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ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 6 (2): 237-241, 2007
ISSN 1812-5638

Factors Affecting Performance of AODV

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Abstract: In Mobile Ad Hoc Networks (MANETs) it is hard for a route to sustain for a longer period of time due to the mobility of nodes. High mobility of nodes results in active route failure and re-route discoveries. Such frequent route discoveries result in decreased network performance. In this study we have analyzed in detail the affect of different node mobility parameters on the performance of AODV (Ad hoc on Demand Distance Vector) Routing Protocol. Simulation results are provided at the end.

Key words: Mobility, MANET, AODV, throughput, route

INTRODUCTION

Ad Hoc wireless networks are self-organizing multi-hop wireless networks where all nodes take part in the process of forwarding packets (Awerbuch, 2003). MANETs consist of mobile nodes, which communicate via wireless means and perform the roles of both hosts and routers. MANETs do not have a centralized controller, nor do they require any infrastructure, that is why MANETs are also known as infrastructure-less networks (Hussain *et al*., 2005). The network topology of MANETs is dynamic as mobile nodes are free to move around and can even freely leave or join the network. Physical security is somewhat limited as mobile devices are more easily misplaced or stolen than nodes in wired networks. These characteristics make MANETs very different from wired networks.

Many ad hoc routing protocols exist for route discovery in MANETs. They are categorized as proactive and reactive (Misra, 1999). Proactive routing mechanisms are invoked periodically. Examples of proactive routing protocols are Destination-Sequenced Distance Vector (DSDV) Routing Protocol and Optimized Link State Routing Protocol (OLSR).

Reactive routing mechanisms are invoked on demand (when a source has a packet to send to a destination). Examples of reactive routing protocols are Dynamic Source Routing (DSR) and Ad hoc On Demand Distance Vector (AODV) Routing. Reactive ad hoc routing protocols generate less route management traffic than proactive protocols.

THE AD-HOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL

Route discovery process: The route discovery process is started whenever a source node wants to communicate with another node for which it has no routing. Every node maintains two separate counters: a node sequence number and a broadcast-ID (Perkins *et al*., 2003). The source node initiates path discovery by broadcasting a route request (RREQ) packet to its neighbors. The RREQ packet format is shown in Fig. 1 (Perkins *et al*., 2003).

The pair <Sourceaddr; Broadcast-ID> uniquely identifies a RREQ packet. Broadcast-ID is incremented whenever the source issues a new RREQ packet. Each neighbor either satisfies the RREQ by sending a route reply (RREP) back to the source if it knows the path to destination or rebroadcasts the RREQ to its own neighbors after increasing the hop count field. A node

Type	J|R|G|D|U	Reserved	Hop count
RREQ ID			
Destination IP address			
Destination sequence number			
Originator IP address			
Originator sequence number			

Fig. 1: The RREQ packet format

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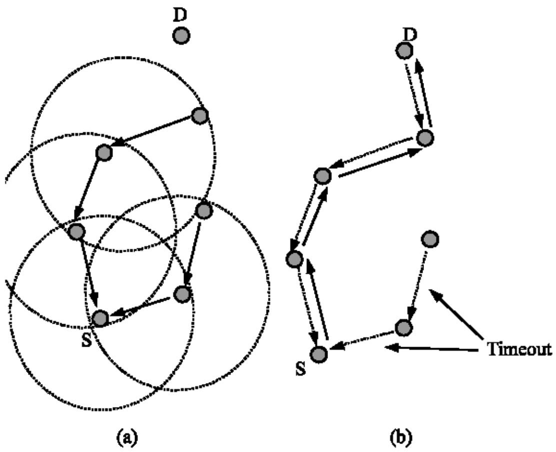

Fig. 2: (a) Reverse and (b) forward Path formation in AODV Protocol (C. Perkins *et al*., 2003)

may receive multiple copies of the same RREQ packet from various neighbors. When an intermediate node has already received a RREQ with the same Broadcast-ID and source address, it drops the redundant RREQ packet and does not rebroadcast it. If a node cannot satisfy the RREQ, it keeps track of the following information in order to implement the reverse path setup, as well as the forward path setup that will accompany the transmission of the eventual RREP:

- Destination IP address
- Source IP address
- Broadcast-ID
- Expiration time for reverse path route entry
- Source node's sequence number

Reverse path setup: Two sequence numbers (in addition to the Broadcast-ID) are included in a RREQ as shown in Fig. 1. The source sequence number is used to maintain freshness information about the reverse route to the source and the destination sequence number specifies how much fresh a route to the destination must be before it can be accepted by the source (Perkins *et al*., 2003).

As the RREQ travels from a source to various destinations, it automatically sets up the reverse path from all nodes back to the source (Perkins *et al*., 2003), as illustrated in Fig. 2a. To set up a reverse path, a node records the address of the neighbor from which it received the first copy of the RREQ. These reverse path route entries are maintained for at least enough time for the RREQ to traverse the network and produce a reply to the sender.

Forward path setup: Eventually, a RREQ will arrive at a node(possibly the destination itself) that possesses a

Type	R|A	Reserved	Prefixed Sz	Hop Count
Destination IP address				
Destination sequence number				
Orininator IP address				
Life time				

Fig. 3: A RREP packet format

current route to the destination. If an intermediate node has a route entry for the desired destination, it determines whether the route is current by comparing the destination sequence number in its own route entry with the destination sequence number in the RREQ (Perkins *et al*., 2003). If the RREQ's sequence number for the destination is greater than that recorded by the intermediate node, the intermediate node must not use its recorded route to respond to the RREQ. Instead, the intermediate node rebroadcasts the RREQ. The intermediate node can reply only when it has a route with a sequence number that is greater than or equal to that contained in the RREQ. If it has a current route to the destination and if the RREQ has not been processed previously, the node then unicasts a route reply packet (RREP) back to its neighbor from which it received the RREQ (Fig. 2b). A RREP packet format is shown in Fig. 3 (Perkins *et al*., 2003).

Route maintenance: Movement of nodes not lying along an active path does not affect the route to that path's destination. If the source node moves during an active session, it can reinitiate the route discovery procedure to establish a new route to the destination. When either the destination or some intermediate node moves, a special RREP is sent to the source nodes. Periodic hello messages can be used to ensure symmetric links, as well as to detect link failures (Perkins *et al*., 2003).

Once the next hop becomes unreachable, the node upstream from the breaking point propagates an unsolicited RREP with a fresh sequence number (i.e., a sequence number that is one greater than the previously known sequence number) and hop count of 1 to all active upstream neighbors. Those nodes subsequently relay that message to their active neighbors and so on. This process continues until all active source nodes are notified. Upon receiving notification of a broken link, source node can restart the discovery process if it still requires a route to the destination.

SIMULATION RESULTS

Simulation environment: The simulations are performed in OPNET (MIL3, 2006) and the test-bed used is OPNET

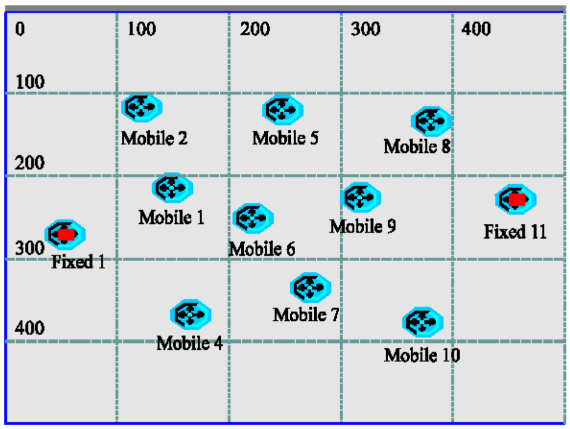

Fig. 4: 11 nodes in 500×500 m region

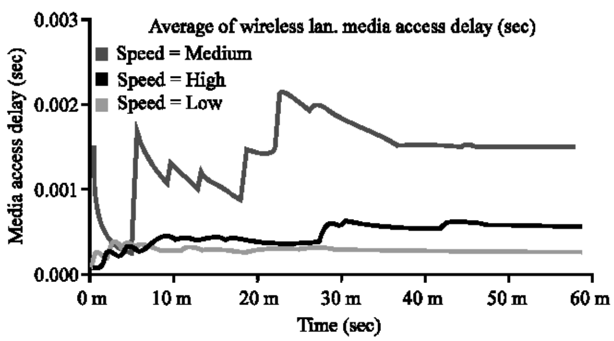

Fig. 5: Affect of speed on media access delay

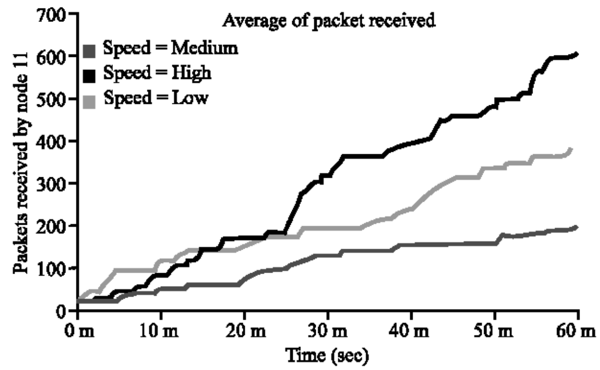

Fig. 6: Affect of speed on packets reaching node 11

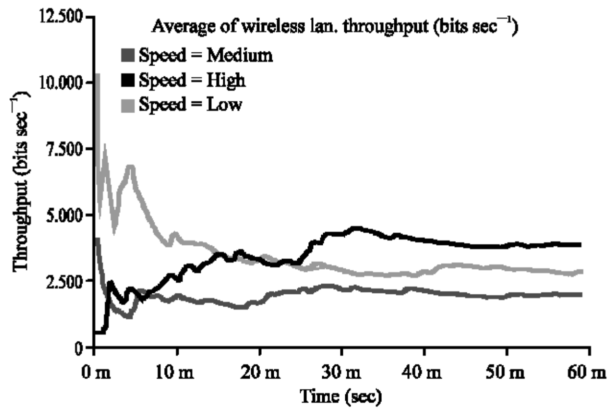

Fig. 7: Affect of speed on throughput

Model from NIST (NIST, 2006). Initially 11 nodes as shown in Fig. 4 are placed in a region of 500×500 m. Some nodes are fixed, while other nodes are moving with different speeds and randomly in different directions. We have performed a series of simulations to find out how different node mobility parameters such as node speed, number of transmitting nodes and number of mobile nodes affect performance of a Mobile ad hoc Network.

Effect of varying speed: In this section we have analyzed how variations in speed of mobile nodes affect performance of an ad hoc network. The results are collected for throughput; media access delay and number of data packets that are received by node 11. Node 1 is sending data to node 11 while other nodes are performing only the routing functionality. All the mobile nodes are moving with different speeds. We called this scenario as low speed scenario. In the 2nd and 3rd scenario the entire configuration is same except that nodes are moving with medium and high speed respectively.

Speeds were assigned to nodes using POS_TIMER and STEP_DIST parameters in OPNET (MIL3, 2006). During simulation each node moves STEP_DIST distance after POS_TIMER time interval in a random direction. Following parameter values were used for low, medium and high speed scenarios:

For low Speed Scenario:
POS_TIMER = 10 (Same for all nodes)
STEP_DIST = 5, 10, 15 (Randomly Assigned)

For medium Speed Scenario:
POS_TIMER = 5 (Same for all nodes)
STEP_DIST = 5, 10, 15 (Randomly Assigned)

For High speed Scenario:
POS_TIMER = 2.5 (Same for all nodes)
STEP_DIST = 5, 10, 15 (Randomly Assigned)

The increase in delay with increase in speed is expected since there would be more path breakages, which would result in more re-route discoveries. This would increase media access delay (Fig. 5).

The number of packets received by node 11 decreases as node speed increases as shown in Fig. 6. This is due to the reason that high speed results in more

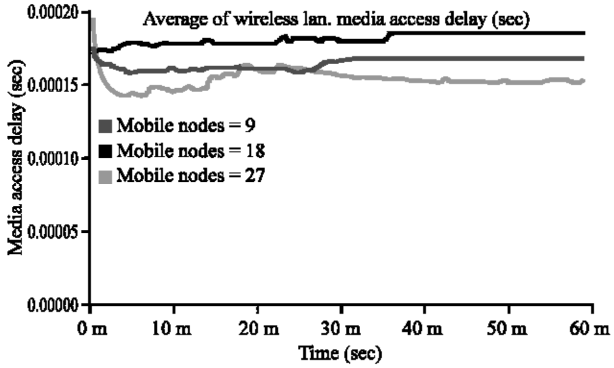

Fig. 8: Affect of number of nodes on media access delay

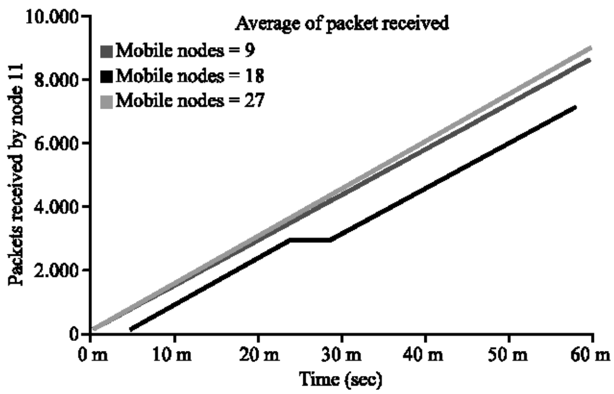

Fig. 9: Affect of number of nodes on packets reaching node 11

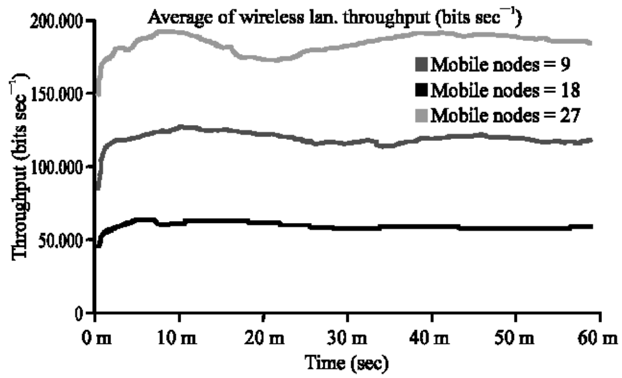

Fig. 10: Affect of number of nodes on throughput

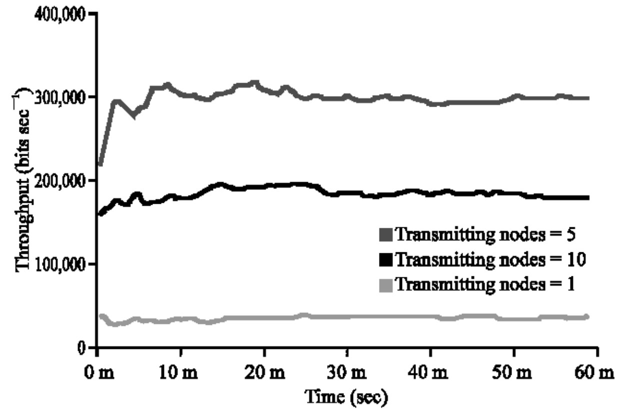

Fig. 11: Affect of number of transmitting nodes on throughput

path breakages and reroute discoveries. Figure 7 indicates that increase in node speed will result in reduction in throughput of the network. The reason for this is that higher speed results in higher re-route discoveries. Routes will be sustained for longer periods of times if nodes move with low speed.

Effect of varying number of nodes: we have analyzed how variations in number of mobile nodes affect the performance of an ad hoc network. The results are collected for throughput; media access delay and number of data packets that are received by node 11. In Fig. 4 node 1 is sending data to node 11 while rest of the mobile nodes are forwarding packets. All the mobile nodes are moving with different speeds. The number of mobile nodes is 9 for the first scenario. In the 2nd and 3rd scenario nodes were increased to 18 (Twice) and 27 (Thrice) respectively. Due to space limitations the node placement scheme for 18 and 27 nodes is not shown here.

Delay in Fig. 8 decreases, with increased number of mobile nodes. The reason for this decrease in delay is that the probability of finding neighboring nodes (when a node wants to send data to a particular node) increases when there are more nodes in the network.

Similarly throughput and number of data packets received by node 11 increases when number of mobile nodes increases as shown Fig. 9 and 10, respectively. The reason for this increase in throughput is that the probability of finding a node for re-route discovery increases as the number of mobile nodes increases.

Effect of varying number of transmitting nodes: In this section we have analyzed how variations in number of transmitting nodes affect the performance of an ad hoc network. Initially we have used the node placement scheme as shown in Fig. 4. Node 1 is sending data to node 11 while rest of the mobile nodes performing routing functionality only. In the 2nd and 3rd scenario half (5) and all (10) nodes are sending data to node 11, respectively.

Throughput increases when more nodes transmit data as shown in Fig. 11.

CONCLUSIONS

This study has discussed in detail the affect of different mobility parameters (Speed, number of nodes and number of transmitting nodes) on performance of AODV network. It has been proved that throughput increases with decrease in node speed and increase in number of mobile nodes and transmitting nodes.

REFERENCES

Awerbuch, B., 2003. High throughput route selection in multi-rate ad hoc wireless networks www.cnds.jhu.edu/research/networks/archipelago/publications/AHR-MediumTimeMetric-Technical Report.pdf.

Hussain, S.A., E. Garcia and M. Idrees, 2005. Throughput Enhancement in AODV Routing Using Mobility Awareness. INMIC 2005, Karachi, Pakistan, December 2005.

MIL3, 2006. http://www.opnet.com

Misra, P., 1999. Routing Protocols for Ad Hoc Mobile Wireless Networks. In CIS 788- Recent Advances in Networking", Ohio State University.

Perkins, C.E., Belding-Royer and S. Das, 2003. Ad hoc on-demand distance vector (AODV) routing. IETF Internet Draft http://www.ietf.org/internetdrafts/draft-ietf-manet-aodv-13.txt, February 2003.

http://www.antd.nist.gov/wctg/manet/2006.