetooth, allowing them to communicate without making use of any kind of fixed infrastructure element. Previous studies show the usefulness of MANETs in scenarios of collaborative mobile work, e.g. catastrophe assistance or coordination in common emergencies; construction sites inspection, industrial or commercial applications, military activities, and search and rescue operations (Charles et al., 2001; Talooki and Ziarati, 2006).

This network can be modeled as a graph G = (V, E), where V is the set of nodes representing the mobile devices and E is the set of arcs modeling the communicational range intersections between two or more devices (Charles and Pravin, 1994). Native ad-hoc wireless networks do not allow communication with devices that are outside the respective wireless signal range. Therefore, in order to enhance the collaboration and interaction possibilities, and create message exchange channels among all possible users inside a MANET graph, each node has to find suitable paths and routing methods to transmit messages to remote devices which are not adjacent neighbors.

To make this mechanism possible, the intermediate nodes must re-transmit data packets which are not necessarily of their own interest. Moreover, the protocol used to support this behavior has to take into account the dynamics of the graph definition. The graph can change in an unpredictable way at any moment of time, because of the users' mobility while carrying the devices, the places where they move, or the wireless signal with respect to strength variation and environmental interference.

Routing protocols for ad-hoc networks

The routing protocols are proactive in that they maintain routes to all nodes, including nodes to which no packets are sent. They react to topology changes, even if no traffic is affected by the change. They are based on either link-state or distance vector principles and require periodic control messages to maintain routes to every node in the network (Charles and Bhagwat, 1994). An alternative approach is reactive route establishment, where routes between nodes are determined only when explicitly needed to route packets. Two routing protocols are studied in this work, namely AODV) and DSDV.

Ad-hoc on demand distance vector routing

The AODV routing protocol shares features of both DSDV and DSR algorithms. AODV shares DSR's on-demand characteristics in that it also discovers route as and when needed by initiating a route discovery process. It maintains one entry per destination in its routing tables unlike in DSR, which maintains multiple route entries for each destination in its route cache. In AODV, the packets carry the destination address and sequence number. In AODV, when a source requires a path to the destination, a route request (RREQ) message is flooded in the network. When an intermediate node receives such a RREQ, it examines its local route cache to check whether a fresh route to the required destination is available or not. If a fresh route exists, then the node unicasts a route reply (RREP) message immediately back to the source. As an optimization, AODV uses an "expanding ring" flooding technique, where a RREQ is issued with a limited TTL only. If no RREP message is received within a certain time by the source node, then another RREQ is issued with a larger TTL value. If still no reply, the TTL is increased in steps, until a certain maximum value is reached. During route discovery process, all IP-Packets generated by the application for destination are buffered in the source node itself. When a route is established, then the packets are transmitted. An important feature of AODV (Charles et al., 2001) is the maintenance of timer-based states in each node, regarding utilization of individual routing table entries. A routing table entry is said to be expired if not used within certain duration. These nodes are notified with route error (RERR) packets when the next-hop link breaks. In the situation of link break, each predecessor node, forwards the RERR to its own set of predecessors. In this way all routes, which contain the broken link, are removed. AODV is designed to support communication between mobile nodes with lowest possible routing path. It maintains the same strategy as DSR as "on demand" but DSR works with source routing where as AODV work on hop by hop routing (Charles and Das, 2003).

AODV does not maintain all route information all the time, it maintains when necessary. It provides a loop free path and supports unicast, multicast and broadcast communication between nodes. It is designed to support both wired and wireless media. It maintains unicast and multicast routing tables. In unicast route procedure, when a node want to send a packet to another node then it checks its route table for desired destination. If there is information inside the route table, it sends the data packet through the desired node. If there is no information, it generates route discovery process to create router request (RREQ) message. As many nodes get RREQ message, it is troublesome for the node of replying the message. So each node setup a reverse route entry to generate an RREP message. When a node gets an RREQ message from more than one neighbor, to respond the RREP message for a node, it considers two criteria as newest sequence number or smaller hop count. In this way it provides a loop free path.

Destination sequenced distance vector

Destination sequenced distance vector (Johnson et al., 2002) is a hop-by-hop distance vector routing protocol. It is proactive; each network node maintains a routing table that contains the next-hop for, and number of hops to, all reachable destinations (Charles and Pravin, 1994; Charles, 2001). Periodical broadcasts of routing updates attempt to keep the routing table completely updated at all times. In DSDV, every node maintains the route table where it collects information of all available nodes and the number of hope from the nodes maintaining the route. This means that every node needs to advertise data to neighbour nodes. It advertises the routing information through broadcasting or multicasting packets, where any topology changed or new information is updated.

DSDV protocol selects route on behalf of sequence number and metric. Metric gives out the possible lowest path to the destination. Due to the huge number of nodes, information carried by packets is very large. It is problematic to maintain routing tables. So, DSDV provide two types of routing packets. One is full dump, which carries all available routing information and requires a multiple network protocol data unit (NPDU). Another one is called incremental, which carries the last updated full dump changed information. By this process, each mobile node keeps two routing tables. One to use with forwarding packets and another to be advertised through incremental routing information packets (Charles and Pravin, 1994).

To guarantee loop-freedom DSDV uses a concept of sequence numbers to indicate the freshness of a route. A route R is considered more favorable than R' if R has a greater sequence number or, if the routes have the same sequence number, R has lower hop-count. The sequence number for a route is set by the destination node and increased by one for every new originating route advertisement. When a node along a path detects a broken route to a destination D, it advertises its route to D with an infinite hop-count and a sequence number increased by one. Route loops can occur when incorrect routing information is present in the network after a change in the network topology, e.g., a broken link. In this context the use of sequence numbers adapts DSDV to a dynamic network topology such as in an ad-hoc network. DSDV uses triggered route updates when the topology changes. The transmission of updates is delayed to introduce a damping effect when the topology is changing rapidly. This gives an additional adaptation of DSDV to ad-hoc networks.

SIMULATION ENVIRONMENT

A detailed simulation model based on network simulator- NS-2 (NS-2) is used to do this paper. The Monarch research group at Carnegie-Mellon University developed support for simulating multihop wireless networks complete with physical, data link, and medium access control (MAC) layer models on NS-2 (Josh et al., 1998). The distributed coordination function (DCF) of IEEE 802.11 for wireless LANs is used as the MAC layer protocol. The radio model uses characteristics similar to a commercial radio interface, Lucent’s WaveLAN. WaveLAN is modeled a shared-media radio with 1 Mb/s preamble rate (used for headers and synchronization), a nominal bit rate of 2 Mb/s and a nominal radio range of 250 m. An unslotted carrier sense multiple access technique with collision avoidance (CSMA/CS) technique is used to transmit the data packets to avoid well-known hidden terminal problem.

Traffic pattern

Continuous bit rate (CBR) traffic sources are used to generate the simulated network traffics. A random flow of traffic generation TCL script called “cbrgen.tcl” is used to simulate continuous bit rate sources in NS-2. The source-destination pairs are chosen randomly among 50 nodes in a network within simulation time. Traffic sessions are established at random time–with–*seed* value=1 which is given to *cbrgen.tcl* program to generate traffic pattern, at the beginning of simulation and sessions are established until ending of simulation. The number of sessions and the packet sending rate in each pair are varied to change the offered load in the network. 10, 20, 30 and 40 traffic sources are generated to do this simulation work. The packet size is 512-byte and transmission rate is 4 pkt/sec. Data rate for the simulation is 2 Mb/sec.

Mobility

A mobility generation tool called “*setdest”* is developed by CMU for generating random movements of nodes in the wireless network of NS-2 is used to generate mobility model for this simulation work. The mobility model uses the random waypoint model (Josh et al., 1998) in a rectangular field. In this model each node starts at a random location and moves independently during simulation time. It remains stationary for a specified period called pause time and then moves to some new randomly chosen location with a randomly chosen speed (in this simulation, between 0 and max. speed 10 m/s). When any node reaches the new location, the node again remains stationary for the pause time and chooses a new random location with a new randomly chosen speed. It continues to repeat this behaviour throughout the simulation. In this mobility, it produces large amounts of relative node movement and network topology changes. So it helps to generate good movement model to evaluate DSDV and AODV routing protocols. The simulation is consists of 1000m*500 m field area for 50 nodes and run for 600 simulated seconds. The pause time is varies from 0 to 600 s.

Performance metrics

While comparing two protocols, five performance measurements are compared with the following metrics:

Normalized routing load

The number of routing packets transmitted per data packet delivered at the destination.

Packet delivery fraction

Ratio of data packet received by destinations, sending from CBR sources. Also, it can represent the ratio of the number of data packets successfully delivered to the destinations to those generated by CBR sources. Packet delivery fraction = (Received packets/Sent packets)*100

Average end-to-end delay of data packets

It includes the average delay data packets that happened during transmission time from source to destination. So it consist of route discovery latency, the queuing delays at a node, retransmission delays at the MAC layer and the propagation and transfer time of wireless channel. So, this time can be calculated as: Calculate the send(S) time (t) and receive (R) time (T) and average it.

Throughput of receiving bits

Total number of bits successfully delivered to particular destination in a time interval length of simulation time.

Routing efficiency

The number of data packets sent with respect to routing packets sent, in a simulation time. So, each hop wise transmission of a routing packet is counted as one transmission. Routing Load = Routing Packets Sent / Received Packets.

Number of nodes and simulation time

The models were generated for 10 nodes and 25 nodes with simulation times of 10, 20,30,40,50 and 100.

SIMULATION RESULTS

Two attempts were taken to evaluate more reliable performance of two protocols in same simulation field. Normalized routing load and packet delivery fraction are taken from 0, 100, 200, 300, 400, 500 and 600 pause time of simulation environments. Average end-to-end delay, Throughput of receiving bits and routing efficiency are taken from 0 pause time (high mobility) of simulation environments. In this simulation environment pause time is constant 0 and it helps to observe the routing protocols behaviour more closely. From this type of simulation it is possible to comprehend internal characteristics of routing protocols. Simulation results are collected from total 56 scenarios of DSDV and AODV protocols. Performance metrics are calculated from trace file, with the help of some additional programs, e.g. Perl and Trace graph (Trace graph - Network Simulator NS-2 trace files analyser).

Normalized routing load

Normalized routing load of DSDV and AODV protocols in different sources are presented in Figures 1 to 4. In 10 sources (Figure 1), DSDV and AODV demonstrates lower routing load than other higher sources. Proactive routing protocol, DSDV showed slightly higher routing load then reactive routing protocols. As pause time is increased, AODV's normalized routing load is almost 0 at 600 pause time. From 20 to 40 sources (Figures 2 to 4), as network load is increased, normalized routing load of AODV is much higher than DSDV protocol. In this simulation it maintains 4 pkt/sec, so due to high congestion and certain positions of nodes in ad-hoc network, AODV requires more routing packets to maintains transmission of data packets of the simulation network. Though the simulation environment path, mobility and traffic patterns are same for two protocols, AODV has worse normalized routing load with increasing of traffic sources. In three cases, all routing protocols maintains stable routing load in the simulation.

Packet delivery fraction

Packet delivery fraction of DSDV and AODV protocols in different sources are presented in Figures 5 to 8. The packet delivery fraction of DSDV is lower than AODV protocol of 10 sources (Figure 5). For DSDV of 10 sources, delivery fraction is increasing with respect to decreases of mobility of nodes. And 600 pause times all protocols reached almost 100% packet delivery fraction for 10 sources. With 20, 30 and 40 sources (Figures 6 to 8), DSDV outperforms AODV. The result from the simulation, in lower mobility (from 500 to 600 pause time) both protocols performs higher packet delivery fraction. From 20 to 40 sources, DSDV has average 10% more delivery fraction than AODV protocols.

Average end-to-end delay

Average end-to-end delay of CBR traffic is done with 0 pause time and 600 simulation seconds. Each protocol is described in individual part.

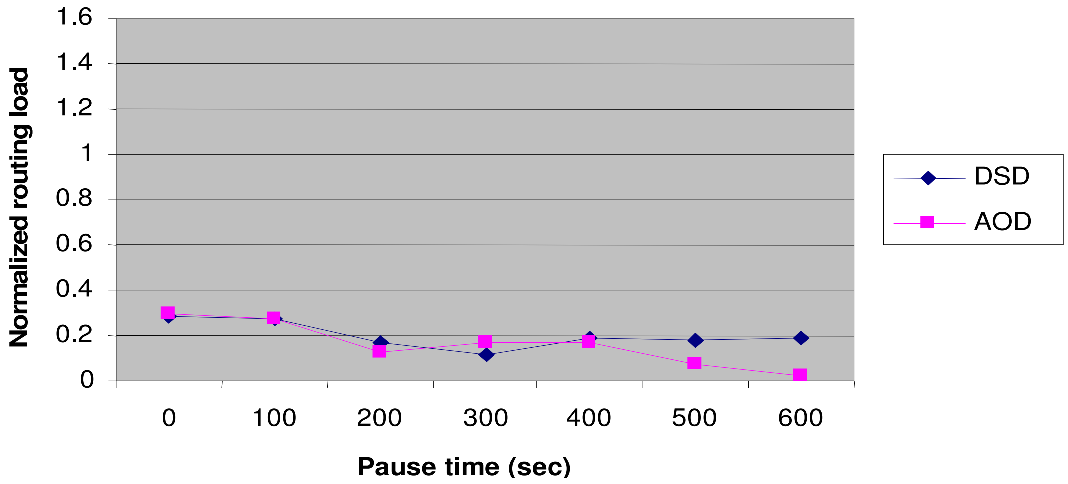

Figure 1. Normalized routing load -10 sources.

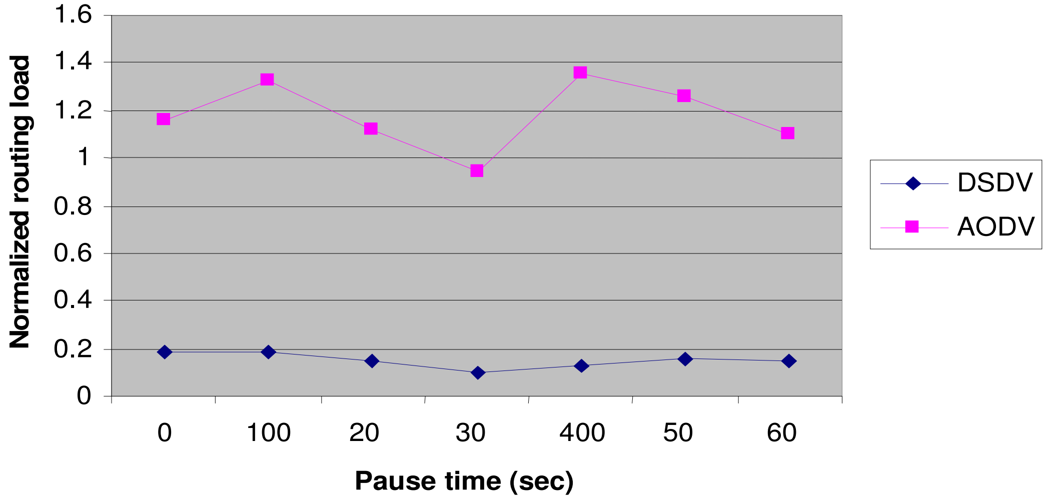

Figure 2. Normalized routing load -20 sources.

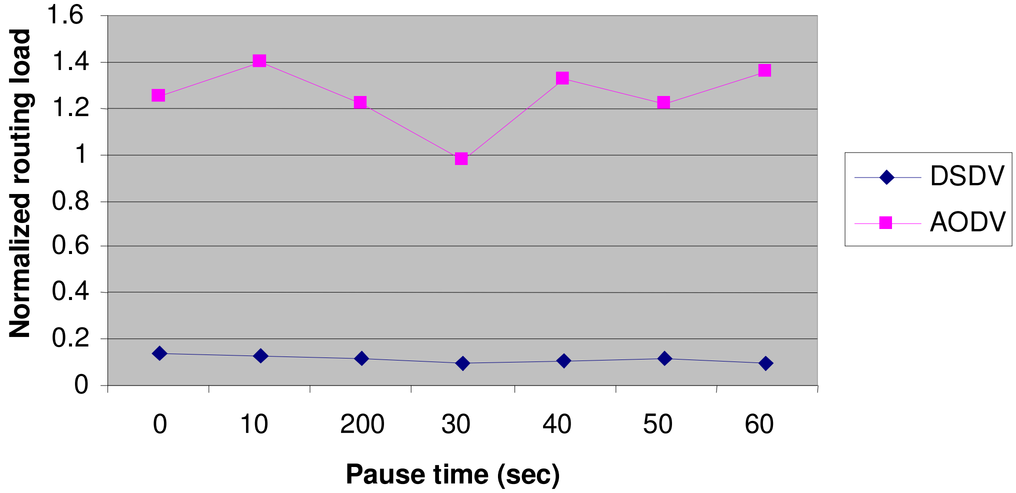

Figure 3. Normalized routing load -30 sources.

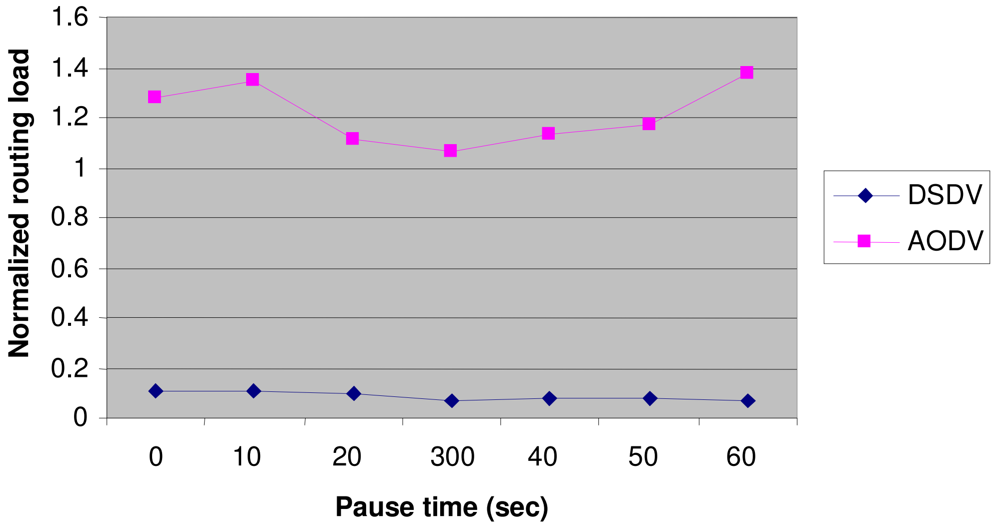

Figure 4. Normalized routing load -40 sources.

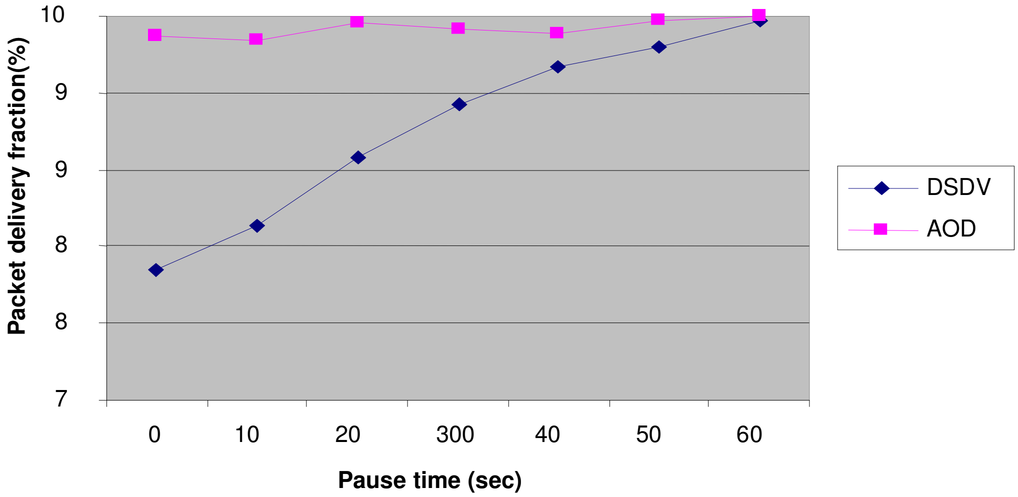

Figure 5. Packet delivery fraction 10 sources.

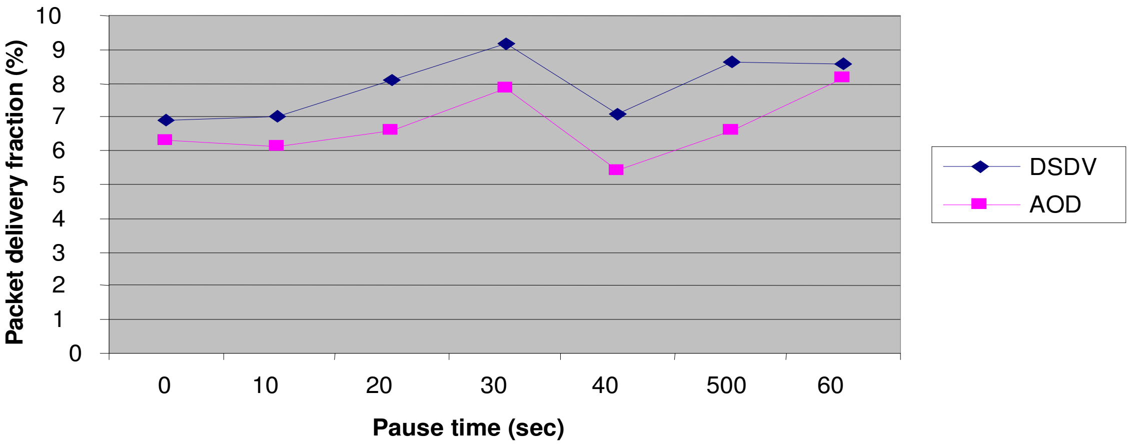

Figure 6. Packet delivery fraction 20 sources.

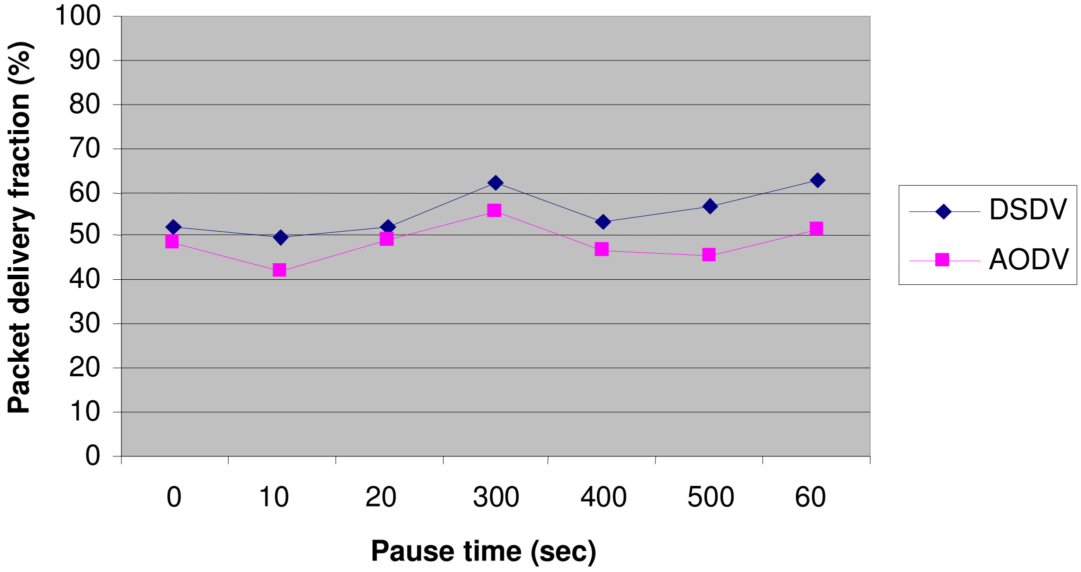

Figure 7. Packet delivery fraction 30 sources.

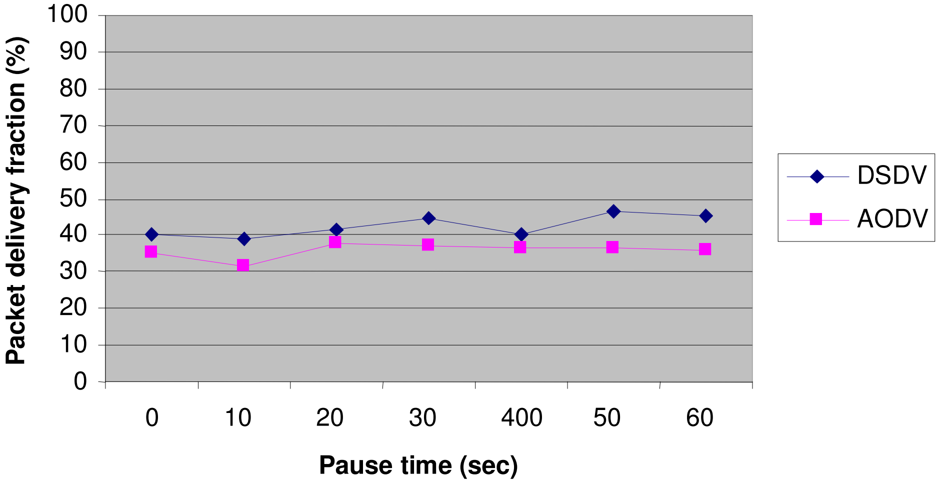

Figure 8. Packet delivery fraction 40 sources.

Destination sequenced distance vector

Average end-to-end delay (sec) Vs throughput of receiving bits (bits/sec) of DSDV protocol in different sources is presented in Figures 9 to 12. With 10 sources (Figure 9), it recorded 0.17 s average end-to-end delay at the beginning of simulation. As number of data bit increases, end-to-end delay increases and 150 Kbit/sec throughput needs average end-to-end delay 0.12 s. With 20 sources (Figure 10), from 50 to 100 Kbit/sec there is no delay recorded, and then a lot of fluctuations occurred of average end-to-end delays until 350 Kbit/sec throughput of receiving bits.

With 30 and 40 sources (Figures 11-12), it needs too much average end-to-end delay at beginning of simulation, which reached at peak value of 24 s for 30 sources and 16 s for 40 sources. Like 20 sources, it has recorded no end-to-end delay from 25 to 125 Kbit/sec throughput of receiving bits. Then it maintains around 5 to 10 s average end-to-end delay for rest of the throughput.

Ad-hoc on demand distance vector

Average end-to-end delay (sec) Vs throughput of receiving bits (bits/sec) of AODV protocol in different sources is presented in Figures 13 to16. In all cases AODV maintains good average end-to-end delay with respect to throughput of receiving bits. With 10 sources

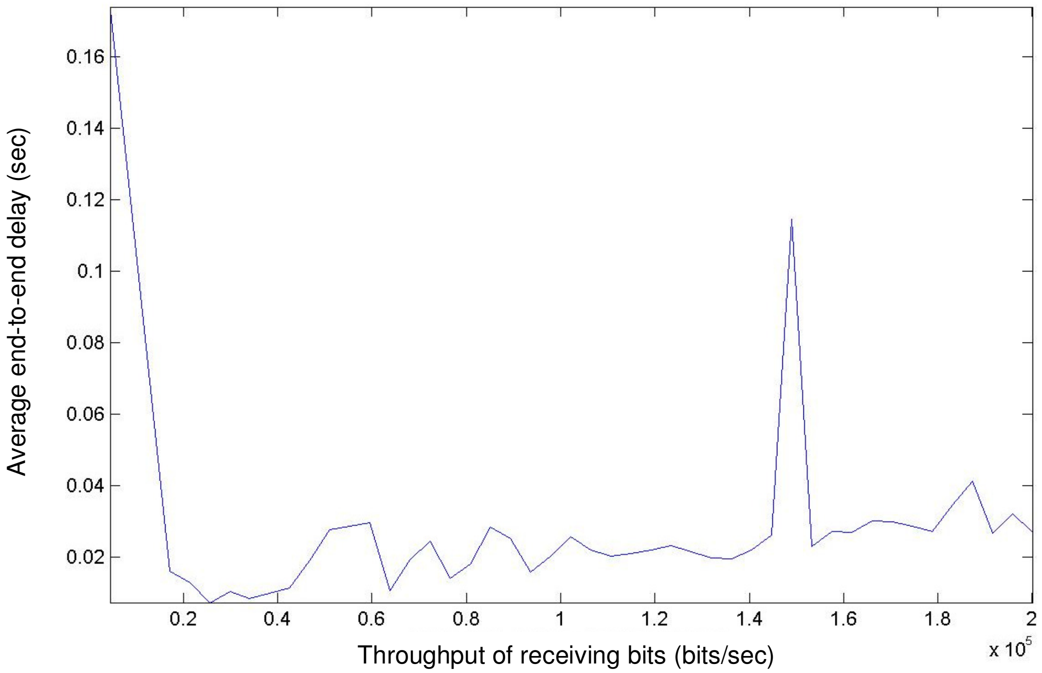

Figure 9. Average end-to-end delay-10 sources DSDV.

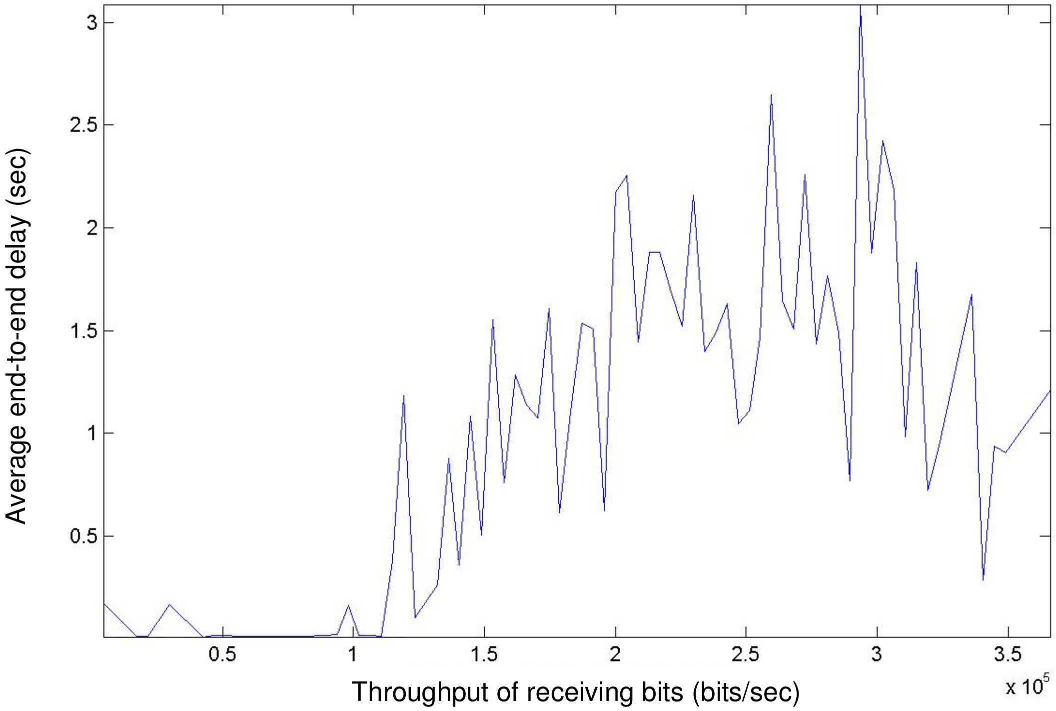

Figure10. Average end-to-end delay-20 sources DSDV.

(Figure 13), it demonstrated 5.5 s average end-to-end delay from the beginning of simulation. And 3.8 s delay recorded with 100 Kbit/sec throughputs. Between (20 to 100 Kbit/sec and 140 to 200 Kbit/sec), no delay is recorded. With 20 sources (Figure 14) 5.5 s average end-to-end delay recorded. It maintains average delay 1.5 to 3.5 s for rest of the simulation. Delay for 30 and 40 sources (Figures 15 to 16) maintain almost same

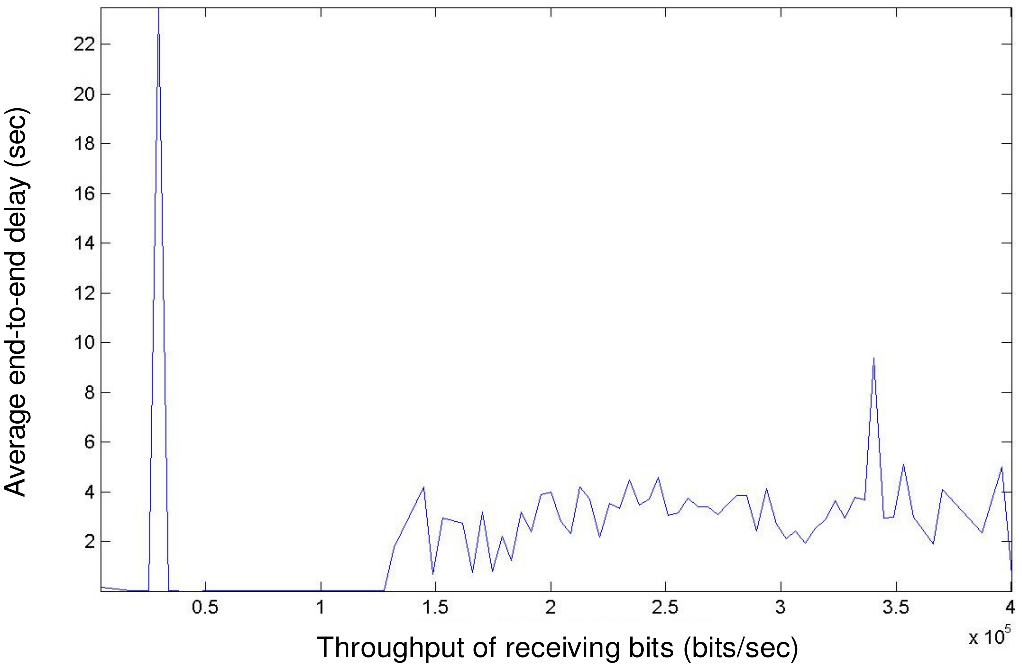

Figure 11. Average end-to-end delay-30 sources DSDV.

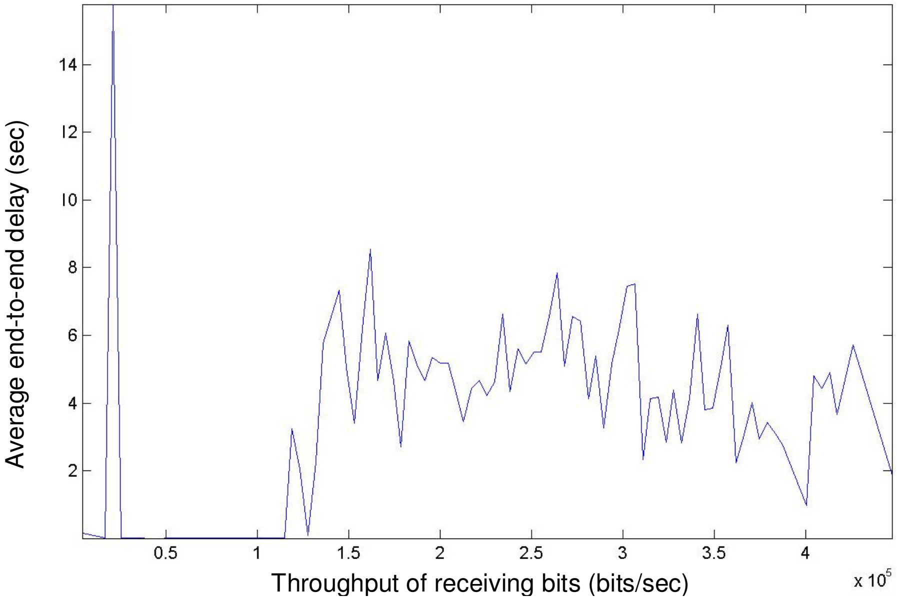

Figure 12. Average end-to-end delay-40 sources DSDV.

fluctuation of delay for entire simulation. It recorded 5.5 s delay for 30 sources and 7 s delay for 40 sources.

Throughput of receiving bits

Throughput of receiving bits of CBR (Continuous Bit Rate) traffic flows are simulated with 0 pause time and 600 simulation seconds. Each protocol is described in individual part.

Destination sequenced distance vector

Throughput of receiving bits (bits/sec) Vs Simulation time (sec) of DSDV protocol in different sources is presented

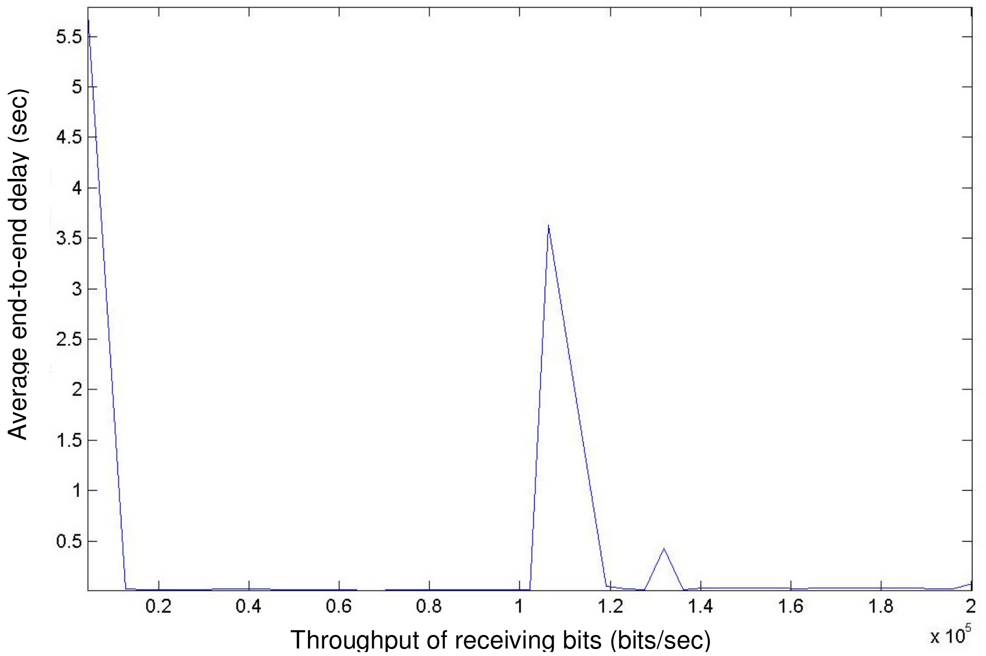

Figure 13. Average end-to-end delay-10 sources AODV.

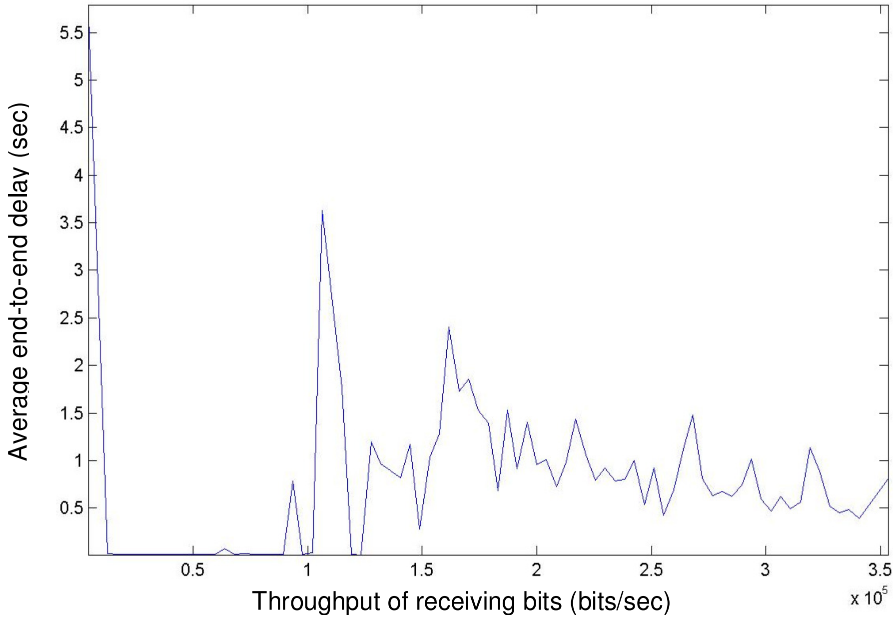

Figure 14. Average end-to-end delay-20 sources AODV.

in Figures 17-20. In all sources, DSDV protocol seams to start transmission of CBR traffic within few milliseconds after starting the simulation. With 10 sources (Figure 17), data packet increases with respect to simulation time. At 147 s of simulation time all 10 sources are transferred data, it reaches 180 Kbit/sec of throughput of receiving bits. It maintains average 140 Kbit/sec throughput of receiving bits in small number of sources.

But every source at 350 s of simulation time, throughput drops due to intermediate nodes position in simulation environment. At 170sec of simulation time of 20, 30 and 40 sources (Figures 18 to 20), all sources are started to transfer data. Though number of sources increased in DSDV, it maintains almost average

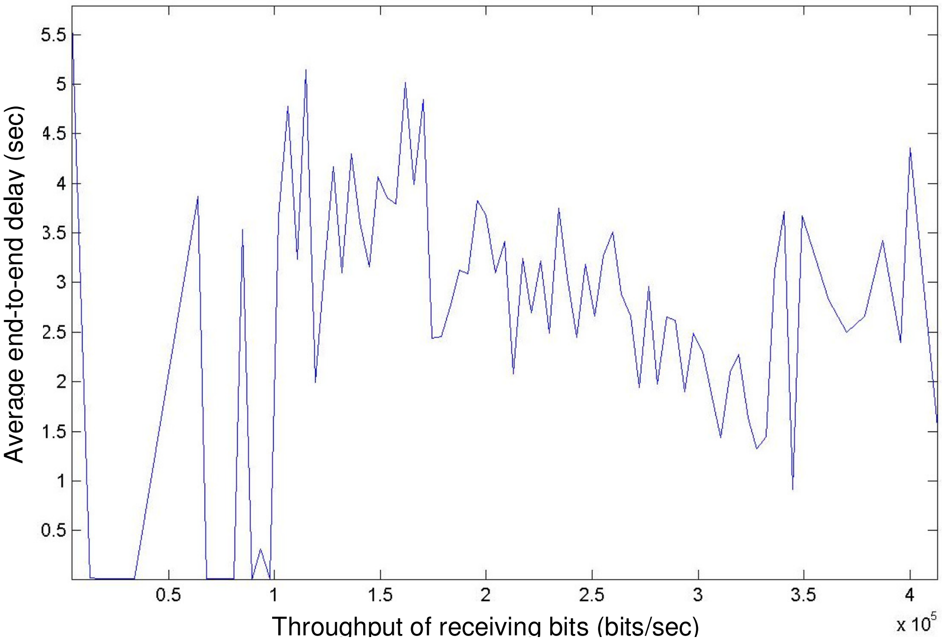

Figure 15. Average end-to-end delay-30 sources AODV.

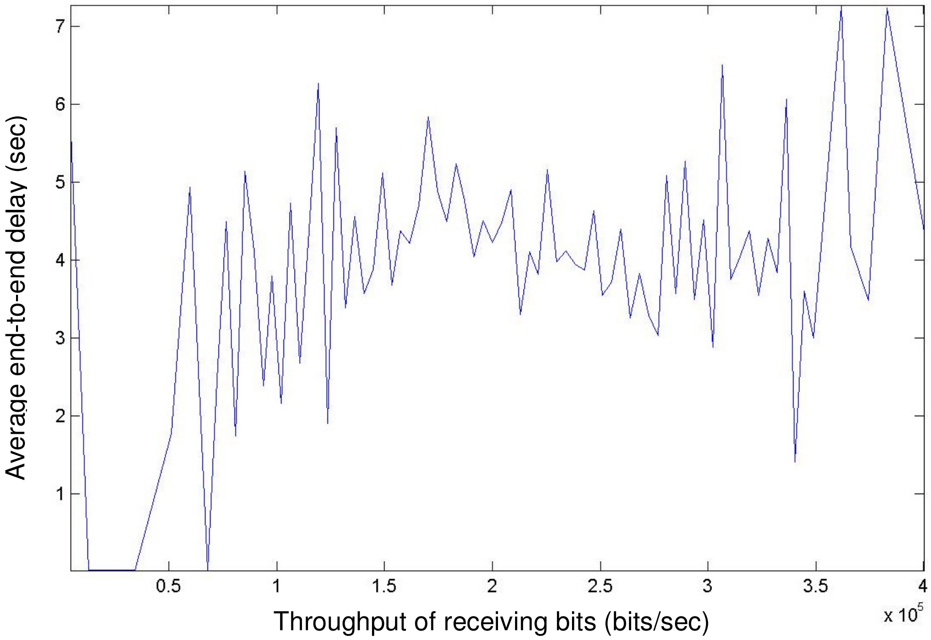

Figure 16. Average end-to-end delay-40 sources AODV.

throughput of 250 to 350 Kbit/sec in entire simulation time.

Ad-hoc on demand distance vector

Throughputs of receiving bits (bits/sec) Vs Simulation time (sec) of AODV protocol in different sources are presented in Figures 21 to 24. Like DSDV, AODV also needs few milliseconds to transfer data after starting the simulation. With 10 sources (Figure 21), throughput is increasing with respect to simulation time. It maintains average 190 Kbit/sec throughput of receiving bits in entire simulation time. At 20, 30 and 40 sources, in

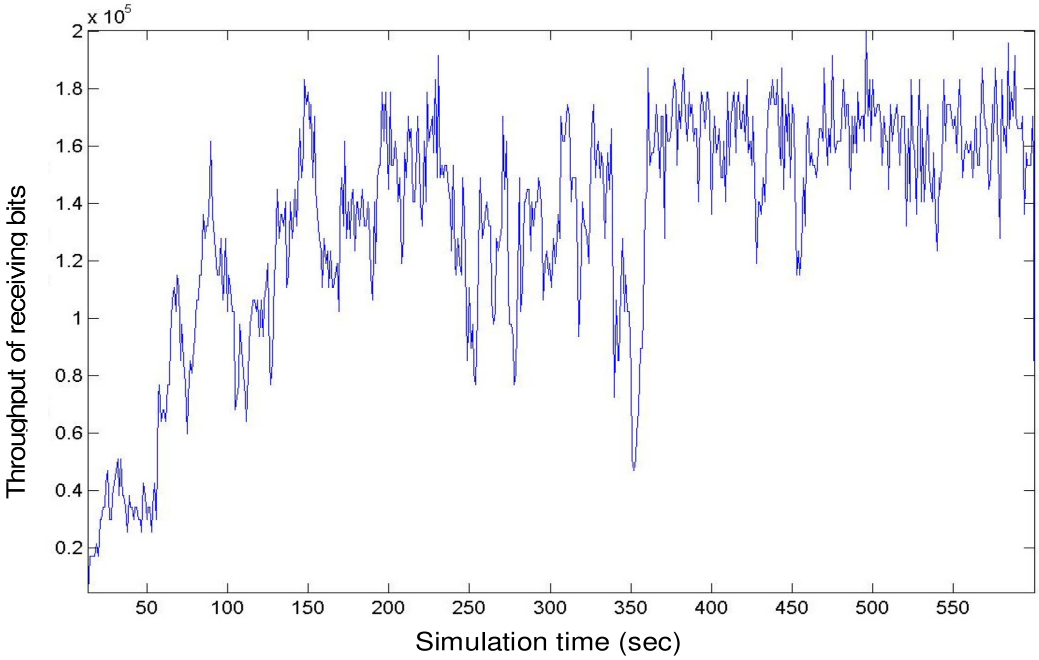

Figure 17. Throughput of receiving bits -10 sources DSDV.

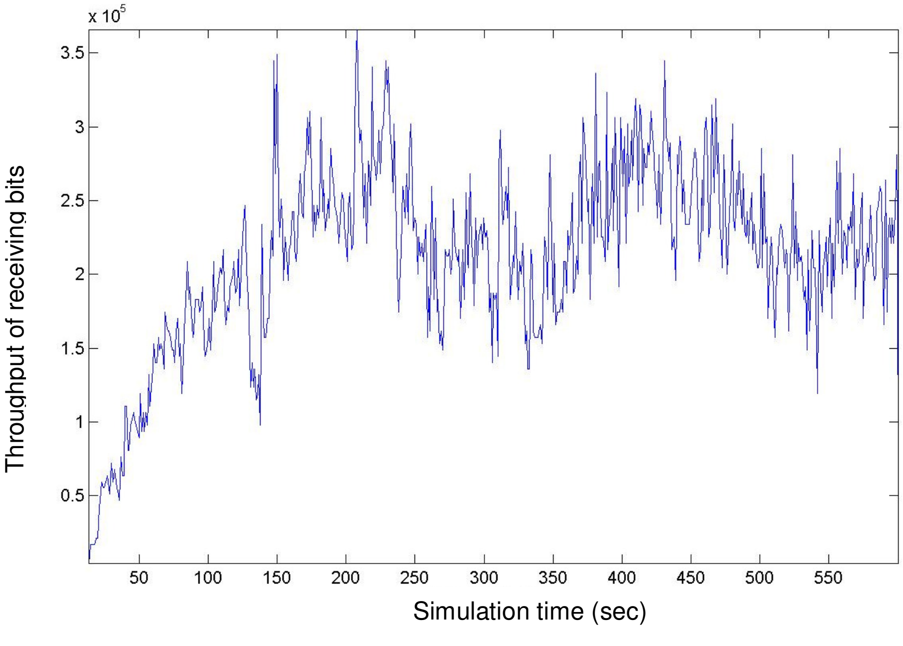

Figure 18. Throughput of receiving bits -20 sources DSDV

stressful situation AODV kept average 250 to 350 Kbit/sec throughput of receiving bits in entire simulation.

Routing efficiency

Routing efficiency of all protocols in different sources are presented in Figures 25 to 28. In all cases, DSDV sent almost same number of routing packets with respect to different data packets. Whereas there are some variations of number of routing packets found AODV protocol. Though simulation environment is same, due to reactive characteristics of this protocol it increased number of routing packets. In AODV, it always uses fresh

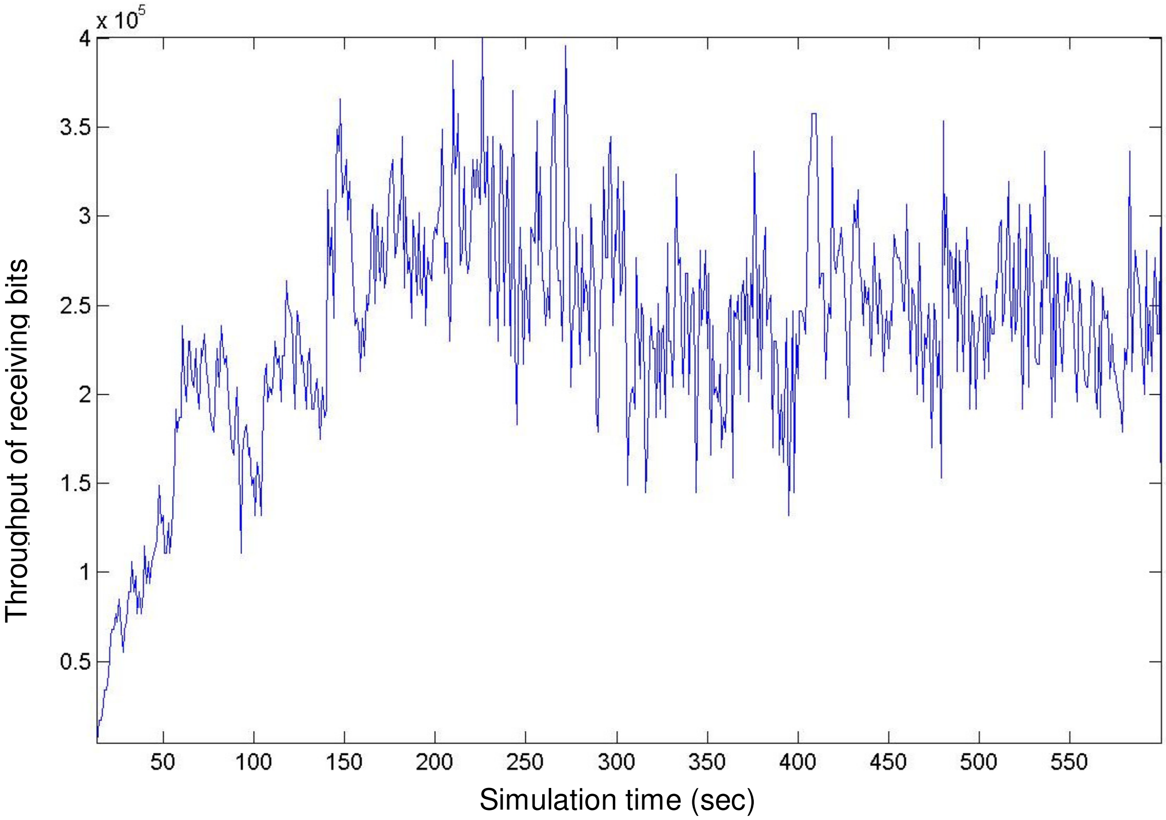

Figure 19. Throughput of receiving bits -30 sources DSDV.

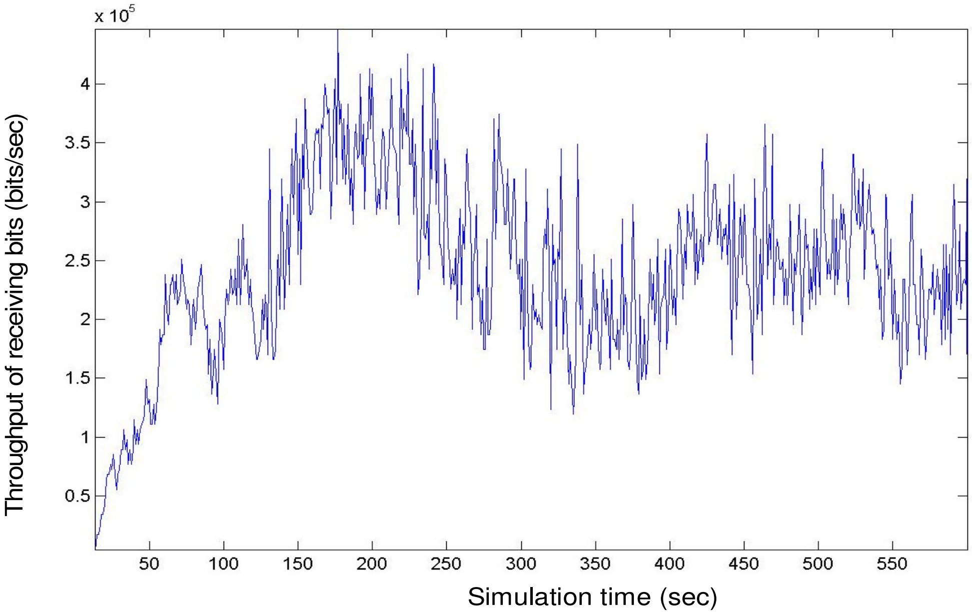

Figure 20. Throughput of receiving bits -40 sources DSDV.

path and needs more routing packets to maintain same simulation environment for sending data packets. It is showed that AODV's routing packets increases with respect to number of sources.

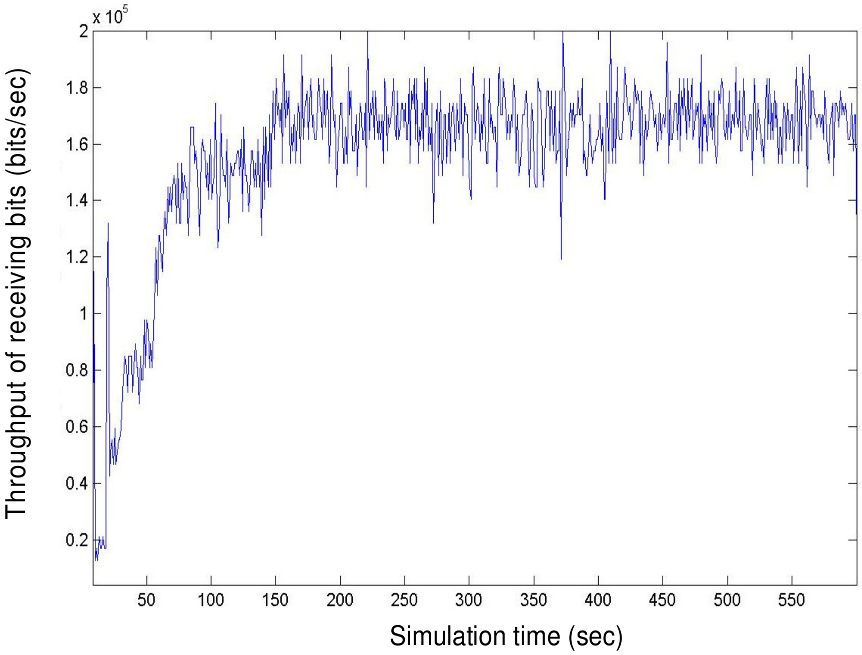

Figure 21. Throughput of receiving bits -10 sources AODV.

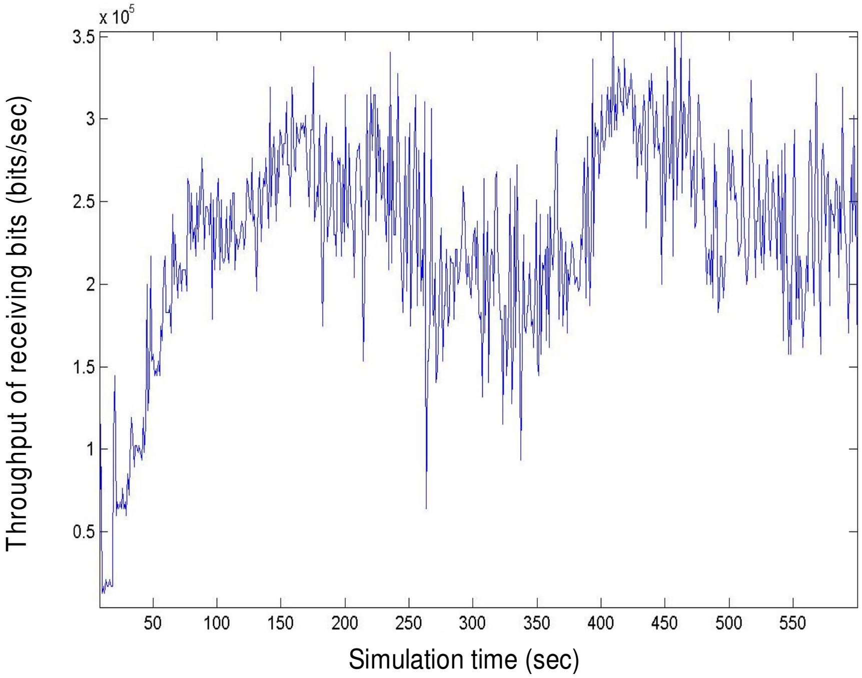

Figure 22. Throughput of receiving bits -20 sources AODV.

CONCLUDING REMARKS AND DISCUSSION

The simulation results bring out some important uniqueness and similarity between DSDV and AODV routing protocols. In Normalized routing load, DSDV demonstrates significantly lower routing load than AODV. Moreover, DSDV's normalized routing load is fairly stable with an increasing num0ber of sources with compare to AODV. But both protocols points up stability of their current position from 20 to 40 sources (Figures 2 to 4). A relatively stable normalized routing load is considered for scalability of the protocols. DSDV exemplified more

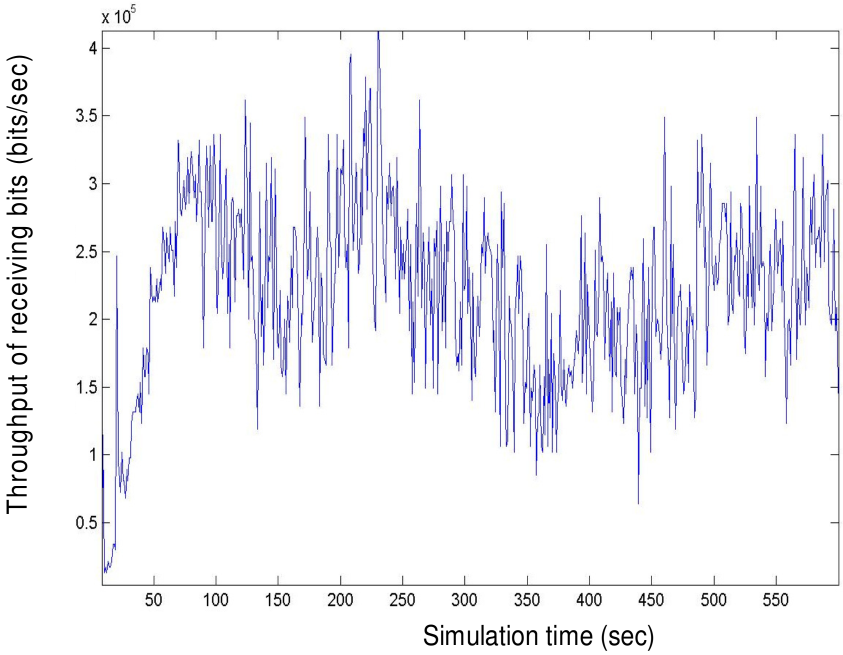

Figure 23. Throughput of receiving bits -30 sources AODV.

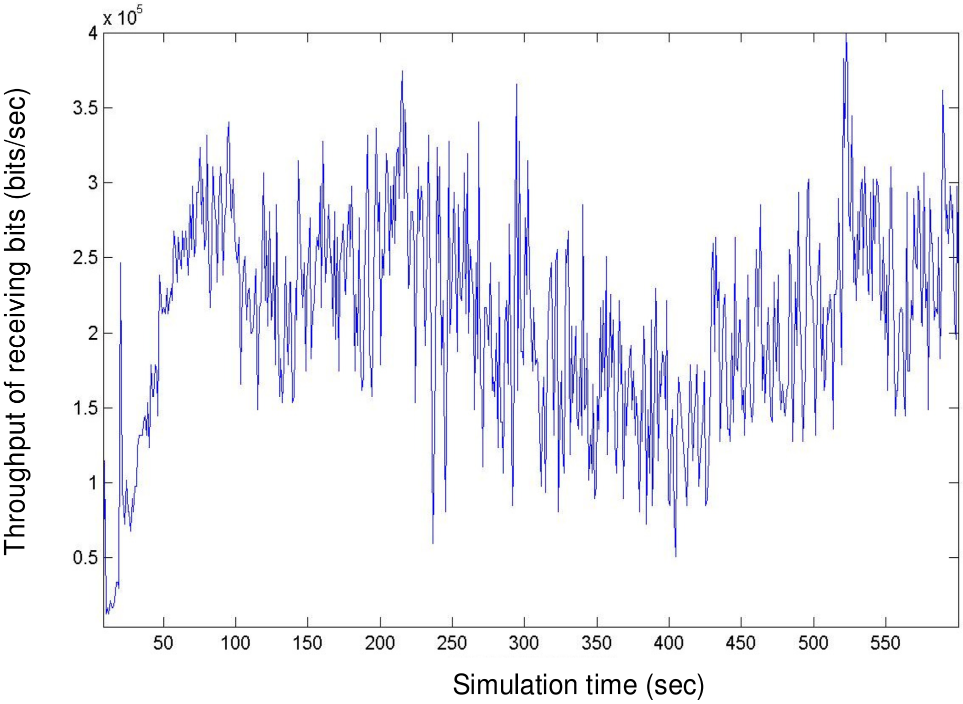

Figure 24. Throughput of receiving bits -40 sources AODV.

scalable than AODV. Due to on demand strategy of ADOV, it needs more routing packets to maintain topology. Since AODV has always more routing control packets to maintains transmission that found in normalized routing load results, it always choose the fresh route and packet delivery fraction is increased. There are near able similarity found in packet delivery fraction between DSDV and AODV. When number of sources increased, DSDV has a better delivery fraction than AODV. Overall performance it shows that AODV

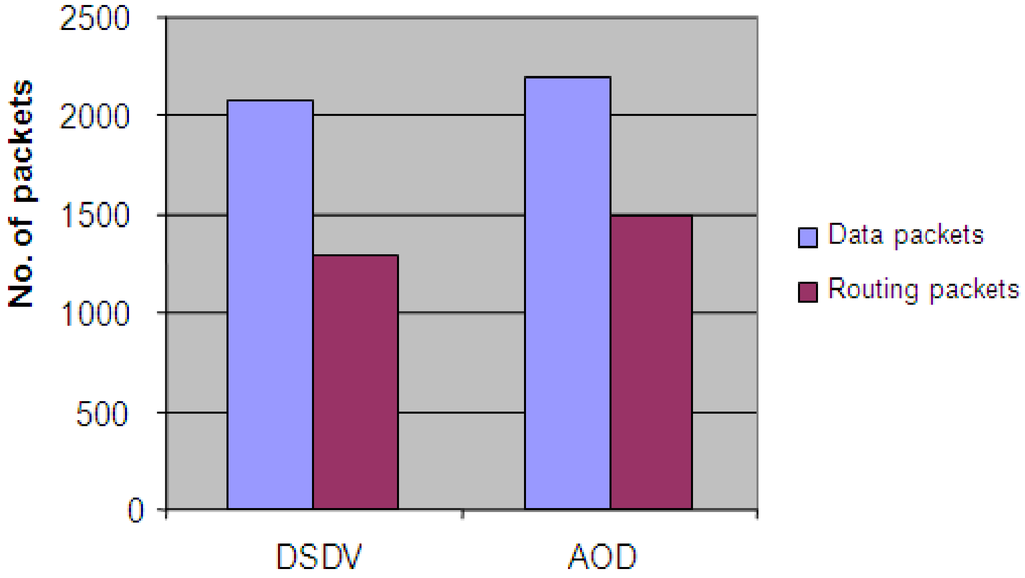

Figure 25. Routing efficiency-10 sources.

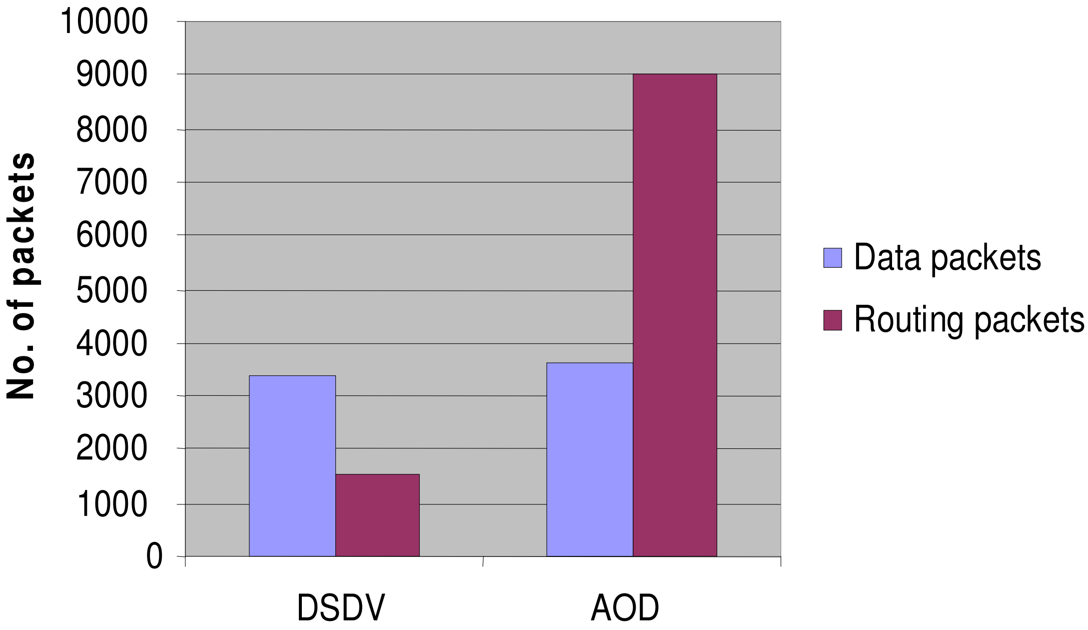

Figure 26. Routing efficiency-20 sources.

and DSDV performs good packet delivery fraction in low mobility and lower number of sources.

In average end-to-end delay, DSDV delay is increased with respect to increasing nodes. In opposite AODV maintains almost same stable average delay in different load. An observation on average end-to-end delay of both protocols is that delay increases with 40 sources (Figures 12 to 16). This happened for high level of network stressful situation.

In throughput, AODV demonstrated good performance in throughput. AODV uses routing table, one route per destination, a mechanism to prevent loops and determine freshness of route. In both protocols, throughputs of receiving bits with simulation time are decreased at 350 s. Due to high level of network congestion and multiple access interference of different places of simulation field, throughput decreases on that simulation time. As throughput of receiving bits collected from 0 pause time simulation environment, if compare it with 0 pause time packet delivery fraction of same protocols. It is found

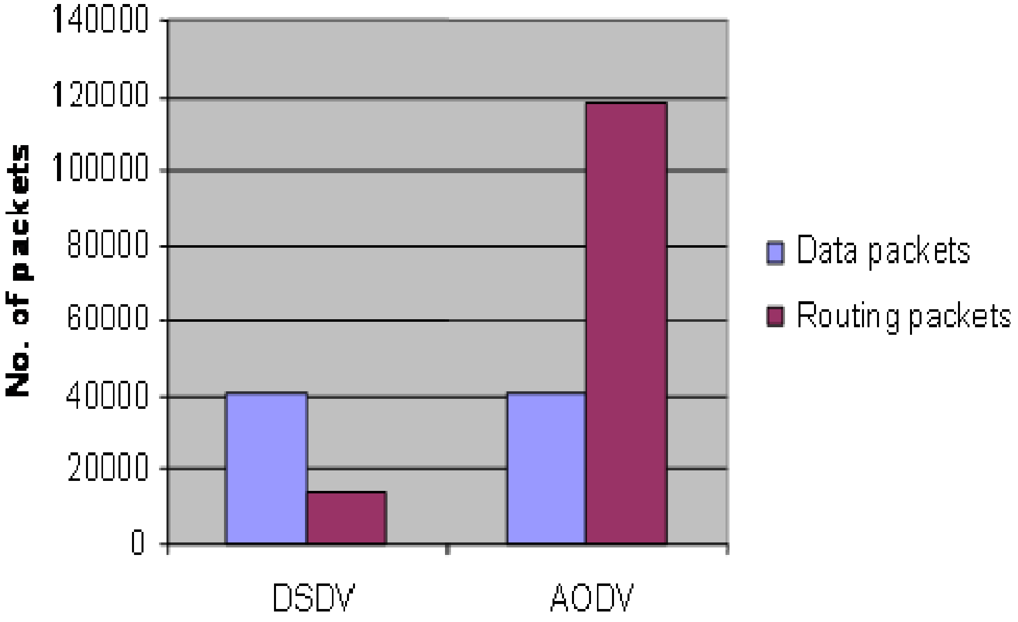

Figure 27. Routing efficiency-30 sources.

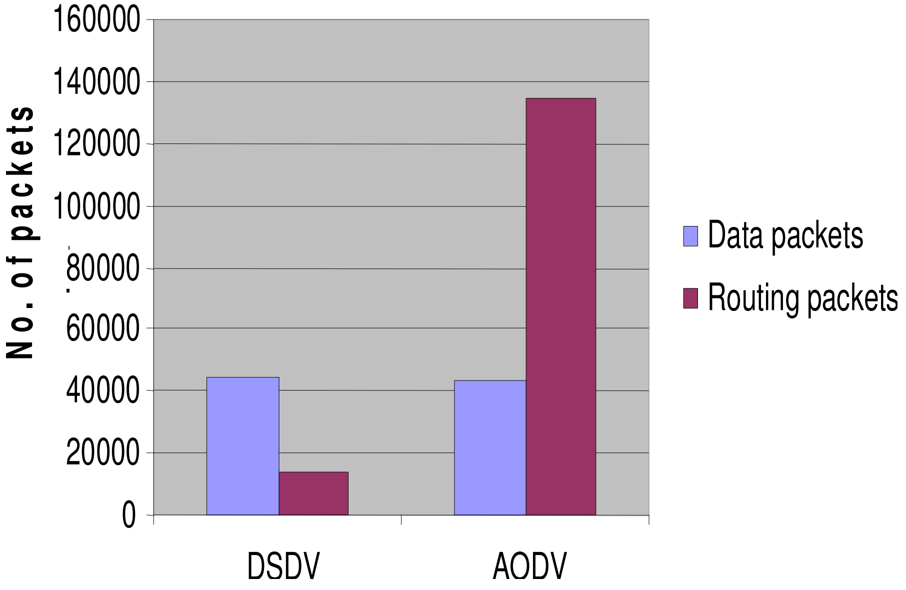

Figure 28. Routing efficiency-40 sources.

that the relative performance of both protocol packets delivery fraction is similar with the throughput.

In routing efficiency with 0 pause time (high mobility), the results found that DSDV outperforms AODV. Due to high mobility, link failure can happen very often. It generates new route discovery process in AODV, as it has at most one route per destination in its routing table. So, frequency of route discovery process is proportional to the number of route breaks in AODV. But in DSDV it occurs less often with advantages of table driven approach.

Conclusion

This paper used two types of simulation work to compare the performance of DSDV and AODV routing protocols of mobile ad-hoc networks with NS-2 simulator. Some performance metrics are done from different pause time with same simulation environment. Other performance metrics are done from constant 0 pause time with same simulation environment. From two types of simulation work, it is evaluated that DSDV and AODV protocols has individuality with mobility and traffic sources. DSDV uses proactive table-driven routing procedure where as AODV maintains reactive “On demand” routing strategy but their routing mechanics are different. For application oriented metrics such as throughput and end-to-end delay, AODV outperform DSDV in higher stressful situation. But, DSDV consistently generates lower routing normalized routing load and better packet delivery fraction than AODV. Finally, according to results of practical works, we can clearly say that the routing protocols AODV gives less fluctuation results and better performance as compared with DSDV , with respect to some identified parameters of routing protocol such as, routing over head, throughput and average end-to-end delay. So it is clear that under these characteristics AODV giving best output as compared to the others which perform poor and having no reliability as compared to DSDV and AODV for MANETs.

REFERENCES

Broch J, Maltz DA, Johnson DB, Hu YC, Jetcheva J (1998). A Performance Comparison of Multi-Hop Wireless Network Routing Protocols. MobiCom,pp. 25-30.

Charles EP (2001). Ad-hoc networking. Addison-Wesley.

Charles EP, Pravin B (1994). Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers. SIGCOMM 94 -8/94 London England UK.

Charles EP Bhagwat P (1994). Highly Dynamic Destination- Sequenced Distance-Vector Routing (DSDV) or Mobile Computers. Comp. Comm. Rev., pp. 234-244.

Charles EP, Royer EM, Das SR, Marina MK (2001). Performance Comparison of Two On-Demand Routing Protocols for Ad-hoc Networks. IEEE Personal Commun., pp. 16-28.

Charles EP, Das S (2003). Ad-hoc On-Demand Distance Vector (AODV) Routing. Nokia Research Center. RFC 3561. (http://www.ietf.org/rfc/rfc3561.txt).

Chenna R, ChandraSekhar P, Reddy P (2006). Performance Analysis of Adhoc Network Routing Protocols. ISAUHC '06.pp. 186-187

Corson S, Macker J (1999). Mobile Ad-hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations. University of Maryland. (http://www.ietf.org/rfc/rfc2501.txt)

Das SR, Castaneda R, Jiangtao Y, Sengupta R (1998). Comparative performance evaluation of routing protocols for mobile, ad-hoc networks. 7th Int. Conf. Comput. Commun. Networks. pp. 153-161.

Das SR, Charles EP, Royer EM (2001). Performance Comparison of Two On-Demand Routing Protocols for Ad-hoc Networks. IEEE Personal Commun. Magazine. Special Issue on Mobile Ad-hoc Networks. 8(1): 16-29.

Geetha, Aithal V, Chandra, Sekaran SK (2006). Effect of Mobility over Performance of the Ad-hoc Networks. Ad-hoc and Ubiquitous Computing. 2006 ISAUHC '06. Int. Symposium: pp.138-141. (www.cs.virginia.edu/~cl7v/cs851-papers/dsdv-sigcomm94.pdf)

Johnson D, Hu Y, Maltz D (2007). The Dynamic Source Routing Protocol (DSR) for Mobile Ad-hoc Networks for IPv4. Rice University. Microsoft Research. RFC 4728. (http://tools.ietf.org/html/rfc4728).

Johnson D, Maltz D, Jetcheva J (2002). The Dynamic Source Routing Protocol for Mobile Ad-hoc Networks. Draft-ietf-manet-dsr-07.txt.

Josh B, David AM, David BJ, Yih-Chun H, Jorjeta J (1998). A Performance Comparison of Multi-Hop Wireless Ad-hoc Network Routing Protocols. Proceedings of the IEEE/ACM MOBICOM: pp. 85-97.

Lakshmikanth, Gaiwak G, Vyavahare MA (2008). Simulation based comparative performance analysis of adhoc routing protocols. 10 Conference TENCON: pp.1-5.

Mahdipour E, Aminian E, Torabi M, Zare M (2009). CBR Performance Evaluation over AODV and DSDV in RW Mobility Model. ICCAE '09. Int. Conf., 238-242.

Mbarushimana C, Shahrabi (2007). Comparative Study of Reactive and Proactive Routing Protocols Performance in Mobile Ad-hoc Networks. AINAW’07.21st Int. Conf. 2: 679-684.

Talooki, Ziarati VNK (2006). Performance Comparison of Routing Protocols for Mobile Ad-hoc Networks. APCC '06: pp.1-5.