Analysis Study of Routing Protocols in MANET

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ABSTRACT: MANET (Mobile Ad-hoc Network) consists of group of nodes with decentralized network to configure itself. It does not want to make any pre existing plan or infrastructure, such as routers and access points. Now a day's many researches are doing in this area. Routing is the process of finding path. Many routing protocols were proposed for wireless ad hoc network due to dynamic topology, redundant links, and interference. This paper describes various types of routing protocols and analyzing the performance of protocols by their characteristics, functionality merits and demerits. Some of the routing protocols are DSR, AODV, and DSDV.

KEYWORDS: DSDV, WRP, TORA, ODMR, ZRP.

I. INTRODUCTION

The wireless network divided into two types:
- Infrastructured wireless network.
- Infrastructure less or Ad Hoc wireless network

In Infrastructure wireless networks, the fixed base stations are used when the mobile node move to other region or out of the range. The base station coverage areas or cell are in the form of hexagonal so mobility is made easily as shown in Fig.1
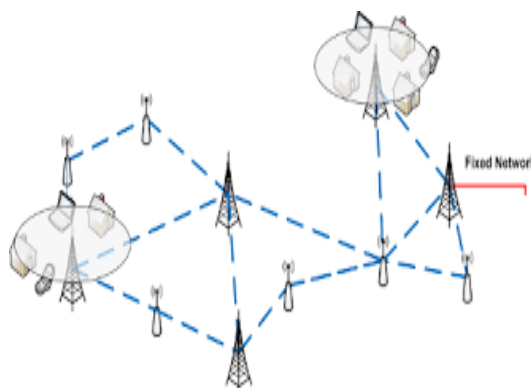

Figure 1: Infrastructured wireless network

In Infrastructure less or Ad Hoc wireless network, there is no fixed base stations so, nodes are act as routers. So the mobile nodes create routing between themselves to form a network.

MANET (Mobile Ad-hoc Network)

MANET is one of the types of an ad-hoc network. Mobile ad-hoc network consist of group of mobile nodes without any centralized control as shown in Fig.2
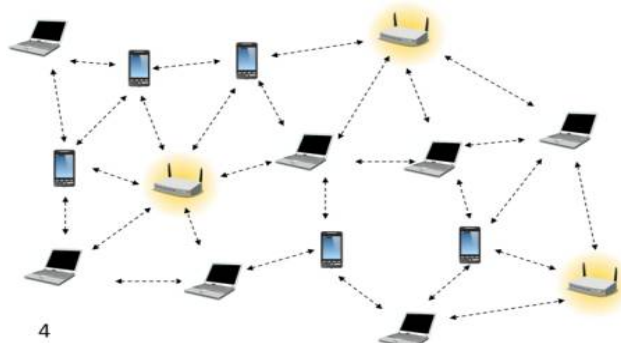
Figure 2: Mobile Ad-hoc network

II. ROUTING

It is the process of finding route or path. Routing is a table contains source, destination. In routing, there are two possible links: good link- strong to transmit, weak link- not strong to transmit.

Difficulties in Routing

- Asymmetric Links
- Redundant Link
- Interference
- Dynamic topology

The node wants to send packet to the destination needs routing protocol due to dynamically changing of topology in ad hoc network.

2.1 Taxonomy of Routing Protocols

Ad hoc network protocols are dived into three types that are proactive, reactive and hybrid protocols according to traditional classification.

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 [1].

Reactive Routing Protocols

Reactive routing protocol is also known as on demand routing protocol. In this protocol route is discovered or created whenever it is needed.

Route discovery: In this phase source node initiates route discovery process. The source node includes the destination address, intermediate nodes to the destination in the packet.

Route maintenance: Due to route failure between the nodes arises due to link breakage. So route maintenance is done by acknowledgement mechanism.

Hybrid Routing Protocol

Hybrid routing protocol is the combination of both proactive and reactive routing protocols.

III. PERFORMANCE ANALYSIS OF ROUTING PROTOCOLS

3.1 Performance Metrics

i. *Packet Delivery Fraction*: It is the ratio of data packets delivered to the destinations to those generated by the CBR sources. This papers about the performance of a protocol that how successfully the packets have been delivered.

ii. *Average End To End Delay*: Average end-to-end delay is an average end-to-end delay of data packets. Buffering during route discovery latency, queuing at interface queue, retransmission delays at the MAC and transfer times, may cause this delay.

iii. *Packet Loss:* It is defined as the difference between the number of packets sent by the source and received by the sink

3.2 Routing protocols in MANET

A. Dynamic Destination Sequence Distance Vector Routing Protocol (DSDV)

DSDV is a proactive routing protocol because it maintains a routing table. It's an enhancement of Distance vector routing for ad hoc networks. This protocol consists of two factors

i. *Sequence numbering:* Each node is in the network keeps a routing table. Routing table contains list of all available Sources and destinations and possible paths. Each entry in the table is differing by sequence number to avoid loops and inconsistencies.
ii. *Damping:* It means advertise. Each node has to advertise its routing table to its current neighbours by broadcasting. The neighbouring nodes know about there is any changes in the network by Damping. The routing updates sent by two ways: full dump and incremental. Full table sent to neighbours called as full dump. Only the entries sent to neighbours called as incremental.

B. Wireless Routing Protocol (WRP)

WRP is a proactive routing protocol because it maintains four things that are

i. A distance table
ii. A routing table
iii. A link cost table
iv. A message transmission list (MRL)

MRL is to avoid temporary routing loop. WRP uses update message transmission to neighbor nodes. If node has update should send acknowledgements. If node has no change from last update should send idle hello to ensure connectivity. A node only decides whether to update or not after getting update message from neighbor. This protocol also looks for best path. If a node gets best path, relay backs that information to original nodes. After that original node gets an acknowledgment updates its MRL.

C. Cluster Gateway Switch Routing Protocol (CGSR)

CGSR is also a proactive protocol. In this protocol the nodes are separated into interrelated group of nodes. In these groups, one of the nodes elected as cluster head to achieve distributed mechanism. This protocol is differing from DSDV by hierarchical cluster-head-to-gateway routing approach. The node that is in the range of two or more cluster heads called as gateway node. Gateway node switches the packets between one cluster head to another cluster head. Finally From their own cluster head to node are receiving their packets.

Parameters	DSDV	CGSR	WRP
Time Complexity (link addition / failure)	$O(d)$	$O(d)$	$O(h)$
Communication Complexity (link addition / failure)	$O(x=N)$	$O(x=N)$	$O(x=N)$
Routing Philosophy	Flat	Hierarchical	Flat[1]
Loop Free	Yes	Yes	Yes, but not instantaneous
Multicast Capability	No	No[2]	No
Number of Required Tables	Two	Two	Four
Frequency of Update Transmissions	Periodically & as needed	Periodically	Periodically & as needed
Updates Transmitted to	Neighbors	Neighbors & cluster head	Neighbors
Utilizes Sequence Numbers	Yes	Yes	Yes
Utilizes "Hello" Messages	Yes	No	Yes
Critical Nodes	No	Yes (cluster head)	No
Routing Metric	Shortest Path	Shortest Path	Shortest Path

Table 1: Performance Analysis of Proactive Protocols

D. Ad Hoc On-Demand Distance Vector Routing (AODV)

AODV is a Reactive protocol and it is an improvement of DSDV instead of proactive protocol. In AODV, if the node that wants a connection then broadcasts a request (RREQ).

Source node broadcasts a RREQ across the network as the process of route discovery. If a destination node receives RREQ then it will send a route reply (RREP). If in case of failure it rebroadcasts RREQ. If the node discards RREQ that already had. The major difference between DSR & AODV, DSR uses source initiated routing and doesn't have intermediate nodes to choose the next hop address. In AODV, intermediate nodes will choose the next hop address.

E. Dynamic Source Routing (DSR)

DSR is a reactive protocol to initiates route discovers process by source. The source node only decides the route from source to destination and intermediate nodes too. It is a beaconless protocol in which no HELLO messages are exchanged between nodes to notify them of their neighbors in the network [1].

F. On-Demand Multicast Routing Protocol (ODMR)

ODMR is a Reactive protocol for routing multicast and unicast traffic throughout ad hoc wireless mesh networks [6]. It creates routes only when needed, instead of creating by proactively. It provides multiple routes for one particular destination.

G. Associativity-Based Routing (ABR)

In ABR, a route is discovered by the degree of association stability of nodes. In the network, to announce each node has to periodically generate beacon. A neighbor node updates when it receives beacon message. Associativity tick is reset when any neighboring node moves out of the neighborhood of any other node [2].

H. Signal Stability-Based Adaptive Routing Protocol (SSA)

SSA is a reactive protocol to obtain the more stable routes in ad hoc network. This protocol performs a route discovery process by signal strength and location stability. SSA detects weak or strong channels by signal strength

SSA classified into two 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 signal strength of the neighboring nodes as weak or strong by beacon message received from neighbor node. DRP is to send to SRP after all transmissions completed. If it is a destination, SRP have to send packets to upper layer stack. Otherwise, it is look for destination and forward the packet. In destination, node sends back route-reply message after getting request.

I. Temporaily Ordered Routing Algorithm (TORA)

TORA [3] is a reactive routing protocol with some proactive enhancements where a link between nodes is established creating a Directed Acyclic Graph (DAG) of the route from the source node to the destination In this protocol, direction of the link between two nodes determined by height parameter. To initiate a route discovery, broadcasts a QUERY and propagated throughout the network. This QUERY packet is rebroadcast till it reaches to the destination.

J. Zone Routing Protocol (ZRP)

ZRP is a hybrid protocol. It is more suitable for large span and diverse mobility patterns. In ZRP, Routing zone means each node in the network maintains proactively maintains routes within a local region. The QUERY-REPLY mechanism is used for route creation. If it's a packet's destination in same zone, already stored routing table is used immediately by proactive protocol. If it's a packet's destination in other zone, a routing is done by reactive protocol Neighbor discovery information is used as a basis for Intra-zone Routing Protocol (IARP), which is described in detail in [4].

K. Sharp Hybrid Adaptive Routing Protocol (SHARP)

SHARP protocol is act as proactive and reactive so it is a hybrid protocol. SHARP [3] adapts between reactive and proactive routing by dynamically varying the amount of routing information shared proactively. Proactive zone consists of node determined by zone radius to become these nodes are member of particular proactive zone. To discover a route when there is no destination within the proactive zone by reactive protocol. 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 [1][5].

Performance Parameters	AODV	DSR	TORA	ABR	SSR
Time Complexity (initialization)	O(2d)	O(2d)	O(2d)	O(d+z)	O(d+z)
Time Complexity (postfailure)	O(2d)	O(2d) or 0 (cache hit)	O(2d)	O(l+z)	O(l+z)
Communication Complexity (initialization)	O(2N)	O(2N)	O(2N)	O(N+y)	O(N+y)
Communication Complexity (postfailure)	O(2N)	O(2N)	O(2x)	O(x+y)	O(x+y)
Routing Philosophy	Flat	Flat	Flat	Flat	Flat
Loop Free	Yes	Yes	Yes	Yes	Yes
Multicast Capability	Yes	No	No[3]	No	No
Beaconing Requirements	No	No	No	Yes	Yes
Multiple Route Possibilities	No	Yes	Yes	No	No
Routes Maintained in	route table	route cache	route table	route table	route table
Utilizes Route Cache/Table Expiration Timers	Yes	No	No	No	No
Route Reconfiguration Methodology	Erase Route; Notify Source	Erase Route; Notify Source	Link Reversal; Route Repair	Localized Broadcast Query	Erase Route; Notify Source
Routing Metric	Freshest & Shortest Path	Shortest Path	Shortest Path	Associativity & Shortest Path & others[4]	Associativity & Stability

Table 2: Performance Analysis of Reactive Protocols

IV. CONCLUSION

In this research paper we discussed about the overview of performance of the routing protocols in mobile ad-hoc network. Routing protocol is an important because of dynamically changing network topology and transmitting packet delivery.   The Objective of this paper is to make compared of all the routing protocols by their performance in wireless ad-hoc network. We classified these protocols as proactive, reactive and hybrid. It may difficult to choose a routing protocol for different application.

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