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Assessment of Routing Protocols in MANET

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Abstract: Mobile Ad-hoc Network (MANET) is a wireless network and is a collection of independent mobile nodes which dynamically forms a temporary network. MANET does not have any fixed infrastructure or centralized management. These nodes know the self-aware architecture of MANET and can move in any directions, which render its topology. Owing to its dynamic topology and mobile nature of nodes, routing in MANET is perplexing compared to fixed wired networks. In this paper, we have compared the three classification of routing protocols. Protocols like: DSDV, CSGR, WRP, AODV, OLSR, DSR, TORA, ZRP, ZHLS, DYMO are compared with respect to Protocol type, Routing Approaches, Routing structure, Route selection, Route, Routing table, Route maintenance, Operation of protocols, Merits and Demerits.
Keywords: MANET, Routing Protocol, DSDV, CSGR, WRP, AODV, OLSR, DSR, TORA, ZRP, ZHLS, DYMO.

I. Introduction

MANET is the combination of three words[1]: Mobile (which means in moving), Ad-hoc (means temporary which is not permanent) and last one is Network (means thousands of nodes or hubs). Nodes in MANET are autonomous and self -configuring devices. As nodes are moving randomly, its topology changes dynamically. Owing to its dynamic topology, MANET has no fixed infrastructure and nodes are communicating with the help of wireless links. MANET poses number of challenges such as: dynamic topology, limited bandwidth, variable capacity links, energy constrained operation, limited physical security, limited resources and multihop communication. For any communication network optimum routes are required and this is possible only through routing protocol [2]. It specifies which route is shortest, congestion free and safe to transfer the data from one source to destination.

The rest of the paper is organized as follows. classification of routing protocols in MANET is explained in section II. Further the comparison of routing protocols DSDV, DSR, AODV & OLSR is explained in Section III. Concluding remarks are given in section IV.

II. Classification of Routing Protocol

There exist so many routing protocols for ad hoc network and these can be categorized in three schemes: Proactive protocols, Reactive protocol and Hybrid protocols. In MANET, the routing protocols are capable enough to handle a very large number of nodes with limited resources. The major issue associated with the routing protocol involves being appeared and disappeared nature of nodes frequently. It is necessary to reduce routing message overhead despite the increasing number of nodes. Another important issue is to keep the routing table small, reason being increasing the routing table affects the control packets sent in the network and in turn affects large link overheads [3].

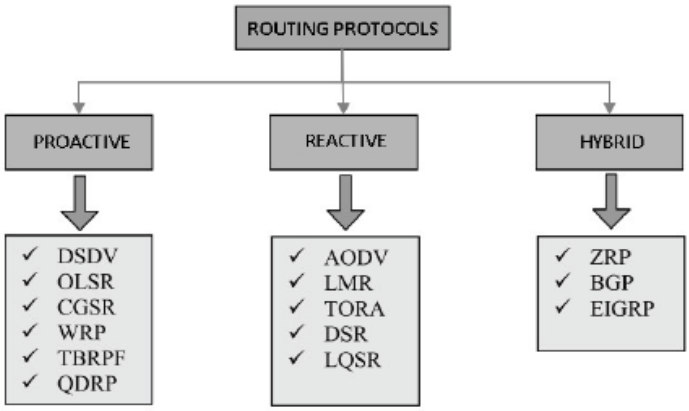

Figure 1: Classification of Routing Protocols

Routing protocol must have some qualities like: distributed operation, loop freedom, demand based operation, proactive operation, security and unidirectional link support. Distributed operation means that any node can enter or leave whenever they want. Loop-freedom is to prevent overhead created during sending information uselessly. Demand based operation is to decrease traffic and use bandwidth resources more efficiently. Proactive operation is used when they require enough bandwidth and energy resources. Security is the most important issue for any communication [3]. Wireless networks whether it is MANET, WSN or other network, all are more vulnerable to attacks e.g. Black hole attack [1], wormhole, sinkhole, hello, etc.

Routing protocols are classified according to how and when routes are discovered and their main focus on to select the shortest path to the destination.

A. Proactive Routing Protocols

Proactive routing protocols are also known as Table-driven routing protocol. These protocols uses link-state routing algorithms for route the data packets to destination which floods link information about its neighbours frequently. These protocols maintains an up-to-date routing information between every pair of nodes with the help of sending control message periodically in network. There are various proactive routing protocols present for MANET like DSDV, OLSR, and WRP etc [8].

B. Reactive Routing Protocols

Reactive routing protocols are also known as on-demand routing protocols [1]. These were designed to reduce overheads present in proactive protocols by maintaining information. It uses distance-vector routing algorithm and establishes the route to given destination only when a node request it by initiating route discovery process. The reactive routing protocols available in MANET [4] are DSR, AODV, TORA and LMR etc.

C. Hybrid Routing Protocols

Hybrid as the name suggests, it is combination of reactive as well as proactive routing protocols. ZRP, BGP, EIGRP are the example of Hybrid routing protocols.

III. COMPARSION OF ROUTING PROTOCOL

In this section, we will make the comparison of explain the ten routing protocol DSDV, CSGR, WRP, AODV, OLSR, DSR, TORA, ZRP, ZHLS, DYMO. The comparison is done with respect to Protocol type, Routing Approaches, Routing structure, Route selection, Route, Routing table, Route maintenance, Operation of protocols, Advantages, Limitation[5][6][7][8][18] as shown in below tables.

Now we will compare proactive routing protocols i.e. DSDV, CSGR, WRP[19] and OLSR[9] in table 1 [7][8][10][11][12][13] and our comparison metrics are Protocol type, Routing Approaches, Routing structure, Route selection, Route, Routing table, Route maintenance, Operation of protocols, Merits and Demerits.

Table 1: Comparison of Proactive routing protocol

Parameters	DSDV	CSGR	WRP	OLSR
Protocol type	Destination sequence distance vector	Cluster switch gateway routing	Wireless routing protocol	Optimized Link State Routing Protocol
Routing approaches	Proactive	Proactive	Proactive	Proactive
Routing structure	Flat structure	Hierarchical Structure	Flat structure	Flat structure
Route selection	Link state	Shortest path	Shortest path	Link State
Route	Single route	Single and multiple route	Single route	Multiple Route
Routing table	Each node maintains a complete address to each destination	Two table 1.Routing table 2.Cluster member table	Four tables	Each node maintains a complete address to each destination

Route maintenance	Each node in the mobile network maintains a routing table	Each node maintains a routing table which is used to determine the next hop to reach the destination.	Routing node maintains the distance and second to last hop information for each destination	Control messages sent in advance
Operation of protocols	Routing information is always available	Mobile nodes are grouped into cluster and each cluster has cluster head and cluster head to gateway routing approach to move traffic from source to destination.	In WRP, routing nodes communicate the distance and second to last hop information for each destination in wireless network and it belong to path finding algorithm.	OLSR supports three mechanisms: neighbor sensing, efficient flooding of control traffic and sufficient topology information.
Merits	1. Loop free 2. Shortest path to every destination is chosen.	1. Cluster head can control a group of ad-hoc hosts. 2. Cluster provide a framework for code separations, channel access, routing, bandwidth allocation.	1. Avoid the count to infinity problems by forcing each node to perform consistency checks. 2. Routing information is accurate, mobile send updates messages periodically to their neighbors.	1. Minimize the overhead 2. Improve the transmission quality
Demerits	1. High overhead 2. It does not support multipath routing	1. If a cluster head is changing frequently and nodes will be spending a lot of time converging to a cluster head.	1. More overheads are required due to "hello" messages.	1.Require more processing power and bandwidth

Now we will compare reactive routing protocols i.e. AODV[19], DSR[19], TORA and DYMO in table 2 [14][15][16][17][19]and our comparison metrics are same as above.

Table 2: Comparison of Reactive routing protocol

Parameters	AODV	DSR	TORA	DYMO
Protocol type	Ad-hoc on demand distance vector routing	Dynamic source routing	Temporally Ordered Routing Algorithm	Dynamic MANET On-demand
Routing approaches	Reactive	Reactive	Reactive	Reactive
Routing structure	Flat structure	Flat structure	Flat structure	Flat
Route selection	Shortest and updated path	Shortest and updated path	Link Reversal	unicast multipath routes
Route	Multiple Route	Multiple Route	Single route	Multipath
Routing table	Each node maintain a route table in which next hop routing information for destination node is stored	Route cache Full route to destination	Use the Direction of the next destination Construct the Direct Acyclic Graph	Route. Address, Route.Prefix, Route.SeqNum, Route.NextHop-Address, Route.NextHop-Interface, Route.Forwarding, Route.Broken

Route maintenance	Every node maintains two counters: Sequence no and broadcast ID	Two different processes: 1. Hop by hop acknowledgement 2. End to end acknowledgement	Link reversal and Route Repair	It performs route discovery again for that destination when receive RERR message
Operation of protocols	1. RREQ broadcast 2. RREP Propagation 3. RERR message	1. RREQ broadcast 2. RREP Propagation 3. RERR message	Route Creation, Route Maintenance and Route Erasure	1. RREQ broadcast 2.RREP Propagation 3. RERR message
Merits	1. Adaptable to high dynamic topology 2. loop free 3. Higher bandwidth efficiency because of lesser overheads	1.Support Multipath routing	1. Able to rapidly build routes 2. Decrease the communication's overhead, Multiple routes	1. It is loop-free protocol 2. Handles a wide variety of mobility patterns, handles a wide variety of traffic patterns 3. Supports routers with multiple interfaces
Demerits	1. Scalability problems due to large delay 2. AODV takes more time to build the routing table.	1. Scalability problems due to source routing and flooding. 2. Being a reactive protocol DSR suffers from high route discovery latency.	1. In large networks the overhead, consume a large bandwidth, Temporary routing loops and Overall complexity	1. Increases the size of the routing packets

Now we will compare reactive routing protocols i.e. ZRP and ZHLS in table 3[16][17][18] and our comparison metrics are same as above.

Table 3: Comparison of Hybrid routing protocol

Parameters	ZRP	ZHLS
Protocol type	Zone Routing Protocol	Zone-based Hierarchical Link State
Routing approaches	Hybrid	Hybrid
Routing structure	Flat structure	Hierarchical
Route selection	Link Reversal	zone-based hierarchical link state
Route	Multiple Route	Multipath
Routing table	Route Table	Depended on the performance of proactive and reactive routing protocols chosen
Route maintenance	Link Reversal and information stored in link table	Proactive routing for intrazone communication and reactive routing for interzone
Operation of protocols	1. RREQ broadcast 2. RREP Propagation 3. RERR message	Two routing tables, an intrazone routing table and an interzone routing table
Merits	1. With properly configured zone radius, outperform both proactive routing protocols and reactive routing protocols.	1. Generates less overhead than the schemes based on flooding 2. Reduces the traffic and avoids a single point of failure
Demerits	1. Path to a destination may be suboptimal. 2. Memory requirement is greater	1. Additional traffic produced by the creation and maintaining of the zone level topology, needed a system location assistance such as GPS

In general these routing protocols can be compared on the basis of comparison metrics like routing overhead, latency, scalability, routing information, periodic updates, mobility, storage requirements, bandwidth requirements and power requirements. Table 4 shows the difference between the Proactive, Reactive routing protocol and Hybrid protocols.

Table 4. Comparison between protocols [2][7]

Features	**Reactive**	**Proactive**	**Hybrid**
Routing Structure	Mostly Flat	Both Flat & Hierarchical	Hierarchical
Route Acquisition	On demand	Table driven	Combination of both
Routing Overhead	Low	High	Medium
Latency	High due to flooding	Low due to routing tables	Inside zone Low outside similar to reactive protocols
Scalability	Not suitable for large networks	Low	Designed for large networks
Routing information	Available when required	Always available	Combination of both
Periodic Updates	Not needed	Yes whenever the topology of the network changes	Yes
Mobility	Route Maintenance	Periodic updates	Combination of both
Storage Requirement	Low	High	Medium
Bandwidth Requirement	Low	High	Medium
Power Requirement	Low	High	Medium

IV.**CONCLUSION**

MANET is growing rapidly in the field of research. Scalability, mobility, battery consumption, routing protocols and security are the major areas of research and so much work has been done by the researchers. This paper provides a comparison routing protocols in mobile ad-hoc networks. These protocols are categorized into three classes i.e. proactive, reactive and hybrid routing protocols. There are number of protocols exist for each of these classes. Each routing protocol has unique feature. The major point of distinction among protocols is the method of discovering routes within source-destination pairs. The routing protocol DSDV, CSGR, WRP, AODV, OLSR, DSR, TORA, ZRP, ZHLS, DYMO is compared with respect to Protocol type, Routing Approaches, Routing structure, Route selection, Route, Routing table, Route maintenance, Operation of protocols, merits and demerits.

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