Extended AODV for Nodes with High Mobility

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Abstract
Mobile ad hoc networks (MANETs) consist of a collection of wireless mobile nodes which dynamically exchange data among themselves without the reliance on a fixed base station or a wired backbone network. MANET nodes are typically distinguished by their limited power, processing and memory resources as well as high degree of mobility. AODV, a novel algorithm for operation of such ad-hoc networks. Each mobile host operates as a specialized router and routes are obtained as needed (i.e., on-demand) with little or no reliance on periodic advertisements. AODV is a reactive protocol and is one of the best so far. To have an improvement over AODV we have extended it by introducing the concept of “favorable nodes”. Favorable nodes are the nodes which fail less frequently as compared to other nodes in scenario. When the route reply is received from more than one path then the packet is forwarded to that route which has more number of favorable nodes.

Index Terms
AD-HOC NETWORK, AODV, FAVORABLE NODES.

1. Introduction

Recently, there has been tremendous growth in the sales of laptop and portable computers.[10] Laptops continue to show improvements in convenience, mobility, memory capacity, and availability of disk storage. Moreover, because of these small, in size, computer operates on battery so they are free move anywhere at any point of time without depending on any type of wiring. As more and more people opt for these mobile devices, sharing of information has become a need. Such sharing is made difficult by the need for users to perform administrative tasks and set up static-bidirectional links between their computers. However, if the wireless communications systems in the mobile computers support a broadcast mechanism, much more flexible and useful ways of sharing information can be imagined. Thus, one of our primary motivations is to allow the construction of temporary networks with no wires and no administrative intervention required. Such interconnection between mobile computers is known as ad-hoc network.

Ad-hoc networks differ significantly from existing networks. First of all the topology of interconnections may be quite dynamic, secondly most users will not wish to perform any administrative actions to set up such a network. In order to provide service in the most general situation we do not assume that every computer is within communication range of every other computer. This lack of complete connectivity would certainly be a reasonable characteristic of, say, a population of mobile computers in a large room which relied on infrared transceivers to effect their data communications.

Routing protocols for existing networks have not been designed specifically to provide the kind of dynamic, self-starting behaviour needed for ad-hoc network. Most protocols exhibit their least desirable behaviour when presented with a highly dynamic interconnection topology.

Several research papers on ad-hoc network has focused on optimal set of ad-hoc routers, while others has proposed new solutions using the features from existing internet routing algorithms.

The destination Sequenced [7] Distance Vector Routing (DSDV) algorithm has been proposed as a variant of distance vector routing method, by which mobile nodes co-operate to form an ad-hoc network. DSDV is effective for creating ad-hoc network for small population of mobile nodes. However if the population grows extensively, DSDV fails to respond correctly to the situation as the control message overhead grows O(n2). DSDV requires each node to maintain a complete list of routes one for each destination within the ad-hoc network, no matter whether the packets need to be sent on that destination or not. It is, however possible to design a system where by routes are created on demand. Such systems must take steps to limit the time used for route acquisition; otherwise, uses of the ad-hoc nodes might experience unacceptably long waits before transmitting urgent information. Keeping these characteristics in mind an improvisation over DSDV resulted into AODV.

[10] AODV uses a broadcast route discovery mechanism, as is also used (with modifications) in Dynamic Source Routing (DSR) algorithm. Instead of source routing, however, AODV relies on dynamically establishing route table entries at intermediate nodes. This difference pays off in networks with many nodes, where a larger overhead is incurred by carrying source routes in each data packet. To maintain the most recent routing information between nodes, we borrow the concept of destination sequence number from DSDV. Unlike in DSDV, however, each ad-hoc node maintains a monotonically increasing sequence number counter which is used to avoid stale cached routes. The combination of these techniques yields an algorithm that uses bandwidth effectively (by minimizing the network load

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for control and data traffic), is responsive to changes into topology, and ensures loop free routing.

2. AODV ROUTING PROTOCOL DESCRIPTION

Ad hoc On Demand Distance Vector (AODV) [10] is a reactive routing protocol which initiates a route discovery process only when it has data packets to send and it does not know any route to the destination node, that is, route discovery in AODV is "on-demand". AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to avoid the routing loops that may occur during the routing calculation process. All routing packets carry these sequence numbers.

A. Route Discovery Process

[9]During a route discovery process, the source node broadcasts a route query packet to its neighbours. If any of the neighbours has a route to the destination, it replies to the query with a route reply packet; otherwise, the neighbours rebroadcast the route query packet. Finally, some query packets reach to the destination.

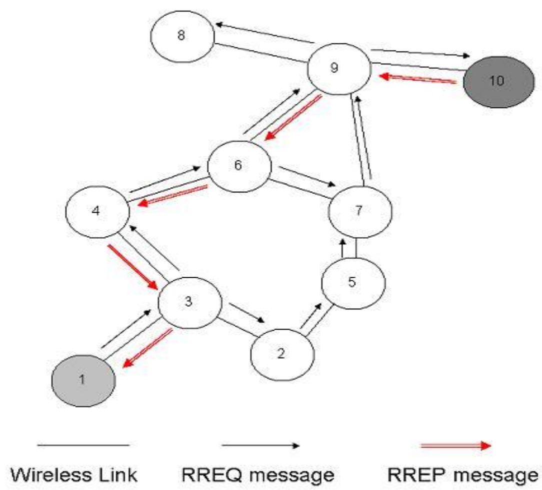

Figure 1. AODV Route Discovery Process

"Fig. 1" shows the route discovery process from source node1 to destination node 10. At that time, a reply packet is produced and transmitted tracing back the route traversed by the query packet as shown in "Fig. 1".

B. AODV Route Message Generation

The route maintenance process in AODV is very simple. When the link in the path between node 1 and node 10 breaks the upstream node that is affected by the break, in this case node 4 generates and broadcasts a RERR message. The RERR message eventually ends up in source node 1. After receiving the RERR message, node 1 will generate a new RREQ message (Fig. 2).

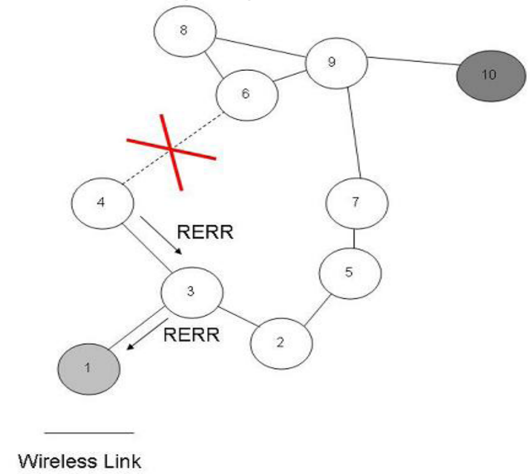

Figure 2. AODV Route Error message generation

C. AODV Route Maintenance Process

Finally, if node 2 already has a route to node 10, it will generate a RREP message, as indicated in Figure 3.Otherwise, it will re-broadcast the RREQ from source node1 to destination node 10 as shown in "Fig.3".

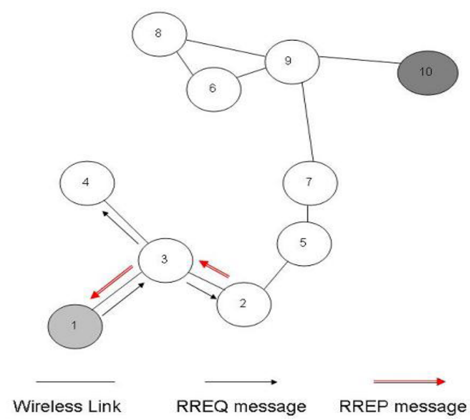

Figure 3. AODV Route Maintenance Process

D. Effect of Mobility on Performance of AODV

In the presence of high mobility, link failures can happen very frequently. Link failures trigger new route discoveries in AODV since it has at most one route per destination in its routing table [8]. Thus, the route breaks due to high mobility results into frequent route discoveries. These frequent route discoveries acts as an overhead in AODV protocol. Thereby reducing the efficiency of the protocol.

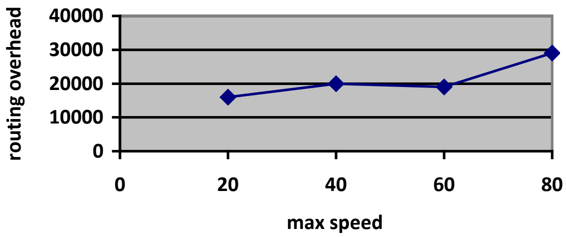

Figure 4. Routing overhead.

Fig 4 [6] shows the routing overhead incurred when the mobility of the nodes increases. We see that the routing overhead increases when the speed increases resulting into more link failure and thus poor performance of AODV.

2. Proposed Work

As we have seen that the mobility disturbs the performance of AODV. So, we have considered this area for improvisation in this paper. We have developed the concept of the use of "favourable nodes" for data sending.

To elaborate, whenever a node needs to send data to some other node then, as per the original concepts of AODV, the node goes for the route discovery. Whenever it receives reply from more than one path, it considers that path for data sending which has least number of hop counts and has most recent sequence number. In our paper we have extended this concept for more reliable data sending when mobility of nodes increases by introducing "favourable nodes". Here, mobility means that there are more link failures. These favourable nodes are the nodes which fail less frequently. To determine the frequency of failure of a node and categorising it into favourable node we define a "threshold value". So, if any nodes fail less than the threshold value it is considered as favourable node. After the ROUTE REQUEST, if the node receives ROUTE REPLY from more than one path then it considers that route for data packet sending which has more number of favourable nodes.

Thus, the data is sent on that route which has less number of hop count, most recent sequence number and "which has more number of favourable nodes".

To explain this concept more clearly consider the scenario shown in Fig.5.

Node S wants to send packet to node D. Source node S floods the ROUTE REQUEST (RREQ). Node E and node C receives the request and checks for the sequence number and destination number. If the sequence number is most recent it does not discard the request instead floods it to its other neighbours and set up a REVERSE PATH to its preceding node. Till now everything has been done according to AODV protocol. Now according to our proposed protocol the changes play the role here. The node K shown in gray is that node which fails more than the threshold value and hence is unfavourable node and other nodes are favourable nodes. Now while setting up reverse path node E and node C checks for its next hop that is source node S. The node S is favourable node therefore they set up the reverse path. In the similar manner node A and node J checks for their next hop as favourable node in path 1. Similarly, node G and node K checks for their next hop to be as favourable node in path 2. Now when node D has received the RREQ from path 1 and path2 it checks which of the node K or node J is favourable node. In this scenario, node D finds node J to be favourable node and hence sets the reverse to node J. Therefore, in this situation the data packet is sent on path 1.

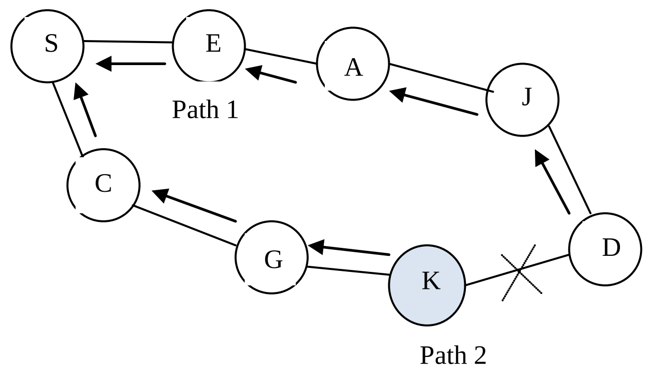

Figure 5

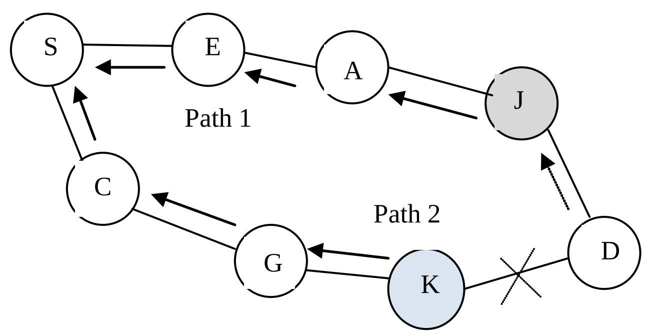

Figure 6

Now consider the situation shown in Fig 6. Here all nodes are favorable except node K and node J. However the ROUTE FAILURE of node J is less than that of node K. Therefore, in this situation when node D checks for its next hop in the favorable nodes list, it finds that neither node J nor node K is in favorable node. In this situation the data to be sent on which path is determined by comparing the ROUTE FAILURE of the nodes. Node D finds that the route_failure of node J is less than that of the route_failure of node K. So node D sets up a reverse path to node J and

not to node K. Therefore the data is sent on path 1 and not path 2.
The above two scenarios have shown that if in the original AODV the hop count and sequence number fulfils the criterion and mobility tries to worsen the situation then, this modified protocol still serves a better a way to comprehend the situation.

3. Conclusion

In summary, this paper represented the protocol which tried to improve upon one of the drawbacks of the AODV protocol. It was seen that AODV tends to show a poor performance when mobility increases resulting into more link failure and an increased overhead of doing the route discovery every time. The key concepts which the modified protocol followed to improve the scenario are-

- Prepare the list of favorable nodes.
- If the route reply is received is from more than one path then consider that path which has more number of favorable nodes.
- If there is equal number of favorable nodes then it follows that path in which the node has lesser route failure than the other one.

Thus, the modified protocol makes a better amendment to the existing AODV protocol to let it serve better when mobility is high.

4. FUTURE WORK

In future, this extension of AODV can be more improvised by developing a better algorithm for considering the threshold value in this protocol. Probabilistic models can be used for recording node failures and preparing the threshold value based on that model.

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