# Analysing a Consistent Node Disjoint Multipath Routing Protocol for Manets

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**Abstract**

Many link failures are caused in mobile ad-hoc networks due to node's mobility and exploit undependable wireless channels for data conduction. Due to this, multipath routing protocols become an important research issue. In this paper, we suggest and implement a consistent node disjoint multipath routing protocol. The key purpose of the proposed scheme is to determine all available reliable node-disjoint routes from source to destination with minimum routing control overhead. In the route discovery method, the routes with good link quality and route expiration time are selected as the primary and backup routes. If there is any route failure during the data transmission through primary path, the next obtainable backup route with good link quality and route running out time is selected from the list. The performance of the proposed protocol will be evaluated using NS-2 and will be revealed that it reduces the packet drop and delay there by escalating the packet delivery ratio.

**Index Terms**—*Average End-to-End Delay, Node-disjoint, Packet drop, Primary and Backup Routes*, Routing protocols.

## I INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless. Ad hoc is Latin and means "for this purpose".Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet.

MANETs are a kind of wireless ad hoc networks that usually has a routable networking environment on top of a Link Layer ad hoc network**.**The growth of laptops and 802.11/Wi-Fi wireless networking has made MANETs a popular research topic since the mid-1990s. Many academic papers evaluate protocols and their abilities, assuming varying degrees of mobility within a restricted space, usually with all nodes within a few hops of each other. Different protocols are then evaluated based on measure such as the packet drop rate, the overhead introduced by the routing protocol, end-to-end packet delays, network throughput etc. Routing protocols that determine and store more than one route in their routing table for each destination node are referred to as multipath routing protocols. In wireless scenarios, routes are broken due to node movement. Also, the wireless links used for data transmission are intrinsically unreliable and error prone. Therefore, multipath routing protocols are used to conquer the disadvantages of shorest path routing protocols. Multipath routing protocols are used to increase the consistency (by sending the same packet on each path) and fault tolerance (by ensuring the availability of backup routes at all times). It can also be used to furnish load balancing, which reduces the congestion on a single path caused by bursty traffic [9].The remainder of the paper is structured as follows. In Section II, we present related work in our area by providing a brief depiction of existing multipath extensions of AODV routing protocol. The proposed method AOMDV used for discovering multiple paths is presented in Section III. In Section IV, we present the investigational setup details and offer results with analysis obtained through a variety of simulations. Finally, the conclusions and directions for future work are provided in Section V.

## II Extension Work

In this section, we discuss the previous work done on multipath routing methods on AODV. Ad hoc On-Demand Distance Vector (AODV) Routing is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad-hoc networks. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. In contrast, the most common routing protocols of the Internet are proactive, meaning they find routing paths independently of the usage of the paths. AODV is, as the name indicates, a distance-vector routing protocol. AODV avoids the counting-to-infinity problem of other distance-vector protocols by using sequence numbers on route updates, a technique pioneered by DSDV. AODV is capable of both unicast and multicast routing.

In AODV, the network is silent until a connection is needed. At that point the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time. Much of the complexity of the protocol is to lower the number of messages to conserve the capacity of the network. For example, each request for a route has a sequence number. Nodes use this sequence number so that they do not repeat route requests that they have already passed on. Another such feature is that the route requests have a "time to live" number that limits how many times they can be retransmitted. Another such feature is that if a route request fails, another route request may not be sent until twice as much time has passed as the timeout of the previous route request.

The advantage of AODV is that it creates no extra traffic for communication along existing links. Also, distance vector routing is simple, and doesn't require much memory or calculation. However AODV requires more time to establish a connection, and the initial communication to establish a route is heavier than a few other approaches [3].In this section, the existing NDMP-AODV protocol is described [4]. The main goal of NDMP-AODV is to find all available node-disjoint routes between a source-destination pair with minimum routing overhead. When a source node has a data packet to send, it verifies its routing table for the next hop towards the destination of the packet. If there is an active entry for the destination in the routing table, the data packet is forwarded to the next hop. Otherwise, the route discovery phase begins. In route discovery phase, routes are determined using two types of control messages: (i) Route request messages (RREQs) and (ii) Route reply messages (RREPs). The source node floods the RREQ message into the network. Each intermediate node that receives a RREQ, checks whether it is a duplicate or a fresh one by searching an entry in the Seen Table. Seen Table stores two entries (i.e. source $IP$ address and RREQ flooding ID ($f\ id$)) that uniquely make out a RREQ message in the network. If an entry is present in the Seen Table for the received RREQ n message, it is considered a duplicate RREQ message and discarded without further transmission. Otherwise, the node creates an entry in the Seen Table and updates its routing table for forward path before broadcasting the RREQ message.

| Source IP Address | Flooding ID | Seen Flag |
|---|---|---|
| --- | --- | --- |

Fig. 1. NDMP-AODV Seen Table structure

| Type | R | A | Reserved | Prefix Size | Hop Count |
|---|---|---|---|---|---|
| Destination IP Address | | | | | |
| Destination Sequence Number | | | | | |
| Source IP Address | | | | | |
| Source Sequence Number | | | | | |
| Broadcasting ID | | | | | |

Fig. 2. NDMP-AODV RREP structure

In NDMP-AODV, only the destination node can send RREPs upon reception of a RREQ message. The intermediate nodes are forbidden to send RREPs even if they have an active route to destination. This is done so as to get the node-disjoint routes. In NDMP-AODV, the destination node has to send a RREP message for each RREQ received, even if the RREQ is a duplicate one. We add an extra field that works as a flag known as seenflag. This flag is set to FALSE at start i.e. when an entry is first inserted in the Seen Table after a node gets its first RREQ message. The RREP messages initiated by destination node in NDMP-AODV contain one extra field known as broadcast ID ($b\ id$). The route discovery method used to discover node-disjoint paths .When a destination node receives a RREQ message, it creates the equivalent RREP message. The destination node copies the $f\ id$ from the received RREQ message into the $b\ id$ field of sent RREP message.

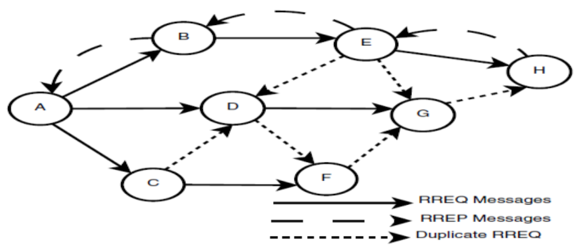


Fig. 3. Traditional AODV route discovery process

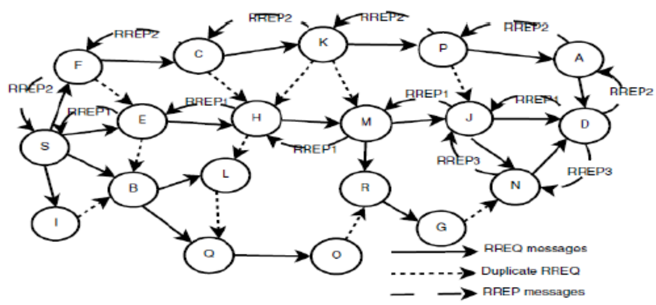


Fig. 4. NDMP-AODV route discovery process

Figure shows the route discovery process of traditional AODV protocol. In Figure we demonstrate with an example how the route discovery process in NDMP-AODV gets all node-disjoint routes between a source-destination pair. Suppose, node $S$ is the source node and node $D$ is the destination node. When node $S$ has data to send, it initiates the route discovery process by flooding RREQ in the network. Let us assume that destination $D$ receives its first RREQ from intermediate node $J$ at time $t1$ and $D$ initiates the RREP1 message. RREP1 is unicast towards source $S$ by creating the reverse path D→J→M→H→E→S. When RREP1 is received by an intermediate node along the reverse route each transitional node resets the value of seenflag in their Seen Table. Suppose, $D$ receives the first duplicate RREQ message from $A$ at time $t2$. Again node $D$ initiates a RREP2 for this duplicate RREQ and sends it back towards node $S$ through the same path it came to $D$ (i.e. S→F→C→K→P→D→D) to make the reverse route D→A→P→K→C→F→S. This helps to create a forward route towards node D. Finally, say at time $t3$, node $D$ receives the third duplicate RREQ message from node $N$. Node $D$ initiates RREP3 for this duplicate RREQ and sends it towards $S$ through $N$. The RREP3 reaches node $J$ through $N$. Node $J$ checks the value of seenflag for RREP3 before forwarding it to next hop. Node j determines that the seenflag is set to TRUE. So node $J$ considers RREP3 as a duplicate message and drops it. This helps to maintain the node-disjoint property of our method.

## III Results

In this section, we discuss the results obtained from intensive simulations that have been performed to show the effectiveness of proposed route discovery and route maintenance methods. The simulation results include the average packet delivery ratio (PDR), average end-to-end delay (EED), percentage availability of backup routes and routing manage overhead caused by route discovery and route maintenance processes. The efficiency of proposed methods are tartan against the effect of node mobility.

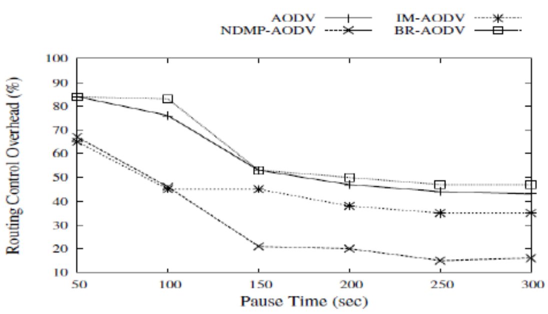


Fig.5. Routing control packet overhead with change in mobility

Figure 5 shows the overhead caused by routing control messages during route discovery process. Routing overhead created during transmission of one video stream are calculated and plotted in Figure 5. The routing overhead is calculated by dividing the total number of routing control messages with the total number of packets in the network (i.e. control messages plus data packets). As we can see in Figure 5, AODV causes about 50% more routing overhead in moderate or low mobility networks (i.e. when node pause time is greater than 100 sec) as compared to NDMP-AODV. This is due to the fact that NDMP-AODV uses one RREQ flooding to compute all node disjoint routes as compared to AODV which uses one RREQ flooding for each route detection.

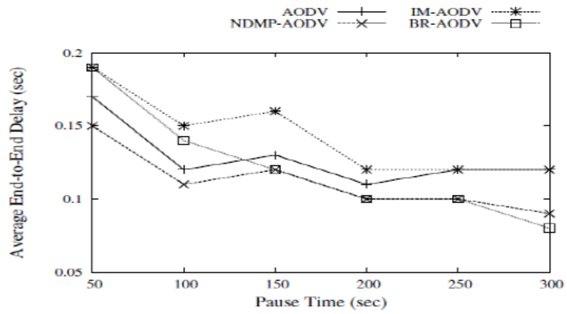


Fig.6. Average End-to-End delay with change in node mobility.

The number of RREP messages in NDMP-AODV is greater than AODV but they are very few in number because the RREPs are unicast towards source. Also, the intermediate nodes will not forward the duplicate RREPs. Low routing overhead saves the limited network bandwidth, thus escalating the network capacity. The number of routes stored in routing table for a destination from the available node disjoint routes very much depends on the mobility of network. If the network mobility is high, the probability that the secondary route is expired with the principal route is high. As shown in Figure 5, BR-AODV has the highest routing overhead because only two routes for destination are stored in the routing table. Due to this, BRAODV has to flood the RREQ messages whenever anyone route is busted to maintain the backup route at all times. In this case, the overhead for route maintenance is around more or equal to AODV protocol.

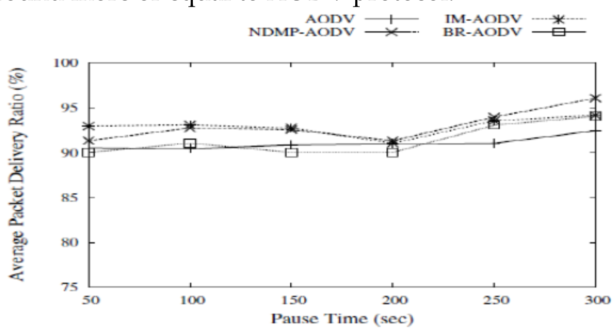


Fig.7. Packet delivery ratio with change in node Mobility.

Effect of mobility on EED and PDR are shown in Figure 6 and Figure 7. The delay in NDMP-AODV is less as compared to other protocols. This is because NDMP-AODV keeps a backup routing path more than 50% of the time when the primary route fails with the lowest routing overhead. We can observe from Figure 6, that EED of all routing protocols decreases with increase in node pause time. NDMP-AODV EED again increases at the end of simulation due to increase in its PDR. Also, IM-AODV causes the highest delay because it uses the backup route from the point the link is broken. We evaluate the performance of AODV and AOMDV according to the following performance metrics:

**Packet delivery fraction:** the ratio of data packets delivered to the destinations to those generated by the constant bit rate.
**Average End-to-End delay of data packets:** this includes all possible delays caused by buffering during route discovery, queuing at the interface queue, retransmission delays at the MAC, propagation and transfer times.
**Routing Overhead:** the total number of routing packets transmitted during the simulation. For packets sent over multiple hops, each conduction of the packet (each hop) counts as single transmission.

# IV CONCLUSION

In this we propose a scheme known as an on-demand, multipath distance vector routing protocol for mobile ad hoc networks. Specifically, we propose multipath extensions to a well-studied single path routing protocol known as ad hoc on-demand distance vector (AODV). The resulting protocol is referred to as ad hoc on-demand multipath distance vector (AOMDV). The protocol guarantees loop freedom and disjoint ness of alternate paths. Performance comparison of AOMDV with AODV using ns-2 simulations shows that AOMDV is able to effectively cope with mobility-induced route failures.

A novel set of on-demand routing protocols (e.g., DSR, TORA, AODV) for mobile ad hoc networks has been developed with the aim of minimizing the routing overhead. These protocols reactively discover and maintain only the needed routes, in disparity to proactive protocols (e.g., DSDV) which maintain all routes apart from their usage. The key characteristic of an on-demand protocol is the source-initiated route sighting process. Whenever a traffic source needs a route, it initiates a route discovery process by sending a route request for the destination (typically via a network-wide flood) and waits for a route reply. Each route discovery flood is associated with significant latency and overhead. This is particularly true for large networks. Therefore, for on-demand routing to be effective, it is desirable to keep the route discovery frequency low contrast was based on of packet delivery fraction, routing overhead incurred, average end-to-end delay and number of packets dropped, we conclude that AOMDV is better than AODV. AOMDV is a better on-demand routing protocol than AODV since it provide better statistics for packet delivery and number of packets dropped. But if routing overhead is a concern, then AODV is preferred over AOMDV.

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