Performance Evaluation of AODV Routing Protocol on Isolated Nodes in MANET with Unreliable Links

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ABSTRACT
An Ad hoc network is a autonomous system of nodes moving in a arbitrary fashion forming an network without any centralized support. In an Ad hoc network each node acts as a router enabling communication between source and destination node. Non infrastructure based ad hoc network is expected to utilize the full potential of future 4G network. Ad hoc networks finds extensive application in remote locations where implementing infrastructure is expensive or simply not possible to implement. Ad Hoc On Demand Distance Vector Routing is one of the most popular routing protocols and has been extensively studied in sparse and dense networks with various types of mobility pattern and speeds. In this paper we investigate the performance of AODV routing protocol on nodes which are isolated and on the edge of the network which is highly vulnerable to packet losses, unreliable link and poor network connectivity. These nodes are compared with the performance of fast moving vehicular nodes.

KEYWORDS
Ad hoc network, Ad hoc on demand distance vector routing, routing performance.

1. INTRODUCTION
Wireless network is gaining popularity with IEEE 802.11 emerging as the standard for wireless communication [1]. Wireless networks can be broadly classified into infrastructure based wireless network and infrastructureless wireless networks or Ad hoc networks. In an ad hoc network the nodes are mobile and routing between source and destination node which are not in radio range is achieved by intermediate nodes.As Ad hoc networks are highly dynamic, routing protocol plays a crucial role to achieve quality of service. Other important factors to be considered in Ad hoc networks are dynamic network topology, frequency of network updates, scalability, security and energy required. The challenge faced in each layer of the Ad hoc network OSI model is shown in table I.

In Ad hoc networks routing protocols are broadly classified into proactive (table driven) routing protocol and reactive(on demand) routing protocol[2]. In pro active routing each node in the ad hoc network maintains a table or tables containing routing information of the network. Any node that needs to transmit data can start transmitting data using routes already present in the routing table enabling immediate data transmission. Popular proactive routing protocols include Destination sequence distance vector (DSDV) routing protocol[3], Wireless routing protocol (WRP)[4] and Optimized link state routing protocol (OLSR).Irrespective of data traffic, proactive protocols periodically updates the routing table and the control overhead of these protocols is foreseeable as it is independent of the data traffic in the network and this is an advantage of proactive routing protocols.

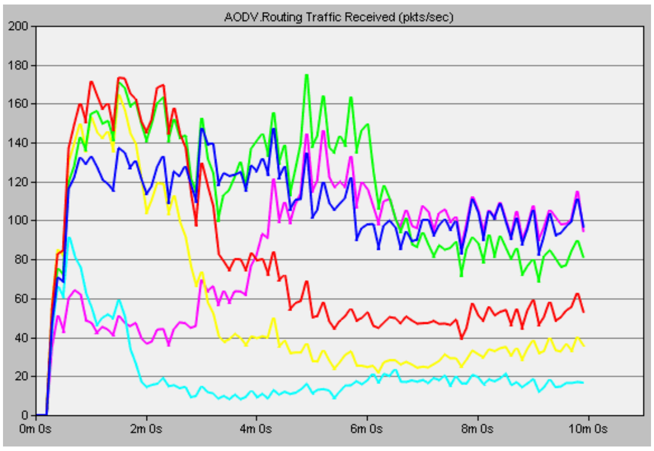
Table I :Major challenges in each layer of Ad hoc network

Network Layer	Major Issues
Application Layer	Security
Transport Layer	Authentication, Quality of Service
Network Layer	Routing
Physical / Link Layer	Power Management

Unlike table drive routing protocols, reactive protocols update routing information only when a route is required by a source node to transmit data. Reactive routing protocols reduce the control overheads which is advantageous in high mobility networks where periodic updates in routing information leads to significant increase in network overheads when there is no data transmission between nodes in the network. Some of the popular ad hoc routing protocols falling in this category are Dynamic source routing (DSR)[5][6], Ad hoc on demand distance vector (AODV) routing[7][8] and Temporarily ordered routing algorithm (TORA)[9].

AODV has been extensively studied in terms of the route recovery mechanism[10], security[11], Anomaly detection[12], sparse and dense network with different mobility patterns and speeds.A common problems faced by nodes in ad hoc network located in the edge of the network are unreliable links, poor signal quality, higher latency and larger packet losses. In this paper we investigate the behaviour of nodes in the network edge and their performance evaluation when adapting AODV routing protocol. This paper is organized into the following sections. Section II describes in detail AODV routing protocol, Section III presents our experimental setup and the findings. Section IV discusses the obtained results.

2. AD HOC ON DEMAND DISTANCE VECTOR ROUTING PROTOCOL
AODV is an adaptation of Destination Sequenced Distance Vector (DSDV) protocol used in wired networks and overcomes the shortcomings of DSDV in wireless environment. AODV eliminates the counting to infinity problem faced in other distance vector protocols by implementing sequence number. Unlike DSR which carries the entire route between the source and destination in the packet, the nodes in AODV carry only the next hop information corresponding to each data flow. Being a reactive routing protocol routes are discovered as and when needed and the discovered routes are maintained as long as they are required.



A route discovery is initiated when one of the nodes in the network wants to send data packet to another node. If an active route is not available AODV initiates the route discovery process with the source node broadcasting a route request message(RREQ) to find a route to the destination. The route is found either with the RREQ reaching the destination or an intermediate node in the network which has "fresh enough" route to the destination with the sequence number equal to or greater than the sequence number contained in the RREQ. Once a valid route is found it is made available by a route reply(RREP) message back to the originator of the RREQ. Once the route is established the nodes monitor the state of the links continuously. If a link breaks in an active route, a route error message (RERR) is sent to the other nodes of the link breakage. This initiates a new route discovery process.

The advantages of AODV routing protocol is the selection of the least congested route instead of the shortest path. AODV supports both unicast and multicast data transmission. Performance is not drastically affected even if the topology changes continuously. Since source routing is not used, there are no additional overheads in the data packet. However AODV performance metrics starts deteriorating as the network size grows and since there is no built in security mechanism it is vulnerable to outside attacks.

3. EXPERIMENTAL SETUP

Opnet was used to setup our simulation. 30 mobile nodes were used in an area of 4 square kilometre. Each node has a transmission power of 0.5 w and is capable of creating raw traffic over IP and WLAN. Each node has a capability of 2 Mbps. Each node was designed to send traffic randomly to all other nodes with an exponential packet-interval-arrival time. Five of the nodes were programmed to move fast at 60 Kmph within the network and another four nodes were programmed to move to the edge of the network and remain isolated which is the focus of this study.

Simulation was run for 600 seconds and the result obtained is shown in figure I through IV.

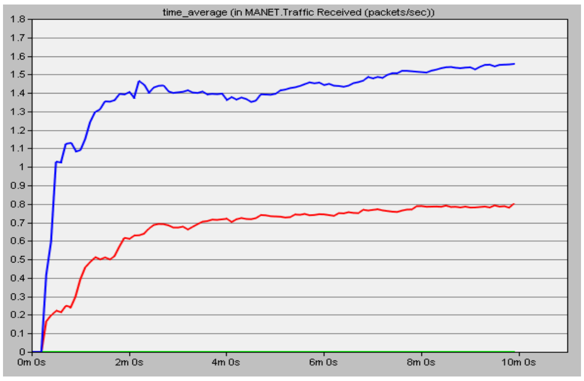


Figure I. Routing traffic received by the five fast moving nodes in the simulation environment.

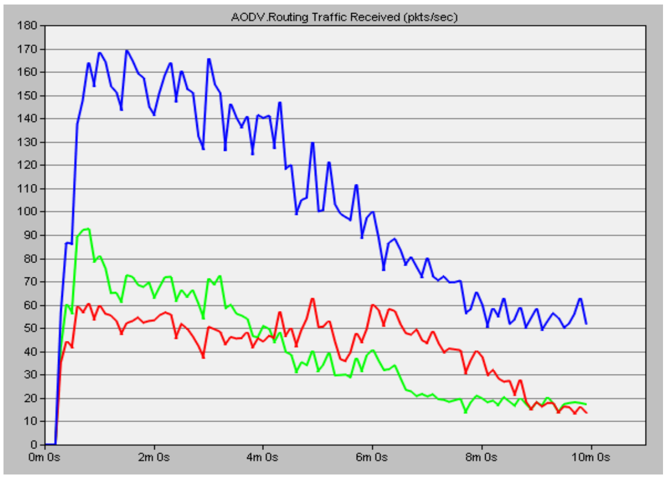


Figure II . Routing traffic received by three of the isolated nodes in the simulation environment.

From figure II and III it is seen that the routing traffic received is lower in two thirds of the nodes in the isolated network whereas it is much higher in fast moving nodes. Though the isolated nodes have less mobility and are slow moving, their performance lower than that of fast moving nodes in general.

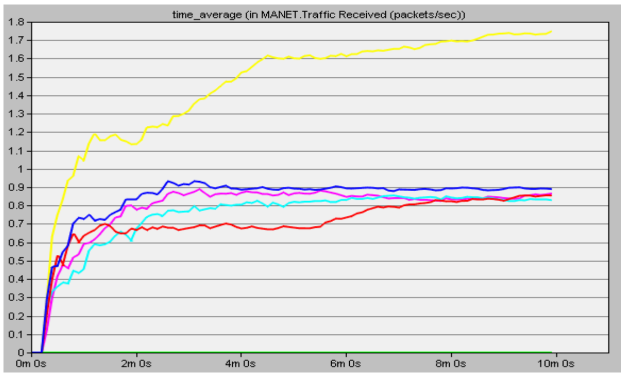


Figure III : Time average traffic received by five of the fast moving nodes.

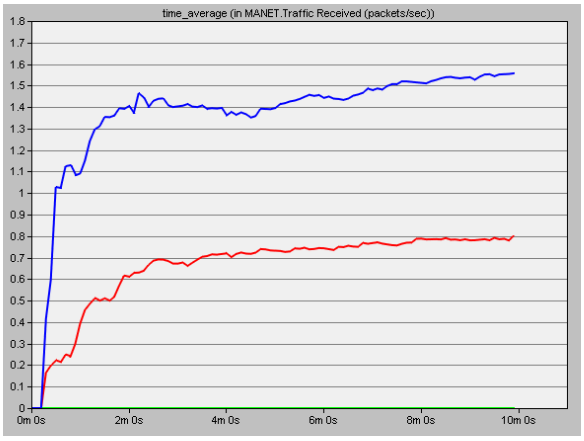


Figure IV : Time average traffic received by 3 of the isolated nodes.

From figure III and IV shows the time average traffic received by the nodes under study. It is seen that two of the isolated nodes are able to receive traffic whereas one of the node is unable to receive traffic during the entire simulation period which need not be considered for our evaluation.

4. CONCLUSION

In this paper we studied the performance of nodes which are isolated in the network against fast moving nodes in the network. The performance of isolated nodes which are able to establish communication with other nodes is relatively lower than that of fast moving nodes. This can be attributed to the nodes not able to establish communication most of the time. AODV performs almost consistently for fast moving nodes however methods need to be identified to improve its performance in isolated nodes.

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