Implementation of Multipath AODV for Enhanced Performance in Wireless Ad hoc Network

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Abstract: *In our paper, most effort has recently been reported to improve reliability and performance of ad hoc network. The multipath routing protocol has been implemented to achieve higher throughput and reliability than the current single path routing algorithm. The multipath routing allows a sender to transmit data via multiple paths to the same destination. Although several researcher studies of multipath routing have been recently and reported in our work. Therefore, this work implements multipath routing protocol. This technique prevents the loss of packets due to break the link, because of the new path will be available for packet transmission. The performance routing was compared with the single path routing. Simulation result showed that the multipath routing achieved better throughput and PDF than single path algorithm with variation of speeds in network.*

Keywords - *AODV, Multipath AODV, Performance Metrics, MANET, NS-2.*

I. INTRODUCTION

Ad hoc is Latin and means "for this purpose". MANET is an acronym for "Mobile Ad-hoc Network". It means a network in which mobile devices communicate through wireless medium for a specific purpose. Wireless communication technology has received great interest and research attention over the previous few decades. Consequently the field has rapidly matured and the technology has been extensively adopted by users. Wireless communication has witnessed faster growth worldwide compared to its traditional wired counterpart in the past decades due to the explosive use of mobile equipment such as smart phones, laptops, etc., and an increase of connection speed. Since its first introduction has emerged to improve the experience of wireless communications among which mobile ad hoc network is an alternative.

In MANET, a wireless node can be the source, the destination, or an intermediate node of data transmission. When a wireless node plays the role of intermediate node, it serves as a router that can receive and forward data packets to its neighbor closer to the destination node. Due to the nature of an ad-hoc network, wireless nodes tend to keep moving rather than stay still. Therefore the network topology changes from time to time [1-3]. Routing is the process of searching and maintaining routes between the source node and the destination node in the network. A routing protocol is needed whenever a packet needs to be transmitted via a number of intermediate nodes.

In MANETs, another classification of routing protocols can be made in terms of the number of paths one protocol delivers per source destination pair. There exist unipath and multipath routing protocols. For a unipath routing protocol, a single route is used to deliver data from the source node to the destination node. Most of the routing protocols in MANETs form a single-path, such as DSR and AODV. Single-path routing protocols need to repair routes each time the route is broken, therefore these type of issues solve by using multipath, so multipath routing schemes have been implemented our work.

In this work, we focus on the design of a multipath routing protocol for wireless network, in which the data is transmitted through the available multipath simultaneously. The objective of designing a multipath routing protocol is to provide enhanced robustness to node or link failures. If one could provide multiple paths from a source to a destination, one could envision that the transmission of redundant information on various paths would help the receiver reconstruct the transmitted information even if a few of the paths were to fail. In addition, multipath routing has the advantages of balancing load, minimizing end to end delay, increasing fault-tolerance, reducing the frequency of route inquiries and achieving a lower overall routing overhead.

The rest of this paper is organized as follows; section 2 and 3 discusses the AODV and Multipath AODV routing. In section 4,5and 6 authors have present the details of Related Work, performance matrices, simulation parameter and simulation model. We then evaluate our protocol and present the results in section 8. Finally, section 9 provides our conclusions and then last section is References.

II. AD-HOC ON-DEMAND DISTANCE VECTOR

In November 2001 the MANET Working Group for routing of the IEFT community has published the first version of the AODV Routing Protocol. AODV belongs to the class of Distance Vector Routing Protocols. In a DV every node knows its neighbors and the costs to reach them. A node maintains its own routing table, storing all nodes in the network, the distance and the next hop to them. If a node is not reachable the distance to it is set to infinity. Every node sends its neighbors periodically its whole routing table. So they can check if there is a useful route to another node using this neighbor as next hop. When a link breaks a Count to Infinity could happen. AODV is an 'on demand routing protocol' with small delay. That means that routes are only established when needed.

Ad-hoc On Demand Distance Vector Routing Protocol is one of the reactive protocol in which source node initiates data packet to destination node only when requires the route discovery is occur. There are no periodical exchanges of routing information [16].The Protocol consist of two phases:

- Route Discovery
- Route Maintenance.

A. Route Discovery: The route discovery process is initiated when a source needs a route to a destination and it does not have a route in its routing table. To initiate route discovery, the source floods the network with a RREQ packet specifying the destination for which the route is requested. When a node receives an RREQ packet, it checks to see whether it is the destination or whether it has a route to the destination. If either case is true, the node generates an RREP packet, which is sent back to the source along the reverse path. Each node along the reverse path sets up a forward pointer to the node it received the RREP from. This sets up a forward path from the source to the destination. If the node is not the destination and does not have a route to the destination, it rebroadcasts the RREQ packet. At intermediate nodes duplicate RREQ packets are discarded. When the source node receives the first RREP, it can begin sending data to the destination [1-3].

B. Route Maintenance: When a node detects a broken link while attempting to forward a packet to the next hop, it generates a RERR packet that is sent to all sources using the broken link. The RERR packet erases all routes using the link along the way. If a source receives a RERR packet and a route to the destination is still required, it initiates a new route discovery process. Routes are also deleted from the routing table if they are unused for a certain amount of time. It is performed by the source node and can be subdivided into: i) source node moves: source node initiates a new route discovery process, ii) destination or an intermediate node moves: a route error message (RERR) is sent to the source node. Intermediate nodes receiving a RERR update their routing table by setting the distance of the destination to infinity. If the source node receives a RERR it will initiate a new route discovery. To prevent global broadcast messages AODV introduces a local connectivity management. This is done by periodical exchanges of so called HELLO messages which are small RREP packets containing a node's address and additional information [2-5].

III. MULTIPATH AODV

In this work, single path on demand routing algorithm extended to multipath routing algorithm in given below. In multipath aodv provide an alternative path for data transmission. In multipath each source node and destination node have a set of paths which consist of a multiple path if primary path fails reinitiate the protocol and search one or more alternate paths. Multipath routing protocols generally are considered more reliable and robust than single-path routing protocols [18]. Furthermore, whenever a link failure is detected on a primary route, the source node can select the optimal route among the other available routes. This mechanism enhances route availability and consequently reduces control overhead. It also enhances data transmission rate, and increases the network throughput.

In multipath AODV, RREQ propagation from the source towards the destination establishes multiple reverse paths both at intermediate nodes as well as the destination. Multiple RREPs traverse these reverse paths back to form multiple forward paths to the destination at the source and intermediate nodes. Multipath AODV also provides intermediate nodes with alternate paths as they are found to be useful in reducing route discovery frequency. On demand multipath protocols discover multiple paths between the source and the destination in a single route discovery process. A new route discovery is needed only when all these paths fail. In contrast, a single path protocol has to invoke a new route discovery whenever the only path from the source to the destination fails. Thus, on demand multipath protocols have fewer interruptions to the application when routes fail [27].

Recently, several multipath routing protocols have been proposed, and many of them are based on AODV. In this section, we will present a selection of them.

- In the route table file, create a new type of object called multiple route entry. The multiple route entry is an array to keep route entries. The objective of multiple route entry is to keep the routes to the same destination.
- Every method in the AODV main file should change "finding route to the destination" to "finding multiple routes" to the destination.

- The receive request method should be modified to receive the RREQ with the same ID as previous one in order to create the multiple reverse routes.
- The receive reply method should be modified to accept the multiple route reply to create the multiple forward routes.
- The receive reply method should be modified to forward RREP packet to every reverse routes
- The receive error method should be modified to check if the node still has another active route to the destination. If the node still has another active route to the destination, the node no needs to forward the RERR packet.
- Route resolve method for source node should be set to switch from one active path to another active path and switch back in next transmission. The multiple paths will be used to transmit the data packet.

IV. RELATED WORKS

In this section, author discuss the existing aodv and extended multipath aodv work done, Single path abstraction in routing protocols means that multiple routes could be detected due to routing discovery process and one route of them (the optimal) should be maintained in a source node routing table. AODV are examples of single path routing protocols. In multipath routing protocols, multiple routes could be detected due to routing discovery process and all of these routes should be maintained in a source node routing table. All of these routes could be used for data transmission between source and destination nodes.

Many multipath extensions of AODV have been developed to improve the performance of AODV protocol especially in high mobility scenarios where link failures increase so that launching a route discovery process frequently causes more routing overhead and more consuming of bandwidth and power. In such situations, there is a need for backup routes by applying a sort of route maintenance. Examples of such extensions are Ad hoc On-demand Multipath Distance Vector [18], AODV Backup Routing, Multiple Next Hops and Multiple Route AODV. Criteria that have been used in this work for comparing single-path routing and multi-path routing in MANETs are the average routing discovery overhead.

V. PERFORMANCE METRICES

These parameter shows the performance of Routing Protocol is as follows:

Average end-to end delay- It is defined as the time taken for a data packet to be transmitted across an MANET from source to destination.

Normalized Routing Overhead- It can also be defined as the ratio of routed packets to data transmissions in a single simulation. It is the routing overload per unit data delivered successfully to the destination node

VI. SIMULATION PARAMETER

In this section mention table of parameters used in this work.

PARAMETERS	VALUE
Simulator	NS-2
Routing protocol	AODV, Multipath AODV
Number of Nodes	50
Area	1000mx1000m(Constant)
Packet size	512 byte
Simulation time	500s
Pause time	10s (Constant)
Traffic type	CBR
Mac protocol	Mac/802.11
Maximum Speed	20 to 50 m/s(Variations)
Propagation model	RWP
Channel	Wireless

VII. SIMULATION MODEL

The mobility model uses the random waypoint model in a rectangular field. The field configurations used is: 1000m×1000m field with 50 nodes. Here, each packet starts its journey from a random location to a random destination with a chosen speed from 20 to 50 m/s. Once the destination is reached, another random destination is targeted after a constant interval of pause time 10s. The pause time, which affects the relative speeds of the mobiles, is varied. Simulations are run for 500 simulated seconds. Identical mobility and traffic scenarios are used across protocols to gather fair results. Mobility models were created for the simulations using 50 nodes.

VIII. SIMULATION RESULTS ANALYSIS

We have demonstrated and investigate the performance of the proposed solution the types of scenarios are taken into Consideration i.e. based on speeds. In both the cases the effect of Node Mobility and network performance discussed in next section and gives a result in graphical form. The main goal of our research work is to improve the Quality of Services in wireless Ad hoc network using multipath routing protocol. Multipath routing has been a promising technique in MANETs. As opposed to their single path AODV, on-demand routing protocols with multipath capability can effectively deal with dynamic mobility induced link failures in mobile ad hoc networks. The outcome of this fact is the multipath routing protocols that have been

proposed for mobile ad hoc networks throughout the decades. In this chapter presented the performance using aodv and extended aodv routing scheme the simulation done NS-2 tool. Result obtained from simulation shows how several performance metrics such as NRL and Average Delay affected by change in factors like simulation time and Maximum Speed. Author observed that the multipath routing scheme have better results than existing scheme.

Table-1 Average Values of End to end Delay with Variations of speeds

Speeds	AODV	Multipath AODV
20	148.41	40.05
30	91.55	32.75
40	82.03	52.94
50	59.01	26.56

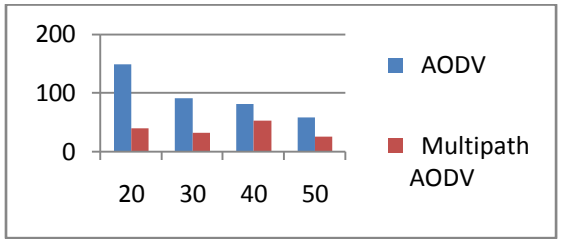

Figure 1: Average End to End Delay with varying pause time.

Average Values of Normalized Routing Load with variations of speeds.

speeds	AODV	Multipath AODV
20	2.43	2.29
30	3.84	3.79
40	3.69	3.53
50	3.31	3.21

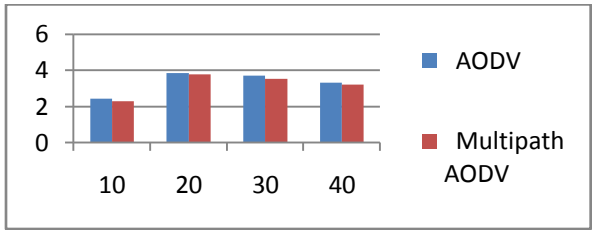

Figure 2: Normalized routing Load with varying pause time.

IX. CONCLUSION

We have demonstrated that: Most of the conventional routing schemes use a single path for data transmission between the sink and source nodes. A single node failure on the path will force the search of an alternate path, which is costly in terms of network resources. Another drawback of the single path routing is that it stresses a particular path and has a negative impact on the network lifetime. The implemented technique that the traffic can be distributed and carried by multiple simultaneously available paths so that the available bandwidth can be better utilized by using multiple active transmission tasks, especially under low traffic load conditions. It also provides a better fault tolerance for the system if a path fails.

The multipath routing is able to improve the reliability of the wireless sensor net-works, as alternate paths are made available in the initial phase. However, the majorities of the existing multipath protocols still uses only one primary path for data transmission and consider other alternative paths as backups. The energy saving is made by eliminating the route discovery when the primary path fails. In simulation part, in order to make a comparison, we have collected different simulation results which have already been done by others. We have designed same MANET scenarios in NS-2.31. In terms of delay and network load low compared with conventional single path routing protocols.

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