"A Review of Multipath Routing protocols for AD-HOC network"

Purva Pandey[1], Prof. Vinod Sonkar[2]
Student, Electronics and Communication Dept, SDBCT, M.P., India
Asst.Professor, Electronics and Communication Dept, SDBCT, M.P., India

ABSTRACT

Ad- hoc networks contain a collection of wireless nodes which communicate among themselves without the exigency of fixed infrastructure. Limited transmittal span of wireless network nodes causes multiple hops to share information with any other node in the network. The main function of Mobile Ad Hoc networks is to find and establish the route between source nodes and destination node, and forwards the traffic from source node to neighbour node to reach destination when the transmission range exceeds. The major issue in Mobile Ad-hoc networks (MANET) is maintaining the topological information in the network. An ad-hoc network has certain characteristics, which imposes new demands on the routing protocol. The most important characteristic is the dynamic topology, which is a consequence of node mobility. Nodes can change position quite frequently, which means that we need a routing protocol that quickly adapts to topology changes .Many routing protocols are available in Mobile Ad-hoc networks.

Keywords- *Ad-hoc, Proactive, Reactive, AOMDV, Multi hop, Mobility*.

INTRODUCTION

Ad hoc networks are characterized by dynamic topology, high node mobility, and low channel bandwidth. Research in Ad hoc networks seems to have downplayed the concern of scalability. Mobile nodes are grouped randomly and act as router and a host that transmit the data packet to other node stochastically [1]. In fact, current ad hoc architectures do not scale well beyond a few hundred nodes [2]. Mobility causes complication in routing due to frequent changes in network topology. To search and maintain route a mechanism is required to be flexible to frequent changes in topology. Due to dynamic nature, node moves and the settled paths between these nodes may break. the routing protocols must search for other feasible routes dynamically. even maintaining connectivity With a changing topology is very difficult. Several routing methods have been proposed [2] [3].

Challenges in MANETs:

- Reducing overhead
- Improving the Packet Delivery Ratio and Mobility issues.
- Decreasing End-to-End delay and Latency.

ROUTING IN MANET:

It commences a route discovery process by sending a message to its neighbours, and acknowledge back to source node with another message [2]. As MANETs is a multi-hop network topology, The routing protocol has two main functions, selection of routes for various source-destination pairs and the delivery of messages to their correct destination. The second function is conceptually straightforward using a variety of protocols and routing tables. There should be an efficient routing protocols to establish communication route path between each nodes [3].

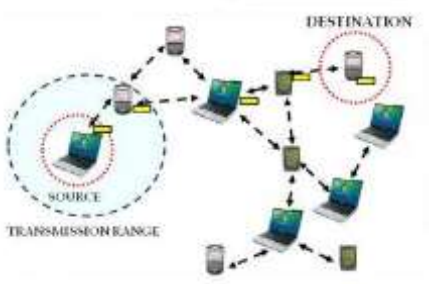

Fig -1: Routing in MANET

Conventional protocols: Link state and distance vector would probably work very well in an ad-hoc network with low mobility, they are highly dependent on periodic control messages.
Link State: In link-state routing [6], each node maintains a view of the complete topology with a cost for each link. To keep these costs consistent; each node periodically broadcasts the link costs of its outgoing links to all other nodes using flooding. As each node receives this information, it updates its view of the network and applies a shortest path algorithm to choose the next-hop for each destination.
Distance Vector : In distance vector [2] each node only monitors the cost of its outgoing links, but instead of broadcasting this information to all nodes, it periodically broadcasts to each of its neighbours an estimate of the shortest distance to every other node in the network. The receiving nodes then use this information to recalculate the routing tables, by using a shortest path algorithm.
Source Routing : Source routing [6] means that each packet must carry the complete path that the packet should take through the network. The routing decision is therefore made at the source. with this approach it is very easy to avoid routing loops but each packet requires a slight overhead.
Flooding : routing protocols uses broadcast to distribute control information, that is, send the control information from an origin node to all other nodes[6]. The origin node sends its information to its neighbours. The neighbours relay it to their neighbours and so on, until the packet has reached all nodes in the network. A node will only relay a packet once and to ensure this some sort of sequence number can be used. This sequence number is increased for each new packet a node sends.

CLASSIFICATION:

Routing protocols can be classified [1] into different categories depending on their properties.

- Centralized vs. Distributed
- Static vs. Adaptive
- Reactive vs. Proactive

One way to categorize the routing protocols is to divide them into centralized and distributed algorithms. In centralized algorithms, all route choices are made at a central node, while in distributed algorithms, the computation of routes is shared among the network nodes.
Another classification of routing protocols relates to whether they change routes in response to the traffic input patterns. In static algorithms, the route used by source-destination pairs is fixed regardless of traffic conditions. It can only change in response to a node or link failure. This type of algorithm cannot achieve high throughput under a broad variety of traffic input patterns. Most major packet networks uses some form of adaptive routing where the routes used to route between source-destination pairs may change in response to congestion.
A third classification that is more related to ad-hoc networks is to classify the routing algorithms as either proactive or reactive. Proactive protocols attempt to continuously evaluate the routes within the network, so that when a packet needs to be forwarded, the route is already known and can be immediately used. The family of Distance-Vector protocols is an example of a proactive scheme. Reactive protocols, on the other hand, invoke a route determination procedure on demand only. Thus, when a route is needed, some sort of global search procedure is employed. The family of classical flooding algorithms belongs to the reactive group. Proactive schemes have the advantage that when a route is needed, the delay before actual packets can be sent is very small. On the other side proactive schemes needs time to converge to a steady state. This can cause problems if the topology is changing frequently.

Reactive methods are based on demand for data transmission. Routes are determined when an explicit need for forwarding packets between hosts is created. routing overhead can be significantly reduced when the lightweight traffic is used and the topology variation is less dramatic, as periodically updating route information and their route maintenance on which there is no traffic is not required.
Proactive methods maintain a constantly updated route to all nodes; including nodes those are not sharing packets. Proactive methods react to small changes in topology regardless that traffic is affected or not. One observation of routing protocols is that, though the source actually explores multiple paths over the process of route discovery, it elects only the best route and reject the rest route [4]. Due to non availability of alternate path to the destination, route breaks frequently and causes the drop in packet by intermediate nodes. This affects the overall throughput and may reduce packet delivery ratio. Moreover, frequent route discoveries in high mobility scenarios create high average end-to-end delay.
Multipath routing protocols try to pacify these issues by computing and caching multiple paths during a single route discovery process. The performance tends to increase due to availability of number of

alternate paths as node density increase. In such protocols, source switches to an alternate path if link through which data transmission is actually taking place fails in the primary path. Current multipath routing protocols cache multiple routes obtained during the route discovery process [1].The best path, i.e., the path with the shortest hop count, is chosen and considered as the primary path for data transfer while other paths are used only when the primary path fails [1].

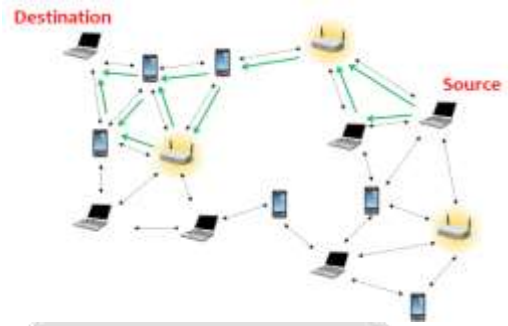

Fig -2: Multipath Routing in MANET

As maintenance of the alternate paths is no not performed by these protocols, the alternate path is likely to also be invalid. In case of node mobility path maintenance is must otherwise more packets will be dropped while each of the alternate paths is tried in succession. Multipath routing protocols initiate route discovery only when all alternate paths fail. Multipath routing protocols like node disjoint, link disjoint paths store paths that do not have common nodes or links exist [5].

Destination Sequenced Distance Vector – DSDV [2] is a hop-by-hop distance vector routing protocol that in each node has a routing table that for all reachable destinations stores the next-hop and number of hops for that destination. DSDV requires that each node periodically broadcast routing updates. DSDV uses a sequence numbers to tag each route. The sequence number shows the freshness of a route and routes with higher sequence numbers are favorable. DSDV basically is distance vector with small adjustments to make it better suited for ad-hoc networks. These adjustments consist of triggered updates that will take care of topology changes in the time between broadcasts. To reduce the amount of information in these packets there are two types of update messages defined: full and incremental dump. The full dump carries all available routing information and the incremental dump that only carries the information that has changed since the last dump.

Ad-hoc On Demand Distance vector – AODV

The Ad Hoc On-Demand Distance Vector (AODV) [7] routing protocol enables multi-hop routing between participating mobile nodes wishing to establish and maintain an ad-hoc network. AODV is based upon the distance vector algorithm. The difference is that AODV is reactive, as opposed to proactive protocols like DV, i.e. AODV only requests a route when needed and does not require nodes to maintain routes to destinations that are not actively used in communications.

The algorithm uses different messages to discover and maintain links. Whenever a node wants to try and find a route to another node, it broadcasts a Route Request (RREQ) to all its neighbours. The RREQ propagates through the network until it reaches the destination or a node with a fresh enough route to the destination. Then the route is made available by unicasting a RREP back to the source.

The algorithm uses hello messages (a special RREP) that are broadcasted periodically to the immediate neighbours. These hello messages are local advertisements for the continued presence of the node and neighbours using routes through the broadcasting node will continue to mark the routes as valid. If hello messages stop coming from a particular node, the neighbour can assume that the node has moved away and mark that link to the node as broken and notify the affected set of nodes by sending a link failure notification (a special RREP) to that set of nodes.

MULTIPATH ROUTING PROTOCOL:

I) Pro-Active / Table Driven

Open Shortest Path First Protocol (OSPF)

OSPF has two primary characteristics. It is a protocol based on the shortest path first (SPF) algorithm also called as Dijikstra algorithm. The second characteristic is it is an open protocol which means that the specification is public domain. Unlike other protocol which use distance-vector or

Bellmanford technology, the OSPF use line-static or SPF based technology to find the route to destination.

The link state database is formed in the network by flooding the individual link state Advertisement (LSA). The LSA describes small pieces of the routing domain. The link state database is used for each router builds a routing table calculating shortest path tree. In OSPF when exist several equal cost routes to a destination, the traffic is distributed equally among them. These multiple routes need not be node-disjoint or link disjoint. Each node find its neighbours by the use of Hello message. These messages are also function as keep-alive packets.

Optimized Link State Routing Protocol (OLRS)

The OLSR is a pure link state protocol. The complete information is flooded through network. It compacts the size of information sent in each message and reduces the retransmission of packet to the network. In OLSR, the multipoint relaying (MPRS) technique is used to flood it's the control message in the network. The multipoint relays technique is used to minimize the flooding of broadcast packets in the network by reducing retransmissions in same region.

In OLSR, each node selects a set of 1-hop neighbours called multipoint relays (MPRS) of that node. The neighbours of any node N that are not present in the MPR Set, they read and process packets but not retransmit the broadcast packets received from node N. Each node maintains a set of neighbours for retransmission of packets. The multipoint relay set node of N satisfies the following condition: Every node in the two hop neighbourhood of N must have a bidirectional link towards other nodes in N. These bidirectional links are periodically broadcasting Hello messages containing information. Each node maintains a topology table and routing table. Each entry having a destination address, next-hop address and number of hops to the destination. The routing table in constructed based on neighbours node table and topology table.

Topology Broadcast Based on Reverse Path Forwarding (TBRPF)

The TBRF use the concept of reverse path forwarding to broadcast link-state updates in the reverse direction along the spanning tree formed by minimum-hop path from all nodes to the source. It computes minimum-hop path from the tree. The TBRPF generates last update traffic than pure link-state routing algorithm. In TBRPF, each node maintains a list of its neighbours and topology table. In topology table, each entry contains the most recent cost and sequence number associated with the link. Each node has the following information. Topology table which consists of link-states stored at the nodes. A list of neighbour nodes. Each node contain a present node, a list of children and sequence number of the most recent link state update.

II) Re-Active / On Demand

Re-active or On-demand multi path routing protocols are reducing the path Compare with proactive multi path protocols. The routes are maintained and determined whenever the nodes want to send data to destination. The route discovery process happened. It sends a route reply packet back to the source using link reversal.

AODV-BR Protocol

The AODV-BR protocol is implemented from the AODV protocol. Its route construction process is same as AODV. When a source needs send data to destination, and there is no route to destination then its search rules a route by flooding a route request (RREQ) packet. Each of these RREQ packets has unique ID. The intermediate nodes can detect and drop duplicates. When an intermediate node receiver a RREQ Packets, it records the previous hop and source node information then sends a route reply (RREP) packet back to the source node if route to the destination is known. The destination sends a RREP via the selected route. When the source receive the first RREQ or latter RREQ then find out the better route.

Ad-hoc On-demand Multipath Distance Vector Routing Protocol (AOMDV)

The AOMDV uses the basic concept of AODV route construction process. It creates multiple loop free, link-disjoint paths. It eliminates frequent link failures and route breaks in network.

Two rules will be followed during route discovery process:

i) To establish and maintain multiple loop-free paths at each node

ii) Find a link-disjoint paths

The link failure may occur node failure, congestion in traffic packet collision and etc. When a source needs to send information to the destination, it initiates a route discovery process. It sends RREQ Route request packet to destination through network. The RREQ packets identified by unique

sequence number. So the duplicate packets can be discarded. When an intermediate node receiving non-duplicate RREQ packets, it records previous hop and check valid fresh route entry to the destination in routing table. The node sends back RREP to the source. The node sends back RREP to the source, if not it rebroadcast the RREQ. A node updates its routing information and propagates the RREP upon receiving further RREPs only if a RREP contains either a larger destination sequence number or a shorter route found. In AOMDV each RREQ, respectively RREP arriving at a node potentially defines an alternate path to the source or destination. When a node S floods a RREQ packet in the network, each RREQ arriving at node via a different neighbour of S node-disjoint path to destination.

Temporally-Ordered Routing Algorithm (TORA)

TORA is a highly adaptive, distributed routing algorithm based on the link reversal. It has multiple loop free paths from source to destination. TORA has three basic functions

i) Route Creation

ii) Route maintenance

iii) Route Erasure

In route discovery process, TORA creates a directed-acyclic graph (DAG) Which is based on a "height" metric. This height differ per destination. The height of the destination is always zero, where as the height of the other intermediate nodes increased by 1 towards source node. In TORA, a node to initiate a route discovery process, it broadcast QUERY to neighbours node. The node re-broadcast the query packet through the network until it reaches the destination. This node replies an UPDATE Packet with height respect to the destination. Each node receiving the UPDATE sets its own height to one greater than that of the neighbour that sent it.

Comparison of Re-Active protocols:

Protocol /properties	**AODV- BR**	**AOMDV**	**TORA**
Implementation	AODV	AODV	TORA
Source flood packet	RREQ	RREQ	QUERY
Destination floods packet	RREP	RREP	UPDATES
Multiple routes	NO	YES	YES
Loop free paths	YES	YES	YES
Route known by source	NO	NO	NO

Comparison of Pro-Active protocol

Protocol /properties	**OSPF**	**OLSR**	**TBRPF**
Implementation	OSPF	OLSR	TBRPF
Route known by source	YES	YES	YES
Loop free paths	YES	YES	YES
Multiple routes	YES	YES	YES
Node Disjoint path	NO	NO	NO

CONCLUSION: The routing protocol is needed to provide multiple complete route from source to destination. The proactive multipath routing maintains the network connectivity positively. The Re-active multipath routing determines routes dynamically when the route needed. The hybrid multipath routing employs both proactive and reactive properties.

REFERENCE:

[1] Chandni, Sharad Chauhan, Kamal Kumar Sharma, "Routing Protocol In MANET – A Survey" Chandni al. International Journal of Recent Research Aspects, Vol. 1, Issue 2, 2014, pp. 48-52.

[2] Beigh Bilal Maqbool, Prof.M.A.Peer,Classification of Current Routing Protocols for Ad Hoc Networks - A Review, International Journal of Computer Applications, October 2010

[3] Charles E. Perkings, Elizabeth M. Belding-Royer, Samir R.Das, AdHoc On-Demand Distance Vector (AODV) Routing, http://www.ietf.org/internet-drafts/draft-ietf-manet -aodv-13.txt, IETF Internet draft, Feb 2003

[4] Mahesh K marina and Samin R Das , "on denand multipath Distance Vector Routing in Ad-hoc Network."In Proceeding of IEEE international conference on Network Protocol, November 2001
[5] T. Goff, N. B. Abu-Ghuzaleh, D. S. Phatak, and R. Kahvecioglu, Preemptive routing in ad hoc networks, in Proc. ACM MobiCom, 2001.
[6] L.Shriinithi, K.Santhi,MCA, M.phil,(PhD), "Survey on Cooperative Opportunistic Routing Schemein MANET", International Journal of Advent Research in Computer & Electronics (IJARCE)Vol.1, No.1, 2014.
[7] Goyal, P. "Simulation study of comparative performance of AODV, OLSR, FSR & LAR, routing protocols in MANET in large scale scenarios," Information and Communication Technologies (WICT), 2012 World Congress on 2012, Page(s): 283 – 286
[8] Benjie Chen and Robert Morris, "L+: Scalable landmark routing and address lookup for multi-hop wireless networks," 2002
[9] Nadia Qasim, Fatin Said and Hamid Aghvami, "Mobile Ad hoc Networks simulations using Routing protocols for Performance comparisons", Proceedings of the world congress on Engineering, WCE, VOL I, 2008
[10] P. Jacquet, P. Muhlethaler, T. Clausen, A. Laouiti, A. Qayyum and L. Viennot, "Optimized Link State Routing Protocol for Ad-hoc Networks," Multi Topic Conference, 2001. IEEE INMIC 2001, Technology for the 21st Century. Proceedings. IEEE International. 2001.