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RESEARCH ARTICLE

Energy Efficient Routing Protocols in Mobile Ad hoc Network Based on Enhanced AODV Protocol

R. Rajeshkanna[1], S. Poorana Senthilkumar[2], C. Kumuthini[3]

[1]Department of Computer Applications, Dr. N.G.P College of Arts & Science, Coimbatore, India
[2]Department of Computer Applications, Dr. N.G.P College of Arts & Science, Coimbatore, India
[3]Department of Computer Applications, Dr. N.G.P College of Arts & Science, Coimbatore, India

[1] vishnurajeshkanna@gmail.com; [2] mail2pooranan@gmail.com; [3] kumuthini.vasanth@gmail.com

Abstract— A Mobile Ad-hoc Network (MANET) is a self-configuring network composed of mobile nodes without any fixed infrastructure. Energy efficiency is a major issue of concern in mobile ad hoc networks as mobile nodes rely on batteries, which are limited sources of power, and in several environments, it is quite a unwieldy task to replace or renew them. Energy is limited factor in case of Ad-hoc networks. The life of a node is directly relative to the battery in the instrument operating at the node. Maximize the use of energy and maximize the life of network is still the key challenge of Mobile Ad hoc network. Different routing protocols for mobile adhoc networks could be opposed depending upon the network design and the application. This paper presents an improved the energy conservation techniques using the enhanced AODV energy efficient routing protocols in MANETs. This EAODV protocol use energy optimal routes to reduce the energy consumption of nodes. Simulations are carried out using the NS2.

Key Terms: - Mobile Ad-hoc Network; On-demand Routing; Energy Efficient Routing; Routing Protocols; AODV

I. INTRODUCTION

Mobile ad-hoc networks can turn the vision of getting connected "anywhere and at any time" into reality. Recent advancements such as Bluetooth introduced a new type of wireless systems known as mobile ad-hoc networks. Mobile ad-hoc networks or "short live" networks operate in the absence of fixed infrastructure. Nodes in mobile ad hoc networks are constrained by limited battery power for their operation. Hence, energy efficiency is an important issue in adhoc networks.

The characteristics of mobile networks are summarized as follows:

- Communication via wireless means.
- Nodes can perform the roles of both hosts and routers.
- No centralized controller and infrastructure.
- Dynamic network topology. Frequent routing updates.
- Autonomous, no infrastructure needed.
- Can be set up anywhere.
- Energy constraints
- Limited security

Application Areas

Some of the applications of MANETs are

• Military or police exercises.
• Disaster relief operations.
• Mine site operations.
• Urgent Business meetings
• Robot data acquisition

Ex: Mobile Adhoc Network

Key challenges in Mobile Ad hoc networks are as follows:

- Limiting power supply
- Dynamically Changing Topology
- Limited Bandwidth
- Security
- Mobility-induced route change
- Battery constraints

II. ROUTING PROTOCOLS

Several routing protocols have been proposed for routing in MANET with the goal of achieving efficient routing. These algorithms differ in the approach used for discovering a new route and maintaining a identified route when node moves. The mobile ad hoc routing protocols may be categorized as proactive (table driven), reactive (On-demand) and hybrid routing protocols.

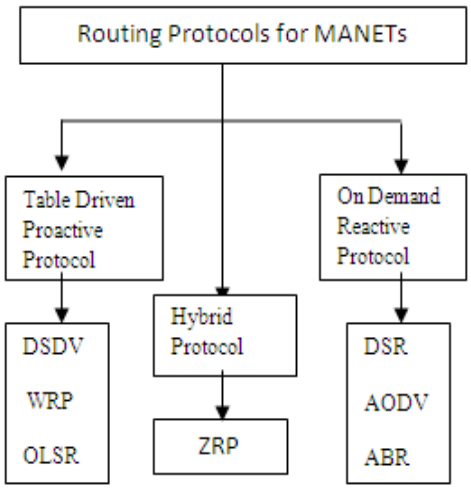

Figure 2.1. Different types of Routing protocols in MANETs

These algorithms are based on the some of the following areas:

- Keeping track of the residual battery power.
- Keeping track of the previously used paths.
- Keeping back-up paths.
- Keeping track of the message overhead.
- On-demand calculation/update of routing tables.
- Sending data packets at a lower energy compared with the RREP/RREQ.
- Moving the nodes to sleep mode when they are not being used.
- Requiring a node to send packets with energy proportional to the distance rather than with fixed energy.
- Using a hierarchical routing technique.
- Using directional antennas.
- Transmitting the data packets by taking into consideration the actual amount of energy required to transmit.

2.1 Proactive Protocols (Table Driven Routing Protocols)

The proactive protocols are maintained the routing information even before it is needed. Each and every node in the network maintains routing information to every other node in the network. Routes information is generally kept in the routing tables and is periodically updated as the network topology changes. Many of these routing protocols come from the link-state routing. There exist some differences between the protocols that come under this category depending on the routing information being updated in each routing table. DSDV, WRP and OLSR come under table driven protocols.

2.2 Reactive Protocols (On-Demand Routing Protocols)

The reactive protocols do not maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to another node then this protocol searches for route in an on-demand manner and establishes the connection in order to transmit and receive the packet. These protocols were designed to reduce the overhead encountered in proactive protocols by maintaining information for active routes only. This means that the routes are determined and maintained for the nodes that are required to send data to a particular destination. The route discovery usually occurs by flooding the route request packets throughout the network. DSR, AODV and ABR come under reactive protocols.

2.3 Hybrid Routing Protocols

Both of the proactive and reactive routing methods have some pros and cons. In hybrid routing a well combination of proactive and reactive routing methods are used which are better than the both used in isolation. It includes the advantages of both protocols. As an example facilitate the reactive routing protocol such as AODV with some proactive features by refreshing routes of active destinations which would definitely reduce the delay and overhead so refresh interval can improve the performance of the network and node. So these types of protocols can incorporate the facility of other protocols without compromising with its own advantages. Examples of hybrid protocols are Zone Routing Protocol (ZRP).

III. METHODOLOGY

Many research works has produced so much innovation and novel ideas in this field. We have discussed different reactive routing protocols based on AODV. Most of the work today is based on energy efficient routing because power is main concern in ad-hoc wireless networks. Each and every protocol has some advantages and shortcomings. None of them can perform better in every condition. It depends upon the network parameters which decide the protocol to be used.

3.1 Ad-hoc on demand Distance Vector Routing (AODV)

Ad-hoc on demand Distance Vector Routing (AODV) is a reactive routing algorithm, improvement over DSDV routing protocol algorithm. It minimizes the number of broadcasts by creating routes on-demand as opposed to all possible routes as in DSDV. This protocol checks the route table when source needs to transmit data. AODV is a loop- free, single path, distance vector protocol based on hop-by-hop routing approach. There are two main procedures in AODV:

1. Route discovery
2. Route maintenance

Route discovery: the route discovery process is begins when a source needs a route to a destination to send data. It checks its routing table to determine if it has a current route to the destination. If it has route, forwards the packet to next hop node otherwise it starts a route discovery process. Route discovery begins with the creation of a Route Request (RREQ) packet. Packet contains the following: Source node's IP address, Source node's current sequence number, Destination IP address, Destination sequence number, Broadcast ID number.

Broadcasting is done via flooding, and waits for a route reply (RREP). An intermediate node receiving a RREQ packet set a reverse route entry to the source in its rout table. Reverse route entry consists of: Source IP address, Source seq. number, number of hops to source node, IP address of node from which RREQ was received. When the destination node receives a RREQ, it also generates a RREP. The RREP is routed back to the source via the reverse path. As the RREP reaches to source, a forward route to the destination established.

Route maintenance: route maintenance is done using route error (REER) packets. A route is "expired" if not used recently. A set of predecessor nodes is maintained for each routing table entry, indicating a set of adjacent nodes that use that entry to route data packets. These nodes are notified with route error (RERR) packets when the next hop link breaks. Each predecessor node, in turn, forwards the RERR to its own set of predecessors, therefore, effectively erasing all routes using the broken link. Then this RERR is propagated to each source routing traffic through the failed link, causing the route discovery process to be reinitiated if routes are still needed.

Advantages of AODV

- The benefits of AODV protocol are that it favors the least congested route instead of the shortest route and it also supports both unicast and multicast packet transmissions even for nodes in constant movement.
- It also responds very quickly to the topological changes that affects the active routes.
- AODV does not put any additional overheads on data packets as it does not make use of source routing.

Limitations of AODV

- This approach is shortest-path specific and static, i.e. these algorithms keep on using the same path, without taking into consideration its energy impact on the network.
- It could be possible that the path taken by them might put the system into imbalance of energy levels in the network and might affect the connectivity of the network
- There is also a lot of wastage of energy, as RREQs and RREPs are sent a lot of unnecessary times.
- Potentially, very high overhead
- Data packets may be delivered to too many nodes who do not need to receive them
- Potentially lower reliability of data delivery
- Flooding uses broadcasting -- hard to implement reliable broadcast delivery without significantly increasing overhead

3.2 ENERGY EFFICIENT ROUTING ALGORITHMS FOR MANET

Energy Efficient Routing Algorithms are not just related to minimize the total energy consumption of the route but also to maximize the lifetime of each node in the network to increase the lifetime of the network. The main purpose of energy efficient algorithm is to maintain the network functioning as long as possible. In MANETs energy consumption is done in three states of the nodes which are transmitting, receiving and sleeping state. Nodes consume more energy while transmitting than in sleep state. Sleep state means nodes are idle, in which they neither transmit nor receive any signals. More energy can be saved by keeping more nodes in sleep state. The energy consumption of nodes should be minimized not only during the transmission but also during sleep state to accomplish the network functioning goal.

The metrics are as following:

- Minimize Energy consumed per packet: the most perceptive metric, however not optimal for maximum lifetime.
- Maximize Time to Network Partition: important or mission critical applications, hard to maintain low delay and high throughput concurrently.
- Minimize Variance in node power levels: balance the power consumption for all the nodes in the network i.e. all nodes in the network have the same significance.
- Minimize Cost per packets: try to maximize the lifetime of all the nodes.
- Minimize Maximum Node Cost: try to delay the node failures.

Minimizing Total Transmission Power

In the Proposed route request packet by adding some new variables, like data size, unstable nodes count, sum of neighbors and sum of buffered packets. A node is able to calculate its residual battery energy. The paths with stable nodes will be selected and the node's stability will be checked before it broadcast route request with the condition that it should not change certain rate of its neighbors in specific time. A node can broadcast the request packet only if it has more lifetime than the required time to send the packet. This way the nodes that have less energy are prevented from participation and the paths which have less unstable nodes, nodes with fewer neighbors and buffered packets are selected. The result shows that the proposed algorithm consumes lower energy and sends less number of request packets

Enhanced AODV

In the proposed an energy efficient algorithm, which is used for AODV. They used HELLO massages of AODV to calculate the difference between transmitting power and receiving power and which gives the value of propagation loss, slightly modified the original 32-bits destination sequence number field to a new 32-bit value, obtained from the source battery function in RREQ. The formatted HELLO RREP by reserving a field of (9 bits) for power loss level with 8 bit long length. This field is a power loss for specific link. As source is having all the information so it is easy to calculate the power loss by subtracting the received power from the transmitting power. The proposed an adaptive low battery alert mechanism to overcome the overuse of the firstly established route. They used 50% or 40% of the new battery capacity. The result shows that this algorithm can improve network lifetime in both static and mobile networks.

IV. CONCLUSION

In this Paper discussed about reactive routing protocol AODV and its modification which includes energy efficiency with the importance of energy efficient routing protocols. These AODV extensions increase the network survivability and lead to a longer battery life of the terminals. They achieve balanced energy consumption with minimum overhead. We conclude there is not a single protocol which can give the best performance in ad hoc network. Performance of the protocol varies according to the variation in the network parameters and ad hoc network properties continuously vary. So, the choice of the protocol is the basis to perform in a particular type of network. Sometimes the mobility of the node of the network is high and sometimes it is low but energy of the node is our prime concern.

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