Impact of CBR Traffic on Energy Consumption in MANET

Mr. Shridhar Kabbur1*, Dr. G.F. Ali Ahammed2 Dr. Rashma Banu3
1*Department of Electronics and Communication, Global Academy of Technology, Bengaluru
2 Department of Computer Science and Engineering, VTU Regional Center, Mysuru
3 Department of Information Science and Engineering, GSSSIETW, Mysuru

Abstract: Mobile Ad hoc networks (MANETs) are power constrained since nodes are operated with limited battery supply. If a battery of the node drains, its ability to forward the traffic gets affected results in reduced network lifetime. There has been considerable progress in the battery technology, but not in par with the semiconductor technology. There are various techniques adopt different approach to achieve energy efficiency. The proposed approach uses a cost metric for path selection, which is a function of residual battery and current traffic load at a node. The simulation has been carried out using QualNet simulator. The performance is based on average energy consumption for varying CBR applications.

Keywords: MANET, CBR, network lifetime, QualNet

1. INTRODUCTION

In Mobile Ad Hoc networks (MANET), routing is a major concern as the nodes are battery operated. Multipath routing approaches [8] are being introduced to overcome the limitation of single path routing. The paths chosen can be link disjoint or node disjoint. Node disjoint paths have no common nodes except source and destination. Link-disjoints have no common links but can have common nodes. Multipath approaches have several benefits such as higher utilization of bandwidth, lower end-to-end delay and higher network lifetime. It also provides load balancing by forwarding the traffic through multiple paths. An energy aware multipath routing protocol provides a tradeoff between energy consumption and other metrics, such as link reliability, network capacity, throughput and end-to-end delay. Many of the energy efficient techniques minimize the energy consumption by selecting energy efficient path. However, when some nodes on the path forward large amounts of traffic.

2. Related Work.

In Minimum Energy Routing (MER) authors [10] described that a node consumes the minimum amount of energy to get the packet to the destination with the knowledge of cost of the link. MER has higher routing overhead, but consumes minimum energy. AODV Multiple alternative Paths (AODV-MAP) [2] is another variant of AODV. It considers both fail-safe paths and disjoint path. The main idea of the protocol is to find more number of alternate paths. Scalable Multipath On-demand Routing (SMORT) [3] is a multipath routing protocol based on AODV [5]. It minimizes the routing overheads by using fail-safe paths instead of node-disjoint and link-disjoint
paths. AOMDV [4] is one of the extensions of AODV [7]. It searches the paths without loop and link-disjoint paths.

3. Energy Efficient Routing Protocol

The proposed scheme describes route cost metric, technique to minimize node over utilization and computation of transmission power.

3.1 Route Cost Metric:

The lifetime of a node is based on cost function includes Residual Battery (RB) power and Energy Consumption rate (EC). Let the energy consumption rate of a node $u$ at time $t$ is $CR_u(t)$ and its residual battery be $RB_u(t)$. Let $LT_u(t)$ be the lifetime of a node $u$ at time $t$ is given by Equation [1].

\[ LT_u(t) = \frac{RB_u(t)}{CR_u(t)} \]  

(1)

The energy consumption rate $CR_u(t)$ is given by Equation [2].

\[ CR_u(t) = (1-\eta) \times CR_{old} + \eta \times CR_{new} \]  

(2)

Where $CR_{old}$ and $CR_{new}$ represents the last and newly calculated value of energy consumption rate respectively $\eta (< 1)$ is a weight function.

3.2 Minimizing Node Overutilization:

A critical node may exhaust battery and die due to the heavy traffic. This affects and reduces the network lifetime. A node drops RREQ packets if the connection request between source-destination exceeds the limit and reset the connection limit to that destination to one for the critical node requirement. Thus the node will forward subsequent RREQ packets for the connection establishment.

3.3 Computation of Transmission Power:

A node calculates its transmission power for data packets based on next-hop node’s location and mobility pattern. A node $u$ compute the required transmission power to reach the next node $v$ is given by Equation [3].

\[ Tx = (D + \Delta)^\beta + C \]  

(3)

Where $D$ is the Euclidean distance between $u$ and $v$. $\Delta$ is the expected variance of distance between $u$ and $v$ considering the mobility. $\beta$ is the path loss exponent with $2 \leq \beta \leq 4$ and $C$ is a constant. Expected variance is given by Equation [4]

\[ \Delta = (Current_{time} - Reply_{time}) \times S_N \]  

(4)

Where $Current_{time}$ is the time at which node $u$ is computing its transmission power, $Reply_{time}$ is the time at which node $u$ has received the RREP packet from node $v$, $S_N$ is the speed of node $v$. 

4. Simulation Parameters and Results

We have evaluated the scenario with 60, 80 and 100 nodes for 30 CBR applications using Qualnet 4.5 simulator. The simulation parameters are as shown in the table 1 and the scenario in Fig [1].

![Simulation Scenario](image)

**Table 1: Simulation Parameters**

| Simulation Parameters   | Parameter Values |
|-------------------------|------------------|
| Simulation Time         | 120 Minutes      |
| Terrain-Dimension       | 1500 X 1500 m²   |
| Traffic Type            | CBR              |
| Mobility model          | Random Waypoint  |
| Speed                   | 0 - 10 m/s       |
| Pause time              | 30 second        |
| Radio type              | 802.11b          |
| Propagation limit       | -111 dBm         |
| Receiver sensitivity    | -89              |
| Data rate               | 2 Mbps           |
| Packet size             | 512 bytes        |
| Battery model           | Linear           |
| Initial battery capacity| 300 mAh          |

The plots of average energy consumption for different node densities with varying CBR connections in transmit, receive and idle modes are as shown in figures [3] to [10].

![Average Energy Consumption](image)

Fig 2: 60 nodes with 30 CBR traffic in transmit mode.
Fig 3: 60 nodes with 30 CBR traffic in receive mode.

Fig 4: 60 nodes with 30 CBR traffic in idle mode.

Fig 5: 80 nodes with 30 CBR traffic in transmit mode.

Fig 6: 80 nodes with 30 CBR traffic in receive mode.
It is observed that the average energy consumption is low when the number of CBR connections are less in transmit mode. The number of RREQ packets increases as the CBR is increased results in increased energy consumption at the receiver. In idle mode, all the nodes consume energy while
sensing the channel. When the connection limit is increase, less number of nodes will be in idle mode and energy consumption decreases.

5. Conclusion

In this paper we have used route cost metric based on residual battery power for the path selection for the efficient routing which avoids node overutilization. As the CBR traffic is increased, battery gets drained results in reduced network lifetime.

References

[1] M. Tarique, K. E. Tepe, S. Adibi, and S. Erfani, “Survey of multipath routing protocols for mobile ad hoc networks,” Journal of Network and Computer Applications, vol. 32, no. 6, pp. 1125–1143, 2009.
[2] B. Vaidya, J. Pyun, J. Park, and S. Han, “Secure multipath routing Scheme for mobile ad hoc network,” Third IEEE International Symposium on Dependable, Autonomic and Secure Computing, IEEE, pp.163–171, 2007.
[3] L. Reddeppa Reddy and S. Raghavan, “Scalable multipath on demand routing for mobile ad hoc networks,” Ad Hoc Networks, vol. 5, no. 2, pp. 162–188, 2007.
[4] M. K. Marina and S. R. Das, “Ad hoc on-demand multipath distance Vector routing,” Wireless Communications and Mobile Computing, vol. 6, no. 7, pp. 969–988, 2006.
[5] C. E. Perkins and E. M. Royer, “Ad-hoc on-demand distance vector routing,” Second IEEE Workshop on Mobile Computing Systems and Applications, pp. 90–100, 1999.
[6] P. Periyasamy and E. Karthikeyan, “Survey of current multipath routing Protocols for mobile ad hoc networks,” International Journal of Computer Network and Information Security (IJCNIS), vol. 5, no. 12, p. 68, 2013.
[7] C. Perkins, E. Belding-Royer, S. Das et al., “Rfc 3561-ad hoc on demand Distance vector (aodv) routing,” Internet RFCs, pp. 1–38, 2003.
[8] M. Tarique, K. E. Tepe, S. Adibi, and S. Erfani, “Survey of multipath Routing protocols for mobile ad hoc networks,” Journal of Network and Computer Applications, vol. 32, no. 6, pp. 1125–1143, 2009.
[9] N. K. Ray, “Techniques to enhance the lifetime of mobile ad hoc Networks,” Ph.D. dissertation, 2013.
[10] Mohammed M. Energy,” efficient location aided routing protocol for Wireless MANETs” (IJCSIS) International Journal of Computer Science and Information Security Vol. 4, No. 1 & 2, 2009.

Mr. Shridhar Kabbur received his M.E degree from Gulbarga University and presently pursuing Ph.D in VTU, Belagavi, Karnataka. He is currently working as an Associate Professor in the Dept of Electronics and communication Engg. Global Academy of Technology, Bengaluru. His research interests are Wireless Communication and FPGA implementation.
2) **Dr. G.F. Ali Ahammed** obtained his Ph.D from Sri Krishna Devaraya University, Ananthpur, Andhra Pradesh. He is working as an Associate Professor in the Dept of Computer science and Engineering, P.G Center, VTU, Mysuru. His research areas are wireless Communication, Computer Networking, Cloud Computing.

3) **Dr. Reshma Banu** working as an Associate Professor & HOD in the Department of Information Science & Engineering at GSSS Institute of Engineering and Technology for women, Mysuru. She is having 14 years of Teaching and Research Experience. She pursued Ph.D., Computer Science & Technology, from Sri Krishna Devaraya University, Andra Pradesh, India. Currently Nominated as Coordinator for implementation of ICT initiative’s to VTU from GSSSIETW, Mysuru. She has published several Research papers in International, National Journals / conferences. She is a Member of various Professional bodies (CSI, IAENG, IBM Academic Initiative, and LM ISTE). Dr. Reshma Banu’s area of interest and research include Networking, Performance enhancement algorithms, Cloud Computing, cryptography and Communication. Serving as a Reviewer, Organizing Chair, Editorial Board Member and session chair for various National and International Conferences (IEEE Elsevier). She has won the Young Scientist Award from VIRA-2016 for the Initiatives, Discoveries and Developments in the discipline of Wireless Communication Networks.