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A Survey: Routing Protocols in MANETs

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ABSTRACT: Mobile ad hoc network is a collection of wireless nodes that can dynamically be set up anywhere and anytime to exchange information without using any pre-existing network infrastructure. It is a self organized and self configurable network where the mobile nodes move randomly. In MANETs mobile nodes can receive and forward packets as a router and each node operates not only as an end system, but also as a router to forward packets. There is no fixed infrastructure, which results in addition and exclusion of any number of nodes from the network for relatively small networks routing protocols may be sufficient. However, in larger networks either hierarchical or geographic routing protocols are needed. In this survey paper three routing protocols AODV (Ad- Hoc On-Demand Distance Vector), OLSR (Optimized Link State Routing Protocol) and DSR (Dynamic Source Routing Protocol) along with many other algorithms are described briefly.

I. INTRODUCTION

A network consists of two or more computers that are linked in order to share resources (such as printers and CDs), exchange files, or allow electronic communications. The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams**.** Networking is the practice of linking two or more computing devices together for the purpose of sharing data. Networks are built with a mix of computer hardware and computer software.

There are many types of computer networks, they can be distinguished based on many parameters and one such parameter is the way in which the nodes in network communicate with each other. Two major types of networks exist and they are wired networks and wireless networks.

Wireless networks are an emerging new technology that will allow users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two types: - infrastructure network and infrastructure-less (ad hoc) networks. Infrastructure network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the network (called base station) within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. This is called handoff. In this approach the base stations are fixed.

In contrast to infrastructure based networks, in ad hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network.

A Mobile ad hoc Network (MANET) is a self-configuring infrastructure-less network of mobile devices connected by wireless. Each device in a MANETs is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANETs is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. MANETs are a kind of Wireless ad hoc network that usually has a routable networking environment on top of a Link Layer ad hoc network. The applications include military services, sensor networks, rescue operations, students on campus and many more.

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In a MANETs, the router connectivity may change frequently, leading to the multi-hop communication paradigm that can allow communication without the use of Base Station/Access Point, and provide alternative connections inside hotspot cells. A dual-mode MS can operate in both the infrastructure (communicating directly to a BS or AP) and MANETs modes using the WLAN interface. A MANETs is a type of ad hoc network that can change locations and configure itself on the fly. All nodes in this network are mobile and they use wireless connections to communicate with various networks.

Routing is one of the core problems of networking for delivering data from one node to the other. Wireless ad-hoc networks are also called Mobile ad-hoc multihop networks without predetermined topology or central control. This is because MANETs can be characterized as having a dynamic, multihop, potentially rapid changing topology. The aim of such networks is to provide communication capabilities to areas with limited or no existing communication infrastructures. A MANETs is usually formed by mobile nodes using wireless communications. It uses a peer-to-peer multihop routing instead of a static network infrastructure to provide network connectivity.

Routing protocols for MANETs can be broadly classified into three main categories:-

1. **Proactive routing protocols**: - Every node in the network has one or more routes to any possible destination in its routing table at any given time.
2. **Reactive routing protocols**:-Every node in the network obtains a route to a destination on a demand fashion. Reactive protocols do not maintain up-to-date routes to any destination in the network and do not generally exchange any periodic control messages.
3. **Hybrid routing protocols**:-Every node acts reactively in the region close to its proximity and proactively outside of that region, or zone.

Several routing protocols have been suggested and used for MANETs. Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV) and Destination Sequenced Distance-Vector (DSDV) have been implemented.

1. **Ad Hoc On-Demand Distance Vector Routing (AODV) –** uses traditional routing tables, one entry per destination. This is in contrast to DSR, which can maintain multiple route cache entries for each destination. Without source routing, AODV relies on routing table entries to propagate an RREP back to the source and, subsequently, to route data packets to the destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops. All routing packets carry these sequence numbers.
2. **Destination-Sequenced Distance Vector (DSDV)-** The first MANETs algorithm that we implemented as part of this work is called the Destination-Sequenced Distance Vector (DSDV) routing algorithm. It is a proactive routing algorithm. The DSDV algorithm is a Distance Vector (DV) based routing algorithm designed for use in MANETs, which are defined as the cooperative engagement of a collection of Mobile Hosts without the required intervention of any centralized Access Point (AP).
3. **Dynamic Source Routing (DSR)-** It is a routing protocol for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. However, it uses source routing instead of relying on the routing table at each intermediate device. This protocol is truly based on source routing whereby all the routing information is maintained (continually updated) at mobile nodes. It has only two major phases, which are Route Discovery and Route Maintenance. Route Reply would only be generated if the message has reached the intended destination node (route record which is initially contained in Route Request would be inserted into the Route Reply). Therefore, it is an on-demand protocol designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages required in the table-driven approach. The major difference between this and the other on-demand routing protocols is that it is beacon-less and hence does not require periodic hello packet (beacon) transmissions, which are used by a node to inform its neighbors of its presence. The basic approach of this protocol (and all other on-demand routing protocols) during the route construction phase is to establish a route by flooding Route Request packets in the network. The destination node, on receiving a Route Request packet, responds by sending a Route Reply packet back to the source, which carries the route traversed by the Route Request packet received.

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II. RELATED WORK

The following section provides the details regarding various routing protocols used in MANETs. Each protocol excelling in different parameters, for getting the good outcome from a particular protocol, it is required to integrate two or more protocols or to just compromise with other parameters.

Sangeeta Kurundkar, Apoorva Maidamwar, "An Improved AODV Routing Protocol For Mobile Ad-Hoc Networks" [1].The paper presents an improved AODV (I-AODV) protocol. In I-AODV protocol, Stability factor is used to keep track of the remaining energy of node in the network. Node in the network decides whether to act as router or not depending on this stability factor. In original AODV protocol, whenever a node receives a RREQ message it is processed without considering its energy level. In I-AODV, when a source node sends a RREQ message and it reaches to its neighboring node, then that node first checks its stability factor. As a conclusion the author proposes the I-AODV routing protocol for MANETs that effectively reduces the energy consumption and the end to end delay during the route discovery process. By using these techniques in routing protocol it is possible to reduce the energy and end to end delay by about 7% to 24%.

Vijayan R, Mareeswari V and Samyukta V, International Journal of Engineering and Technology, VIT University [2]. Energy conservation is also an important issue in MANETs because mobile nodes are often battery powered and cannot function without enough power level. They gave a solution to energy conservation by a cross layered approach. This can be achieved by applying congestion control algorithm for the MAC layer and then finding the maximum residual energy route in the network layer for packet transfer. To ensure an efficient cross layer interaction, issues related to efficient channel access, quality-of-service (QoS) support and congestion control are addressed with an energy efficient MAC protocol that adjusts with the enhancements in the performance of the network layer protocol. Since energy efficiency is a major challenge in MANETs the paper proposes an emerging solution to support flexible layer approaches in MANETs. In the solution of the paper an energy conservative model based on slow start, exponential increase of congestion window is integrated with the MAC layer where, the congestion increases exponentially for every acknowledgement received and for every Round Trip Time and once the threshold for congestion window is reached, congestion avoidance takes place and if packet loss occurs, fast recovery is done. Then, the residual energy of each node is calculated in the network layer and each node's residual energy is added to other nodes' residual energy, the maximum energy is compared and this goes on until the destination node is reached. This results in energy efficient route discovery with maximum residual energy and then the total hop and remaining hop count from the source node to destination node is received from the network layer, using this information the hop count ratio of remaining hops is calculated and based on the obtained ratio the packets to be forwarded are prioritized. The packets with lesser remaining hop ratio get more priority.

Rachna Bagwari, Neha Garg, Emmanuel S. Pilli., Energy Efficient Enhancement of QoS-AODV Routing Protocol for MANETs, the Second Intl. Conf. on Advances in Electronics, Electrical and Computer Engineering [3]. Energy efficiency is nothing but using less energy to provide the same service. Rachna Bagwari, Neha Garg, Emmanuel S. Pilli[6], put forth a new approach for Energy Efficiency Enhancement of QoS-AODV routing protocol by setting a threshold limit and compare it with QoS-AODV routing protocol, End-to-End delay, packet delivery ratio, throughput and life time of network is measured and compared for QoSAODV and EEEQoS AODV. In the initial stages of the paper a general review of Adhoc On-demand Distance Vector (AODV) routing protocol and QoS-AODV is made and then EEEQoS-AODV route discovery is discussed. By seeing the performance the writers say that EEEQoS-AODV routing protocol is good in terms of energy efficiency that increases the life time of the network and as well as the quality of service.

Nitin Manjhi; Nilesh Patel, "Signal Strength Based Route Selection in MANETs" [4]. A method is proposed which measure the signal strength between nodes (intermediate nodes) and compare with RSSI threshold values, if it is greater than the threshold values, then it is accepted for further processing otherwise discarded. The lifetime of the network can be increased by the selecting the strong route to the destination. SSAODV take lesser end- to – end delay than AODV due to lesser retransmission, SSAODV performs better in terms of delivery ratio and throughput. It is more reliable in data transmission by reducing the network partition and packet loss in network.

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San-Yuan Wang; Jia-Yu Liu; Chun-Chien Huang; Mao-Yuan Kao; Yi-HoLi; , "Signal strength-based routing protocol for mobile ad hoc networks," [5]. A signal strength based on-demand routing protocol proposed first uses the earliest established path to forward packets for fast transmission and then changes to the strongest signal strength path for long transmissions. Each channel is assigned a signal strength level, at which route discover packets are exchanged. The routing protocol demonstrated gives superior performance compared to normal AODV.

JiwonPark; Moh, S.; Ilyong Chung, "A multipath AODV routing protocol in mobile ad hoc networks with SINR-based route selection" [6]. A multipath routing protocol called cross-layered multipath AODV (CM-AODV) selects multiple routes on demand based on signal to interface plus noise ratio measured at physical layer. CM-AODV assigns the construction of multiple paths to the destination and makes the algorithm simple and improved performance of packet delivery ratio and decreased overhead. The future work is to apply the CM-AODV scheme to other routing protocols of MANETs to provide more robust routing paths.

P.Srinivasan, K.Kamalakkannan "Signal Strength And Energy Aware Reliable Route Discovery In Manet" [8]. The signal strength and energy aware routing protocol directly follows the signal strength and residual battery capacity of nodes for route selection through cross layer approach. The parameters used to calculate the link stability are the signal strength of the link and selective speed between the nodes. Protocol used both the signal strength and remaining battery capacity of nodes during path selection for reliable data transimission. Route selection from source to destination is done by considering the link with greater signal strength and the node with greater residual energy.

Husnain Mansoor Ali, Amina Meraihi Naimi, "Signal Strength Based Link Sensing for Mobile Ad Hoc Networks" [9]. A new link management algorithm to locally manage links is been presented. It is based on the signal strength measurements. To overcome the problem of node mobility and link failure, signal-strength to determine the improved link- quality is used. The link management is made more robust and anticipates link breakages, thereby improving performance.

Silvia Giordano, Ivan Stojmenovic, Ljubica Blazevic "Position Based Routing Algorithms For Ad Hoc Networks:A Taxonomy"[11]. The availability of small inexpensive low power GPS receiver and techniques for finding relative coordinate based on signal strengths provided justification for applying position based routing methods in ad hoc networks. Considering the different classes of existing position based routing schemes, hierarchical routing and other relevant issues of routing, the successful design of localized single path loop free algorithms with guaranteed delivery is the matter of future research. Due to the booming of the adhoc networks and the battery power is not expected to increase significantly in future, power aware routing schemes need the better investigation.

Sujata V Mallapur, Siddarama R. Patil, "Stable Backbone Based Multipath Routing Protocol for Mobile Ad-Hoc Networks"[12]. Stable backbone based multipath routing protocol focuses on finding the stable path to transfer the data packets. There are 2 phases, first the selection of candidate node having high residual bandwidth, residual energy, link quality and high mobility. Multiple paths are established using these nodes. Second, the construction of routing backbone from the source to destination. If any node in one route fails or tends to tail, then transmission happens through the alternate path.

LIU Jian, LI Fang-min "An Improvement of AODV Protocol Based on Reliable Delivery in Mobile Ad hoc Networks" [13] This paper presents an AODV with reliable delivery (AODV-RD), a link failure fore-warning mechanism, metric of alternate node in order to better select, and also repairing action after primary route breaks basis of AODV-BR. Performance comparison of AODV-RD with AODV-BR and traditional AODV using ns-2 simulations has been carried out and the results shows that AODV-RD significantly increases packet delivery ratio(PDR). Finally the author proposed AODV-RD based on link failure prediction mechanism with due consideration given to link status and improved AODV-BR combination to achieve the full purpose of improving PDR. The outcome is that AODV-BR increases PDR, but has longer end-to-end delay since AODV-BR delivers more packets, and those packets are delivered in AODV-BR but not in AODV, taking alternate and possibly longer hop routes. The AODV and AODV-BR routing protocol were analyzed in this paper, and some problems on reliable delivery were pointed out.

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Deepak Dembla, Dr. Yogesh Chaba "Modeling and Analysis of an Intelligent AODV Routing Protocol based on Route Request Retransmission Strategy in MANETs" [14]. Here, an intelligent AODV protocol that follows an efficient method of route discovery based on network density and probability, and adjusts itself dynamically based on the network density of MANETs is proposed. The approach is that the intermediate node forwards the RREQ packet to its neighbor with some probability, based on the density of neighborhood nodes. Neighborhood densities are divided in two categories; dense and sparse. If the node is in the sparse region, it retransmits the RREQ packet with high probability so that it can reach to maximum no. of nodes, otherwise it forwards the packet with a low probability, if node is in the dense network region. The results shown in the paper tells that the model offers better cost effective performance than conventional AODV protocol which uses simple flooding for route discovery process. The paper also tells that, in the approach of selective flooding based on neighbor node density and probability of rebroadcasting, RREQ retransmissions are reduced a lot, hence the performance of the algorithm is improved.

III. CONCLUSION

We have seen a great development in the field of wireless networks (infrastructure based) and in the field of Mobile ad hoc network (infrastructure less network).In this paper a number of routing protocols for, which are broadly categorized as proactive and reactive and Hybrid protocols. The effort has been made on the comparative study of Reactive, Proactive and Hybrid routing protocols has been presented in the form of table. There are various shortcomings in different routing protocols and it is difficult to choose routing protocol for different situations as there is tradeoff between various protocols. There are various challenges that need to be met, so these networks are going to have widespread use in the future.

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