IJCES International Journal of Computer Engineering Science , Volume1 Issue 3, December 2011
ISSN : 2250:3439
https://sites.google.com/site/ijcesjournal
http://www.ijces.com/

New Algorithm "DRREQ" Applied in AODV Route Discovery Mechanism for Energy Optimization in Mobile Ad hoc Networks

A.A.BOUDHIR, M. BOUHORMA, M. BEN AHMED and ELBRAK SAID
LIST Laboratory, Faculty of Sciences and Techniques, Tangier Morocco
CBAR, Al Yamamah University, Kingdom of Saudi Arabia
hakim.anouar@ieee.org , bouhorma@gmail.com, med.benahmed@gmail.com, elbraks@gmail.com

Abstract. In Mobile Ad hoc Networks, The route discovery mechanism utilize simple flooding method, where a mobile node massively rebroadcasts received route request (RREQ) packets until a route to destination is established. This can cause more retransmissions and thus excessive energy consumption. This work aims to reduce the number of messages RREQ (Route Request), by a new probabilistic and dichotomic method for the discovery of destination. This method can significantly reduce the number of RREQ packets transmitted during route discovery operation. Our simulation analysis can result in significant performance improvements in terms of energy. We propose a new probabilistic algorithm DRREQ (Dichotomic Route Request) which minimize significantly the energy consumption. Extensive simulations have been carried out for evaluation of the performance of our algorithm in different scenarios.

Keywords: RREQ, Energy, End to End delay, NS2.

1 Introduction

Optimizing the energy consumption becomes more and more critical. Due to this, several studies focuses their works on energy, especially in wireless applications like sensor networks which present a challenge in this area of search. In this context, the processing of data sent by the sensors consumes also a considerable energy mainly in ad hoc networks. In these networks, route discovery mechanisms used in protocols like AODV and DSR consume a huge energy when broadcasting the "Hello" message. In traditional on-demand routing algorithms such as AODV and DSR, a node that needs to discover a route to a particular destination, broadcasts a route request control packet (RREQ) to its immediate neighbors.

Each neighboring node blindly rebroadcast the received RREQ packet until a route is established. This method of route discovery is referred to as simple flooding. Since every node rebroadcast the RREQ packet the first time it is received and assuming that the destination node is reached, the possible number of rebroadcasts is around N-2, where N is the total of number of network nodes. This method of broadcasting can potentially lead to excessive redundant retransmissions in congested networks and hence causing high energy consumption.

2 Related Works

A growing interest focused on energy conservation in wireless communications. Hence, several works [1], [2] are done with techniques that optimize algorithm in order to decrease processing. The process of route discovery is one of axes used to improve the communication efficiency by attacking the limitations like the impact of flooding the provoke redundancy, contention and collision. Another works [3] based on MMBCR (Min-Max Battery Cost) Routing, uses periodic route discovery to get more updated information about the routes. In this method, periodically the route discovery process is done. If there are any changes in the route, the route information is updated. Because of this method, different routes are used for the transmission of data packets and periodic shifting between the routes which avoids the over usage of nodes and node exhaustion leading to the decrease of the energy consumption and the lifetime of the network. Several techniques use the link adaptation.

3 The Probabilistic Approach

The probabilistic broadcast has been recommended [4], [5] as one of the solutions to mitigate the broadcast storm problem associated with the simple flooding method. In conventional probabilistic broadcast methods, each mobile node rebroadcasts a received packet once based on a predetermined fixed-value forwarding probability. The probabilistic [5] schemes do not require the global topological information of the network in order to make rebroadcast decisions. Based on [4] the probabilistic concept used here, is focused on the number of neighbors (1) and the directional antenna of nodes which is equipped by rotator motor able to change direction. In the fixed probabilistic route discovery, the number of possible broadcasts of an RREQ packet is p* (N 2) [6].

For N nodes in the network, let Ni the number of neighbors at a node xi at a particular time instant, the average number of neighbors $\tilde{n}$ at a node in the network at that time instant is defined by the relation [6]:

$$\tilde{n} = \frac{\sum_{i=1}^{N} Ni}{N} \qquad (1)$$

4 The Dichotomic Approach

Applied in our study, the concept of Dichotomic algorithm focuses on finding the target nodes following a request RREQ. In principle, it consists of a probabilistic search for RREP (route replay) from destination node, in the right field, before the left one, of the node by minimizing the number of queries initiated by the node. This done, the node economize his energy for this set of queries.

In the following algorithm, let θ_0 the angle of antenna, and t_0 the time needed for waiting for a RREP.

Algorithm:

```
INPUT:
upon receiving RREQ packet  at node x
Θr and Θ1  are respectively the angle of antenna
 at right research and left research
  Get number of neighbors Nx at node x
  Compute the average number of neighbors ñ
  BEGIN
  if the RREQ is received for the first time
  toto :
  if   Nx   ≤ ñ
  // research on right field
      Θr = Θ0 + π
       the node x rebroadcast RREQ packet
      wait t0 seconds for RREP from neighbors

 if RREP received END.//stop broadcasting in the left
 else
 // research on left field
      Θr = Θ0 - π
       the node x rebroadcast RREQ packet
      wait t0 seconds for RREP from neighbors
 if RREP received  END. // stop broadcasting
 else
 goto toto
END.
```

5 Discussion

In this case of study, we consider a fix topology of N nodes. The main idea of our work is to limit the number of broadcast in RREQ mechanism. Indeed, the node limits his research at first time in the right area (or the left by probabilistic approach of presence of destination based on routing table), thus the node can save until the half of energy when finding the destination. At least this technique can be used to localize the destinations at right or left (fig1 and fig2) then with increasing the probability that can help to the choice of the location field and consequently the energy can be economized considerably for the posterior requests.

Fig.1: Area selected for broadcasting DRREQ

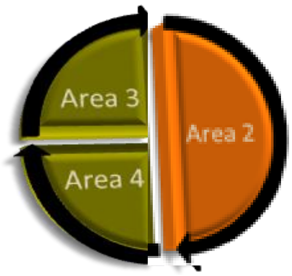

Fig.2: Dichotomic Approach For RREQ Mechanism

6 Simulations and Results

In this section, we evaluate and compare the performance between DRREQ and RREQ. The simulation was done by the NS2 simulator using the version ns2.29. we based our work on various simulations in mobile context of nodes (20m/s) and by varying the number of nodes with 10j of initial energy for each one (table1). We evaluate two metrics; energy (fig.3) and the average end-to-end delay (fig.4) that can be affected by the performance of the route discovery mechanism.

Constant Bit Rate (CBR) traffic is used with 10 traffic instances with a rate of 40.96kbits/s. The packet size is 512 bytes and the interval is 0.1s. FTP traffic is used to simulate TCP performance. The packet size is 1500 bytes. For TCP, only 1 ftp traffic is simulated and TCP-Reno is adopted. The results of 10 different scenarios are averaged.

Fig. 3 indicates that DRREQ consumes less energy compared to the traditional RREQ. This is due to the fact that in DRREQ, a packet will be broadcasted and forwarded only on the right (or left) area with half probability to find destination, which decrease the energy consumption to broadcast messages for route discovery mechanism.

Fig. 4 shows that DRREQ obtains Less time to reach a destination which is due to high probability to discover destination quickly. Thus DRREQ achieves an obvious improvement by reducing route energy consumption with high performance of end to end delay which is related to energy and distance .

On the other hand, fig. 5 and fig.6 shows an improvement of energy consumption when varying at first the speed of 10 nodes from 5m/s to 30m/s, then by varying the pause time from 10ms to 60ms. In fact, the energy consumption decrease when the speed is less then 20m/s especially with a good result for DRREQ than RREQ, but it increase more with this speed. Hence, we conclude that the dichotomic approach used in this mechanism give high performance by separating two areas for requesting destinations by broadcasting fewer messages and minimize the treatments. The same results are proved by varying the pause time, where DRREQ performs well, in these simulations, by using less energy for high values of pause time which coincide with low mobility context.

Table 1: Parameters of Simulation

Parameters	
Protocol	AODV
Mac /phy	802_15_4
Chanel	Wireless Channel
Propagation	TwoRayGround
Topology	100*100
Traffic	CBR
Number of nodes	4,6,8,10,12,14,16,1
Speed	5 to 30m/s
RtPower	0.00075 w
TxPower	0.00175 w
Initial Energy	10 j
Sleep Energy	0.00005j

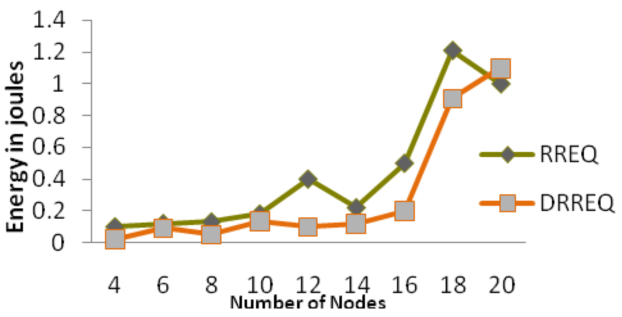

Fig.3: Comparison Of Energy Consumption for RREQ and DRREQ

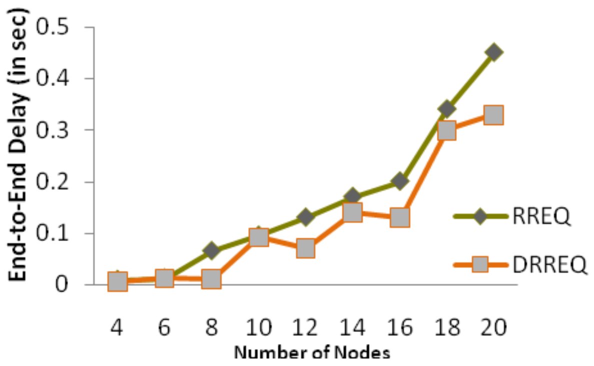

Fig.4: Comparison Of End-to End delay for RREQ and DRREQ

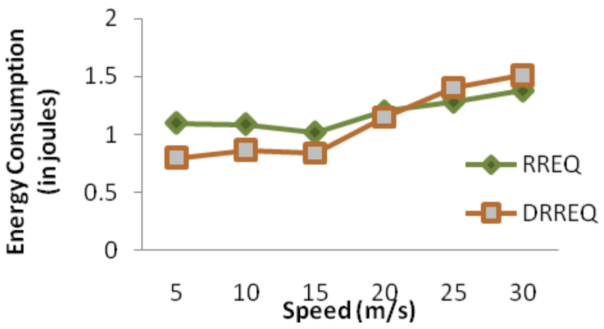

Fig.5: Energy consumption vs speed for RREQ and DRREQ

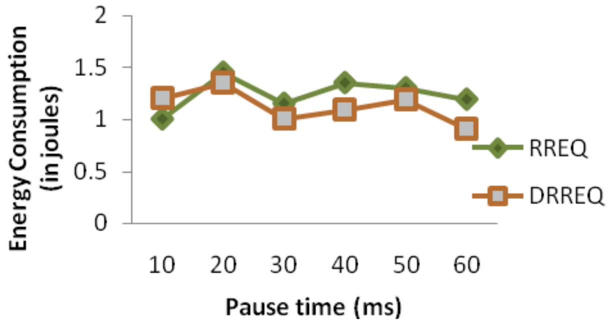

Fig.6: Energy consumption vs pause time for RREQ and DRREQ

Conclusion

In this article, we presented a new technique of RREQ which combine two mathematical approaches; Dichotomy and Probability, used to minimize the energy consumption in the RREQ mechanism frequently used in popular protocols like AODV and DSR in Wireless Ad hoc Network. The Results shows an improvement in saving energy and delay compared to the classic protocols. The future work will consist to restrict the angle of directional antenna to multiple parts and to analyze the performance of nodes in the same metrics in mobile Ad hoc Networks.

References

[1] Yoav Sasson David Cavin Andr´e Schiper, "Probabilistic Broadcast for Flooding in Wireless Mobile Ad hoc Networks" Wireless Communications and Networking, 2003. WCNC 2003. 2003 IEEE.

[2] Ch. Balaswamy, " An Energy Efficient Routing Protocol based on Periodic Route Discovery for Mobile Ad Hoc Networks", International Journal of Next-Generation Networks (IJNGN) Vol.3, No.1, March 2011.

[3] Carlos Henrique Pereira Augusto and Jos´e Ferreira de Rezende "Distributed Broadcast Scheduling in Mobile Ad Hoc Networks " Ad Hoc Networking Workshop (Med-Hoc-Net), 2010 The 9th IFIP Annual Mediterranean.

[4] Romit Roy Choudhury , Nitin H. Vaidya, "Performance of ad hoc routing using directional antennas", ELSEVIER, Ad Hoc Networks 3 (2005) 157–173.

[5] Bani-Yassein M, Ould-Khaoua M, Mackenzei LM, Papanastasiou S. Performance analysis of adjusted probabilistic broadcasting in mobile ad hoc networks. Int J Wireless Inform Networks 2006;13(April):127–40.

[6] LIU Wang-gui, QU Zhao-wei, "Scheme for on-demand route protocol in Ad-hoc networks",ELSEVIER September 2008, 15(Suppl.): 41–45

[7] Chen Hongsong, Ji Zhenzhou, Hu Mingzeng, Fu Zhongchuan , Jiang Ruixiang," Design and performance evaluation of a multi-agent-based dynamic lifetime security scheme for AODV routing protocol", Journal of Network and Computer Applications 30 (2007) 145–166

[8] Swapnil Shukla, "An Adaptive Probabilistic Routing Algorithm"thesis of INDIAN INSTITUTE OF TECHNOLOGY, KANPUR, May 2005.

[9] Jamal-Deen Abdulai, Mohamed Ould-Khaoua, Lewis M. Mackenzie, "Adjusted probabilistic route discovery in mobile ad hoc networks", Computers and Electrical Engineering 35 (2009) 168–182.

[10] Zhang Q, Agrawal DP. Performance evaluation of leveled probabilistic broadcasting in MANETs and wireless sensor networks. Trans Soc Modell Simul Int 2005;81(August):533–46.

[11] Wang-gui, QU Zhao-wei, "Scheme for on-demand route protocol in Ad-hoc networks" School of Computer Science and Technology, Beijing University of Posts and Telecommunications, Beijing 100876, China, ELSIVIER September 2008, 15(Suppl.): 41–45.