SURVEY ON ROUTING PROTOCOLS FOR MOBILE AD HOC NETWORK

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Abstract

Mobile ad hoc networks (MANETs) is a collection of wireless mobile nodes which dynamically exchange data among themselves without wired backbone network. MANET nodes are typically characterized by their limited power, processing, and memory resources as well as high degree of mobility. MANET has dynamic topology and due to the limited transmission range of wireless network nodes, multiple hops are usually needed for a node to exchange information with any other node in the network. Thus routing is a crucial issue to the design of a MANET. In this paper we specifically examine routing protocols based on route selection like single path routing and multipath routing. In MANET multipath routing is major area for research. Therefore we discussed some multipath routing with their advantages and disadvantages.

Index Terms: Mobile ad hoc network, DSR

I. INTRODUCTION

Ad-hoc network are mobile wireless network that have no fixed infrastructure. A MANET (Mobile Ad-hoc Network) in simple words can be defined as ad-hoc network with rapidly changing topology. MANET is characterized by dynamic topologies due to uncontrolled node mobility, process and memory resources, limited power. In MANET node moves frequently, therefore topology changes frequently and the rate of change is directly proposal to the velocity of the nodes. The mobile nodes may enter or leave the network dynamically which is the basic functionality of the MANET. In that case routing is major issue to design of a MANET.

Routing is a mechanism to transfer data packet from source to destination. Routing protocols are classified into two different categories as proactive (table-driven) and reactive (source-initiated or on-demand). In proactive routing protocols, each node should maintains routing table of other node in the network. Like Destination Sequence Distance Vector (DSDV). On Other hand, on–demand routing protocols were designed to reduce the overhead because routing paths are searched only when needed. Like On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR).

A. AN OVERVIEW OF MANET

MANET is a collection of wireless mobile nodes which dynamically exchange data among themselves without relay on any pre-existing infrastructure. Due to dynamic topology of MANETs any node can enter or leave the network at any time. Also each node has some inherent limitations in terms of limited resources such as battery, processing power, and on-board memory. Routing means a mobile node sends a packet to the destination node via intermediate node. Therefore routing is crucial issues in MANET.

B. ROUTING IN MANET

MANET has two types of routing categories: unipath (single path) and multipath. Unipath routing means there is single path available between source and destination. In single path routing, if intermediate node will be fail. It will not work. Thus communication between nodes

would typically endure period of intermediate node failure and as well as packet loss. Second, many of nodes are power constrained in MANET. Because of that, it is possible that some of the nodes might not be able to work. Therefore long term failure will occur. Major issues in single path routing is node failure or link failure. To overcome this limitation multipath routing is introduced. It is proposed as an alternative to single path routing to distribute load and alleviate congestion in the network.

C. Challenges and Issue

1) How to find multiple path: To find multiple path between source nodes to destination node, the basic route discovery process used in AODV and DSR protocols needs to be modified. For multipath routing, route should be node disjoint or link disjoint. Thus, the route discovery process of existing routing protocols need to be modified to find a maximum number of node joint or link disjoint path. After discovering route there is arise another issues how to select a suitable path or what node should make this selection, mainly the source or destination.

2) How to select path: Once all multiple paths are discovered, a multipath routing protocol should decide how to select a path form source to destination. So if there is more than one path available, then check for that which paths should be used? If few paths are used, then it will work same as shortest path algorithm. On the other hand if all path are used, then there is a chance to selecting largest path, which will helpful for multipath routing protocol.

3) How to distribute load: Once all suitable path are discovered, a good protocol need to decide that how to use these multiple paths to send data. For that there is more option available like randomly path selection, path can be selected to send a present number and then a different path can be selected to send the same number of packets and last path can be selected based on delay constrain of the network. So after selection of path or set of paths from source to destination there is again one issues arise how to send data. Either it may divide a packet into multiple segments and send these segments into different path or it may send duplicate copies of packet through different paths.

II. PARAMETERS FOR ROUTING PROTOCOL

Paper	Throughput	Latency (msec)	Packet delivery	Number of packet	Normalize routing load	Hop distance
[1]	No	No	No	No	No	No
[2]	Yes	yes	No	No	No	No
[3]	No	Yes	Yes	Yes	Yes	Yes
[4]	No	yes	No	No	No	Yes
[5]	No	No	No	No	No	No
[6]	No	Yes	No	No	No	Yes
[9]	No	Yes	Yes	No	No	No
[10]	No	Yes	Yes	No	No	No

Table 1. Survey table

III. UNIPATH ROUTING IN MANETS

Routing protocols are used for finding routes between sources to destination. Many routing protocols have been proposed and these protocol categorized into two part: table driven (proactive) and on-demand (reactive).

In proactive routing protocol like destination sequence distance vector routing (DSDV), each node should maintain routing table which contains routing information to all nodes in to the network. Each node must periodically exchange message with routing information to keep routing tables up to date. Therefore it is not suitable for large area network. In on-demand routing protocol (reactive) the nodes only discovers path when they are needed.so that on demand routing protocols are more scalable to dynamic large network. When a node needs a path to another node it will initiates a route discovery process to find new route. On demand routing protocol has two main phase: first route

discovery, source node will find the route to the destination and second route maintenance, worked when source node detect any topology change or any kind of route failure. Two most common routing protocol used for MANET is Dynamic Source Routing (DSR) and Ad-hoc On Demand Routing (AODV) protocol.

A. DSR

The DSR[1](Broch et al.,1998) is an on-demand routing protocol for MANET .In DSR source node include full route in the packets' header. DSR protocols consists of two basic mechanism:1)route discovery and 2)route maintenance. In route discovery mechanism, when source node want to send data packet, it will show the route cache if path is available or not. If path is not available it will initiate route discovery mechanism using broadcasting of RREQ (Route Request) message to its neighbor node. The RREQ message includes a route record which specifies the sequence of nodes traverse by the message. When an intermediate node or neighbor node will receive a RREQ message , it will check whether it is already in the route record or not. If it is, it will drop the message, this is help to prevent routing loops. If an intermediate node finds that it is the destination, it will send RREP(Route Reply) message back to the source after copying of routing information contained in RREQ message into a RREP message. If neighbor node is neither destination nor a it has a route in route cache to the destination, it attaches its address in the RREQ message and then it forward to its next neighbor .this process will continues until a RREQ message find its destination node. If an intermediate node has route to destination in its cache then it can append the route in to the route record and find RREP back to its source node. It can reduce limit flooding of the RREQ. Now in route maintenance mechanism when a node detects any topology change or broken link, it removes link from its routing cache and send route error(RERR) message back to each node that has sent packets from that link.

B. AODV

The AODV (Ad-hoc On-demand Distance Vector) protocol (perkins,1997)[1] is an on demand, loop free distance vector protocol. AODV contains on-demand route discovery mechanism in DSR with the concept of destination sequence number from DSDV.DSR uses source routing while AODV use hop by hop routing mechanism to maintain routing table at intermediate node. AODV protocol also contains two mechanism like DSR-1) Route discovery and 2) Route Maintenance. But format of route request message (RREQ) of AODV protocol is different from DSR protocol. To find a fresh route from an unavailable route, each node should maintain two counters one is node sequence ID and another is broadcast ID. Each route request message contain information of the destination sequence number and source sequence number and in addition it also contains source address and destination address. When route is needed source node initiate route discovery procedure. If neighbor node is destination node it will send route reply (RREP) message back to the source node. If it is not, then it needs to keep track of Request message to set up reverse path and forward path. Node can find that this route is a current one or stale one by comparing the destination sequence number in the route request (RREQ) message with that of the sequence number stored in the route record. If the RREQ sequence number is greater than the stored sequence number then it does not send RREP message to the source. An intermediate node can only reply if its sequence number is greater or equal to the RREQ sequence number. While maintaining a route mechanism when a node detects any broken link while it is broadcasting a packet to the next hop, it generates a RERR message that is sent to all source which are using these broken link. If source receives RERR message and it still required destination, then it initiate new route discovery process.

IV. MULTIPATH ROUTING PROTOCOL

Reactive routing protocols like DSR and AODV do not work with large area network. The scalability problem arises from high delay, excessive routing overhead and unreliable data transfer and energy efficiency. In unipath routing protocol message control overhead is very high during route discovery process to find destination node. Another problem in reactive routing protocol is high end to end delay. This delay occurs because of unreliable path selection, unfair load distribution and high

overhead. Next unreliable data packet transfer is another problem of reactive routing. This problem occurs due to node movement.

Benefits of Multipath Routing:

1) Multiple paths routing can provide load balancing, fault-tolerance, and higher aggregate bandwidth. Spreading the traffic along multiple routes can be achieved by Load Balancing. This can alleviate two issues such as congestion and bottlenecks.

2) Multipath routing protocol has three main phase: route discovery, route maintenance, and traffic allocation.

A. SMR

Split multipath routing (SMR) is on-demand multipath source routing protocol introduced in Lee and Gerla(2000).In SMR route discovery process is similar to DSR protocol, but intermediate node is not allowed to reply from its route cache if it has already path available to the destination therefore intermediate node do not need to keep a route cache. This protocol uses the scheme to distribute a load into multiple path. Therefore it is reduce the control overhead of the network. SMR protocol allows destination to accept all receiving route and find maximally disjoint path and maximally disjoint path means minimum number of nodes or links are common. In DSR protocol, intermediate node need to discard duplicate Route request(RREQ)message. Instead, it forwards this request message in a different incoming link and whose hop count is not larger than that previously received RREQ message. In route discovery process when destination node receives multiple RREQ message, it selects two maximally disjoint paths. In that paths first it selects shortest delay path. After then destination waits for more route request message .From that it selects maximally disjoint from the shortest delay path. If more than one shortest path is available then it selects shortest hop path. But in this protocol intermediate node do not discard duplicate RREQ message, sop frequency of route discovery process need to be reduce to curb the overhead.

B. AOMDV

Ad hoc on-demand multipath distance vector routing(AOMDV)an extension to the AODV protocol for computing multiple loop-free and link disjoint paths. AOMDV has three batter ways to compare to other protocols. First, it does not have high inter-model coordination overheads like some other protocols like TORA. Second, without the use of source routing it ensure disjointness of alternate routes via distributed computation. Finally, AOMDV computes alternate paths with minimal additional overhead over AODV. In AOMDV RREQ message can traverse from source to destination through multiple reverse paths both at intermediate node as well as destination node. In AOMDV, it also provide an alternate path at intermediate node if they are useful in reducing route discovery frequency. To keep track of multiple routes, the routing entry for each destination will contains a list of the next hops along with the corresponding hop counts. All the next hops have same sequence number. So for each destination a node maintains the advertised hop count, which is defined as the maximum hop count for all the paths and it is used for routing advertisements of the destination. Each duplicates route advertisements received by a node define an alternate path to the destination. In this paper they describe comparison between AODV and AOMDV and they give simulation result that AOMDV in comparison with AODV, reduce the packet loss up to 40% and improve routing overhead 30% by reducing frequency of route discovery operations. But still many issues describe in this paper. Initially the protocol can be improved by effectively dealing with the route cut-off problem and compute more disjoint path when source-destination pairs are far away. Second, they do not studied carefully interaction between timeout setting and AOMDV performance.

C. AODVM

AODVM is also an extension of AODV protocol for finding multiple node disjoint path. Unlike AODV, intermediate node does not discard duplicate RREQ message and it stores this information in RREQ table. In AODVM intermediate node is not able to send reply message to the source .When a destination node receives a RREQ message, it updates its sequence number and generate route reply (RREP) message. Route reply message contains an additional field called last hop id to indicate a

neighbor from which this particular copy of RREP message is received. Then destination node sends reply message to all of its neighbors. When an intermediate node receives the RREP message from a neighbor node, it deletes the entry for that neighbor node from its RREQ table and adds routing entry into its routing table. Each entry in routing table indicates the discovered route from itself to destination node. While forwarding a RREP message to a neighbor node, an intermediate node selects a neighbor that is on shortest path. When an intermediate node receives RREP message and if there is no recorded in RREQ table entry to which it can forward that reply message, it will generate a path identification with an error message and sends it to its neighbor from which it has received that route reply. When a source receives a route reply packet from destination it sends another type of message called route request confirmation message (RRCM).one of the advantage of AODVM is that intermediate nodes cannot use previously cache routing information to generate RREP.

D.TROA

The TROA (Temporally Ordered Routing Algorithm) is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal. These algorithm is proposed for highly dynamic mobile, multi-hop wireless networks. It is a source-initiated on-demand routing protocol. The main feature of TORA is that the control messages are localized to a very minute set of nodes near the occurrence of a topological change. To achieve this, the nodes maintain routing information about adjacent nodes. The basic functionality of the protocol consists of creating routes, maintaining routes and erasing routes. These protocol models the network as a graph initially and thus all the edges in the graph i.e. links in the network are undirected. So each link will be undirected or directed from node i to node j or directed from node j to node i. Each node maintains a metric called “height”. This metric is used in assigning directions to links with each neighbor. Routes can be formed in reactive or proactive mode. The Reactive mode route creation require establishing a series of directed links from the source to the destination node. This is done by constructing a directed acyclic graph rooted at the destination using a query reply process. When a route is required the source broadcasts a QRY (query) packet to its neighbors. The query packet is propagated until it is received by one or more routers that have a route to the destination. The router that has a path to the destination sends an UPD (update) packet to all its neighbors. The node which receives an update packet from the other node will set its height one greater than the height of the node from which it received the UPD packet. In a proactive mode it is noted that the destination initiates route creation by sending a OPT which is known as optimization packet which is then processed by the neighbors and forwarded further. Route maintenance is performed only for routers that will have a non-null height. And so the routers with a null height will not use for computations. When a node loses its last downstream link at that time only reaction to link failure is initiated. Temporally Ordered Routing Algorithm has a unique feature of maintaining multiple routes to the destination so that in order to make any topological changes it do not require any reaction at all. So the protocol only reacts when all the routes to the destination are lost. When considering network partitions the protocol is able to detect the partition and erase all invalid routes.

E. ZRP

The ZRM algorithm aims to address the issues by combining the best properties of both approaches. ZRP can be categorized as a hybrid or reactive/proactive routing protocol. It proactively maintains the routing table information of nodes inside the local zone, which reduces the time in route search operation if the destination is inside the zone. However, for the nodes outside the local zone, it re-actively searches the route on the basis of route discovery procedure. A routing zone or radius is the distance in number of hops from the node under consideration. Routing zone is divided into two parts: peripheral nodes and interior nodes. Peripheral nodes are nodes whose minimum distance to the central node is exactly equal to the zone radius ρ and even whose minimum distance is less than ρ is interior node. ZRP refers to the locally proactive routing component.

V. CONCLUSION

This paper presented a survey of most recent routing protocols for MANETs. The surveyed protocols showed that multipath routing can improve network performance in terms of delay, throughput, reliability and life time. Yet it is hard to find a single protocol or a set of protocols that can improve all these performance parameters. Selection of a multipath routing protocol depends on a particular application and trade- offs. Some of the objectives are energy efficiency, low overhead, reliability and scalability. With this survey paper, researchers can acquire what has been investigated, and network designers can identify which protocol to use, and what are the trade-offs.

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