Optimized AODV using cross-layer optimization technique for mobile ad-hoc network

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Abstract

Mobile Ad-hoc network is wireless ad-hoc network which is infrastructure-less network which is decentralized in nature. It is difficult to make the technology to work effectively for the networks where there is no fixed infrastructure. A strong protocol is needed for making such networks to work efficiently and to remove the problems regarding to the routing. AODV is a popular on demand distance vector routing algorithm for the Ad-hoc networks. But still it is necessary to improve the performance of existing protocols for better performance and if we use the cross layer optimization techniques in the existing algorithms then it can give better performance. In this paper we have proposed modified AODV routing protocol which uses the physical layer information for the purpose of routing. The proposed modified AODV protocol gives better performance than the existing AODV routing protocol. The results of the simulations show improvement on performance metrics like end to end delay of existing AODV.

Key words- MANET, AODV, cross-layer

1. Introduction

Mobile ad hoc network (MANET) has attracted much attention recently. MANET is a self-configuring infrastructure-less network of mobile devices which is wireless. In MANET, the nodes themselves are responsible for routing and forwarding of packets. If the nodes are out of range from each other, and therefore are not able to communicate directly, intermediate nodes are needed to make up the network in which the packets are to be transmitted. Examples of MANETs include emergency operations where there exist no infrastructure and military operations where the existing infrastructure might not be trusted.[1]
The design of efficient routing protocols is a critical issue for MANET having no fixed topology. The on-demand routing protocols for ad hoc networks, in which a node attempts to discover a route to some destination only when it has a packet to send to that destination. On-demand routing protocols have been demonstrated to perform better with significantly lower overheads than periodic routing protocols in many situations, since the protocol is able to react quickly to the many changes that may occur in node connectivity, yet is able to reduce or eliminate routing overhead in periods or areas of the network in which changes are less frequent.[2] The layered concept was primarily created for wired networks and naturally follows their architectural design. Designing wireless networks with strict layering principle did not fulfill the expectation raised in wire-line network design. The ad hoc mobile networks oppose strict layered protocol design because of their dynamic nature, infrastructure-less architecture, limited resources, mobility of nodes and time varying unstable links and topology. The concept of cross-layer design is based on architecture where the layers can exchange information in order to improve the overall network performances. [1]

2. MANET & Routing protocol

The term MANET stands for Mobile Ad-hoc Network. Ad hoc wireless networks are defined as the category of wireless networks that utilize multi-hop radio relaying and are capable of operating without the support of any fixed infrastructure (infrastructure less networks). The absence of any central coordinator or base station makes the routing a complex one compared to cellular networks. Each node acts as a host and a router at the same time. This means that each node participating in a MANET commits itself to forward data packets from a neighboring node to another until a final destination is reached. These networks are deployed 'on the fly'. Among the issues of Adhoc Wireless Networks, routing is one of the key features. Since the network is dynamic and channel state is continuously changing, discovering the appropriate path for data transfer is very important. The MAC for 802.11b uses CSMA/CA for accessing the channels by different nodes. But, one of the major concerns is not only selecting the nodes along with the path from source to destination but also pick those nodes in such a way that, they provide best service in

the form of relaying data with high rate, least error and least time. As such, this research mainly focuses on the routing issue. [1]Routing protocols for MANETs can be classified into several types based on different criteria. Here depending on the working they are classified as Reactive protocols, Proactive protocols. [3]Reactive protocols seek to set up routes on-demand. If a node wants to initiate communication with a node to which it has no route, the routing protocol will try to establish such a route.[3] Such protocols do not maintain the network topology information. They only obtain the necessary path on requirement basis. As a result these protocols do not exchange routing information periodically. Examples are: DSR, AODV etc. While such protocols may be taking time to establish routing path, they have much lesser control overhead. They are the classical distance vector protocols.[1]

A proactive approach to MANET routing seeks to maintain a constantly updated topology understanding. The whole network should, in theory, be known to all nodes. This results in a constant overhead of routing traffic, but no initial delay in communication.[3] Every node maintains the network topology information in the form of routing tables by periodically exchanging routing information. The routing information is generally flooded in the network. Whenever a node requires a path to a destination, it runs in an appropriate path finding algorithm on the topology information it maintains. Examples of such protocols are DSDV, OLSR, WRP etc. Such protocols have both advantages and disadvantages eg. Availability of routes to all destinations at all times facilitates route setup quickly. But, it has excessive control overhead which is proportional to the number of nodes in network.[1]

2. AODV

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. When a link fails, a routing error is passed back to a transmitting node, and the process repeats. 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 some other approaches. [4]

4. Proposed modified AODV

In the MANET, the performance is affected by channel conditions, network connectivity, mobility and resource limitations. Various cross-layering approaches are utilized to improve the performance of MANETs and their associated routing protocols. We have proposed a modified version of AODV routing protocol utilizing Physical Layer information i.e. SNR, RSSI value. The proposed model uses the received SNR to find its route instead of the default hop count mechanism of AODV protocol. The basic is same as the AODV protocol. The main steps for the proposed protocol are as follow.

Step -1:
Source will send control packet and it will calculate its RSSI value.
Step -2:
All intermediate nodes will check with threshold value.
Step -3:
Calculate optimized path for path 1 to n.
Step-4:
Find max as best path and destination reply to that path.
Step -5:
If values are same then calculate hop_count and reply with less value of hop count.

5. SIMULATION RESULTS

The model is developed first in the ns2 simulator tool. And the existing and the modified both the AODV is applied on the network model. The network area is 3052km X 52km. the maximum packet range is 50. The MAC 802.11b is used. Frequency is 2.4GHz. For different values of number of nodes, the simulation is done applying both the algorithms to the model. Number of nodes is varied as 10, 20, 30, 40, 50 and 60 and the performance metric end to end delay is

calculated each time. From the simulation results the graph is plotted which is shown in figure. The results and graph shows that end to end delay is improved by using the modified AODV.

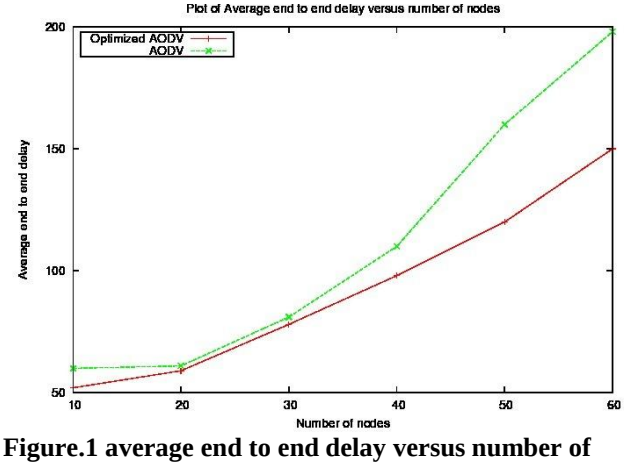

Figure.1 average end to end delay versus number of nodes

6. Conclusion and future work

MANETs are infrastructure-less networks where all the nodes act as host as well as routes to deliver data. Due to the nature and the architecture of MANET the performance is affected by channel conditions, network connectivity, mobility and resource limitations. Various cross-layering approaches are utilized to improve the performance of MANETs and their associated routing protocols. We have proposed a modified version of AODV routing protocol utilizing Physical Layer information i.e. SNR, RSSI value. The proposed model uses the received SNR to find its route instead of the default hop count mechanism of AODV protocol. The simulation of proposed AODV shows performance improvement in the AODV protocol.[1]For the further improvement in the cross-layer performance, one can use the channel coding information and according can modified the algorithm further. Also the information of other layers can be useful to modified existing one for the improvement.

7. References

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