

International Journal of Advance Research in Computer Science and Management Studies

Research Article / Survey Paper / Case Study

Available online at: www.ijarcsms.com

Design of Radio-Channel Quality Based Routing Protocol for Multi-hop Mobile Ad-hoc Networks Required

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Abstract: Mobile ad-hoc network is the gathering of mobile nodes that interact with other node without any pre installed infrastructure or integrated control system. A mobile node can work as host as well as router but due to dynamic nature of nodes, routing is very laborious. But now days due to MANET's application such as battlefield, disaster management and multimedia applications, lot of research work in conducting in this field. Ad hoc On-Demand Distance Vector Routing (AODV) is one of the leading reactive routing protocol for routing but it also have its limitation. QoS is major task for it which depends purely on parameter like delay, bandwidth, link lifetime etc. Here we are proposing a noble protocol named as Radio-channel Quality based routing (RQBR) which is derived from AODV by discovering stable routes between source and destination.

Keywords: Mobile Ad-hoc network (MANET), AODV, RQBR, SNR, QoS.

I. INTRODUCTION

The MANET is constructed by the mobile nodes which may be move by the people. These mobile nodes connected by each other by sending information via wireless port. It is an infrastructure less network which powered by battery, so it can work any situation. The target of MANET is to provide long lasting and powerful mobile network with the routing capacity.

In MANET we have not any centralized control system or fixed router. Instead of this all the mobiles nodes itself can work as router, so they can connect with each other by spreading the route request in order to discover route as well as they can also maintain the route. MANET is useful in infrastructure less environment likewise disaster management, rescue operation, battlefield etc [1,2].

Characteristics of mobile ad hoc networks [1, 2]

1. Autonomous and infrastructure less
2. Multi-hop routing
3. Dynamic network topology
4. Device heterogeneity
5. Energy constrained operation
6. Bandwidth constrained variable capacity links
7. Limited physical security
8. Network scalability
9. Self-creation, self-organization and self administration

QoS in MANETs [3]

QoS can refer as set of service requirements that must be achieve during transferring data packet from source node to destination node. In today's scenario, requirement of QoS increasing day by day as real time applications such audio/video streaming, VOIP, file and mail transfer are mounting high, so it is necessary to support these service in MANET. So the network is typically wants to provide QoS in terms of bandwidth, end to end delay, packet delivery ratio, energy (power), jitter, link stability etc.

II. ROUTE DISCOVERY AND MAINTENANCE MECHANISM OF STANDARD AODV

Ad-hoc on Demand Distance Vector Routing (AODV) was introduced by Charles E_ Perkins and Elizabeth M Royer [4, 5]. They presented a new algorithm which, called as AODV, brings a loop free routes even while reconstruction of collapsed links.

AODV is type of reactive routing protocol. For route selection, it uses hop count as metric. Every node keeps the information of the next hop, so that reach to destination. For route discovery and maintenance, AODV uses three message mechanisms as Route Reply (RREP), Route Request (RREQ), and Route Errors (RERR) messages.

It broadcast a RREQ message, when a node demands a route to other node, this message propagated through the networks until it reaches the final destination node, or an intermediate node, which have correct route to the destination. Later on destination node passes back a RREP message via the discovered route to source node. If a link collapse occurs, any nodes which detect it, inform all other nodes that route is no longer in working condition. This is managed by sending a RERR message to all those nodes and again a route discovery phase starts. Whenever a node finds out a fresh route to destination node, it evaluates this fresh info through the route updated law:

```
if(seq_nrdi < seq_nrdj) or ((seq_nrdi = seq_nrdj) and (hop_countdi > hop_countdj))
```

```
then
```

```
seq_nrdi := seq_nrdj;
```

```
hop_countdi := hop_countdj + 1;
```

```
next_hopdi := j;
```

```
endif
```

The notation applies for:

node I : receives routing information to destination d from neighbor j.

seq_nrdi : The destination sequence number,

hop_count di : hop count

next_hopdi : next hop for a destination d at node i is represented

As a part of 1 or more active routes, a node broadcasts a Hello message locally every HELLO_INTERVAL to offer connectivity info.

III. PROPOSED PROTOCOL

In the proposed Radio-channel Quality based routing (RQBR) protocol each node selects a link with the highest signal-to-noise (SNR) value from the available set of links it has during the route discovery process between a source-destination pair. An info field called snr_info is added in the RREQ message of AODV routing protocol to pass the SNR value from the physical of the received RREQ message to the network layer using a cross-layer design function. The information about the SNR of the received RREQ message is then used by the network layer during the route discovery process to select the route that consists

with the links that has the highest SNR as compared to the other routes available between the source destination pair for which the route discovery phase is initiated.

Route Discovery phase of Radio-channel Quality based routing (RQBR)

The Algorithm given below is implemented in the trial version of Qualnet simulator in order to see the effectiveness and correctness of our proposed routing method using the simulation results generated during the simulation processes. Let's assume that the S is the source and D is the destination node in the network for which a route has to be discovered using our proposed RQBR protocol. When a source node S got a data packet for transmission to a destination node D, it checks its routing table for an active route for the destination. If an active route is available in the routing table of node S, then the data packet is transmitted towards the node D using the next hop address given in its routing table.

On the other hand, if the routing table of node S does not have a valid entry for the node D it starts our proposed route discovery process using the RQBR protocol. The node S initiates the RREQ message and broadcast them in the network. When an intermediate node which is also the neighbor of the node S in this case receives the RREQ message at the physical layer it calculates the SNR of the received RREQ message. To calculate the SNR at the physical layer the intermediate node will use the ratio of the received signal power and the noise in the received signal. The calculated SNR of the received RREQ message is then placed in the INFO field of the RREQ message and that RREQ message is then send to the MAC layer from where it will reach to our RQBR protocol which is at the network layer.

Pseudo Code for proposed Algorithm Route discovery process of RQBR protocol

//Variable used in the Algorithm

S = Source node

D = Destination node

I = Intermediate node

R_buf = RREQ message buffer

SNR_rreq = Signal-to-noise ratio of received RREQ message

RT = Routing table of a node

Tx = Timer of Rbuf at node x

IF1 (S got data packet for D)

IF2 (S has route for D in its RT)

S send packet to next-hop towards destination node

ELSE2

S starts the RQBR protocols route discovery process

IF3 (I receive a fresh RREQ or duplicate message)

Physical layer of I calculates the SNR and add it in the INFO field of RREQ message

I store the RREQ message in its R_buf and set the timer if it's fresh RREQ

When Ti expire node I extract the RREQ with the highest SNR

Node I rebroadcast the extracted RREQ and discard the R_buf

ENDIF3**IF4** (D receives the RREQ message)

I store the RREQ message in its R_buf and set the timer if it's fresh RREQ

When Ti expire node I extract the RREQ with the highest SNR

Node D gets the pervious hop address of the extracted RREQ message

Node D creates a RREP message and sends it towards node S using the previous hop selected in last step

ENDIF4**IF5** (Node S receives the RREP message)

S updates its RT and sends the buffered data packet to D

ENDIF5**ENDIF2****ENDIF1**

IV. SIMULATION AND RESULTS

Qualnet is used to create different scenarios of wireless ad hoc networks using different values of many scenario parameters. The Simulation parameters to build the scenarios are given in the Table 1. All the simulation results are calculated by taking the average of ten different runs.

Table 1: Simulation Parameter

Parameters	Values
Simulator	Qualnet
Network Size	1000 x 1000 meter square
Simulation time	900 Seconds
Application Layer Process	Constant Bit Rate (CBR)
Transport Layer Protocols	User Datagram Protocol (UDP)
Routing protocol	AODV and RQBR
Number of Nodes	50
Mobility model	Random way point
Node pause time	15 Seconds
Mobility speed	0 to 25 meters/sec
MAC specification	IEEE 802.11
Network Bandwidth	11 Mbps
Performance Metrics	Packet Delivery Ratio, End-to-end delay and Routing Control Overhead
PHY Specification	802.11b

Effect of Network Mobility

Figure 1 shows the effects of change in network mobility on end-to-end network delay (EED) for both the comparing routing protocols i.e., AODV and RQBR routing protocols. As it can be seen from the figure that the end-to-end delay of both the protocols increases with increase in the network mobility because due to mobility the number of route breaks increases

during the communication process which increases the number of re-routing processes and due to the reactive nature of both the routing protocols each re-routing increases the end-to-end delay. Although, the EED of RQBR are lower than the AODV routing protocol because RQBR uses more stable radio links during the route discovery process for route formation. Due to this, the number of routes broken in RQBR is lower as compared to AODV.

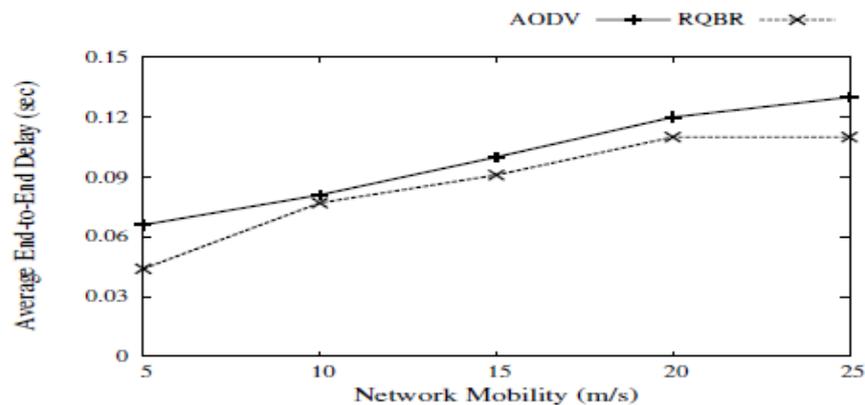


Fig. 1. Average end-to-end delay with increase in network mobility

Effect of Network Load

In Figure 2 we have shown the effect of increase in network load on end-to-end delay when using AODV and RQBR routing protocols for data communication in MANETs. As it can be observed from the Figure 5.4 that the EED of both the routing protocols increases with increase in network load because as the network load increases the congestion in the network increases which increases the waiting time of data packets on the congested intermediate or source node due to which the average EED of the data session is increased. As our proposed RQBR protocol is not using any type of admission control at application layer so the effects of increase in network load cannot be mitigated on full scale but still the average EED of RQBR is lower than the AODV routing protocol because of the stable route selection process of RQBR which consists of links that are less congested as compared to the routes that are selected during the route discovery process of AODV routing protocol.

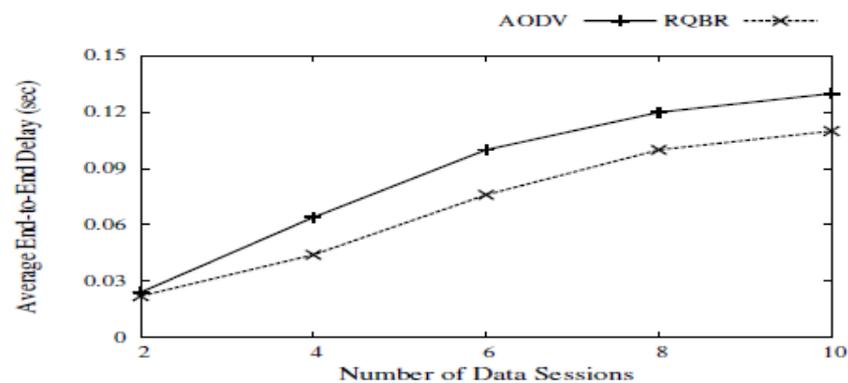


Fig. 2. Average end-to-end delay with increase in number of data sessions in network

V. CONCLUSION

Our proposed Radio-channel Quality based routing (RQBR) protocol uses the received signal power, interfering signal power and noise over a radio link to identify whether it is a stable radio link or not during the route discovery process. Therefore at the end the path which is selected for the data transmission is the one which consists of radio links that has lower interference and low noise in conjunction to high received signal strength. Due to this, the possibility that the selected route will broke sooner in the future during data transmission decreases. Furthermore, due to this the network throughput increases and the routing overhead decreases due to lower number of re-routing processes in the network during a data communication process. We have proved through simulation results that our proposed method which we called Radio-channel Quality based routing

(RQBR) protocol is largely unaffected with increased network mobility and network load. It has been also seen that the network throughput has been increased and the routing overhead with the end-to-end delay has been decreased when our proposed method is compared with the traditional AODV routing protocol. This is because the paths selected based on our proposed routing protocol contains radio links that are long lived and due to which the possibility that they will broke in the future anytime sooner will be lower as compared to the AODV routing protocol. Finally, we can conclude that our proposed Radio-channel Quality based routing (RQBR) protocol is an improvement on the traditional AODV routing protocol because of its improved route discovery process used during the route discovery process

References

1. Azzedine Boukerche., 2009. *ALGORITHMS AND PROTOCOLS FOR WIRELESS AND MOBILE AD HOC NETWORKS*. Willey Publication.
2. A Mishra and K.M Nadkarni, security in wireless Ad -hoc network, in Book. The Hand book of Ad Hoc Wireless Networks (chapter 30), CRC press LLC, 2003.
3. A. Orda, A. Sprintson, "Precomputation Schemes for QoS Routing" IEEE/ACM Transaction on Networking, vol. 11, pp. 578 à 591, 2003.
4. Charles C. Perkins, E. Royer, and S. Das (2000), "Ad hoc on demand distance vector (AODV) routing", Internet draft, Internet Engineering Task Force.
5. C. E. Perkins, E. Belding-Royer (2000), "Quality of Service for Ad hoc On-demand Distance Vector Routing", Mobile Ad Hoc Networking Working Group, Internet Draft, <http://www.tcs.hut.fi/~antti/manet/drafts/draft-ietf-manet-aodvqos-00.txt>