



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 Issue: V Month of publication: May 2019

DOI: <https://doi.org/10.22214/ijraset.2019.5368>

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Overview of Power Efficient Routing in Wireless Ad-Hoc Networks

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Abstract: The wireless ad hoc network is a fast-deployment, infrastructure-free, self-organizing network that is ideally suited for applications involving special outdoor events, communications in regions that have not infrastructure, natural disasters and military operations. Routing is one of the main issues of the in such networks because of their very dynamic and distributed nature. In particular, energy-efficient routing is the most important design criterion for ad-hoc networks since wireless nodes will be powered by limited-capacity batteries. The power outage of a mobile node affects not only the node itself but also its ability to transfer packets on behalf of others and thus the overall lifetime of the network. The paper focuses on reviewing the work done in the routing of energy efficiency in the wireless ad-hoc networks.

Keywords: ad-hoc networks, routing , energy efficiency ,battery power, mobile.

I. INTRODUCTION

The ad-hoc wireless network is a collection of two or more devices equipped with communication and wireless network capabilities. Wireless ad hoc network is a communication network in which all nodes are mobile and communicate with each other via wireless connections. Nodes can join or leave the network at any time and they communicate with each other that are immediately in their radio range and communication beyond that range is established by using intermediate nodes to set up a path Hop-by-hop access. There is no fixed infrastructure. There is no need for fixed radio base stations, wires or fixed routers. All nodes are equal and there is no centralized control or overview that is that it is self-organizing and adaptive. This means that a trained network can be de-trained on the fly without the need for a system administration. There are no designated routers: all nodes can serve as routers for each other, and data packets are transferred from node to node in a multi-hop mode. Because of the presence of mobility, the routing information will need to change to reflect changes in link connectivity. The diversity of mobile ad hoc devices also implies that the battery capacity of these devices will also vary. Because ad hoc networks are based on the transmission of packets of data sent by other nodes, energy consumption becomes a critical problem. The characteristics of the ad hoc wireless network are represented in table 1.

II. ROUTING MECHANISM

Routing is the process of selecting paths in a network along which to send important data. Routing is one of the most important challenges in ad hoc networks to develop support for routing is essential for the basic operation of the network. A routing mechanism specifies how routers communicate with each other, disseminating information that allows the Protocol to select routes between two nodes of the network, with the choice of the route being done by algorithms of Routing. Mobility in the mobile ad hoc network that is nodes in an ad hoc network are allowed to move in an uncontrolled way which translates into a very dynamic network with rapid topological changes causing frequent failures of Routing.

Table 1: Ad-hoc networks: Characteristic and Challenges

Characteristic of Ad-hoc networks	Challenges of Ad-hoc networks
Dynamic Topologies	Spectrum Allocation
Asymmetric link characteristic	Media Access
Multi-hop Communication	Routing
Decentralized Operation	Multicasting
Bandwidth constrained variable capacity link	Energy efficiency
Energy constrained operation	Security and privacy

Thus, a perfect routing mechanism for the mobile ad hoc network environment must dynamically adapt to the changing network topology. The channels in the wireless network provide much lower and more variable bandwidth as compared to wired networks. Wireless channels work as a shared medium in the wireless network. This channel makes the bandwidth available per mobile node

even weaker. Thus, a perfect routing mechanism should be efficient in bandwidth by delimiting a minimum overhead for compute routes so that much of the remaining bandwidth is available for actual data communication. The nodes in the mobile ad hoc network operate on batteries that have a limited power supply. For nodes to stay and communicate for longer periods, it is desirable that a routing mechanism also be energy-efficient.

A. Routing in MANET is a dynamic optimization task for providing paths that are

- 1) Optimum in terms of criterion (e.g. minimum distance, maximum bandwidth, shortest delay)
- 2) Meet certain constraints (e.g., limited power of mobile nodes, limited capacity of wireless links)

Routing mechanisms use multiple metrics to calculate the best way to route packets to its destination. These metrics are a standard metric that can be the number of hops, which is used by the routing algorithm to determine the optimal path for the packet to its destination.

B. *The Different Delivery Semantics For Routing In MANET Are As Follows*

- 1) *Unicast*: transmits a message to a single specific node within the transmission range
- 2) *Broadcast*: transmits a message to all nodes of the network in the transmission range
- 3) *Multicast*: sends a message to a group of nodes that have shown interest in receiving the message in the transmission range
- 4) *All cast*: sends a message to one of the node groups, usually the one closest to the source in the transmission range
- 5) *Geo cast*: transmits a message to a geographical area within the transmission range.

III. POWER EFFICIENCY IN THE WIRELESS AD-HOC NETWORK

Energy efficiency is a major issue of concern in wireless networks, because mobile nodes depend on batteries, which are limited energy sources, and, in many environments, it is quite a heavy task of replace or recharge them. Despite advances in battery technology, the lifespan of battery-powered devices continues to be a key challenge and requires further research into the efficient design of platforms, protocols and systems. Nodes within an ad hoc network are usually based on batteries (or exhaustive energy sources) for power supply. Since these energy sources have a limited lifespan, the availability of energy is one of the most important constraints for the operation of the ad hoc network. There are different sources of power consumption in a mobile node. Communication is one of the main sources of energy consumption. Since the rate of performance improvement of the battery is relatively slow at present, and in the absence of breakthroughs in this area, other measures must be taken to achieve the objective of achieving more performance on the resources batteries currently available. The types of energy consumption identified:

- A. Energy consumption when sending a package
- B. Energy consumption when receiving a packet
- C. Energy consumption in standby mode
- D. Energy consumption in standby mode that occurs when the wireless interface of the mobile node is disabled. 16, 17, 18

Devices used in mobile ad hoc networks require portability and as they are mobile, they also have size and weight constraints as well as restrictions on the power source. If the battery power is increased, it can make the knots bulky and less portable. Thus, energy efficiency remains an important design consideration for these types of networks. A major challenge that a routing mechanism designed for mobile ad hoc wireless network faces is resource constraints. Therefore, the mobile ad hoc routing mechanism must optimally balance these conflicting aspects.

IV. ENERGY OPTIMIZATION TECHNIQUES

As the wireless ad hoc network has no fix infrastructure, it follows the individual mobile node that relies on limited energy sources. Energy optimization is therefore an important issue in the ad hoc wireless network. Some of the power optimization schemes in MANET are listed below:

- 1) *Energy conservation by controlling transmission energy*: The main objective of power conservation is to reduce the total energy exhausted in packet transmission and increase the service life of the network by increasing the residual battery power.
- 2) *Energy conservation through energy management techniques*: Power management techniques are used to minimize power consumption of battery-powered wireless nodes. The main idea behind this scheme is to trigger the wireless nodes to low power mode which is the sleep mode from the high power node, when they are not in use that is either in idle mode or inactive mode.
- 3) *Conserve power using the energy aware routing mechanism*: The main purpose of the routing mechanism is to maximize power efficiency, network throughput, network life and minimize delays. The main distinguishing feature for energy aware routing

mechanisms is its use of energy for each route entry. It is given more than one route to a specific destination, a requesting node is needed to select one with the best state in terms of power of the node and more active. Thus, energy aware routing becomes the most useful problem in the ad-hoc networks because it has been proven with the best energy-saving techniques.

- 4) *Power saving at the mobile node:* the mobile nodes of MANET are all hardware devices. As they are hardware devices, they consume energy in standby mode also because TRANS receivers are hearing signals for it at all times. Much effort is needed to reduce energy consumption in all aspects of mobile nodes.

Now, from the discussion above, it is clear that energy can be consumed at different levels in MANET. The energy saving to the routing mechanism is much easier compared to the energy saving at the transmission level or at the level of the mobile nodes. Energy-conscious routing mechanisms are compared with the following energy efficiency metrics:

- a) *Relative routing overhead:* This is the ratio of the number of control packets to the number of packets of data delivered.
- b) *The delivery ratio:* This is the ratio of the number of packets delivered to the total number of packets sent.
- c) *End-to-end delay:* This is the average of delays between each pair of a communication session.
- d) *Normalized hops:* This is the ratio of the average number of hops to the optimal hop.
- 5) *Energy consumed per packet:* The selection of the minimum power path depends on which minimizes the sum of the cost of linking with the path.

V. CONCLUSION

Energy-efficient routing is an important issue in the ad-hoc networks. It is the need of hour for effective communication. The different characteristics and problems of the wireless ad-hoc networks are discussed here in the document. The deficiency of several protocols is the main object of this document. It is necessary to have an effective protocol to address the issue of mobility with an efficient use of battery power

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