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AODV EXTENSIONS FOR MANETS AND VANETS

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ABSTRACT

Use of MANETs and VANETs is increasingly becoming popular. The energy issues related to mobile devices involved in these networks are a key area of research. The majority of solutions involve a good routing approach so that packet delivery is increased in the network thereby improving performance and efficiency. AODV is claimed by many to be the preferred choice of routing protocol. Many improvements are suggested in past years to improve its efficiency. This paper surveys the recent modifications suggested improving AODV protocol for MANETs and VANETs. The study attempts to establish the link between characteristics of Ad hoc networks and these improvements of routing protocol.

Keywords: AODV, MANET, QoS, VANET

I. INTRODUCTION

Ad hoc network are like other networks, a collection of two or more connected devices, but here the devices have wireless communication and networking capability. Each node in the network works as both router and host. The connection for communication can be single hop (within range) or multi hop(through an intermediate node). The striking feature is that the Ad hoc wireless network is self-organizing and adaptive which means that the ad hoc network does not rely on any fixed network entities. The ad hoc network itself is essentially "infrastructure less". The ad hoc network can be heterogeneous which means the nodes can be of different types (such as Personal Digital Assistant, laptop and mobile phone) with different computation, storage and communication capabilities [1].

The advancement in technology and falling price of electronic devices has made mobile technology easily available Hence, generally ad hoc networks are found between mobile devices here they are MANETs. Mobile ad hoc networks (MANETs) are infrastructure less networks consist of wireless mobile nodes which dynamically exchange data among themselves [2]. Position of nodes in MANETs changes frequently. Design of efficient routing protocols in such dynamic networks is a challenging issue.

VANET is a special application of MANETs and have some similar characteristics such as short range of transmission low bandwidth, high mobility, Omni-directional broadcast and low storage capacity. Fast changing network topology and varying communication conditions pose a great challenge for routing protocols being used in VANETs. For using routing protocols in VANET they should be robust, reliable, minimize latency and network load.

The MANET routing protocols can generally be categorized as proactive, reactive and hybrid routing protocols. Proactive protocols, like Destination Sequence Distance Vector (DSDV)[3], also known as table-driven

protocols, involve in attempting to maintain routes between nodes in the network at all times, including when the routes are not currently being used. Reactive protocols also known as on demand protocols, involve in searching for routes to other nodes only as they are needed. Ad hoc On demand Distance Vector (AODV)[4] is one example of reactive protocols. Hybrid protocols like Zone Routing Protocol (ZRP)[3] integrate the characteristics of proactive and reactive methods. These protocols allow for flexibility based on the characteristics of the network.

Routing algorithms are often difficult to be formalized into mathematics they are instead tested using extensive simulation. Therefore, most of the research works carry out performance analysis using various popular simulators like NS-2, OMNET++ etc. These simulators can generate various scenarios pertaining to specified network parameters and show the output in form of different performance metrics.

The rest of the paper is organized as follows. Section 2 briefly discusses the AODV Routing Protocol. Section 3 and 4 explain the challenges and characteristics of MANETs and VANETs respectively. Section 5 presents brief survey of routing protocols for VANETs and MANETs based on AODV. Finally, the conclusions are presented in Section 6

II. AODV PROTOCOL

AODV (Ad Hoc On-Demand Distance Vector) is a routing protocol [4] for MANET and VANET. In AODV, a route is established in a network to pass messages through their neighbor to nodes with which they cannot directly communicate. It is reactive routing protocol (on- demand) means, it creates a route when source node needs it for data packets transmission.

Each node in a network, keep track of its neighbor by listening a HELLO message that each node broadcast after a certain interval. AODV uses a distance vector algorithm with some extension to provide routing in on demand ad hoc network which has less control message overhead, provide loop free routing and which also responsive to changes in topology.

2.1 Processes

The protocol consists of route discovery and route maintenance processes and uses 3 kinds of control messages: Route Request (RREQ), Route Reply (RREP) and Route Error (RERR).

2.1.1 Route Discovery

Whenever a packet is to be sent from a source node to destination, route discovery starts, 0if a route to destination does not exist in source nodes routing table. Source node initiates by broadcasting RREQ message for the destination. An intermediate node receiving RREQ first sets up a reverse route to the source node if needed, then rebroadcasts the RREQ. This process is repeated by all intermediate nodes. If an intermediate node is the destination or has a “newer” route to the destination, it may generate a RREP. When RREP routes back to the source node, it means reverse path is established. Now, a forward path to the destination can be established by intermediate nodes based on the information carried by RREP.

2.1.2 Route Maintenance

Considering the dynamic features of networks, a route maintenance phase is necessary to update routing tables of all nodes. It involves hello message, local repair, RREQ and RERR packet. Nodes in the active routes

periodically broadcast hello message to their neighbors to announce the connectedness. Its neighbors update their route table according to the information carried by hello message. If a node doesn't receive hello message within fixed intervals, the corresponding node is considered to be unreachable, and this node initiates local repair mechanism by broadcasting RREQ downstream if its location is rather close to the destination. During local repair process, the initial node buffers data packets until receiving the corresponding RREP which means new route is reconstructed. However, if local repair is unsuccessful, this node sends RERR packet to the source node. As a result, the source node will try to reestablish a new route discovery process, and intermediate nodes may detect the link break.

III. MANETs

A Mobile Ad hoc Network (MANET) is a collection of independent mobile nodes which is a self-configuring network of mobile routers that can communicate to each other via radio waves [5]. In MANET the participating nodes act as router. These nodes are free to move independently in any direction and manage themselves arbitrarily. Each node bound to forward traffic unrelated to its own use. Each of these nodes has a wireless interface to communicate with each other. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. Hence the topology of the network is much more dynamic and the changes are often unpredictable oppose to the Internet which is a wired network.

3.1 Characteristics

Mobile ad hoc network differ slightly from WSNs due to some different characteristics:

- Distributed operations of the nodes: Due to having no background network aiming at the central control of the network operation the nodes get to control the network in a distributed manner for implementing routing and security function, cooperation and communication is needed among the nodes involved in MANET. Such that each node behaves as rely at the time of need.
- Multi hop forwarding/ routing: When sending information from one node to a node out of its communication range, the process should undergo forwarding via in one or more intermediate nodes.
- Autonomous terminal in MANET, each mobile node can act both as a host and router because of its independent nature.
- Dynamic topology: The change in network topology can be random and unpredictable due to the arbitrary movement and nodes at different speeds. In MANET, the nodes establish their own network by traveling around and dynamically establishing routing among themselves.
- Light weight terminals: Almost all the mobile nodes in MANET have less CPU capability, possess small memory and low power storage.
- Shared physical medium: Any entity having appropriate equipment and adequate resources can access wireless communication medium. According to this, no restriction can imposed on the access of the channel.

3.2 Applications

The advantages of MANETs are listed below.

- Information and services are accessible irrespective of the geographical position.
- It is independent from the administration of the central network and has a Self-configuring network, nodes are also performing routing.
- Comparatively less expensive than the wired network.
- More nodes can be accommodated, hence scalable.
- Flexible: Flexibility is improved.
- It decentralized administration makes it robust
- Setting up of network can be done at any place and time.

3.3 Issues and Challenges

There are various issues and challenges described in brief below

- Limited capacity and bandwidth: though developed since long, these wireless links are still not able to beat up the infrastructure networks in terms of capacity and band width and its throughput along with multiple access, fading, noise and interference condition turns out to be much less when compared to a radio's maximum transmission rate.
- Dynamic topology: The inherent dynamic nature of ad hoc networks distributes the trust among the nodes due to changing membership or if some nodes are detected as compromised.
- Routing overhead: the changing of location of nodes with the network generates some stale routes in the routing table thereby increasing unnecessary routing overhead.
- Hidden terminal problem: Some transmitted nodes cannot be within the direct transmission range of the sender but are in the receiver direct transmission range which result in the collision of packets at the receiving nodes and this is called the hidden terminal problem.
- Packet losses due to transmission errors: Due to collision increased as per the hidden terminal problem, interference, unidirectional link and frequent path breaks due to node mobility increased packet loss occur in mobile ad hoc networks.
- Mobility induced route changes: Due to the highly dynamic network topology as a result of movement of nodes, as an ongoing session has frequent path breaks further leading to frequent route changes.
- Battery constraints: Mobile ad hoc network has restricted power source to balance portability, size and weight.
- Security threats: Network is open to new security challenges due to wireless nature of mobile ad hoc nature of MANETs. Also eavesdropping and functionality of an ad hoc network through node cooperation contribute to the numerous security attacks that can affect a mobile ad hoc networks.
- Routing challenges: Routing challenges include the following

a. Scalability: Scalability is the measure of satisfactory service that a device can provide irrespective of the number of nodes in the networks and also is an important issue in ad hoc network in terms of capacity. Also, the routing protocol sets some limits for the scalability. The pro-routing protocol cannot be applied in dynamic environment because of the huge amount of broadcast messages and topology changes. apart from the routing protocol, other tasks that cause overhead increasing with the size of the network are route acquisition, service location and encryption key exchange. .Re-active protocol allows deploying large

networks in the expense of increased route acquisition latency. A lot has to be done to balance capacity and scalability of ad hoc network.

b. Quality of service(QoS): QoS from a network guarantee its performance for flow taking into account the quantities of bandwidth , jitter, packet loss probability etc. this is such an important measure of quality that some routing protocols adhere to QoS for returning paths. the paths only with certain QOS parameter are return but due to link quality variation mobile ad hoc network do not guarantee QoS for long time.

c. Energy conservation: having to rely on portable and limited power source plus despite of numerous failed effort of developing batteries with lower power consumption, the only possible solution to reduce power is by ratio transceiver which is often the largest single consumer of power.

IV. VANETs

Vehicular Ad hoc Networks (VANETs) are a recent development in mobile ad hoc network (MANET's) in sensor network and wireless technology [6]. VANETs is a very interesting real life application which uses the real time communication among vehicles and nearby fixed infrastructure since the vehicles are on move they need to be fitted with mobile communication device. Other wireless devices can be fixed on roadside .The utility of VANETs in so bring traffic problems reducing risk of accidents and better handling of emergency situations is very promising. This is particularly suitable for safety –critical applications i.e. pre-crash feeling, collision avoidance, lane change etc. Road signal arms and in place traffic view will give the driver essential tool to decide the best path along the way. Factors i.e. more vehicle speeds, less signal latencies, varying configuration, traffic density, total message size etc. are major challenges that builds conventional wireless protocols and technologies inapplicable for VANETs (Vehicular Ad hoc Networks).

VANETs can be distinguished from other kinds of ad hoc networks in following aspects as discussed in [7]:

- Highly Dynamic Topology
- Frequently Disconnected Network
- Sufficient Energy And Storage
- Geographical Type of Communication
- Mobility Modeling and Predication:
- Various Communications Environments
- Hard Delay Constraints
- Interaction With On-Board Sensors

V. RECENT DEVELOPMENTS IN AODV

In 2009, Alammari, Ammar Zahary, Aladdin Ayesh [8] studied have multiple paths in the network from a source to destination can be utilized to improve performance of AODV. The multiple paths can be stored in intermediate nodes so that they can be used in future. Though it improves performance , it incurs extra cost of storage . the intermediate nodes store all the paths about which they receive information through RREP packets. The comparison of MIAODV(Multiple paths in Intermediate nodes in AODV protocol) and NMIAODV(Non-

Multiple paths in Intermediate nodes in AODV protocol) has been presented in the study through simulation results using factors routing packet overhead, packet delivery fraction and average end- to- end delay.

In 2010, jiang and hao [9] suggested an improved AODV for ad hoc network. The simulation on NS-2 shows reduction in end to end delay, increased packet delivery ratio and balanced network overload. The author have optimized hello mechanism, local repair mechanism and provide multi backup pathway for the source node.

In 2010, Baozhu Li, Yue Liu and Guoxin Chu [10] have improved AODV for VANET and called it AODV-BD. Their idea is to reduce the delay caused by local repair process of link break. When the node detects a broken link, it will broadcast a packet with incremented packet header, instead of RREQ. This new packet has both the function of reverse routing and route discovery. When this reaches any intermediate node , reverse routing is recorded and packet is rebroadcast. Once this data packet reaches destination node, RREP is sent and data packet is received simultaneously. Thus route is setup without much delay. Experiments on NS-2.3 show an improvement in packet delivery ratio and end to end delay. Baozhu Li, Yue Liu and Guoxin Chu proposed AODV-OBD which is an improvement to AODV-BD with limited hop count for RREQ .so when the RREQ cannot find the destination node, it can go through very small count.

In 2012, Satariya and solanki and mewada [11] proposed AODVLSR (AODV LIMITED SOURCE ROUTING PROTOCOL) for VANET which performs better than AODV as indicated by packet delivery ratio, normalized routing load, average end to end delay and dropped TCP packets. The AODVLSR protocol of DSR protocol combines routing mechanism of DSR protocol into basic AODV protocol. Specifically, route discovery mechanism of AODV is modified for limited source routing up to two Hops.

In 2014, Ahirwar and Rai [2] have improved AODV for link stability and energy efficient routing in MANETs the proposed algorithm can find the number of unknown nodes at each session to minimize RREQ packets. This also reduce energy consumption. Discard limit of each node is used to increased node lifetime and stability. Extensive simulation in NS-2 shows that increased stability leads in substantially better performance.

In 2014, Pandy, Solanki and Dubey [12] applied Traveling salesman Problem with AODV to minimize network load and to maintain throughput of existing protocol. Only throughput was considered for performance comparison in simulation.

In2015, Qi, Wang and jiang[13] have proposed multipath routing protocol based on AODV. The emphases is on node energy. The multipath routing is helpful in the sense that the source node does not need to restart the route discovery process but select the backup route for data transmission directly when link is down or broken . It improves stability and reliability of the network which in turn reduce transmission delay. Authors have found through simulation on NS-2 that when the node average moving speed is greater than 15 m/s and the residence time is in 0-150 ms the advantage of EM-AODV is more obvious

Table 1: Recent Contributions in the development of AODV

Year	Author	Contribution	Simulation Tool	QoS Factor
2009	Abdulsalam Alammari, Ammar Zahary, Aladdin Ayesh	Multipath Contribution of Intermediate Nodes in AODV Extensions.	NS-2	Routing packet overhead, packet delivery fraction, and average end-to-end delay.
2010	Fei Jiang, JianJun Hao	Simulation of An Improved AODV Algorithm for Ad Hoc Network	NS-2	Network end-to-end delay, increase packet delivery ratio and balance network overload (Route overload).
2010	Baozhu Li, Yue Liu and Guoxin Chu	Improved AODV Routing Protocol for Vehicular Ad hoc Networks	NS-2.30	Packet delivery rate and packet delay.
2012	Dharmendra Sutariya, Ronak Solanki and Pratik Mewada.	AODV limited source routing protocol for VANET in city scenarios.	NS-2.34	Packet Delivery Ratio, Avg. End-to-End Delay, Dropped TCP Packets, Normalized Routing Load.
2014	Ahirwar and Rai	Improvement of AODV Routing Protocol Algorithm with Link Stability and Energy Efficient Routing for MANET	NS-2	Reduced routing overhead and reduce energy consumption.
2014	Pandey, Solanki and Dubey	Improved Performance of AODV Routing Protocol with Increasing Number of Nodes using Traveling Salesman Problem	NS-2	Minimize network load(nodes takes from 10 to 50) and maintain the throughput
2015	Qi, Wang and Jiang	Multi-path Routing Improved Protocol in AODV Based on Nodes Energy	NS-2	Stability and Reliability are highly improved and transmission delay is shorten

After surveying 43 papers suggesting improvements in AODV, we have presented brief discussions of a few representative works. The major improvement areas in AODV as can be concluded from all 43 studies are:

- Multiple paths
- Hello packet structure
- Link repair mechanism
- Inclusion of hop count
- Discard limit
- Hybrid of other protocols.

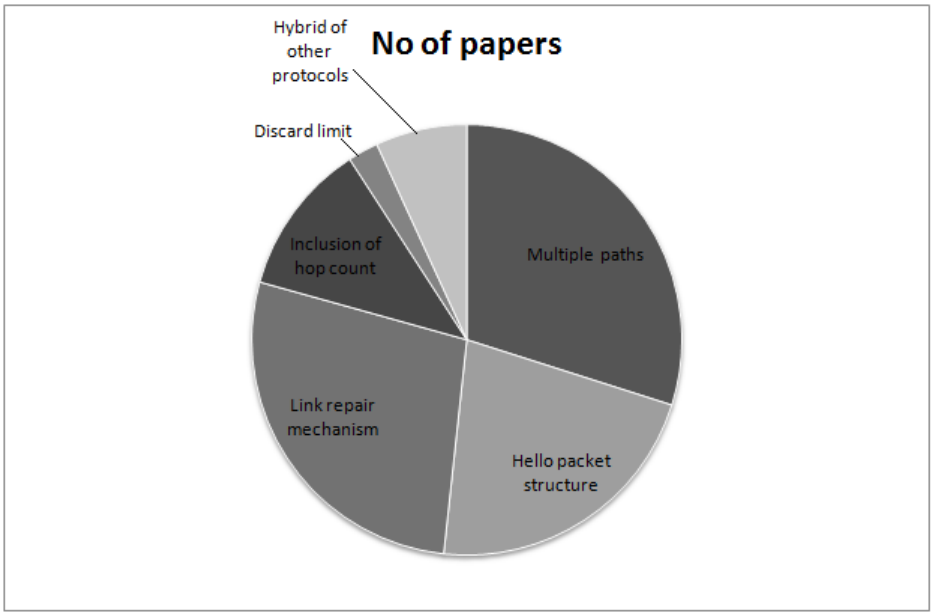

Fig 1: Distribution of Approaches Used to Improve AODV

VI. CONCLUSION

The special characteristics of MANETs and VANETs require some special routing techniques to save overall energy. Majorly, researchers accepts that AODV is good choice of routing protocol for MANETs and VANETs many modifications which have been suggested to AODV to reduce energy consumption focus of optimizing hello mechanism repair process of broken links and limiting hop counts . yet, consideration of multicast instead of broadcast combining proactive and reactive features and taking the load of intermediate nodes between source and destination as a decision criteria are not much explored. Authors are carrying out research to optimized AODV in these directions to obtain energy efficiency through reduced overhead and improved QoS factors.

REFERENCES

[1] S. Corson, and J. Macker, Mobile Ad Hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations", RFC 2501, 1999.

[2] Devideen Ahirwar and Sarvesh Singh Rai, Improvement of AODV Routing Protocol Algorithm with Link Stability and Energy Efficient Routing for MANET, International Journal of Computer Science Engineering and Technology(IJCSET) , Vol 4, Issue 2, pp 36-43 , February 2014

[3] C.S.R. Murthy, and B.S. Manoj, Ad hoc Wireless Networks - Architectures and Protocols, United States of America: Prentice Hall, 2004.

[4] C. Perkins, E. B. Royer and S. Das, Ad hoc on-Demand Distance Vector (AODV) Routing, IETF, vol. 3561, 2003.

[5] Namrata Awasthi, Mr.Anurag Jain, Mr.Himanshu Yadav, MANET: Improved Secured Routing For AODV, (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (3), pp 3232-3236, 2015.

[6] Neha Garg , Puneet Rani, An improved AODV routing protocol for VANET (Vehicular Ad-hoc Network), International Journal of Science, Engineering and Technology Research (IJSETR), Volume 4, Issue 6, , PP 1885-1890, June 2015.

[7] Shiyu Raju and DA Parikh, Performance Improvement in VANET by Modifying AODV Routing Protocol, Computer Engineering and Intelligent Systems, Vol.6, No.5, pp 92-98, 2015.

[8] Abdulsalam Alammari, Ammar Zahary, Aladdin Ayesh , Multipath Contribution of Intermediate Nodes in AODV Extensions, 2009 International Conference on Computer Engineering & Systems (ICCES 2009), pp 347-352, 2009.

[9] Fei Jiang and JianJun Hao, Simulation of An Improved AODV Algorithm for Ad Hoc Network, IEEE conference ICACT 2010, Volume 1, pp 540-543,2010.

[10] Baozhu Li, Yue Liu and Guoxin Chu, Improved AODV Routing Protocol for Vehicular Ad hoc Networks, International Conference on Advanced Computer Theory and Engineering(ICACTE), Volume 4, pp337-340, 2010.

[11] Sutariya, Solanki and Mewada, AODV Limited source routing protocol for VANETS in city scenarios, International Journal of Computer Networking, Wireless and Mobile Communications (IJCNWMC),vol. 2, pp 7-16,2012.

[12] Pandey, Solanki and Dubey, Improved Performance of AODV Routing Protocol with Increasing Number of Nodes using Traveling Salesman Problem, International Journal of Computer Applications , vol. 98, pp 10-13, 2014.

[13] Xiaoxia Qi, Qijin Wang and Fan Jiang, Multi-path Routing Improved Protocol in AODV Based on Nodes Energy, International Journal of Future Generation Communication and Networking, vol. 8, pp 207-214, 2015