Analysis and Enhancement of Parameters over AODV in AOMDV using OPNET 14.5

Manish Kumar Agrawal[1] Narendra Kumar Agrawal[2]
[1]M.Tech Research Scholar [2]HOD
[1,2]Department of Computer Science & Engineering
[1,2]Jaipur Engineering College, Kukas Jaipur, Rajasthan

Abstract— The network in which no. of mobile nodes can communicate with each other through a radio wave without any specified infrastructure is popularly known as Mobile Ad-hoc Network(MANET).MANET has a number of routing protocols. The popular ones so far are Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV), Ad-hoc On-demand Distance Vector (AODV), Ad-hoc On-demand Multicast Distance Vector (AOMDV) and Temporally-ordered Routing Algorithm (TORA)routing protocol. Among them the AODV and AOMDV routing protocol meets efficiently with the ad-hoc network specification. For last few years routing protocols of mobile ad-hoc networks (MANETs) were simulated as a function of mobility, number of nodes, and size of the network but not as a function of route maintenance parameters such as Active Route Timeout (ART) and Delete Period Constant (DPC=n) with moving source-destination (node) pairs in network as well. The simulation study of proposed routing protocol is carried out using OPNET 14.5 simulation tool. The simulation results of different 'ART' and 'n' for the performance metrics net throughput, route discovery time and % of packet drop are analyzed graphically for proposed routing protocols. The default values for AODV are ART =3 and n = 5.Finally this paper presents the Performance matrices evaluation and comparison of AODV and AOMDV routing protocol by varying Active Rote Timeout (ART) and Delete Period Constant (n) at different Source –Destination (node) pair using opnet 14.5.

Key words: MANETs, AODV, AOMDV, ART, DPC, Random WayPoint, Route Maintenance, Opnet 14.5.

I. INTRODUCTION

Mobile ad-hoc network (MANET) is a collection of independent mobile nodes that can communicate to each other via radio waves [11]. The mobile nodes that are in radio range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. These networks are fully distributed, and can work at any place without the help of any infrastructure. This property makes these networks highly flexible. Owing to the limited transmission range of wireless network interfaces, multiple hops are needed to exchange data between nodes in the network. There are various routing protocols such as DSDV, AODV, OLSR, TORA, DSR, etc., which can be categorized as table driven (proactive), on-demand driven (reactive) and hybrid protocols. AODV stands for ad-hoc on-demand distance vector and is, as the name already says, a reactive protocol, even though it still uses characteristics of a proactive protocol. Performance evaluation of different routing protocols is carried out for quality of service (QoS) metrics, such as throughput, drop, delay, jitter, packet delivery ratio etc and route maintenance parameters, such asART, delete period constant, etc., in constantscenario (network load, network size and mobility).

Route maintenance is the mechanism used by a source node to detect a link breakage along its source route to a destination node. Using this mechanism the source node can know it can still use the route or not. When the source node indicates the existence of a broken link in the source route, it can use another route or trigger a new route discovery process [10] [5].

ART is the time at which route is consider as a valid route. When a route is not used for some time, the nodes will remove the route state from the routing table. The time until the node removes the route states is called ART [1]. Delete period constant specifies the time after which an expired route is deleted. An expired route is deleted after delete period multiplied by the greater of Active Route Timeout (ART) or hello interval.

Delete period = Delete period constant (n) × max (active route timeout or hello interval), where delete period constant is having default value of n = 5 s. Delete period is intended to provide an upper bound on the time for which an upstream node. The figure illustrates this concept which described just below. A can have a neighbour B as an active next hop for destination D, while B has invalidated the route to D as shown in Figure 1, where C is source node and D is destination node. As delete period is route maintenance parameter, it is clear that if the path between node C to node D has been setup via node A and node B as intermediate node, and node B has invalidated the route to node D due to the random topology of ad hoc network then up to delete period, node B can setup the route. After the delete period default value if node C still wants to communicate with node D it has to create new setup.

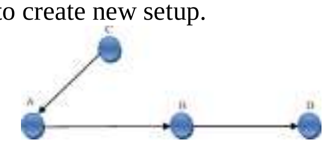

Fig. 1: Concept of delete period

II. BRIEF SUMMARY ON AD-HOC ONDEMAND DISTANCE VECTOR ROUTING

AODV can be called as a pure on-demand route acquisition system [8]. Here, nodes do not lie on active paths neither maintain any routing information nor participate in any periodic routing table exchanges. Further, a node does not have to discover and maintain a route to another node until it needs to communicate.

To maintain the most recent routing information between nodes the concept of destination sequence numbering will be used [4] [5]. Each ad hocnode maintains a monotonically increasing sequence number counter, which is used to supersede stale cached routes. WLAN (IEEE 802.11b), which is mostly used in ad hoc networks to make the physical connection directly between two nodes, is used in this simulation environment [2].

This section explains each process that is required in an AODV network to create, delete and maintain routes [8].

A. *Path Discovery*

The path discovery process is initiated whenever a source node needs to communicate with another node for which it has no routing information in its table. Every node maintains two separate counters; a node sequence number and a broadcast id. The source Effect of variation in active route timeout and delete period constant 181 node initiates path discovery by broadcasting a Route Request (RREQ) packet to its neighbors [4] [5].

B. *Reverse Path Setup*

There are two sequence numbers included in a RREQ; the source sequence number and the last destination sequence number known to the source. The source sequence number is used to maintain fresh information about the reverse route to the Source and the destination sequence number specifies how fresh a route to the destination must be before it can be accepted by the source. As shown in the Figure 2 when the source node S determines that it needs a route to the destination node D and does not have the root available. Immediately node S starts broadcasting RREQ message to its neighboring nodes in quest of route to the destination. The nodes 1 and 4 being as neighbors to the node S receive the RREQ message. So, nodes 1 and 4 create a reverse link to the source from which they received RREQ. Since the nodes 1 and 4 are not aware of the link to the node D, they simply rebroadcast this RREQ to their neighboring nodes 2 and 5. As the RREQ travels from a source to various destinations, it automatically sets up the reverse path from all nodes back to the source as shown in Figure 2. This reverse route will be needed if the node receives a RREP back to the node that originated the RREQ. Before broadcasting the RREQ, the originating node buffers the RREQ ID and the originator IP address. In this way, when the node receives the packet again from its neighbors, it will not reprocess and re-forward the packet.

Eventually, a RREQ will arrive at a node that possesses a current route to the destination or the destination itself.

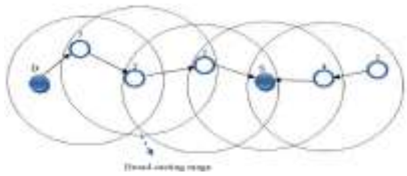

Fig. 2: Reverse path setting

C. *Forward Path Setup*

The receiving node first checks that the RREQ was received over a bi-directional link. 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 to the destination sequence number in the RREQ. 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 does have a current route to the destination and if the

RREQ has not been processed previously, the node then unicast a route reply packet (RREP) back to its neighbor from which it received the RREQ. By the time a broadcast packet arrives at a node that can supply a route to the destination, a reverse path has been established to the source of the RREQ. As the RREP travels back to the source each node along the path sets up a forward pointer to the node from which the RREP came, updates its timeout information for route entries to the source and destination, and records the latest destination sequence number for the requested destination. Figure 3 represents the forward path setup as the RREP travels through the nodes 3,2, 1 from the destination D to the source node Synods 4 and 5 are not along the path determined by the RREP, and will timeout after ART and will delete the reverse pointers from these nodes.

Fig. 3: Forward path setting

A node receiving a RREP propagates the first RREP for a given source node towards that source. If it receives further RREPs, it updates its routing information and propagates the RREP only if the RREP contains either a greater destination sequence number than the previous RREP, or the same destination sequence number with a smaller hop count. Now the source node S can begin data transmission as soon as the first RREP is received, and can later update its routing information if it learns of a better route.

D. *Route Table Management*

A timer associated with reverse path routing entries is called the route request expiration timer. The purpose of this timer is to erase reverse path routing entries from those nodes that do not lie on the path from the source to the destination .The expiration time depends upon the size of the ad-hoc network. Another important parameter associated with routing entries is the route caching timeout or the time after which the route is considered to be invalid. In each routing table entry, the address of active neighbors through those packets for the given destination is received is also maintained. A neighbor is considered active for that destination, if it originates or relays at least one packet for that destination within the most recent active timeout period [8]. This information is maintained so that all active source nodes can be notified when a link along a path to the destination breaks. A route entry is considered active, if it is in use by any active neighbors. A mobile node maintains a route table entry for each destination of interest.

III. AOMDV

The unwired mobile network becomes popular among the users as they provide access for information and can communicate anytime and anywhere. The conformist unwired mobile communication system is normally supported by a fixed wired infrastructure (like ATM or

Internet). A single-hop unwired radio communication is used by the mobile device to access a base station which is connected to it with the wired infrastructure. In contrast, the category of Mobile Ad-hoc Networks does not use any predefined infrastructure. The nodules of MANETs intercommunicate can be done with single-hop & multi-hop routes in a peer-to peer manner. Transitional nodules between a pair of communicating nodules work as routers.

Hence the nodules in MANETs work both as hosts and as well as routers. The nodules are mobile, and so the formation of routing lanes is exaggerated by the addition and removal of nodules. The topology of the network may change rapidly and unexpectedly. The enhancive use of mutual applications and unwired mechanism may further add to the requirements and usages of Mobile Ad-Hoc Networks. Many of these possible applications of MANETs engross point-to-multipoint transmission, and hence would advantage from multicasting support in the network layer. Intercommunication in MANETs differs from that of wired networks in the following aspects.

The unwired communication standard has changeable and random characteristics. The signal strength & propagation delay vary with respect to time and environment. The battery power and bandwidth availability are partial in mobile ad hoc networks. Hence the algorithms and etiquette require preserve bandwidth and energy as well as.

The mobility of the nodules generates an incessantly changing topology for communication. Routing paths shatter and new ones are shaped dynamically. Unlike the wire connected network, unwired medium is a broadcast medium; all nodules in the transmission array of a nodule can hear the packages simultaneously. IP multicasting was first planned simultaneously. Over a decade ago [1] as a conservatory to Internet architecture to sustain multiple patrons at network layer.A fundamental standard for the forward tree is to be branched as nearer to the receivers as achievable. In ad hoc networks (MANETs), we desire to adhere to this condition as closely as achievable because of the strict bandwidth limitations in ad hoc networking environments.

Alike to Internet multicasting, it is essential to deal with vibrant memberships in multicast groups in ad hoc networks. In both ad hoc multicasting and Internet, dynamic membership consigns to the information that personage clients may connect and depart multicasting sessions dynamically. As a consequence, a multicast protocol requires to defining processes of associates join and leave, and how to recuperate from routing breakdown. The data forwarding route is created either as a mesh or a tree.

What makes an ad hoc multicasting eminent from Internet multicasting is that mobile nodules could travel around rapidly and freely. In other words, we have to covenant with high network dynamics due to nodule mobility, which formulates ad hoc multicasting even more difficult. Ad hoc multicasting protocol in existing scenario have either developed from the

Internet multicast etiquette, or designed particularly for ad hoc networks. Most of these etiquettes endeavour to acclimatize to the network dynamics in MANETs. The prime objective of ad hoc multicasting protocols should be to create/uphold a robust & competent multicasting path even through high network dynamics. By "robust", we signify that the etiquette should be capable to function correctly in spite of topology changes and nodule mobility. By "efficient", we mean both data forwarding overheads should be maintained low and controlled.

IV. OPNET 14.5

Opnet 14.5 modeler and simulation software provide solution for application and network management issues.This software is widely used for research and development of emerging networking technologies; for performance evaluation, testing, and debugging of communication networks, protocols, and applications; and for teaching and research. OPNET software has an easy-to-use graphical user interface, which can be used to build various network configurations and test their performance with simple drag-and-drop actions and a few clicks of a mouse. OPNET software contains a huge library of models that simulate most of the existing hardware devices and cutting-edge communication protocols. Opnet is a discrete event simulator which provides a good balance between ease of use and extensibility and power in terms of what scenarios can be simulated. Also, it does not have as much complexity as some tools, which results in a shorter learning curve. Finally, it has quite advanced wireless modules with new technologies being incorporated into the tool relatively quickly.

V. SIMULATION ENVIRONMENT

Different parameters for simulation environment have been considered as per Table 1 Here, the ART is taken as the values of [0.5, 2.0, 3.0, 3.5, and 5.0] (in sec) and for each value of ART, the value of delete period constant (n) is taken as [2, 3, 4, 5, 6, 7, and 8].Default value of route maintenance parameters of AODV and AOMDV routing protocol are given in Table 2.

Parameters at Physical Layer	
Radio type	802.11b
Antenna height	1.5m
Antenna Efficiency	0.8
Antenna model	Omni-Directional
Path loss model	Two ray
No. of channels	1(2.4GHz) Ad-hoc mode
Parameters at MAC Layer	
Mac protocol	802.11
Parameters at Network Layer	
Subnet channel	Wireless
Network protocol	IPv4
Routing Protocol	AODV
Parameters at Application Layer	
Applications	CBR
Packet size	512 Byte
Data Rate	10 kbps
Number of send packet	3600
General parameters	
Network Simulator	QualNet 7.1
Total simulation time	180 seconds
Terrain size	1KM x 1 KM
Number of node	20

Number of SD pair	5, 7
Maximum propagation distance	200 meter
Transmission power	15dbm
Node placement	Randomly
Device type	Human
Mobility model	Random waypoint
Pause time	30 second
Minimum speed	0 m/s
Maximum speed	10 m/s
Routing protocol	AODV
Consider Active Route Timeout (ART)	0.5, 2, 3, 3.5, 5 (second)
Consider Delete Period Constant (DPS)	2, 3, 4, 5, 6, 7, 8 (second)

Table 1: Simulation Parameters

Active Route Timeout (ART)	3 s
Delete Period Constant (DPS)	5 s
My Route Timeout interval	2x Active Route Timeout (ART)
Node Traversal Time	40 s
Maximum Route Request Retries	2
Maximum Number of Buffer Packets	100
Net_Traversal_Time	2*Node_Traversal_Time*Net Diameter
Path_Discovery_Time	2 * Net_Traversal_Time
Allowed_Hello_Loss	2

Table 2: Default Value of Route Maintenance

A. Parameters of AODV Routing Protocol

Graphs have been analyzed using Dfor each value of ART with different values of deleteperiod constant on X-axis and of ReceivedThroughput/Average End to End Delay/AverageJitter and Loss Packet on Y-axis.

VI. RECEIVED THROUGHPUT (BITS/SECOND)

Throughput is the number of packets that is passing through the channel in a particular unit of time.

Performance metrics show the total number of packets that have been successfully delivered from source node to destination node. With ACKs and retransmission, this would not necessarily lead to lost packet, but will add to the network's load as well as the mean delay. Over all received throughput is higher for 7 SD pair because in this number of passing signal is high. And almost it is constant throughout distributed DPC.

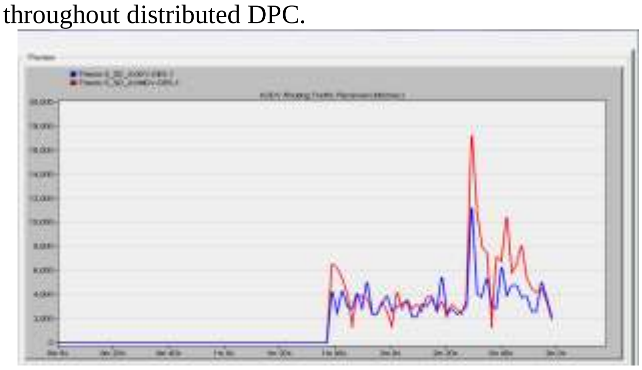

Fig. 4: Throughput at ART= 2 Sec

Fig. 5: Throughput at ART= 3 Sec

VII. AVERAGE END-TO-END DELAY (SECONDS)

Route Discovery Time is defined as the time taken by the source and destination through all connection throughputs the simulation experiment. Each data transmission between a source and a destination will experience a small amount of time to find an optimal route in the network. The route discovery time is defined as the time taken by a source to find a route to reach at the destination through the intermediate nodes. The aggregate of all such connection time is found and average over the total number of transmission connection pairs. It indicates the suitability of using certain routing protocols to support these applications. Or an exact package is broadcasting from transmitter to receiver and computes the distinction between sending times and receiving times.

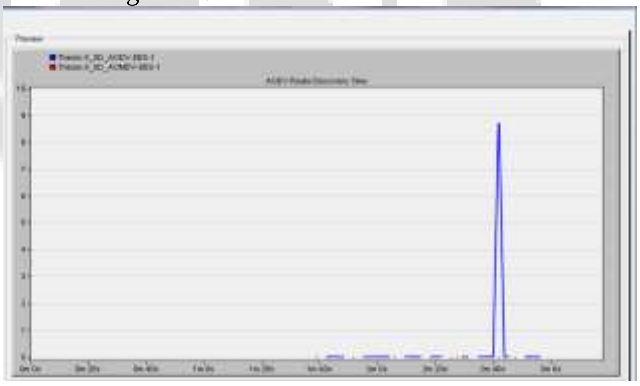

Fig. 6: Route discovery time at ART= 2 Sec

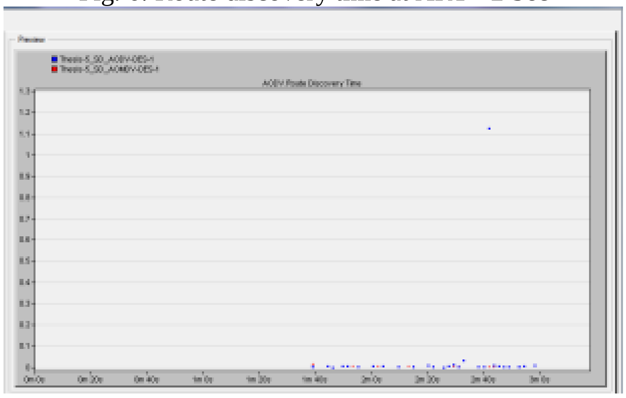

Fig. 7: Route discovery time at ART= 3 Sec

VIII. PERCENTAGE DROP OF PACKETS

This performance matrices parameter shows that the percentage of drop packets. The source sends a number of packets and destination receives a less number of packets.

The difference in receiving no. of packets is represented by %drop of packets.

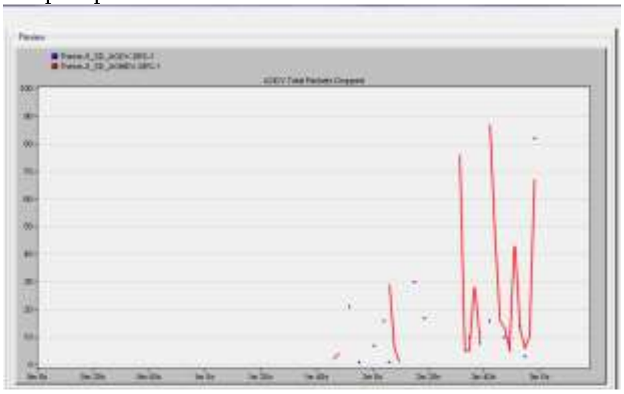

Fig. 8: % drop of packet at ART= 2 Sec

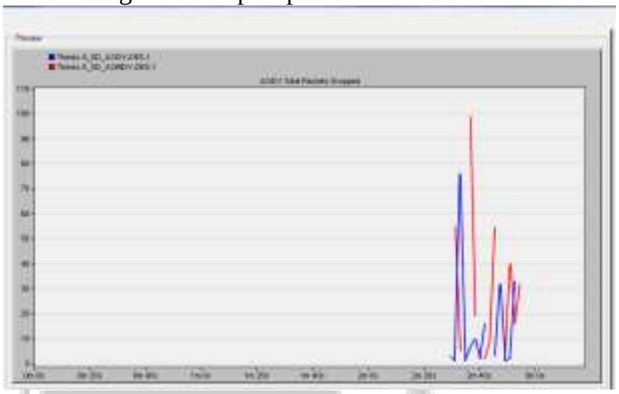

Fig. 9: % drop of packet at ART= 3 Sec

IX. CONCLUSION

The prime objective of this paper is to analyze the performance comparison of AODV and AOMDV routing protocol, if it's default value of route maintenance parameters are varied in mobile ad hoc networks (MANETs) environment. There are various route maintenance parameters of AODV and AOMDV routing protocol, which are listed in Table 2. Among them only two route maintenance parameters have been considered, to analyze the performance for comparison of AODV and AOMDV routing protocol in this paper that are Active Route Timeout(ART) and Delete Period Constant (DPC=n), the default value of these route maintenance parameters are 3 second and 5 second respectively.

According to taken scenario, AOMDV delivered maximum net throughput at "ART=3.0 & DPC=4.0sec." Delivered throughput by AOMDV is always greater than the AODV because number of generated packets from all clients is higher so number of passing packets from channel at particular unit of time is high in case of AOMDV, this can be seen on figure (4, and 5). Increasing of number of path in constant network density doesn't mean that always performance will increase. It may increase till wireless channels are easily available for data transmission after that it may degrade when channel becomes highly congested or transmitted data is highly more than the numbers of free available channels in the network.

In case of route discovery time, AOMDV gives best performance at "ART=3.5 & DPC=2 sec." and at "ART=3.0 & DPC=4 sec." AOMDV gives minimum route discovery time for almost all value of ART but analytical values are uncertain in both AODV and AOMDV; it can be cleared from figure (6 and 7). Minimum route discovery time is possible in case of AOMDV because number of active node is more, so there are a no difficulties in route discovery process. In this presented scenario, network gives minimum% drop of at "ART=3.0 & DPC=6, 7 sec." for AODVand at "ART=3.0 & DPC=4sec." for AOMDV. Here best performance is observed for AOMDV, which is shown on figure (8 and 9) but analytical values are again uncertain like as delay for both cases.

The original default value of ART and DPC have been considered as 3 sec & 5 sec respectively in AODV algorithm developed by C. Perkins, here in this scenario we got best performance of AODV at ART as 3 sec for all performance matrices except route discovery time in case of AOMDV, here it is 3.5 second. Best performance given by AOMDV for net throughput at DPC = 4 second, for route discovery time at DPC= 2 & 4, for % drop of packets at DPC=6 & 7 for AODV and at DPC=4 for AOMDV respectively. So it is clear that as per our analysis in case of throughput DPC value is 1 sec less, for delay average DPC value is 2 sec less, for % drop of packets DPC value is 0.667 sec greater than the original default value, which results in less memory overheads except in case of route discovery time. Generally performance matrices are constraint of each other so it is depends on the user choice.

REFERENCES

[1] Al-Mandhari, W., Gyoda, K. and Nakajima, N. (2008) 'Performance evaluation of active routetime-out parameter in ad-hoc on demand distance vector (AODV)', 6th WSEASInternationalConference on AppliedElectromagnetic, Wireless and OpticalCommunications (Electroscience '08), 2–4July, Trondheim, Norway, pp.47–51, ISSN:1790-5117.

[2] [2] Cheng, Y., Cetinkaya, E.K. and Sterbenz,J.P.G. (2012) 'Dynamic source routing (DSR)protocolimplementation in ns-3', ICSTSIMUTools Workshop on ns-3 (WNS3), March, Desenzanod lGarda, Italy, pp.367–374.

[3] [3] Gupta, S.K. (2011) Performance Evaluationsof DSDV and AODV Routing Protocols inMobileAd-hoc Networks using NetworkSimulator, MTech. Dissertation undersupervision ofDr. R.K. Saket, Department ofElectrical Engineering, Indian Institute ofTechnology, BanarasHindu University, Varanasi, India.

[4] Gupta, S.K. and Saket, Dr. R.K. (2011a)'Performance metric comparison of AODVand DSDVrouting protocols in MANETsusing NS-2', International Journal ofResearch and Reviews inApplied Sciences,Vol. 7, No. 3, June, pp.339–350, ISSN: 2076-734X, EISSN: 2076-7366.

[5] Gupta, S.K. and Saket, Dr. R.K. (2011b)'Routing protocols in mobile ad-hoc networks', Special issue on Electronics,Information and Communication Engineering,International Journalof ComputerApplications, December, New York, USA,ISBN: 978-93-80865-63-9,Vol. ICEICE, No.4, pp.24–27.

[6] Kachhoria, R. and Sharma, S. (2011) 'An implementation in AODV based on active route time out between sensor nodes in wireless sensor networks',

International Journal on ComputerScience and Engineering, Vol. 3,No. 3, March, pp.1245–1251.
[7] Li, C.T., Yang, C.C. and Hwang, M.S. (2012)'A secure routing protocol with nodeselfishness resistance in Mantes',International Journal of MobileCommunications, Vol. 10, No. 1,pp.103–118.
[8] Perkins, C. and Das, S. (2003) 'Ad hoc ondemand distance vector routing', InternetEngineeringTask Force, Request forComments (Proposed Standard) 3561, July.http://datatracker.ietf.org/doc/rfc3561/
[9] Setty, S.P., NarasimhaRaju, K. and NareshKumar, K. (2010) 'Performance evaluation ofAODVin different environments',International Journal of Engineering Scienceand Technology,Vol. 2, No. 7, pp.2976–2981.Taksande, V.K. and Kulat, Dr. K.D.(2011) 'An extensive simulation analysis of AODV protocolwith IEEE 802.11 MAC forchain topology in MANET', InternationalJournal of InternetComputing, Vol. I, No. 1,pp.69–73.
[10] Zahedi, K. and Ismail, A.S. (2011) 'Routemaintenance approaches for link breakagepredictionin mobile ad-hoc networks',International Journal of Advanced ComputerScience andApplications, Vol. 2, No. 10,pp.23–30.
[11] Zhou, H. (2003) A Survey on RoutingProtocols in MANETs, Technical Report, MI48824-1027