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**RESEARCH ARTICLE**

# Routing Protocols in Mobile Ad-Hoc Network

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***Abstract:*** ***In recent years mobile ad hoc networks have become very popular and lots of research is being done on different aspects of MANET. Mobile Ad Hoc Networks (MANET)-a system of mobile nodes (laptops, sensors, etc.) interfacing without the assistance of centralized infrastructure (access points, bridges, etc.). There are different aspects which are taken for research like routing, synchronization, power consumption, bandwidth considerations etc. This paper concentrates on routing techniques which is the most challenging issue due to the dynamic topology of ad hoc networks. There are different strategies proposed for efficient routing which claimed to provide improved performance. There are different routing protocols proposed for MANETs which makes it quite difficult to determine which protocol is suitable for different network conditions .This paper provides an overview of different routing protocols proposed in literature and also provides a comparison between them .An ad hoc network is often defined as an "Infrastructureless" network, meaning a network without the usual routing infrastructure like fixed routers and routing backbones. A mobile ad hoc network (MANET) consists of mobile wireless nodes in which the communication between nodes is carried out without any centralized control. MANET is a self-organized and self-configurable network where the mobile nodes move arbitrarily. The mobile nodes can receive and forward packets as a router. Routing is a critical issue in MANET. Therefore focus in this paper is to 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 simulation is carried out on NS2. The ad hoc nodes are mobile and the underlying communication medium is wireless. Each ad hoc node may be capable of acting as a router. It's characterized by multihop wireless connection and frequently changing networks. we compare the performance of on-demand routing protocols for mobile ad-hoc networks are distributed cache updating for the dynamic source routing protocol(DSR) and ad hoc on-demand distance vector routing (AODV).the simulation model of the medium access control(MAC) layer is evaluating the performance of MANET protocols. DSR and AODV protocols share similar behavours. We evaluate the both on demand protocols DSR and AODV based on packet delivery ratio, packet delivery latency, mobility variation with total number of errors, packet and normalized routing overhead, end-to-end delay by varying in node density. The performance and characteristics are explained by the graph models.***

***Keywords - MANET, Routing Protocols, DSDV, DSR and AODV, Medium Access Control, latency***

## Introduction

Mobile Ad hoc Networks (MANETs) is a collection of wireless nodes which are connected without any infrastructure or any centralized control. In MANET each node can be used as either as endpoint or as a router to forward packet to next node. In contrast to fixed infrastructure networks, MANETs require fundamental changes to network routing protocols. These are characterized by the mobility of nodes, which can move in any direction and at any speed that may lead to arbitrary topology and frequent partition in the network. This characteristic of the MANET makes the routing a challenging issue. In mobile ad hoc network, nodes do not rely of any existing infrastructure. Instead, the nodes themselves form the network and communicate through means of wireless communications. Mobility causes frequent topology changes and may break existing paths. Routing protocols for ad hoc networks can be classified into two major types: proactive and on-demand**.** Proactive protocols attempt to maintain up-to-date routing information to all nodes by periodically disseminating topology updates throughout the network. On demand protocols attempt to discover a route only when a route is needed. The general problem of modeling the behavior of the nodes belonging to a mobile network has not a unique and straightforward solution. Number of problems in designing proper routing schemes for effective communication between any source and destination. The mobile ad hoc networks are envisioned to support dynamic and rapidly changing the multihop topologies which are likely to be composed of relatively bandwidth constrained wireless links. A generic framework to systematically analyze the impact of mobility on the performance of routing protocols for MANET has become important. As many studies have used reference point(RP) and random waypoint(RWP) as reference model In reference point(RP) model an intermediate node can simultaneously serve as relay for more than one source. Hence the resources are shared in an on-demand fashion. This is typical for most of the routing protocols for wireless ad hoc networks. In the random waypoint(RWP) model, the nodes, that is, mobile users, move along a zigzag path consisting of straight legs from one waypoint to the next. Mobility and disconnection of mobile hosts pose a Wireless networks provide connection flexibility between users in different places. Moreover, the network can be extended to any place or building without the need for a wired connection. Wireless networks are classified into two categories; Infrastructure networks and Ad Hoc networks as shown in Figure 1.

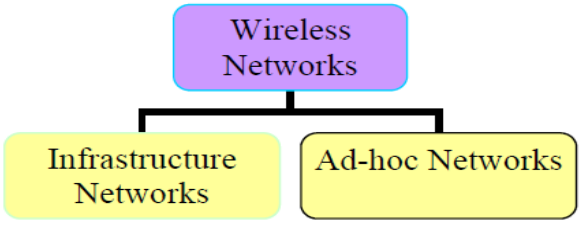



**Figure1: Wireless Networks Categories**

**Infrastructure networks** An Access Point (AP) represents a central coordinator for all nodes. Any node can be joining the network through AP. In addition, AP organizes the connection between the Basic Set Services (BSSs) so that the route is ready when it is needed. However, one drawback of using an infrastructure network is the large overhead of maintaining the routing tables. Infrastructure network as shown in Figure 2.

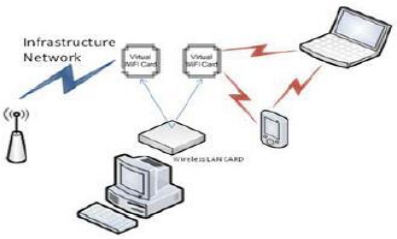



**Figure 2: Infrastructure Network.**

**Ad Hoc networks**

A wireless ad hoc network is a decentralized type of wireless network. The network is ad hoc because it does not rely on a preexisting infrastructure, such as routers in wired networks or access points in managed (infrastructure) wireless networks [1]. Ad Hoc networks do not have a certain topology or a central coordination point. Therefore, sending and receiving packets are more complicated than infrastructure networks. Figure 3 illustrates an Ad Hoc network


**Figure 3: Ad Hoc network.**

Nowadays, with the immense growth in wireless network applications like handheld computers, PDAs and cell phones, researchers are encouraged to improve the network services and performance. One of the challenging design issues in wireless Ad Hoc networks is supporting mobility in Mobile Ad Hoc Networks (MANETs). The mobility of nodes in MANETs increases the complexity of the routing protocols and the degree of connection"s flexibility. However, the flexibility of allowing nodes to join, leave, and transfer data to the network pose security challenges. MANET is a collection of mobile nodes sharing a wireless channel without any centralized control or established communication backbone. MANET has dynamic topology and each mobile node has limited resources such as battery, processing power and on-board memory[3] This kind of infrastructure-less network is very useful in situation in which ordinary wired networks is not feasible like battlefields, natural disasters etc. The nodes which are in the transmission range of each other communicate directly otherwise communication is done through intermediate nodes which are willing to forward packet hence these networks are also called as multi-hop networks. MANET[2] as shown in Figure 4

**Figure 4: MANET**

## CHARACTERISTICS OF MANET

Mobile ad hoc network nodes are furnished with wireless transmitters and receivers using antennas, which may be highly directional (point-to-point), omni directional (broad-cast), probably steerable, or some combination. At a given point in time, depending on positions of nodes, their transmitter and receiver coverage patterns, communication power levels and co-channel interference levels, a wireless connectivity in the form of a random, multihop graph or "ad hoc" network exists among the nodes. This ad hoc topology may modify with time as the nodes move or adjust their transmission and reception parameters[6]. The characteristics of these networks are summarized as follows:

- Communication via wireless means.
- Nodes can perform the roles of both hosts and routers.
- Bandwidth-constrained, variable capacity links.
- Energy-constrained Operation.
- Limited Physical Security.
- Dynamic network topology.
- Frequent routing updates

### CLASSIFICATION OF ROUTING PROTOCOLS

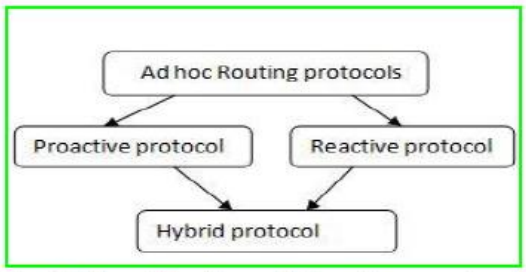
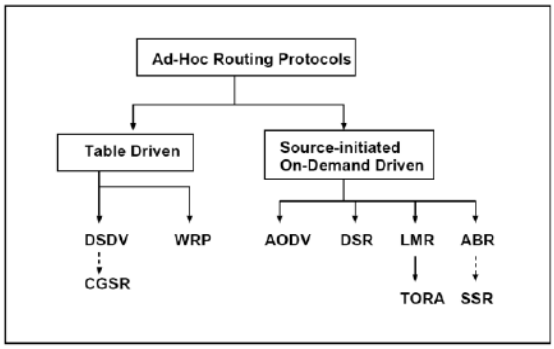



**Fig. 1 Classification of Routing protocols**

**The Family Tree**

**The Family Tree**




### Proactive Routing Protocols

Proactive routing protocols are also called as table driven routing protocols. In this every node maintain routing table which contains information about the network topology even without requiring it This feature although useful for datagram traffic, incurs substantial signaling traffic and power consumption The routing tables are updated

periodically whenever the network topology changes. Proactive protocols are not suitable for large networks as they need to maintain node entries for each and every node in the routing table of every node These protocols maintain different number of routing tables varying from protocol to protocol. There are various well known proactive routing protocols. Example: DSDV, OLSR, WRP etc.

***Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV)*** DSDV is developed on the basis of Bellman–Ford routing[15]algorithm with some modifications. In this routing protocol, each mobile node in the network keeps a routing table. Each of the routing table contains the list of all available destinations and the number of hops to each. Each table entry is tagged with a sequence number, which is originated by the destination node. Periodic transmissions of updates of the routing tables help maintaining the topology information of the network. If there is any new significant change for the routing information, the updates are transmitted immediately. So, the routing information updates might either be periodic or event driven. DSDV protocol requires each mobile node in the network to advertise its own routing table to its current neighbors. The advertisement is done either by broadcasting or by multicasting.

***Wireless Routing Protocol (WRP)***

WRP belongs to the general class of path-finding algorithms defined as the set of distributed shortest path algorithms that calculate the paths using information regarding the length and second-to-last hop of the shortest path to each destination. WRP reduces the number of cases in which a temporary routing loop can occur. For the purpose of routing, each node maintains four things:

1. A distance table
2. A routing table
3. A link-cost table
4. A message retransmission list (MRL).

WRP uses periodic update message transmissions to the neighbors of a node. The nodes in the response list of update message (which is formed using MRL) should send acknowledgments. If there is no change from the last update, the nodes in the response list should send an idle Hello message to ensure connectivity. A node can decide whether to update its routing table after receiving an update message from a neighbor and always it looks for a better path using the new information. If a node gets a better path, it relays back that information to the original nodes so that they can update their tables. After receiving the acknowledgment, the original node updates its MRL. Thus, each time the consistency of the routing information is checked by each node in this protocol, which helps to eliminate routing loops and always tries to find out the best solution for routing in the network.

***Cluster Gateway Switch Routing Protocol (CGSR)*** CGSR considers a clustered mobile wireless network instead of a flat network. For structuring the network into separate but interrelated groups, cluster heads are elected using a cluster head selection algorithm. By forming several clusters, this protocol achieves a distributed processing mechanism in the network. However, one drawback of this protocol is that, frequent change or selection of cluster heads might be resource hungry and it might affect the routing performance. CGSR uses DSDV protocol as the underlying routing scheme and, hence, it has the same overhead as DSDV. However, it modifies DSDV by using a hierarchical cluster-head-to-gateway routing approach to route traffic from source to destination. Gateway nodes are nodes that are within the communication ranges of two or more cluster heads. A packet sent by a node is first sent to its cluster head, and then the packet is sent from the cluster head to a gateway to another cluster head, and so on until the cluster head of the destination node is reached.

**Abbreviations:**

$N = Number\ of\ nodes\ in\ the\ network$
$d = Network\ diameter$
$h = Height\ of\ routing\ tree$
$x = Number\ of\ nodes\ affected\ by\ a\ topological\ change$

***Reactive Routing Protocols*** Reactive routing protocol is also known as on demand routing protocol. In this protocol route is discovered whenever it is needed Nodes initiate route discovery on demand basis. Source node sees its route cache for the available route from source to destination if the route is not available then it initiates route discovery process. The on- demand routing protocols have two major components .

***Route discovery***: In this phase source node initiates route discovery on demand basis. Source nodes consults its route cache for the available route from source to destination otherwise if the route is not present it initiates route discovery. The source node, in the packet, includes the destination address of the node as well address of the intermediate nodes to the destination.

***Route maintenance***: Due to dynamic topology of the network cases of the route failure between the nodes arises due to link breakage etc, so route maintenance is done. Reactive protocols have acknowledgement mechanism due to which route maintenance is possible Reactive protocols add latency to the network due to the route discovery mechanism. Each intermediate node involved in the route discovery process adds latency. These protocols decrease the routing overhead but at the cost of increased latency in the network. Hence these protocols are suitable in the situations where low routing overhead is required. There are various well known reactive routing protocols present in MANET for example DSR, AODV, TORA and LMR.

***Dynamic Source Routing (DSR)***

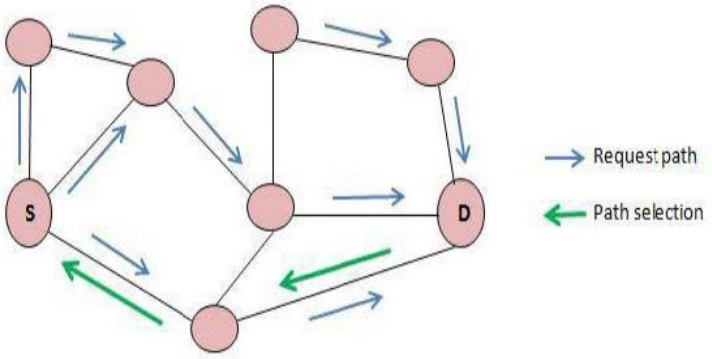



**Fig:2**

Dynamic Source Routing (DSR) is a reactive protocol based on the source route approach. In *Dynamic Source Routing (DSR)*, shown in Figure.2, the protocol is based on the link state algorithm in which source initiates route discovery on demand basis. The sender determines the route from source to destination and it includes the address of intermediate nodes to the route record in the packet. DSR was designed for multi hop networks for small Diameters.

It is a beaconless protocol in which no HELLO messages are exchanged between nodes to notify them of their neighbours in the network.

***Ad Hoc On-Demand Distance Vector Routing (AODV)*** AODV is basically an improvement of DSDV. But, AODV is a reactive routing protocol instead of proactive. It minimizes the number of broadcasts by creating routes based on demand, which is not the case for DSDV. When any source node wants to send a packet to a destination, it broadcasts a route request (RREQ) packet. The neighboring nodes in turn broadcast the packet to their neighbors and the process continues until the packet reaches the destination. During the process of forwarding the route request, intermediate nodes record the address of the neighbor from which the first copy of the broadcast packet is received. This record is stored in their route tables, which helps for establishing a reverse path. If additional copies of the same RREQ are later received, these packets are discarded. The reply is sent using the reverse path. For route maintenance, when a source node moves, it can reinitiate a route discovery process. If any intermediate node moves within a particular route, the neighbor of the drifted node can detect the link failure and sends a link failure notification to its upstream neighbor. This process continues until the failure notification reaches the source node. Based on the received information, the source might decide to re-initiate the route discovery phase.

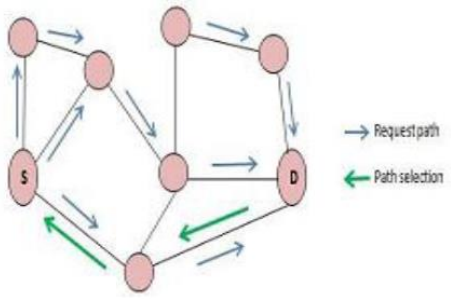



**Fig:3**

***Associativity-Based Routing (ABR)*** ABR protocol defines a new type of routing metric "degree of association stability" for mobile ad hoc networks. In this routing protocol, a route is selected based on the degree of association stability of mobile nodes. Each node periodically generates beacon to announce its existence. Upon receiving the beacon message, a neighbor node updates its own associativity table. For each beacon received, the associativity tick of the receiving node with the beaconing node is increased. A high value of associativity tick for any particular beaconing node means that the node is relatively static. Associativity tick is reset when any neighboring node moves out of the neighborhood of any other node.

***Signal Stability–Based Adaptive Routing Protocol (SSA)*** SSA [19] protocol focuses on obtaining the most stable routes through an ad hoc network. The protocol performs on demand route discovery based on signal strength and location stability. Based on the signal strength, SSA detects weak and strong channels in the network. SSA can be divided into two cooperative protocols: the Dynamic Routing Protocol (DRP) and the Static Routing Protocol (SRP). DRP uses two tables: Signal Stability Table (SST) and Routing Table (RT). SST stores the signal strengths of the neighboring nodes obtained by periodic beacons from the link layer of each neighboring node. These signal strengths are recorded as weak or strong. DRP receives all the transmissions and, after processing, it passes those to the SRP. SRP passes the packet to the node‟s upper layer stack if it is the destination. Otherwise, it looks for the destination in routing table and forwards the packet. If there is no entry in the routing table for that destination.

***Hybrid Routing Protocol*** There is a trade-off between proactive and reactive protocols. Proactive protocols have large overhead and less latency while reactive protocols have less overhead and more latency. So a Hybrid protocol is presented to overcome the shortcomings of both proactive and reactive routing protocols. Hybrid routing protocol is combination of both proactive and reactive routing protocol. It uses the route discovery mechanism of reactive protocol and the table maintenance mechanism of proactive protocol so as to avoid latency and overhead problems in the network. Hybrid protocol is suitable for large networks where large numbers of nodes are present. In this large network is divided into set of zones where routing inside the zone is performed by using reactive approach and outside the zone routing is done using reactive approach. There are various popular hybrid routing protocols for MANET like ZRP, SHARP.

***Sharp Hybrid Adaptive Routing Protocol (SHARP)*** SHARP adapts between reactive and proactive routing by dynamically varying the amount of routing information shared proactively. This protocol defines the proactive zones around some nodes. The number of nodes in a particular proactive zone is determined by the node-specific zone radius. All nodes within the zone radius of a particular node become the member of that particular proactive zone for that node. If for a given destination a node is not present within a particular proactive zone, reactive routing mechanism (query-reply)is used to establish the route to that node. Proactive routing mechanism is used within the proactive zone. Nodes within the proactive zone maintain routes proactively only with respect to the central node. In this protocol, proactive zones are created automatically if some destinations are frequently addressed or sought within the network. The proactive zones act as collectors of packets, which forward the packets efficiently to the destination, once the packets reach any node at the zone vicinity.

**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 MANET, 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 the simulation to compare the performance of two on-demand (DSR and AODV) and one table driven (DSDV) routing protocols on different performance parameters 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. The overall performance of DSR was better than the other two protocols except in the case of end to end delay.

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