International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-4, February 2019

Energy Efficient and Reliable Routing Protocol in Wireless Ad Hoc Network

Altaf C, Shah Aqueel Ahmed

Abstract*: In wireless ad hoc network, increased lifetime, reliability and energy efficiency is main concern. The significant techniques Reliable Minimum Energy Routing (RMER) and Reliable Minimum Energy Cost Routing (RMECR) are developed here to reach this concern. These protocols are compared with TMER (Traditional Minimum Energy Routing) and ETX (Expected Transmission Count) by energy utilization, battery energy of nodes remaining along with quality of links, also comparison has made here. With investigations made on Energy-Aware Routing in ad hoc networks, two techniques namely RMER and RMECR stated here can increase the operational lifetime of the network by means of reliable, energy-efficient routes. The RMECR is the new idea of wireless ad hoc networks in case of energy efficient routing algorithm. RMER technique is the point of reference in understanding Energy Efficiency of the RMECR algorithm determines the routes which are required low energy consumption while transmitting packets without considering the battery energy left of the nodes.

Index Terms*: Mobile Ad hoc network, Routing, Energy Efficiency, Reliability, RMER and RMECR.

I. INTRODUCTION

The Self-arranging system of mobile routes attached by the wireless links which Forms self-assertive with rapid, uncommon topological changes known as Mobile Ad hoc Networks (MANETS). Each device in MANETS change its wireless links to other devices routinely and are moving freely, independently in any direction. Centralized control & administration does not require to MANETS, it should be Self-organizing and restoring routes forward traffic unrelated to its routes. Use of sensible power consumption model of the communication subsystem is a greater provocation which distinguishes the power utilization of individual component and the influence of the external environment clearly.

Across a network, moving of packets which contain useful information from one host to another host or from one host to many other hosts is called Routing performed by the true devices known as routes. Each message is divided into small segments known as packets which are transmitted over the Packet Switched Network (PSN), can use similar or distinct paths in reaching the destination and are assembled to restore original message at destination. The following figure1 shows Ad hoc Network with wireless Links.

Manuscript published on 28 February 2019.
***Correspondence Author(s)**
Altaf C, Research Scholar, Department of ECE, Mewar University, Rajasthan, India.
Dr.Shah Aqueel Ahmed, Principal, Department of EE, Theem College of Engineering, Maharashtra, India.

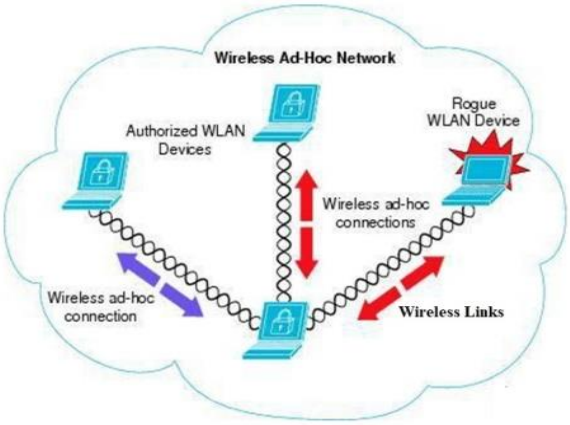

Figure 1: Ad hoc Network with wireless Links.

A constructive technique for bringing cost of energy of data communication in Wireless Ad hoc Networks (WANETS) down is Energy efficient routing [1].Without consideration of links reliability and nodes residual energy ,the Energy-efficient routing of ad hoc network is neither complete nor efficient. The operational lifetime of the network can be increased by avoiding overused nodes in routing by residual energy of nodes consideration; can increase the quality of service by the reliable routes.

Wireless channel bandwidth and its restrictions are to be considered by the routing protocol, without routing the packets over highly-overloaded wireless links and paths. Otherwise increases energy consumption, delay and packet losses leads to retransmission of packets.

II. LITERATURE REVIEW

The studies have shown RMECR algorithm extending the wireless ad hoc network operational lifetime, ability of finding reliable and energy-efficient routes similar to RMER. Per packet limited retransmissions are allowed, packet sizes, and the influence of acknowledged packets is considered while design of RMECR with minute particulars of energy utilized by the transceivers processing elements leads to proposed method in this paper. In TMER [2,3,4], the influence of HBH ACK and energy consumption of processing elements are neglected. TMER can find more reliable routes but in addition to these reliable routes RMER able to find routes which are more energy-efficient. More reliable routes can be achieved in RMER compared to TMER in which energy cost of processing elements is not considered. The routing algorithm ETX, commonly known as Min-ETX determines routes having low accumulated ETX having better quality.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

III. PROPOSED ALGORITHMS

Extension of network lifetime, reliability and energy efficiency in wireless ad hoc networks is mainly addressed in this paper. To achieve these things, RMECR and RMER algorithms are proposed here. RMECR increases the operational network life time by determining energy efficient and reliable routes. Whereas RMER, determines the paths reducing entire energy spent due to End-to-End Transmission of packets.

A. Energy-Aware Reliable Routing

For end-to-end packet transfer with low cost of energy with the help of reliable routes is the major goal. So in route selection reliability and energy cost of routes is taken. Here energy cost of a route is related to its reliability. Less reliable routes lead to increasing packet retransmission probability [5], requires larger quantity of energy per packet due to its retransmissions. For Hop-by-Hop (HbH) and End-to-End (E2E) systems, Energy-Aware Reliable routing algorithms are designed differently to compute energy cost (EC) of the routes namely RMECR and RMER. In End-to-End packet transmission of RMER, EC of the route is anticipated amount of energy utilized for transmission of packets to the destination by all nodes. Whereas the energy cost of the route is nodes battery cost expected on the route in case of RMECR. The minimum EC of a route stated in [6].Proposed algorithms are shown in figure 1.

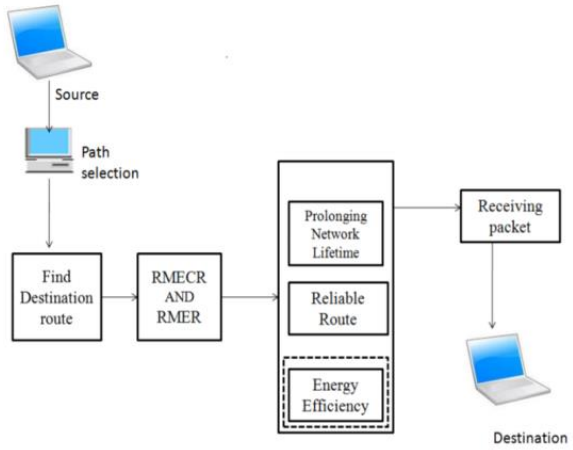

Figure 2: Architecture of routing algorithms proposed

B. Energy Aware HbH Routing

We presented RMER and RMECR algorithms design to the wireless networks holds up Hop-by-Hop (HbH) retransmissions. The reliability of End-to-End (E2E) routes, retransmission across each link or path, data, acknowledged (ACK) packet size is considering in our analysis. The following steps are required to analyze the energy cost of the route.

Step 1: Examine the anticipated the ACK packets and data packets transmission count.

Step 2: Examine the anticipated energy cost of a route including energy cost of retransmissions,

Step 3: The energy cost of the End-to-End (E2E) reliability of a path including energy cost of the links is analyzed.

This inspection makes basis to RMECR and RMER algorithms in case of Hop-by-Hop (HbH) systems.

C. Energy Aware E2E Routing

For the networks supporting End-to-End (E2E) retransmission, the algorithms RMER and RMECR are designed under this section. Here in this E2E, first we analyze the energy cost of the route to transmit the packets from source to destination same as Hop-by-Hop (HbH) systems. In E2E routing the energy cost of a route depends upon number of times that the packets and E2E Acknowledged (ACK) Packets are transmitted also on End-to-End (E2E) reliability of route. End-to-End (E2E) reliability and End-to-End (E2E) ACKs are formulated to determine the expected energy cost which is the cost during one time transmission towards destination from source accumulated by the number of times expected that packets transmitted by source host with End-to-End (E2E) ACK effect on energy cost neglected.

Energy Aware Routing Algorithm

Step 1 Examine the count of transmission of both Acknowledged (ACK) packets and data Packets expected.

$$E[C_{s,d}(L_p)] = \frac{1-(1-P_{s,d}(L_p)P_{s,d}(L_h))^{Q_s}}{P_{s,d}(L_p)P_{s,d}(L_h)} \quad (1)$$

Where L_p=Packet Length

L_h= Hop length

$P_{s,d}(L_p)$ =Power required for transmitting packet of length

L_p $P_{s,d}(L_h)$ = Power required between two hosts(hop count)

$C_{s,d}(L_p)$ = Transmission Count of packet whose length is L_p from source(s) to destination (d)

Q_s= ACK Packets at source

Step 2 Taking the effect of Hop-by-Hop (HbH) into account, the total energy utilized across the link is analyzed.

$$a_{s,d}(L_p)=E[C_{s,d}(L_p)]\varepsilon_{s,d}(L_p)+E[m_{s,d}(L_h)]w_{s,d}(L_h) \quad (2)$$

$$b_{s,d}(L_p)=E[C_{s,d}(L_d)]w_{s,d}(L_d)+E[m_{s,d}(L_h)]\varepsilon_{s,d}(L_h) \quad (3)$$

Where

$a_{s,d}(L_p)$= Total Energy utilized by transmitting node s.

$b_{s,d}(L_p)$= Total Energy utilized by receiving node d.$\varepsilon_{s,d}(L_p)$= During single transmission of packet s, the total energy utilized.

$w_{s,d}(L_d)$= During single reception of single data packet, the total energy utilized.

$m_{s,d}(L_h)$= During single reception of ACK, the total energy utilized.

Step 3 Analyzing link and path reliability.

$R_{s,d}(L_p)$=1-P_l{packet lost after Q_s transmission}

$$= 1-(1-P_{s,d}(L_p))^{Q_s} \quad (4)$$

Step 4 Examine route's expected energy cost.

Step 5 Analyze Energy Cost of a Path which is minimum by taking costs as the weights.

Step 6 RMER and RMECR are derived by suitable link weights.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

IV. PERFORMANCE ANALYSIS

With the help of GNU AWK scripting language trace files are generated and using portable GNUplot graphs are plotted. The derived protocols are compared with the existing protocols to show their performance.

Table 1: List of parameters used in simulation of proposed algorithms

Parameters	Value
Type of Simulator	Network Simulator-2(2.34)
Area of Topology	350*350
Size of Packet	0.512KB
No. of Nodes	200
Pause time in sec	0
Time for Simulation	200seconds
Rate of Packet	1packet/sec
Type of Traffic	Fixed bit rate type
Beginning energy	100joules
Range of Transmission	70 meters
Transmission Energy	0.1Joules
Receiving Energy	0.1Joules

Packet Delivery Fraction (PDF), Reliability of routes, Energy Consumption (EC) and Network lifetime are the metrics used for protocol comparison.

A. RMER Performance

The following Figure 3 reveals the Reliable Minimum Energy Routing (RMER) performance with) x-axis specifies PDF and y-axis with energy consumption (EC) than Traditional Minimum Energy Routing (TMER).PDF decreases EC of nodes and is less in RMER proposed.

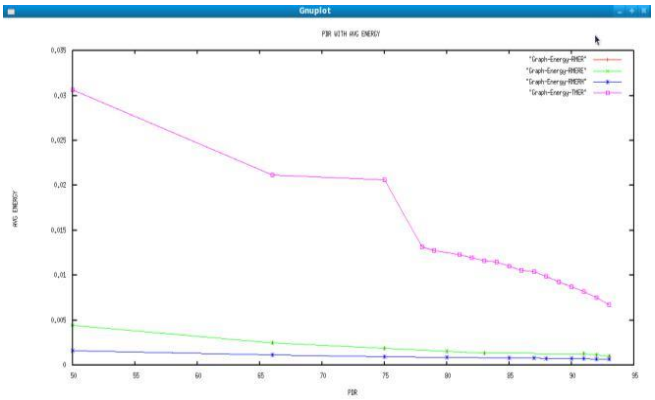

Figure 3: PDF with Average EC in RMER

Figure 4 reveals RMER performance than TMER with respect to PDF. Here PDF is taken on x-axis and y-axis with reliability, as the PDF increases reliability increases.

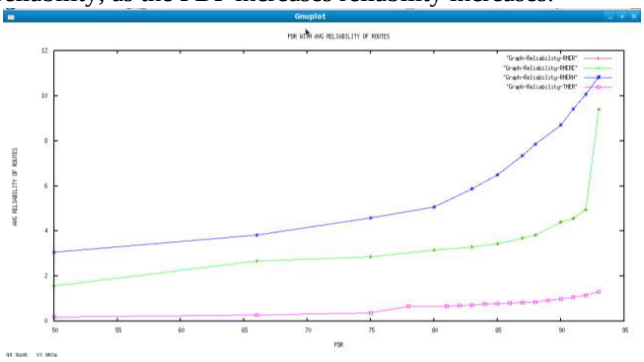

Figure 4: PDF with average Reliability of routes in RMER

B. RMEC and RMER Performance

Figure 5 shows RMER and RMECR performance. Here x-axis indicates PDF and y-axis with EC. The PDF is high in proposed RMECR and RMER, decreases the energy consumption of nodes.

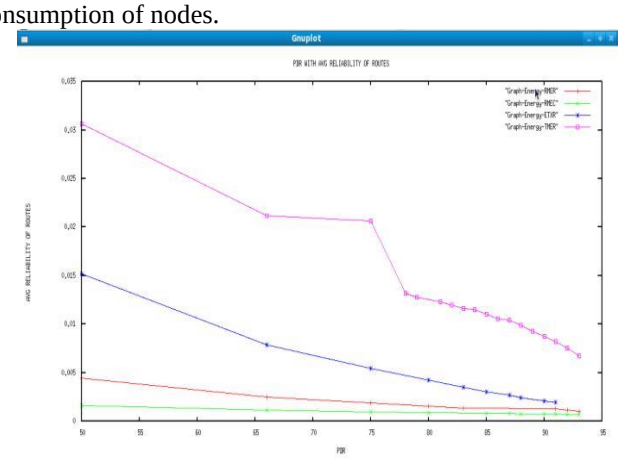

Figure 5: PDF with Average EC in RMECR and RMER

Figure 6 shows RMER and RMECR with x-axis indicating PDF and y-axis with Reliability of Routes. PDF decreases, then EC decreases.

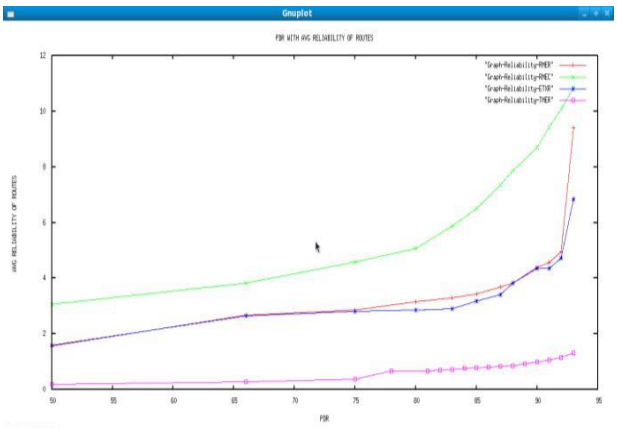

Figure 6: PDF with Reliability of routes in RMECR and RMER

Figure 7 shows RMER and RMECR performance against TMER and Min ETX with x-axis having PDF and y-axis with Network Lifetime.

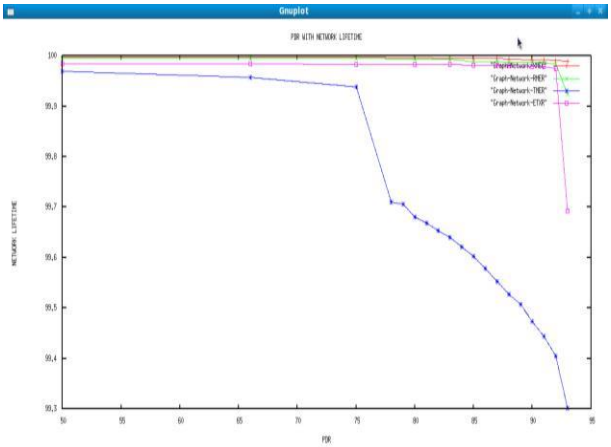

Figure 7: PDF with Network lifetime in RMECR and RMER

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

V. CONCLUSION

With Energy Efficient and routes with reliable, the proposed RMECR algorithm with comprehensive energy consumption model to transmit packet in wireless ad hoc networks increases the operational lifetime of the network. RMECR algorithm was implemented for hop-by-hop retransmissions and E-2-End retransmissions for ensuring the reliability. Also the proposed algorithm detects the routes minimizing the energy consumed by packet transmission without considering still existing battery energy of the nodes leads to Energy-Efficiency of the RMECR algorithm.

REFERENCES

1. D.J. and D.D Vergados and Pantazis NA, "Energy- Efficient Route Selection Strategies for Wireless Sensor Networks," Mobile Networks and Applications, vol. 13, nos. 3-4,pp. 285-296, Aug. 2008.
2. H. Zhang, A.A, and P. Sinha, "Link Estimation and Routing in Sensor Network Backbones: Beacon-Based or Data-Driven?" IEEE Transaction on Mobile Computing, vol. 8(5), pp. 653-667, May 2009.
3. Z.J Qiao.C and Wang.X (2006) 'On Accurate Energy Consumption Models for Wireless Ad Hoc Networks,' IEEE Transactions on Wireless Communications. Vol. 5(11), pp. 3077-3086.
4. Verma, S. Kim, S. Choi, and S.-J. Lee, "Reliable, Low Overhead Link Quality Estimation for 802.11 Wireless Mesh Networks," Proceeding. IEEE Fifth Annual Communication Society Conf. Sensor, Mesh and Ad Hoc Communications and Networks (SECON '08), June 2008.
5. A.Misra and S.Banerjee(2002) 'MRPC: Maximizing Network Lifetime for Reliable Routing in Wireless Environments,' Proceeding. IEEE Wireless Communications and Networking Conference. (WCNC'02).Vol 7,No.6, pp. 800-806.
6. Mohanoor.A.B S.Radhakrishnan and V.Sarangan(2009) 'Online Energy Aware Routing in Wireless Networks,'Ad Hoc Networks. Vol. 7, No. 5, pp. 918-931.
7. J.H Chang and L.Tassiulas (2004) 'Maximum Lifetime Routing in Wireless Sensor Networks,' IEEE/ACM Transactions on Networking.Vol. 12, No. 4, pp. 609-619.
8. Nishant G.S, R. Das, (1998)'Energy-Aware On-Demand Routing For Mobile Ad Hoc Networks', IEEE Transactions on Wireless communications, vol.6 , no.11,pp.1300-1313.
9. Canming J.Yi Shi and Thomas H.Y (2005) 'Cherish every Joule: Maximizing throughput with an eye on network-wide energy consumption' Proceedings. IEEE Wireless communications. Vol 3, No.5, pp.850-857.
10. K.K.H and K.G Shin.V "On Accurate Measurement of Link Quality in Multi-Hop Wireless Mesh Networks," Proceeding. ACM Mobile Communications, pp. 38-49, 2006.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)