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Node Density Based Performance Evaluation of Neighbor Energy Aware and Location Verification Approaches with Conventional Routing protocols in MANET's

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Abstract- **Wireless Mobile Ad hoc networks have a number of advantages over their traditional wired counterparts. They can be deployed in areas without a pre-existing wired. Due to the random mobility of nodes, the topology of the network changes often. A highly topology adaptable ad hoc routing protocol that used to detect and repair the link breakage in dynamic topology. MANET routing protocols are challenged with establishing and maintaining multi-hop routes due to frequent mobility speed. Neighbor Aware AODV (NAAODV) a new approach based on existing standard AODV protocol is presented. The data dissemination concept is based on the neighbor presence and energy information. A Neighbor Discovery and Location Verification (NDLV) is another new scheme proposed to protect the network from adversary nodes and to improve the performance by verifying the location of neighbor nodes. This paper provides node density based performance comparison of neighbor energy aware and location verification approaches with proactive and reactive routing protocols. The simulations are carried out to pinpoint various performance issues and comparison between them.**

Keywords — ***MANETs, routing protocol, reactive, proactive, hybrid, broadcasting techniques, dynamic topology.***

I. INTRODUCTION

MANET Routing protocol is a set of rules which monitors the traversing of message packets from source to destination in a network. MANET has different types of routing protocols and each of them is applied according to the network circumstances. The major types of routing protocols are proactive, reactive and hybrid. Proactive (or Table driven) routing protocols attempt to maintain up-to-date routing information to all nodes by periodically disseminating topological updates throughout the network and thus suffer the disadvantage of additional control traffic that is needed to continually update stale route entries. In NAAODV, the optimization of rebroadcast of RREQ is based on composite metric of neighbor presence and most recent remaining energy information to select the best and stable route in between source and destination using Route Reply (RREP) packet. Due to random movement, neighbor nodes comes into the coverage area of a base station and leaves at every fraction of time, which must be trusted for service handling. It is usually assumed that nodes are cooperative in MANET routing algorithms and adversary nodes could easily become an important routing agent and disrupt network operations by disobeying the protocol specifications and make considerable amount of performance degradation. The NDLV scheme identifies trusted neighbor nodes by extracting timing, finding location and computing the distance between each pair of nodes.

II. REVIEW OF THE LITERATURE

Perkins and Bhagwat, (1994) developed DSDV reactive routing protocol to calculate the shortest number of hops to the destination. There is increasing of routing overhead due to exchange of routing information in dynamic network scenarios and solutions are given for issues related to route discovery and maintenance. Perkins and Royer, (1999) developed the Ad hoc On-demand Distance Vector (AODV) and this is one of the most significant contributions to MANET routing.

Jose Moses et al (2012) evaluated the performance of AODV, DSR and DSDV with Constant Bit Rate (CBR) traffic and it is effective for scalable performance with 40 nodes. Mehmood, (2014) has given a comprehensive performance analysis of DSR, AODV, and DSDV routing protocol for different metrics in different scenarios.

Mohammed et al (2009) conducted comprehensive simulation study on the multipath routing protocols for mobile Ad hoc networks. Deepak and Yogesh, (2011)

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presented a probabilistic broadcasting algorithm based on traffic analysis. Manickam et al (2011) analyzed the performance of the three well known protocols AODV, DSR and DSDV with respect to variable node density.

Camp et al (2002) discussed the salient feature mobility models to established a relationship between path duration and MANET design parameters including node density, transmission range, number of hops and velocity of nodes.

Divecha et al (2007) analyzed the performance of DSR and DSDV routing protocols with different mobility models. Ni et al (1999) discussed the issues of broadcast storm problem due to blind flooding which leads to degradation of entire network performance.

Cartigny and Simplot, (2003) proposed an algorithm which combines the advantages of both probabilistic and distance methods to privilege the retransmission by nodes that are located at the radio border of the sender. Zhang and Agrawal, (2004) proposed a scheme that reduces blind flooding by fixing the probability high when receiving a broadcast packet for the first time in the network. Kim et al (2004) described a probabilistic method for on demand route discovery, where the probability to forward an RREQ packet is determined by the number of duplicate RREQ packets received at a node.

Abdulai et al (2007) investigated the effects of pause time setting for AODV routing protocol using Random Point Group mobility model (RPGM). Abdalla et al (2008) proposed a dynamic probabilistic broadcasting scheme for MANETs where nodes move according to way point mobility model and this approach dynamically sets the value of the rebroadcast probability for every host node according to the neighborhood information.

III. CONVENTIONAL AND NEW APPROACHES

A. Reactive and Proactive routing protocols (AODV and DSDV)

AODV is a reactive or source initiated on-demand protocol which requires that all mobile nodes obtain routes as needed with little or no reliance on periodic advertisements [8]. It has been described as a pure on-demand route acquisition system because when connectivity is required, each host becomes aware of its neighbours by the use of hello messages and a path discovery process is initiated to locate the destination host. It is based on distance vector and does not require any nodes to maintain routes to destination and composed into two important phases are "route discovery" [10] and "route maintenance", which work together to permit discover and maintain routes for appropriate pair of source and destination and need an optimum path for the reliable delivery of data packets.

DSDV is a best known protocol for a proactive routing scheme based on distance vector and routing decision taken by hop count as cost metric [21]. The basic improvements are made to include freedom from loops in routing tables for more dynamic and less convergence time. It requires each node needed to be periodically broadcasting the routing updates and utilize a sequence number to tag every route. Each node maintains a routing table which contains list of all known destination nodes within the network along with number of hops required to reach to particular node. Each entry is marked with a sequence number assigned by the destination node. It requires adequate time to converge before the route can be used and protocol exhibits a shorter delay because it`s a kind of table-driven routing protocol [20]. Each node maintains a routing table in which all of the possible destinations are within the network and the number of hops to each destination is recorded. Only packets belonging to valid routes at the ending instant get through. A lot of packets are lost until new (valid) route table entries have been propagated through the network by the route update messages in DSDV.

B. Neighbor Aware AODV (NAAODV)

The overall network performance is affected by increased routing overhead delay and reduced throughput due to unsighted flooding of redundant RREQ packets to entire nodes. The flooding is a major concern in route request phase in AODV. The data dissemination concept is based on the neighbor presence and energy information on whether the neighbor is with adequate energy for effective routing. Thus the optimization of rebroadcast of RREQ is based on composite metrics of neighbor presence and most recent remaining energy information to select the best and stable route between source and destination using RREP packet. This is evaluated by measurement of energy.

The NAAODV scheme {20} is designed based on AODV. In this modified approach, the routing decision is made based on the energy information of the nodes. The route request packet is broadcasted to their neighbors by the source node if there is no valid route to the destination. After receiving the route request packets, the neighbors check their table whether it has the route. If it doesn't have the route, it will forward the packets to its neighbors. The duplication of route request packets is avoided using the sequence numbers. The sequence number of the received packet is checked with the existing one for the same packet. If the received sequence number is greater than the existing one, it will be replaced. Otherwise the existing entry will be maintained. Here, the transmission of route request packets happens after getting the information about remaining energy of the node.

Energy Consumed (%) = (Initial Energy–Final Energy)/Initial Energy x 100 Average Energy Consumed = Sum of Energy Consumed by All Nodes/Number of Nodes

The energy consumed is measured to transmit a packet p is $E(p) = i * v * t_p * p_s$ in Joule. where i is the current, v is the voltage and t_p the time taken to transmit the packet p and ps is the size of packet. Once RREP is received at the

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destination, the best route needs to be chosen based on latest energy information of intermediate nodes using routing table update is modified.

C. Neighbor Discovery and Location Verification Approach (NDLV)

The Neighbor Discovery and Location Verification (NDLV) is a system utilized to protect the network from adversary nodes by verifying the location of neighbor nodes to improve operation and efficiency in MANETs. The NDLV scheme {18] identifies trusted neighbor nodes by extracting timing, finding a location and computing the distance between each pair of nodes. The scheme adapts quickly to location changes when node movement is frequent, yet requires little or no operating expense during the full stops in which hosts move less frequently. The simulation and performance analysis based on the quantitative metric packet delivery ratio, routing overhead and end-to-end delay are carried out to compare with

An un-trusted system based on existing AODV. NDLV is used to discover and verify the location of the neighbors. In a MANET, there is chance to attackers to easily enter into the network if neighbor node location is not known. If neighbor discovery and location verification are done in a separate node, then it would be a time-consuming process. The NDLV scheme is projected for dynamic ad hoc environments without the presence of a trusted infrastructure. It is reactive, lightweight and low control overhead can be executed by any node, at any point in time and is robust against independent and colluding adversaries and the four set of messages are exchanged between neighbor nodes as given in Fig. 1.

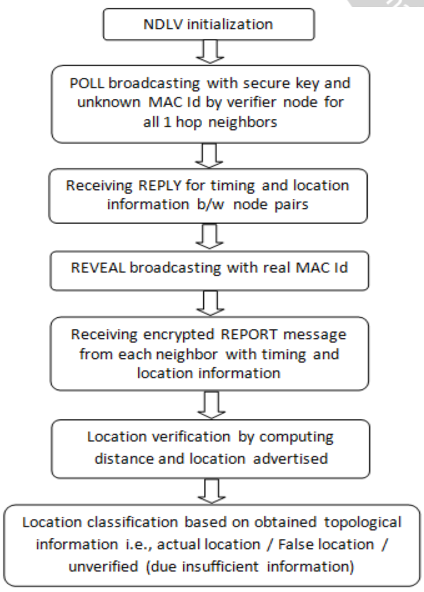

Fig. 1 NDLV Execution

IV. SIMULATION METHODOLOGY

The simulation carried out with the Network Simulator (NS) version 2.34 event driven open source software on a platform with and Ubuntu 9.10. Network Simulator-2 (NS-2) is extensively used in the research community. It is one of the most popular simulator developed by VINT project and it`s a discrete event driven, object oriented network simulating tool, very much used by the researchers, professors and students. Simulation is the process of creating a model with its behavior. The table 1 shows the parameters fixed for entire simulation analysis of the four different approaches.

The four main performance metrics that substantially affect the performance of routing protocol are "throughput", "end to end delay", "Packet Delivery Ratio” (PDR) and "Routing Overhead” (RO). The throughput is measured by the total received size during the time elapsed between sending and receiving. A data packet experiences delay while crossing from source to destination including all possible delays caused by buffering during route discovery delay, queuing at the interface queues and retransmission delays at the MAC, propagation and transfer times known. This total is called as end-to-end delay. The packet delivery ratio is calculated from the ratio of number of data packets sent from the source number of data packets received at the destination.

TABLE.I. Simulation Parameters

Parameter	**Value**
Simulator	NS2(Version-2.35)
Simulation area x (m)	1500m
Simulation area y (m)	1500m
Transmission range	250m
Mobility speed	10 m/s
Number of nodes	10,20,30,40,50
Traffic type	CBR
Mobility model	Random way point
Packet rate	8 packets/sec
Packet size	512 bytes
Protocols	AODV,DSDV,NAAODV, NDLV
Simulation time	50s

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V. RESULT AND DISCUSSION

A. Comparison of Throughput

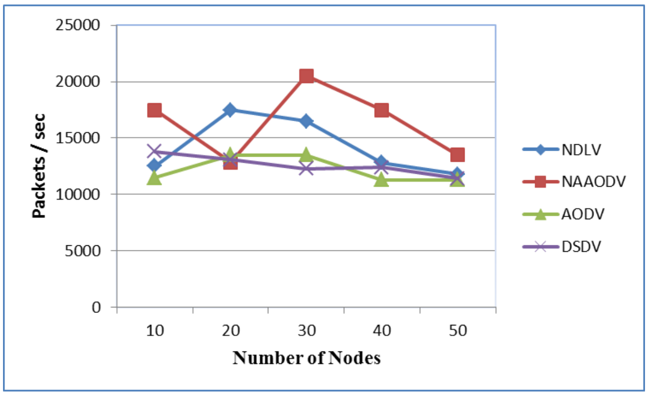

Fig. 1 Variation of throughput

Fig.1 depicts the variation of throughput of AODV, DSDV, NAAODV and NDLV with variation in node density from 10 to 50. It is evident that the NAAODV and NDLV approaches provide better average throughput than conventional routing protocol. The DSDV and AODV show closer performance with node density between 10 to 50.

B. Comparison of End to End Delay

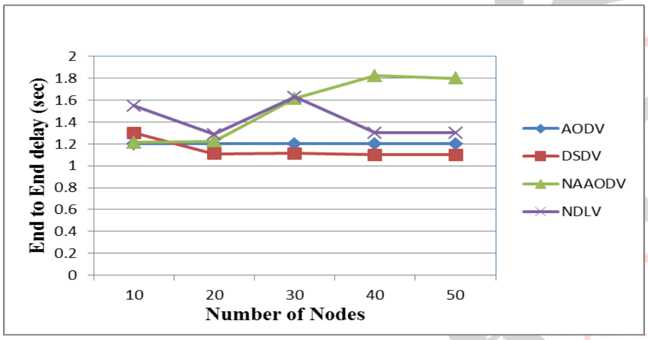

Fig. 2 Variation of end to end delay

Fig.2 shows the variation of end to end delay of AODV, DSDV, NAAODV and NDLV for different node density. The results have revealed DSDV and AODV exhibit superior performance than proposed approaches. It is evident that among the three approaches DSDV consumes minimum delay.

C. Comparison of Packet Delivery Ratio

The bar chart shown in Fig.3 shows the variation of packet delivery ratio for varying node density. It is seen that the delivery ratio for all the four routing protocols is greater than 65 percent. The NAAODV and NDLV have in general higher packet delivery ratio than other schemes.

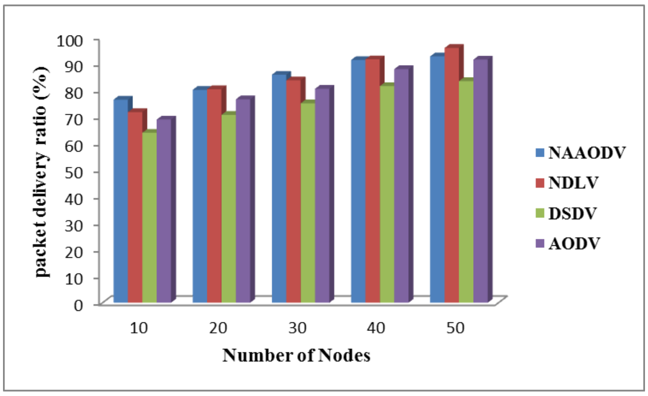

Fig. 3 Variation of PDR

D. Comparison of Routing overhead

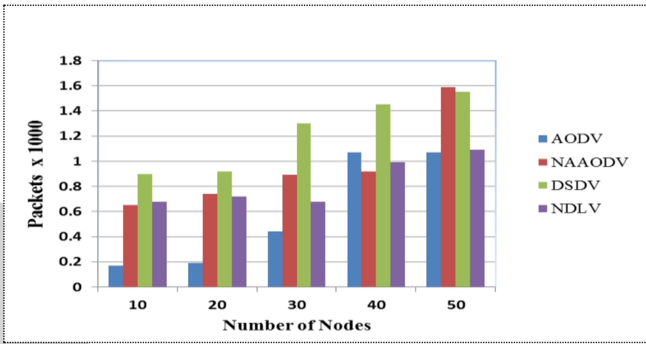

Fig. 4 Variation of RO

Fig.4 depicts the variation of routing overhead (in packets) of AODV, DSDV, NAAODV and NDLV for increasing node density from 10 to 50 and DSDV gives larger routing overhead other than the three approaches due to requirement of periodic routing updates . AODV AND DSDV has less routing overhead with node densities in the range of 10 to 20 nodes.

VI. CONCLUSION

In this paper an effort has been made on the comprehensive examination and comparative study of four different new broadcasting approaches. The approach NAAODV and NDLV is a new broadcast neighbor discovery routing is implemented to reduce the overhead associated with flooding and to provide robust performance even with high traffic environments. In DSDV, the routing overhead increases with the frequency of routing updates. The NAAODV exhibits superior performance in terms of throughput, end to end delay and packet delivery ratio compared with other three approaches. DSDV has decreased PDR and increased routing overhead and nearly same throughput compared with AODV.

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