A Literature Survey of MANET

Parul Gupta

Asst. Professor, Computer Science, P.I.G.G.C.W. Jind(Haryana), India

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Abstract - *Mobile ad hoc networks (MANETs) are a subclass of wireless ad hoc networks having special characteristics of dynamic network topology and moving nodes. Mobile ad hoc networks (MANETs) are infrastructure-less self configuring networks designed to support mobility. The main of this paper is to provide a survey of MANET including its need, characteristics and its applications along with the routing protocols used for communication.*

Key Words: MANET, Characteristics, Applications, DSDV, OLSR, DSR, AODV, ZRP, WRP, TORA, and SHARP

1. INTRODUCTION

Mobile Ad hoc Networks (MANET) is a kind of Wireless Ad Hoc Networks [1]. MANET is the wireless ad hoc network in which each device is free to move independently in any direction. Mobile ad hoc networks are the self-configuring and infrastructure-less networks aiming to support mobility of devices. Each device changes its links to other devices frequently resulting in a highly dynamic and autonomous topology. Each device plays the role of participant as well as router of the network.

Rest of the paper consists: Section 2 presents need of MANETs. Sections 3, presents applications of MANET, in Section 4, characteristics of MANET are explained and in Section 5, Routing protocols are classified and explained in brief. Finally, in section 6, we draw conclusions.

2. NEED OF MANET'S

As user moves in mobile network along with his devices, he wanted to remain in contact to the network. But as user moves from one network to another its address gets changed and packets are delivered with header containing the previous address of destination. The routers don't store the exact destination address of each device but only some prefixes are stored and some optimization is applied. If the receiver can be reached within its physical subnet, it gets the packets. However some solutions exist like assigning of new IP address to the mobile device with the help of DHCP but problem is that no one knows about that address. This problem can be solved by using dynamic DNS but that also works only for nodes that do not move too quickly. Secondly, change of IP address is also not allowed by the higher layer protocols such as TCP in which each connection is identified by the socket pair (IP address, port no.), for which change of IP address during connection is like breaking off the current connection. However, Mobile IP, DHCP, Cellular networks have developed in order to support mobility but these all technologies depend on some infrastructure. Due to these problems, mobile ad hoc networks are the only choice. They do not require any infrastructure and mobile and use wireless communications.

3. APPLICATIONS OF MANET

Mobile ad-hoc networks are the only choice for mobility support where there is no infrastructure or it is too expensive. Some application areas of such use of MANET are given below:

- ➢ **Instant infrastructure:** Unplanned meetings, spontaneous interpersonal communications etc. cannot rely on any infrastructure; therefore, ad-hoc connectivity has to be set up.
- ➢ **Disaster relief:** Disasters break infrastructures and emergency teams have to rely on the infrastructure they set up themselves. Therefore, ad-hoc networks can be a solution.
- ➢ **Military Activities:** Many military activities are confidential and for security reasons it is good to use ad-hoc connectivity for communication.
- ➢ **Remote areas:** In sparsely populated and hilly areas it is too expensive to set up an infrastructure. Depending on the communication pattern, ad-hoc networks can be a solution

4. CHARACTERISTICS OF MANET

There are some characteristics that distinguish MANETs from infrastructure networks are explained below [1, 2]:

> ### Dynamic Network Topology:

In MANETs, nodes might move resulting in change of the topology. Therefore, snapshot of network is valid only for a very small period of time. This makes classic protocols used for wired networks unsuitable for MANETs.

> ### Power Constraint:

Mobile nodes are mostly wireless devices running on battery power. Therefore, while designing protocols special power-saving modes and power management functions should be considered.

> ### Bandwidth Constraints:

In MANETs, mobile nodes use wireless links which have significantly lower capacity than their hardwired counterparts till date.

> ### Security:

No one should be able to read personal data during transmission and to track the person. Therefore, while designing a protocol for MANETs proper mechanisms for encryption and user privacy are to be considered.

> ### Robust transmission technology:

Transmission antennas are not unidirectional but Omni-directional, so, transmission technology must reduce the effects of multiple access, fading, noise, interference conditions, etc.

> ### Storage Constraint:

In MANET, mobile nodes have limited computing and storage capacity.

5. CLASSIFICATION OF ROUTING PROTOCOLS IN MANET

Mobility of nodes and rapidly changing topology are such characteristics of the MANET network that make routing decisions more challenging. Several other factors such as power and storage constraints and security makes routing more challenging in VANET. Routing protocols can be classified on various basis such as on the topology of network for routing [3,4] i.e. proactive and reactive routing protocols, on the basis of communication strategy used for delivery of information from source to

destination [5] i.e. unicast, multicast and broadcast. Some researchers combined basis of classification [6] and some surveyed only a specific type in detail [7, 8] and some compared the protocols on various basis [9]. In this paper, classification is done using topology information as shown below in Fig. 1.
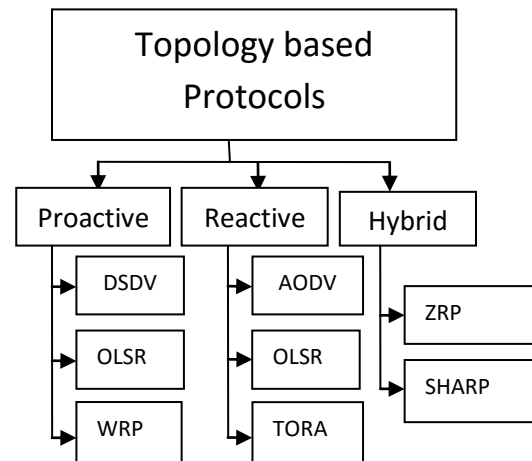
Fig. 1:- Classification of Routing Protocols of MANET

Topology-based routing protocol uses topology information which is stored in the routing table as a basis to forward packets from source node to the destination node. They are further divided into three groups as Proactive, Reactive and Hybrid Protocols.

5.1 Proactive Routing Protocols

Proactive protocols allow a network node to use the routing table to store routes information for all other nodes, each entry in the table contains the next hop node used in the path to the destination, regardless of whether the route is currently needed or not. The table must be updated frequently to reflect the network topology changes. These protocols cause more overhead especially in the high mobility network as they share routing information with the neighbors. However, routes to destinations will always be available when needed. Proactive protocols usually choose the shortest path algorithms to determine which route will be chosen. Proactive based routing protocols may not be suitable for VANETs as they have high mobility nodes and these protocols use much of the bandwidth for sharing routing information with neighbors. Furthermore, size of the table is also quite big for large networks. DSDV and OLSR proactive routing protocols are discussed below:

> **Destination Sequence Distance Vector Routing (DSDV)**

The destination sequenced distance vector routing protocol (DSDV) is a proactive routing protocol [10]. It is extension of classical bellman ford routing mechanism. In DSDV each node maintains a routing table that contains information about all destinations i.e. the total number of hops needed to reach these nodes, next hop to reach the destination and a sequence number initiated by the destination node. The route with the recent sequence number is considered as a fresh route. To maintain routes reliability, each node must periodically share its routing table with its neighbors. The routing table updates can be sent in two ways: a "full dump" or an "incremental" update. DSDV protocol guarantees the loop free routes; it also keeps only the optimal path to every node, rather than keeping multi paths which will help to reduce the total size of routing table.

> **Optimal Link State Routing (OLSR)**

OLSR is a table driven protocol and an optimization of classical link state protocol [11]. In OLSR each node selects a set of Multipoint Relays (MPR) from the set of neighbors with which it has symmetrical links. Thus OLSR requires bidirectional links. Each node has the knowledge as to for which node it acts as a MPR as they periodically announce this information in their control messages. Therefore overhead minimizes as only MPR retransmit the control messages. In OLSR, MPR nodes declare link state information in the network for the nodes to which it acts as a MPR used to provide the shortest route path to all the destinations. MPR nodes are also responsible for formation of routes from source to the destination. The protocol is particularly best for large and dense network as optimization is done by using MPR nodes.

> **Wireless Routing Protocol (WRP)**

WRP is based on the path-finding algorithm [16]. In this routing nodes communicate the distance and second-to-last hop for each destination. WRP reduces the number of cases in which a temporary routing loop can occur. Each node maintains four tables i.e. distance table, routing table, link-cost table and, message retransmission list for the purpose of routing. In WRP, only update messages are propagated to the neighbors of a node. Each MRL entry contains the sequence number of the update message, a retransmission counter, and an acknowledgement required flag and a list of updates sent in the update message. A node can decide whether to update its routing table after receiving an update message from a neighbor. A node checks the consistency of predecessor information reported by all its neighbors each time it processes an event involving a neighbor. Thus, consistency of the routing information is checked by each node which helps to eliminate routing loops and always tries to find out the best solution for routing in the network.

5.2 Reactive Routing Protocols

On demand or reactive routing protocols were designed to overcome the overhead that was created by proactive routing protocols in case of large and highly dynamic network. Reactive routing protocols establish the route only when it is required for a node to communicate with another node. Only the routes that are currently in use are maintained which reduces the burden in the network. Only AODV and DSR routing protocols designed for reactive routing are explained below:

> **Ad-hoc On Demand Distance Vector Routing (AODV)**

AODV routing protocol works purely on demand basis [12]. When a source node needs to communicate with another node, it starts route discovery process by broadcasting a route request message to its neighbor including the last known sequence number for that destination. Each node that forwards the route request also creates a reverse route for itself back to the source node. When the route request reaches a node with a route to destination node that node generates a route reply that contains the number of hops necessary to reach destination and the sequence number for destination most recently seen by the node generating the reply. The state created in each node along the path from source to the destination is hop-by-hop state; that is each node remembers only the next hop and not the entire route, as would be done in source routing. The main features of AODV are quick response to link breakage in active route and loop-free routes by using destination sequence numbers.

> **Dynamic Source Routing (DSR)**

Dynamic Source Routing protocol (DSR) is designed for multi-hop wireless ad hoc networks [13]. This protocol consists of two main mechanisms "Route Discovery" and "Route Maintenance" that makes it self-configuring and

self-organizing. Route discovery is used to discover the routes from source node to destination. A node caches multiple routes to any destination which support rapid reaction to routing changes as another cached route can be tried if the one it has been using should fail. It also avoids the overhead of need to perform a new Route Discovery each time a route in use breaks. In DSR, data packets store information about all the intermediate nodes in its header to reach at a particular destination. Intermediate routers don't need to have routing information to route the data packets, but they save routing information for their future use. The intermediate node which detects broken link through route maintenance also notifies the source node using a route error packet identifying the link over which packet cannot be forwarded.

> ### Temporally Ordered Routing Algorithm (TORA)

TORA is a highly adaptive loop free distributed routing protocol [15]. In this, a Directed Acyclic Graph (DAG) rooted at the destination using query/reply process is created to represent the route from the source node to the destination. In TORA, it is assumed that all nodes have synchronized clocks for maintaining the temporal order of topological changes. TORA uses a parameter height for each node which is a measure of the distance in hops from node to the destination node. The source node uses the height parameter to select the best route toward the destination. It is a loop-free multipath routing to destinations minimizing communication overhead.

5.3 Hybrid Routing

Need of these protocols arises with the deficiencies of proactive and reactive routing and there is demand of such protocol that combines good characteristics of both reactive and proactive routing protocols to make routing more scalable and efficient. ZRP hybrid ad hoc routing protocols is discussed in following:

> ### Zone Routing Protocol (ZRP)

ZRP for reconfigurable wireless networks is based on the idea of routing zones [14]. Each node has a predefined zone centered at itself including other nodes whose distance is in predefined limits in terms of number of hops. Each node has to maintain up-to-date routing information only for nodes in its zone that reduces the network overhead that is caused by proactive routing

protocols. Route Discovery is done to communicate with nodes not present in the zone of a node by forwarding query messages selectively only to the nodes in its zone rather than all the nodes in a network. This causes route discovery mechanism to be much faster than that of global reactive route discovery mechanism.

> ### Sharp Hybrid Adaptive Routing Protocol (SHARP)

SHARP automatically finds the balance point between proactive and reactive routing by adjusting the degree to which route information is propagated proactively versus the degree to which it needs to be discovered reactively [17]. This protocol defines the proactive zones around some nodes. A node-specific zone radius determines the number of nodes within a given proactive zone. All nodes within the zone radius become the member of proactive zone for that node and maintain routes proactively only to the central node All nodes that are not in the proactive zone of a given destination use reactive routing protocols to establish route to that node. In this, proactive zones are created automatically around hot destinations. 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 periphery.

6. CONCLUSION

In this paper, an overview on Mobile ad hoc networks (MANETs) is presented including need of MANETs, its applications and characteristics that distinguish it from other wireless networks. Due to these characteristics, there is need of separate routing protocols for MANET. Classification of routing protocols for MANET has been done on the basis topology of the network i.e. proactive or table- driven and reactive or demand- driven. A summarized overview of routing protocols belonging to each type of classification has also been presented hoping that it will be useful and helpful to students and researchers in the field. From this, we concluded that MANET routing protocols are designed based on the application area and environment and it is not possible to design a single protocol, which is suitable for all MANETs.

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BIOGRAPHY

Ms. Parul Gupta working as an assistant professor in P.I.G. Govt. College for Women, Jind, Haryana, India since Aug, 2015. She has completed B.Tech. (CSE) 2008-12, M.Tech. (CSE) 2012-14 from Guru Jambheshwar University of Sci. & Tech., Hisar, Haryana, India. She has qualified GATE and CBSE-UGC NET and JRF.