Journal of
Data Acquisition and Processing
ISSN: 1004-9037
https://sjcjycl.cn/
DOI: 10.5281/zenodo.777519

MACHINE LEARNING BASED ENERGY EFFICIENT ROUTING PROTOCOLS ANALYSIS FOR MOBILE AD-HOC NETWORKS

[1] **Mrs. Ashwini V. Biradar,** [2] **Dr. Sharanabasappa C Gandage**
Department of Computer Science and Engineering
[1] Research Scholar, Dr. A. P. J. Abdul Kalam University, Indore
[2] Research supervisor, Dr. A. P. J. Abdul Kalam University, Indore

ABSTRACT

Without the aid of centralized administration or specific support services, a group of wireless mobile hosts form a temporary network under the name Mobile Ad-hoc Network (MANET). Consumption of energy is the most important problem in MANETs because a majority of mobile hosts rely on limited battery resources. The lifespan and throughput of the network increase as a result of lower energy use. Regarding concerns with energy conservation, the effectiveness of existing techniques is lower. This study combines a proactive MANET routing technology with an energy consumption approach to get around these restrictions. The nodes' mobility and level of energy both affect the routing protocol. Route discovery in AODV routing is carried out via the flooding approach, which involves broadcasting route request (RREQ) packets to all nodes within a sender's transmission range. Packet collisions and network congestion frequently result from the unneeded re-transmission of RREQ packets and the reply (RREP) packets generated in response. We have suggested an optimized route-discovering mechanism for AODV in this project. The essential concept is to choose the best cluster of RREQ packet forwarders using the K-Means clustering algorithm rather than broadcasting. This method's goal is to lessen network congestion and end-to-end delay by decreasing the delivery of unneeded control packets.
Keywords: *Mobile ad-hoc network, K-Means Clustering, Machine Learning, Clustering, Ad-hoc on demand distance vector etc.*

1. Introduction

Among the most recently created aspects of wireless communication is the Mobile Ad-Hoc Network (MANET). There is no requirement for established infrastructure, unlike conventional wireless networks. As a result, there are no preloaded routers that can, for example, forward packets from one host to another. Known variously as a mobile packet radio network or a mobile multihop wireless network, a mobile ad hoc network (MANET) is a novel way to deliver services in these circumstances. Ad hoc, which typically refers to something made on the spot out of whatever is readily available, here refers to a lack of infrastructure. Physically, a mobile ad hoc network is made up of a number of mobile hosts that are spread out geographically and share a radio channel. As these hosts communicate with one another, the network is built "on the fly." Instead, network participants—also referred to as mobile nodes—must perform this function. Each of those nodes assumes equal roles, allowing them to all function as both hosts and routers. In terms of both the features of the transmission medium and the routing protocols, cluster-based routing offers a method to reduce the shortcomings of MANETs.[1] The primary principle underlying clustering algorithms is the hierarchical organization of the network into groups of overlapping clusters. Each cluster has a node designated as the cluster head, which is chosen based on one or more specific criteria, such as mobility, power, and density. Using clustering techniques, pathways between clusters can be recorded in place of nodes. Each mobile node in a MANET has an antenna-based wireless transmitter and receiver.

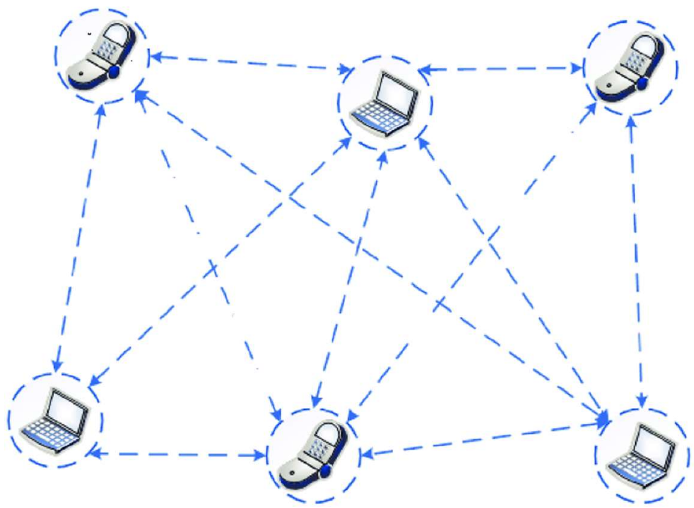

Figure 1. General structure of MANET

Figure 1 shows the general architecture of the MANET. Within the boundaries of their wireless transmission range, nodes can speak with one another directly. Due to factors including signal fading, noise, and finite battery power, wireless networks have much lesser capacity and transmission range than their tethered counterparts. As a result, it may take several hops for one node to send data across the network to another. [2] Each node must therefore be able to function both as a host and a router. Individual nodes distribute and perform packet forwarding, routing, and other network functions.

2. AODV Routing Protocol and Route Discovery Process

Ad-hoc On-Demand Distance Vector Routing (AODV) is a distance vector routing protocol that was first proposed in 1999 and is based on the Destination-Sequenced Distance Vector Algorithm (DSDV) and DSR. It is the most well-liked routing protocol for ad hoc networks and has received much study attention from numerous academics for a wide range of network topologies and conditions. The most recent iteration of AODV was suggested as an experimental routing system for ad hoc networks by IETE in July 2003.Since AODV is purely on-demand, a route is only found when it is needed by a source node.

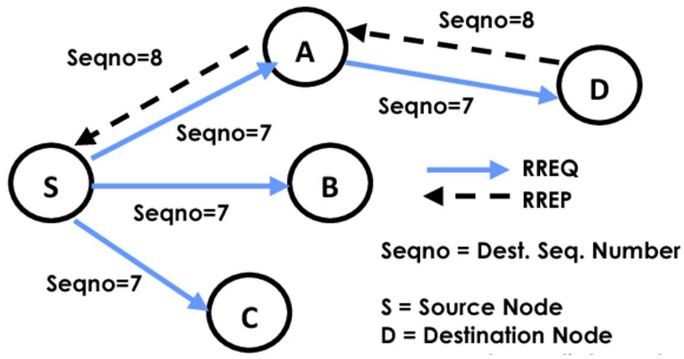

Figure 2. Traditional Method of AODV Route Discovery

When a source node needs to deliver data packets to a destination, it first looks to see if it already has a working route there in the routing table (structure shown in 3.11). If not, a path to the target is discovered by the node via route discovery. The source node first generates an RREQ packet. The RREQ packet contains the destination node's IP address, its most recent sequence number, its own IP address, its current sequence number, and a hop count that is set to zero. It is set to 0 if the source node is unaware of the destination's sequence number. Additionally, each node has an RREQ ID, which is a distinct and increasing number. Additionally, every node has an RREQ ID, which is a special number that is increased each time a node delivers a route request. This RREQ ID appears in the Each route request sent by the originating node is identified by an RREQ packet. The RREQ packet is broadcast to the neighbors by the originating node. A node adds a reverse route entry in its routing database for the source node and (if relevant) the neighbor node from which it received the request after first increasing the hop count value in the RREQ packet. If the intermediate node later receives an RREP packet, it can use this reverse route to send the packet to the source node. If the source is either the destination or has a "fresh enough" route to the destination, the node sends an RREP packet to the source after building the reverse route. If not, it simply repeats the RREQ packet to its nearby neighbors. Nodes are not required to maintain routes or reserve unused bandwidth. To reduce control overhead, AODV does away with routine routing updates and only propagates the information that is actually required. Processing overhead is minimal because it requires little computing and is relatively straightforward. As a result, AODV is ideal for routing with limited capacity.

3. Machine Learning approach for Improving Mobile Ad-Hoc Networks Routing protocols

In this section, there is a discussion on how we have used machine learning to solve problems with ad hoc networks and other MANET protocols.[1] The numerous machine learning techniques for usage in wireless ad hoc networks are explained, identifying the necessary requirements, rewards, and indicating their location. Additionally, the most significant recent and ongoing research in this area is evaluated in this chapter. The quality of the accessible mechanism is evaluated. Machine learning relies on input, such as training data or knowledge graphs, to comprehend things, domains, and the connections between them, much to how the human brain acquires information and understanding. Entities must be defined before deep learning can start. The first step in machine learning is observation or data, such as examples, first-hand knowledge, or instructions. It searches for patterns in the data so that it can later draw conclusions from the supplied instances. The main goal of ML is to make it possible for computers to learn on their own, without aid from humans, and to adapt their behavior accordingly. In order to anticipate future events, supervised machine learning algorithms use labeled examples to apply what they have learned in the past to fresh data.

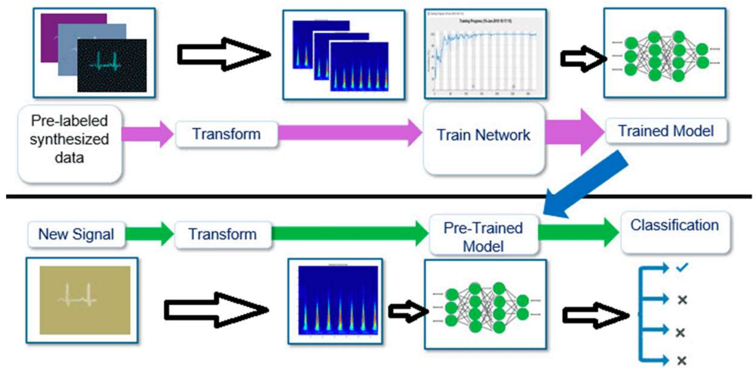

Figure 3. Machine Learning approach in Mobile Communication

The learning method creates an inferred function to forecast output values by examining a known training dataset. After adequate training, the system may provide targets for any new input. In order to identify flaws and correct the model as necessary, it can also compare its output with that which is proper and intended. Algorithms for reinforcement learning [17] interact with their surroundings by taking actions and identifying successes or failures. Trial-and-error learning and delayed rewards are two of reinforcement learning's most important features. With the help of this technique, machines and software agents may automatically select the best course of action in a given situation to enhance performance. The reinforcement signal, which is a straightforward reward feedback, is necessary for the agent to figure out which action is better.

4. Experimental Setup and Results

The flooding strategy used in AODV routing entails broadcasting route request (RREQ) packets to all nodes within a sender's transmission range in order to carry out route discovery. Frequently, the unnecessary retransmission of RREQ packets and the reply (RREP) packets sent in response causes packet collisions and network congestion. In this project, I have recommended an improved route-discovering method for AODV. The key idea is to use the K-Means clustering technique [18] to select the optimal cluster of RREQ packet forwarders rather than broadcasting. In order to reduce network congestion and end-to-end delay, this strategy reduces the delivery of extra control packets. ns3.35 is used to simulate the network.

The following features are employed in K-Means clustering:

- transmission error rate,
- distance to destination
- available buffer room

These characteristics of the neighbors are used to select the best cluster. Clusters are assessed by comparison to an ideal forwarder with the following characteristics.

- Maximum buffer size = free buffer space
- distance to destination = Zero
- number of transmission errors = Zero
- Number of nodes : 10, 20, 30, 40, 50
- Number of packets per second : 10, 20, 30, 40, 50

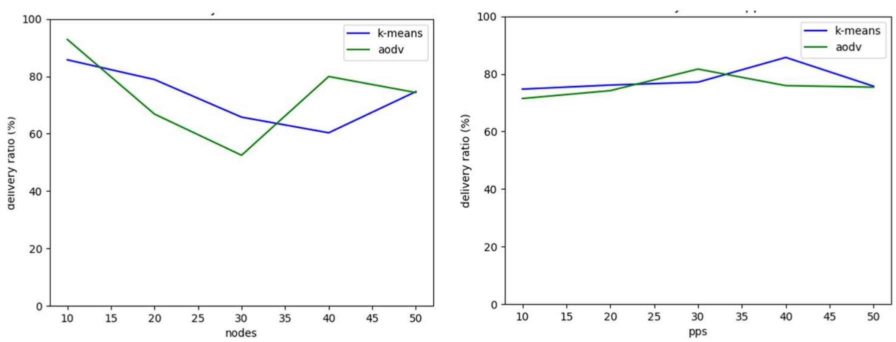

Figure 4. K-Means and AODV a) Delivery Ratio Vs Node b) Delivery Ratio Vs pps

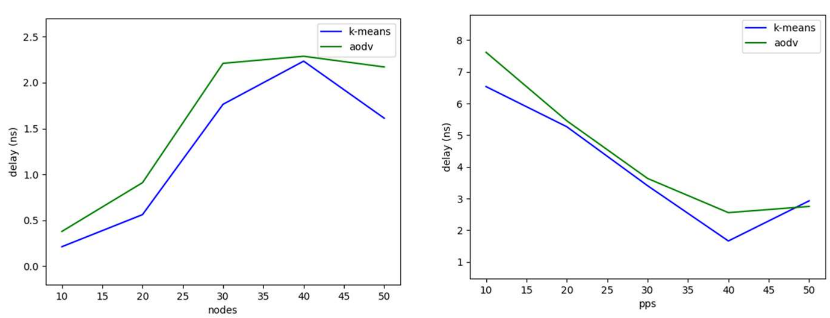

Figure 5. K-Means and AODV a) Delay Vs Node b) Delay Vs pps

The statistics show that the updated algorithm's delivery ratio is marginally lower than AODV. However, given that the updated approach employs a somewhat lower number of forwarders for route identification, the difference in delivery ratio is not particularly noteworthy. On the other hand, we can see that the updated technique has a far lower end-to-end delay than utilizing solely AODV. This is because the improved technique uses less RREQ and RREP packets, which speeds up the route finding process. Therefore, even if selective forwarding utilizing K-Means clustering lowers the delivery ratio slightly, the updated strategy shortens the network's end-to-end delay.

5. Conclusion and Summary

The proposed work will include a demonstration of the use of k-Means machine learning method, which is basically a clustering technique. This section describes the conclusion of the proposed energy conservation mechanism. The energy is calculated based on the prediction of the energy consumption level of the node. The energy computation method is performed using the K Means clustering along with the AODV routing with optimization by selecting the shortest path in the network. In this study, we provide an enhanced AODV route-discovery mechanism. The basic concept is to avoid broadcasting by choosing the best cluster of RREQ packet forwarders using the K-Means clustering technique. By limiting the delivery of unnecessary control packets, this method lessens network congestion and end-to-end delay.

References

[1] S.Y. Han and D. Lee, "An adaptive hello messaging scheme for neighbor discovery in on-demand MANET routing protocols", IEEE communications letters, Vol.17, No.5, pp.1040-1043, 2013.

[2] S.K. Das and S. Tripathi, "Energy efficient routing protocol for manet based on vague set measurement technique", Procedia Computer Science, Vol.58, pp.348-355, 2015.

[3] S. Jamali, L. Rezaei, and S.J. Gudakahriz, "An energy-efficient routing protocol for MANETs: a particle swarm optimization approach", Journal of applied research and technology, Vol.11, No.6, pp.803-812, 2013.

[4] K. Tamizarasu and M. Rajaram, "An AODVbased Clustering Approach for Efficient Routing in MANET", International Journal of Computer Applications, Vol.51, No.15, 2012.

[5] H. Shen and L. Zhao, "ALERT: an anonymous location-based efficient routing protocol in MANETs", IEEE transactions on mobile computing, Vol.12, No.6, pp.1079-1093, 2013.

[6] M. Uddin, A. Taha, R. Alsaqour, and T. Saba, "Energy Efficient Multipath Routing Protocol for Mobile ad-hoc Network Using the Fitness Function", IEEE access, Vol.5, pp.10369- 10381.

[7] G. Singh, N. Kumar, and A.K. Verma, "Antalg: An innovative aco based routing algorithm for manets", Journal of Network and Computer Applications, Vol.45, pp.151-167, 2014.

[8] S. Chettibi and S. Chikhi, "Dynamic fuzzy logic and reinforcement learning for adaptive energy efficient routing in mobile ad-hoc networks", Applied Soft Computing, Vol.38, pp.321-328, 2016. [9] W. Liu and W. Kim, "A stability-considered density-adaptive routing protocol in MANETs", Journal of Systems Architecture, Vol.59, No.9, pp.767-775, 2013.

[10] R.M. Kuchaki and H. Fatemidokht, "FBeeAdHoc: A secure routing protocol for BeeAdHoc based on fuzzy logic in MANETs", AEU-International Journal of Electronics and Communications, Vol.69, No.11, pp.1613-1621, 2015.

[11] S.A. Ade and P.A. Tijare, "Performance comparison of AODV, DSDV, OLSR and DSR Received: November 15, 2018 133 International Journal of Intelligent Engineering and Systems, Vol.12, No.2, 2019 DOI: 10.22266/ijies2019.0430.13 routing protocols in mobile ad hoc networks", International journal of information technology and knowledge management, Vol.2, No.2, pp.545-548, 2010.

[12] P.F.A. Selvi and M.S.K. Manikandan, "Ant based multipath backbone routing for load balancing in MANET", IET Communications, Vol.11, No.1, pp.136-141. 2017

[13] R.C. Biradar and S.S. Manvi, "Neighbor supported reliable multipath multicast routing in

MANETs”, Journal of Network and Computer Applications, Vol.35, No.3, pp.1074-1085, 2012.

[14] S. Gopinath and N. Nagarajan, “Energy based reliable multicast routing protocol for packet forwarding in MANET”, Journal of applied research and technology, Ant based multipath backbone routing for load balancing in MANET, Vol.13, No.3, pp.374-381, 2015.

[15] J. Sathiamoorthy and B. Ramakrishnan, “Design of a proficient hybrid protocol for efficient route discovery and secure data transmission in CEAACK MANETs”, Journal of Information Security and Applications, Vol.36, pp.43-58, 2017.

[16] R.M. Nareshkumar, S. Phanikumar, and M.K. Singh, “Intelligent Routing in MANET Using Self-Adaptive Genetic Algorithm”, In: Proc. of International Conf. On Advances in Systems, Control and Automation, Springer, Singapore, pp.595-603, 2018.

[17] Sutton, R.S., Barto, A.G.: “Reinforcement Learning”, Second edition, in progress, MIT Press (2014).

[18] Bandani Anil Kumar, Makam Venkata Subramanyam, Kodati Satya Prasad, “An Energy Efficient Clustering Using K-Means and AODV Routing Protocol in Ad-hoc Networks”,International Journal of Intelligent Engineering and Systems, Vol.12, No.2, 2019

[19] Danthala, S. W. E. T. H. A., et al. "Robotic manipulator control by using machine learning algorithms: A review." *International Journal of Mechanical and Production Engineering Research and Development* 8.5 (2018): 305-310.

[20] Durgabai, R. P. L., and P. Bhargavi. "Pest management using machine learning algorithms: a review." *International Journal of Computer Science Engineering and Information Technology Research (IJCSEITR)* 8.1 (2018): 13-22.

[21] Pavani, Movva, and P. Trinatha Rao. "Routing protocols in wireless sensor networks: A survey." *International Journal of Computer Networking, Wireless and Mobile Communications (IJCNWMC)* 6.2 (2016): 1-12.

[22] Jain, R. A. C. H. N. A., and I. N. D. U. Kashyap. "An efficient energy aware link stable routing protocol in MANETS." *International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)* 8.3 (2018): 623-634.

[23] Choudhary, Vicky, and Karan Mahajan. "Upgraded Deterministic Energy Efficient Clustering Protocol for Wireless Sensor Network." *International Journal of Computer Networking, Wireless and Mobile Communications (IJCNWMC)* 4 (2014): 1-6.

[24] Sutariya, Dharmendra. "Performance evaluation of multicast routing protocols in mobile ad hoc networks." *proceedings of International Journal of Computer Networking, Wireless and Mobile Communications (IJCNWMC)* 6.2 (2016): 45-54.