A Survey Study of Classification of Ad hoc Routing Protocols: Proactive and Reactive

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Abstract— Mobile Ad Hoc Network (MANET) is a collection of two or more mobile device that communicates with each other without fixed infrastructure and can survive intense changes in the network topology. Each node in network not only operates as an end system, but also as a router to forward packets. Routing in ad hoc networks has become a popular research topic. There are several routing protocols have been developed for ad hoc networks. In MANET, it is very stiff task to predict the performance of routing protocol under varying network conditions and scenarios. During this paper we are discussing three approaches of routing protocols such as Reactive (On demand), Proactive (table driven) and Hybrid routing protocols with main focus on operation of particular routing protocols within their advantage and disadvantage.

Keywords—Proactive, Reactive, Hybrid, Advantage, Disadvantage, Protocols.

I. INTRODUCTION

A mobile ad hoc network (MANET) is an adaptive, self-configurable, self-organizing, infrastructure-less multi-hop wireless network with unpredictable dynamic topologies. With the fast growth of computers and the wireless communication, the mobile computing has already become the field of computer communications in high-profile link. Mobile Ad Hoc Network (MANET) is a completely wireless connectivity through the nodes constructed by the actions of the network, which usually has a dynamic shape and a limited bandwidth [1].The communication is the key of MANET which is conducted by routing protocols. There are many routing protocols presented for MANET. In this paper we are taking review of different MANET routing protocols and discussing the comparative study over them [2]. Routing in ad hoc networks has become a popular research topic. Dating back to the early1980s, there have been a large number of routing protocols designed for multihop ad hoc networks. These protocols cover a wide range of design choices and approaches.

1.1 MANETs Routing Protocols: -

Routing is the process of selecting paths in a network for moving a packet of data from source to destination. A routing protocol composes of a routing algorithm with a set of rules that monitors the operations of the network. The main issue in MANETs is that the routing protocols must be able to respond rapidly to topological changes of the network. Routing protocols are broadly classified into three types, reactive (on demand driven), proactive (table driven) and hybrid protocols [3].

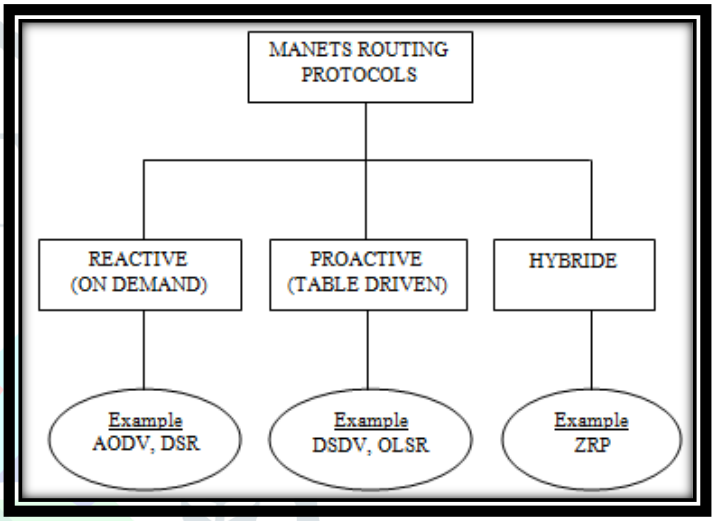


Fig. 1: Three approaches of Manets Routing

1.2 Reactive Routing Protocol: -

Reactive protocols for mobile ad hoc network are also called "on-demand" routing protocols. In a reactive routing protocol, routing paths are searched only when needed. These types of protocols find a route on demand using flooding process with route request packets. Ad hoc on demand distance vector (AODV) and Dynamic Source routing (DSR) routing protocols are examples of reactive routing protocols.

AODV (Ad hoc on demand distance vector): - Ad hoc On-demand Distance Vector (AODV) is a reactive routing protocol. Reactive routing protocols are also called on-demand routing protocols. AODV is loop-free, self-starting, and scales to large numbers of mobile nodes. AODV allows for the construction of routes to specific destinations and does not require that nodes keep these routes when they are not in active communication. AODV avoids the "counting to infinity" problem by using destination sequence numbers. This property makes AODV loop free [15]. AODV performs two major phases. Route Discovery (route set-up) phase In AODV, Route discovery is done when there is no proper route is available to the destination. This is initiated by sending a RREQ packet into the network. This request has the following fields, source address, request id, source sequence number, destination address, destination sequence number, hop count [3]. AODV defines the three types of control messages for route maintenance phase

RREQ - A route request message is transmitted by a node requiring a route to a node. As an optimization AODV uses flooding technique when flooding these messages. Every RREQ carries a time to live (TTL) value that states for how many hops this message should be forwarded. This value is set to a predefined value at the first transmission and increased at retransmissions. Retransmissions occur if no replies are received.

RREP - A route reply message is unicasted back to the originator of a RREQ if the receiver is either the node using the requested address, or it has a valid route to the requested address. The reason one can unicast the message back, is that every route forwarding a RREQ caches a route back to the originator.

RERR - Nodes monitor the link status of next hops in active routes. When a link breakage in an active route is detected, a RERR message is used to notify other nodes of the loss of the link. In order to enable this reporting mechanism, each node keeps a ``precursor list'', containing the IP address for each its neighbors that are likely to use it as a next hop towards each destination [].

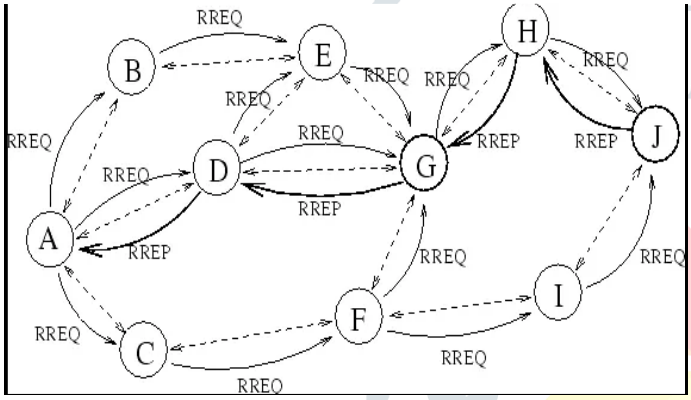


Fig. 2: AODV routing protocols

ADVANTAGE OF AODV:-

1) On-demand route establishment

2) Destination sequence numbers to find the latest route to the destination.

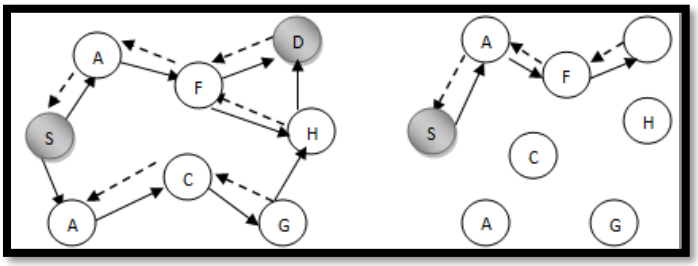
3) Less connection setup delay

DISADVANTAGE OF AODV:-

1) In order to detect the unidirectional link. Bidirectional link is required.

2) Delay is caused by discovery process.

DSR (Dynamic source routing):- DSR is one of the purest examples of in demand routing protocol that is based on the concept of source routing. DSR use no periodic routing message like AODV. DSR is a self-organizing and self-configuring on demand routing protocol. The protocol is composed of two main mechanisms of "Route Discovery" and "Route Maintenance [9]. - Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D Route Discovery is used only when S attempts to send a packet to and does not already know a route to D. - Route Maintenance is the mechanism by which node S is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, S can attempt to use any other route it happens to know to D, or it can invoke Route Discovery again to find a new route for subsequent packets to D. Route Maintenance for this route is used only when S is actually sending packets to D [10].



(a) (b)

Destination,

D Destination

Representation of RREQ

Reverse route entry

Fig. 3: (a) RREQ broadcast (b) RREP forward path

ADVANTAGE OF DSR:-

1) Eliminate the periodic table update message (hello packet beckon)

2) Routes maintained only between nodes who need to communicate (on demand) thus reduces overhead of rate maintenance

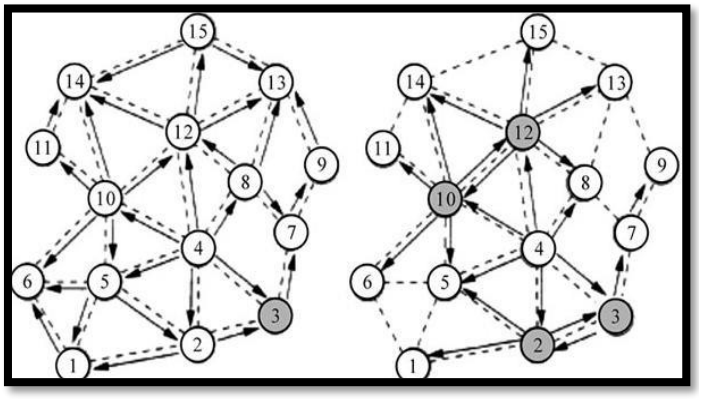
DISADVANTAGE OF DSR:-

1) Flood of route requests may potentially reach all nodes in the network.

2) Potential collision between route requests propagates by neighboring nodes.

1.3 Proactive Routing Protocols: - This type of protocols maintains fresh lists of destination and their routes by periodically distributing routing table throughput the network. Optimized link state routing protocols (OLSR), Destination sequenced distance vector (DSDV) routing protocol are examples of proactive routing protocols.

OLSR (Optimized link State Routing): - Optimized Link State Routing protocol (OLSR) is based on link state algorithm and it is proactive in nature. In OLSR, each node uses the most recent information to route a packet [4]. This protocol was based on the mechanism called as multipoint relaying means MPR flooding technique in order to reduce the packets broadcasting in the topology [2]. Multi point relays (MPR) are selected by each node from its set of neighbor nodes. Only these MPRs are responsible for forwarding control traffic, intended for spread into the entire network. OLSR protocol is well suited for those applications which do not allow long delays in the transmission of the data packets [3] it minimizes flooding of the control traffic by using only the selected nodes, called multipoint relays.



…….. Node 4 selects MPR set <2, 3, 10, and 12>

Network Link

node belonging MPR set of node 4

Broadcast packet forward by members of MPR set Flooding the entire network with six transmission using MPR scheme

Fig. 4: OLSR routing protocols

ADVANTAGE OF OLSR:-

1) This protocol reduces the multiple retransmissions of the existing topology information broadcasting.

2) More network bandwidth saved in this case as compared to the link state routing protocol due to the reduced broadcast packet size.

DISADVANTAGE OF OLSR:-

1) OLSR needs more time re discovering a broken link.

2) OLSR requires more processing power than discovering an alternate route.

3) Wider delay distribution.

DSDV (Destination sequenced Distance Vector):- DSDV protocol is a proactive routing protocol which follow conventional Bellman-Ford routing algorithm. In this protocol each nodes maintains routing table. This routing information must be periodically updated [11]. When network topology changes are detected, each mobile node advertises routing information using broadcasting or multicasting a routing table update packet[12].Each node manages its own sequence number by assigning it two greater than the old one (call an even sequence number) every time. When a route update with a higher sequence number is received, the old route is replaced [13].In a wireless medium broadcasts is limited by the physical characteristic of medium. If a node invalidates its entry to a destination due to loss of next hop node, it increments its sequence number and uses new sequence number in its next advertisement of the route. Data broadcast by each mobile computer will contain new sequence number and

I. Destination IP address

II. Number of hops required to reach the destination.

III. Sequence number of the information received regarding that destination. [14]

ADVANTAGE OF DSDV:-

1) The availability of path to all destinations in network always shows that less delay is required in the path set up process.

2) Incremental updates with sequence no tag makes existing wired network protocols adaptable to ad hoc networks.

DISADVANTAGE OF DSDV:-

1) Generates a lot of control traffic in the network ,rendering an inefficient utilization of network resources

2) DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle.

HYBRID ROUTING PROTOCOLS: - This types of protocols combine the features of proactive and routing protocols. The routing is initially established with some proactively prospected routes and then serves the demand from additionally activated nodes reactive flooding. Zone routing protocol (ZRP) is an example of hybrid routing protocol.

ZRP HYBRID ROUTING PROTOCOLS: - Zone Routing Protocol (ZRP) is a hybrid protocol which combines the advantages of both proactive and reactive schemes [4].ZRP routing protocols consists of different modules such as: Intrazone routing protocol, Interzone routing protocols.

1) Intrazone routing protocol: - This protocol is adopted from the proactive routing protocols which is used to maintain only the local topology. This protocol works in the within the specified zone only.

2) Interzone routing protocol: This protocol is adopted from the reactive protocol which is used when the route between the different zones is needed for the communication in between the source and destination [2].

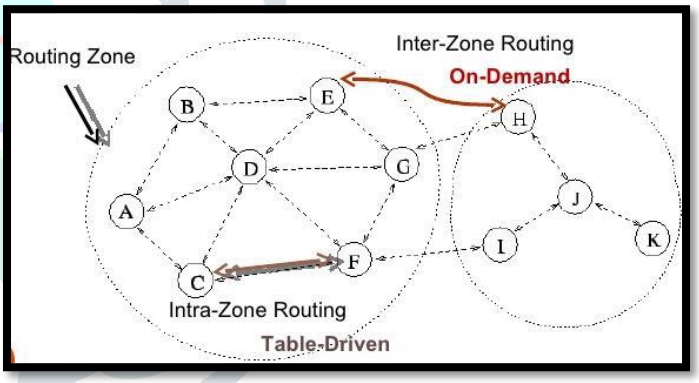


Fig. 5: ZRP routing protocols

ADVANTAGE OF ZRP:-

1) This protocol provides the scalability as compared to reactive routing protocols.

2) Congestion is reduced at most due to fact that the hierarchies are not used.

DISADVANTAGE OF ZRP:-

1) Realistically has higher overhead than proactive and reactive protocols.

2) If zone greatly overlap redundant route request message are flooded through the network.

3) Optimum zone radius must be determined for each situation.

II. RELATED WORK

This section gives the overview of related work by various authors in routing protocols:

Shaily Mittal et al. [6] compare the three different routing protocols (AODV, DSR, ZRP) for mobile Ad-hoc networks ispresented as a function of pause time. They carried out simulations on Qualnet simulator. Three performance

metrics are average end to end delay; average TTL based hop count and packet delivery ratio. AODV shows best results in measuring end to end delay and packet delivery ratio.

Farhat Anwar et al. [8] present the comparison of three protocols AODV, DSDV, OLSR types of proactive and reactive protocols. The performance of these protocols are compared in term their average end to end delay, packet delivery fraction, normalized routing load ,and routing overhead. At low network load AODV perform better in case of PDF but it perform badly in term of average E2E delay, routing load and routing packets. At high network load and mobility OLSR performs well with respect to PDF.

R.Mohan Kumar et al. [7] presented the modified version AODV in which the network performance is enhanced by balancing the load using queue length and link quality. This study focuses on introducing two metrics such as, Aggregate Interface Queue Length (AIQL) and link quality, in AODV to deal with load balancing issues. The modified protocol performs better than the conventional AODV in terms of the average throughput, average end to end delay and packet delivery ratio.

Mina Vajed Khiavi et al. [16] compared AODV, DSDV, DSR and TORA routing protocol in mobile ad hoc networks to determine the best operational conditions for each protocol. In this study performance is measured in terms of Packet Delivery Ratio, Network Life Time, System Life Time, End-to-End Delay and Routing Overhead. The simulations were performed using Network Simulator (Ns-2).

Sushil Kumar et al. [17] compare the performance of three routing protocols DSDV, DSR and AODV for CBR traffic by varying no. of nodes in terms of packet delivery ratio, end to end delay, routing overhead and throughput. The results showed that the performance of the two reactive protocols (DSR and AODV) was better than DSDV.

Ayush Pandey et al. (2014) [18] illustrates the performance of three routing protocols AODV, DSR and DSDV using Network Simulator-2 (NS-2) and measure the performance in Packet Delivery Fraction, Throughput and Round Trip Time with constant mobility. The performance of routing protocols AODV and DSR perform better under high mobility simulations than DSDV. In DSR uses source routing and route caches, and does not depend on any periodic or timer based activities. DSR shows higher throughput than DSDV and AODV.

Sunil Pathak et al. [19]This paper study various kinds of Unicast routing protocols such as proactive ,reactive and hybrid unicast routing protocol and discuss the their working . Result show that all Unicast protocol cannot perform better, in all network conditions. Every protocol performed better in some specific condition according its characters.

III. PROBLEM FORMULATION

In MANET communication between two mobile devices are performed by routing protocol. Routing is the process to moving information / packet from a source node to a destination node in a mobile ad-hoc network [19]. All existing protocols have major drawback that they have not provision for conveying the load and/or quality of a path route setup. They cannot balance the load on different metric. It may cause the packet drop rate, packet end to delay or routing over head increase as traffic is concentrated on a special node [7]. The Ad hoc On-Demand Distance Vector (AODV) routing protocol is designed for mobile ad hoc networks with populations of tens to thousands of mobile nodes. Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network [15]. AODV belongs to the class of Distance Vector Routing Protocols (DV) type of the reactive protocols which work only on demand. AODV routing protocols use flooding process to setup a link between the pair of nodes thus consumes high bandwidth, battery power and generates high end to end delays.

IV. PROPOSED WORK

The objective is to improve the performance of AODV routing protocol using the new technique for transmission of data packet between the source and destination which reduced AODV routing overhead and improve the AODV scalability. For this purpose following are the proposals to implement for improvement.

1) To trim down the average end to end delay of AODV routing protocols.

2) To reduce energy consumption during the transmission of data packets.

3) Implementing improved (I_ AODV) routing algorithm with improving drawbacks of traditional (AODV) routing algorithm using ns-2 network simulator tool.

V. CONCLUSION

In this paper, we basically focused on three different approaches of MANETS routing protocols with their advantage and disadvantage, and their examples: Reactive (AODV, DSR), Proactive (OLSR, DSDV), Hybrid (ZRP) routing protocols. We have review the various papers related to this work and conclude that it is critical issue to select an efficient and reliable protocol. Each protocol in MANET have unique feature and advantage, and depending on the network conditions. After the review of several papers we found some drawbacks in existing work. If we implement proposed technique in future the result may be better.

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