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RESEARCH ARTICLE

PSR: Methodology and Comparative Study along with Different Routing Protocol in Manet

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I. INTRODUCTION

Mobile ad-hoc network (MANET) is a wireless communication network that contains various mobile devices. These mobile devices form a network with each other without any existing infrastructure or any other kind of fixed stations. It is a self-configuring and self organized network of mobile devices. These devices can move in any direction. The links between these devices will be change frequently, due to their movement. In a dynamic environment of the wireless network, nodes are independent and their mobility causes frequent change of network connectivity. Nodes in such network can act as end points of data transmission as well as routers when the two end points are not in direct range of each other. In a decentralized network, a node is responsible to find the topology information and deliverance of data to the destination. The implementation of appropriate routing protocol is based on the nature of application. MANET continuously maintains the information required to properly route the traffic. MANET is a type of wireless adhoc network that usually has a routable networking

In this paper, we propose a lightweight *proactive source routing* (PSR) *protocol* to facilitate opportunistic data forwarding in MANETs. In PSR, each node maintains a breadth-first search spanning tree of the network rooted at itself. This information is periodically exchanged among neighboring nodes for updated network topology information. Thus, PSR allows a node to have full-path information to all other nodes in the network, although the communication cost is only linear to the number of the nodes. This allows it to support both source routing and conventional IP forwarding. When doing this, we try to reduce the routing overhead of PSR as much as we can. Our simulation results indicate that PSR has only a fraction of overhead of OLSR, DSDV, and DSR but still offers a similar or better data transportation capability compared with these protocols.

Index Terms—Mobile ad hoc network, proactive, source routing ,Differential update, mobile ad hoc networks (MANETs), opportunistic data forwarding, proactive routing, routing overhead control, source routing, tree-based routing.

II. RELATED WORK

PSR proposed by Zehua Wang [2] maintains network topology using spanning tree. It takes the concept of BFS and streamlined differential update. Wang also propose a new concept, known as CORMAN [1], which is a network layer solution to the opportunistic data transfer in mobile ad-hoc networks. CORMAN contains three modules that provide a solution for one of the existing challenges. Routing protocols in MANETs can be categorized using an array of criteria. The most fundamental among these is the timing of routing information exchange. On one hand, a protocol may require that nodes in the network should maintain valid routes to all destinations at all times. In this case, the protocol is considered proactive, which is also known as table driven. Examples of proactive routing protocols include destination sequenced distance vector (DSDV) [8] and OLSR [9]. On the other hand, if nodes in the network do not always maintain routing information, when a node receives data from the upper layer for a given destination, it must first find out about how to reach the destination. This approach is called reactive, which is also known as on demand. DSR [10] and ad-hoc on-demand DV (AODV) [11] fall in this category. These well-known routing schemes can be also categorized by their fundamental algorithms. The most important algorithms in routing protocols are DV and LS algorithms. In an LS, every node floods the information of the links between itself and its neighbours in the entire network, such that every other node can reconstruct the complete topology of the network locally. In a DV, a node only provides its neighbours with the cost to reach each destination. With the estimates coming from neighbours, each node is able to determine which neighbour offers the best route to a given destination. Both LS and DV support the vanilla IP packets. DSR, however, takes a different approach to on demand source routing. In DSR, a node employs a path search procedure when there is a need to send data to a particular destination. Once a path is identified by the returning search control packets, this entire path is embedded in each data packet to that destination. Thus, intermediate nodes do not even need a forwarding table to transfer these packets. Because of its reactive nature, it is more appropriate for occasional or lightweight data transportation in MANETs. AODV, DSDV, and other DV-based routing algorithms were not designed for source routing; hence, they are not suitable for opportunistic data forwarding. The reason is that every node in these protocols only knows the next hop to reach a given destination node but not the complete path. OLSR and other LS-based routing protocols could support source routing, but their overhead is still fairly high for the load-sensitive MANETs. DSR and its derivations have a long bootstrap delay and are therefore not efficacious for frequent data exchange, particularly when there are a large number of data sources. In fact, many lightweight routing protocols had been proposed for the Internet to address its scalability issue, i.e., all naturally "table driven." The path-finding algorithm (PFA) is based on DVs and improves them by incorporating the predecessor of a destination in a routing update. Hence, the entire path to each node can be reconstructed by connecting the predecessors and destinations; therefore, the source node will have a tree topology rooted at itself. In the meantime, the link vector (LV) algorithm [35] reduces the overhead of LS algorithms to a great deal by only including links to be used in data forwarding in routing updates. The extreme case of LV, where only one link is included per destination, coincides with the PFA. PFA and LV were both originally proposed for the Internet, but their ideas were later used to devise routing protocols in the MANET. The Wireless Routing Protocol (WRP) [37] was an early attempt to port the routing capabilities of LS routing protocols to MANETs. It is built on the same framework of the PFA for each node to use a tree to achieve loop-free routing. Although it is an innovative exploration in the research on MANETs, it has a rather high communication overhead due to the amount of information stored at and exchanged by the nodes. This is exacerbated by the same route update strategy as in the PFA, where routing updates are triggered by topology changes. Although this routing update strategy is reasonable for the PFA in the Internet, where the topology is relatively stable, this turns out to be fairly resource demanding in MANETs. (Our original intention was to include the WRP in the experimental comparison later in this paper, and we have implemented WRP in ns2. Unfortunately, our preliminary tests indicate that the changing topology in the MANET incurs an overwhelming amount of overhead, i.e., at least an order of magnitude higher than the other mainstream protocols. Thus, we do not include the simulation result of WRP as a baseline in our comparison.)

III. METHODOLOGY

This paper introduces a novel routing method to improve the performance of mobile ad-hoc networks, in which we develop an enhanced proactive source routing protocol for data transmission in such network. It diminishes the routing overhead and enhances the reliability of data transmission between the mobile nodes. This scheme achieves several objectives and challenges. To achieve our goal, some existing methods were used in our research. Such methodology improves the throughput and performance of MANET. Network simulator – 2 (ns-2) is generally used in this research area by the research communities. NS-2 gives better result for mobile ad-hoc wireless networks. Essentially, our method provides every node with a neighbour table for the entire network. To do that, nodes periodically broadcast the table information to their best knowledge in each iteration. Based on the information collected from neighbours during the most recent iteration, a node can refresh its knowledge about the network topology by adding such recent information. This knowledge will be distributed to its neighbours in the next round of operation. On the other hand, when a neighbour is deemed lost, a procedure is triggered to remove its relevant information from the topology repository maintained by the detecting node. Intuitively, the proposed scheme has about the same communication overhead as DV-based protocols. Differential update mechanism is also useful to reduce more routing overhead.

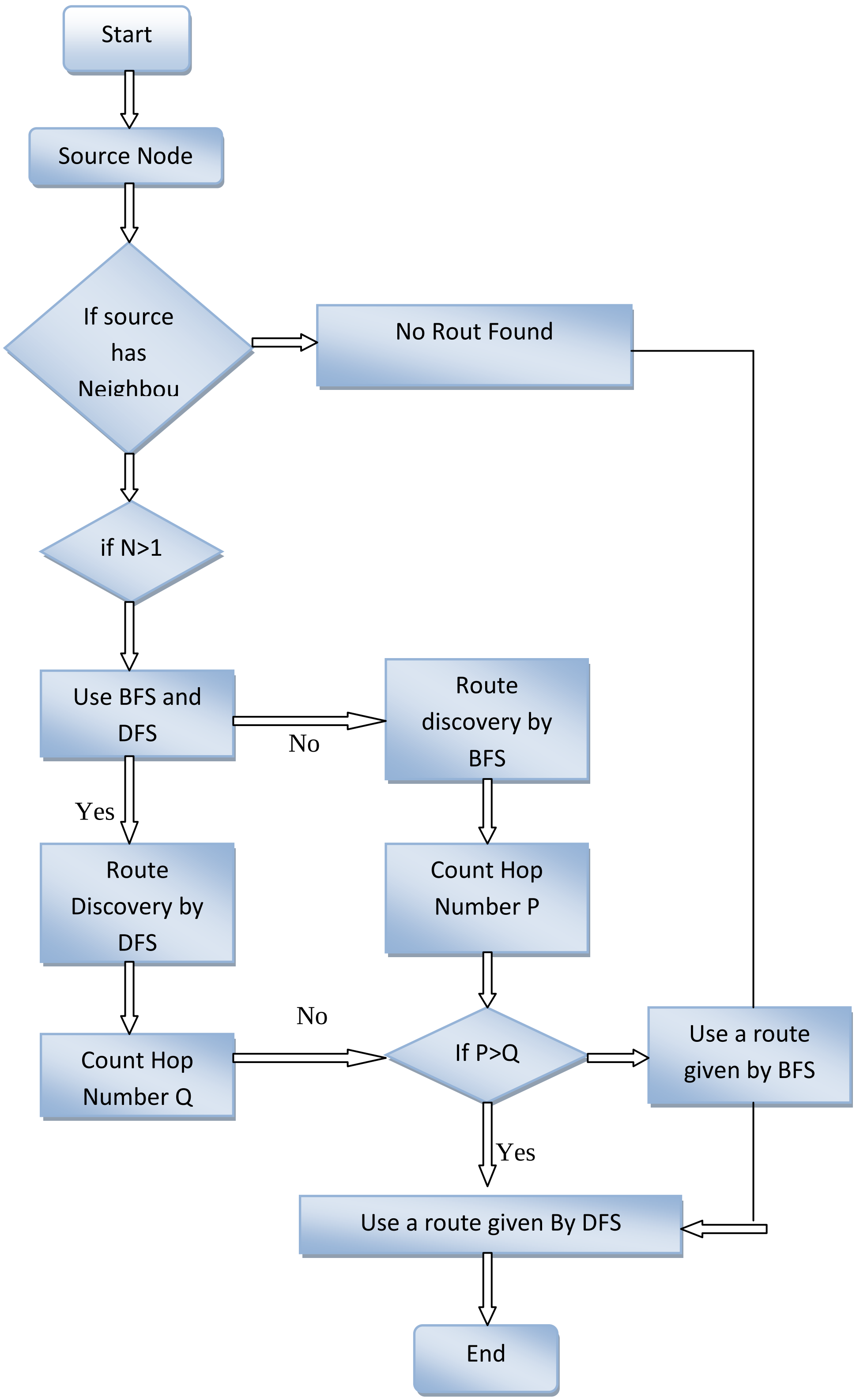

Fig 3: Data Flow Diagram

1) Table Update:

Due to its proactive nature, the update operation of our work is iterative and distributed among all nodes in the network. At the beginning, node is only aware of the existence of itself. By exchanging the table information with the neighbours, it is able to maintain the network topology. In each subsequent iteration, nodes exchange their table data with their neighbours. From the perspective of source node, toward the end of each operation interval, it has received a set of routing messages from its neighbours. Note that, in fact, more nodes may be situated within the transmission range of source node, but their periodic updates were not received by it due to, for example, bad channel conditions. After all, the definition of a neighbour in MANETs is a fickle one. (We have more details on how we handle lost neighbours subsequently.) Source Node incorporates the most recent information from each neighbour to update its own table. It then broadcasts this information to its neighbours at the end of the period. In fact, in our implementation, the given update of the table happens multiple times within a single update interval so that a node can incorporate new route information to its knowledge base more quickly. This does not increase the communication overhead at all because one routing message is always sent per update interval.

2) Lost Neighbour Information Removal

If a neighbour is disconnected from the network then each node removes all the data about the lost node. Such process is triggered by the following cases: No routing update or data packet has been received• from this neighbour for a given time. A data transmission to such node has failed.• This process can be initiated more number of times.

3) Differential Update Mechanism

In addition to dubbing route updates as hello messages in this mechanism, we interleave the “full dump” routing messages, with “differential updates”. The basic idea is to send the full update messages less frequently than shorter messages containing the difference between the current and previous knowledge of a node’s routing module. Our goal is to broadcast the information stored at a node to its neighbours in a short packet.

4) Route Discovery using BFS and DFS

The route discovery procedure is performed by Breadth First Search (BFS) and Depth First Search (DFS) in the wireless network. These search techniques work separately in the nodes of MANET. BFS and DFS algorithms are performed by two separate neighbour nodes of the source node. The optimized result is selected by such scheme and transfers the packet on the network. We can easily understand this process with Fig 3 that shows the data flow diagram

IV. PERFORMANCE METRICES

MANET has number of qualitative and quantitative metrics that can be used to compare ad hoc routing protocols. This paper has been considered the following metrics to evaluate the performance of ad hoc network routing protocols.

1. End-to-end Delay:

This metric represents average end-to-end delay and indicates how long it took for a packet to travel from the source to the application layer of the destination. It includes all possible delay caused by buffering during route discovery latency, transmission delays at the MAC, queuing at interface queue, and propagation and transfer time. It is measured in seconds.

2. Packet Delivery Ratio:

Packet delivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source (i.e. CBR source). It specifies the packet loss rate, which limits the maximum throughput of the network.

3. Throughput:

It is the measure of the number of packets successfully transmitted to their final destination per unit time. It is the ratio between the number of received packets vs sent packets.

4. Packet Jitter:

It is the variation in the delay of received packets. At the sender they are evenly spaced intervals, but due to traffic congestion, improper queuing or configuration errors they come at unequal intervals.

5. Normalized Routing load:
It is defined as number of routing packets —transmitted, per data packet —delivered, at destination. Each hop-wise transmission of a routing is counted as one transmission. It is the sum of all control packet sent by all node in network to discover and maintain route.

V. Simulation And Comparison Of Routing Protocols

A. Comparative Study of Ad Hoc Routing Protocols

TABLE I. COMPARISON

Performance Constraints	DSDV	OLSR	DSR	AODV	TORA	ZRP
Category	Proactive	Proactive	Reactive	Reactive	Hybrid	Hybrid
Protocol Type	Distance Vector	Link state scheme	Dynamic Source Scheme	Distance Vector	Ordered Scheme	Link Reversal
Route Maintained	Route Table	Route Table	Route Cache	Route Table	Route Table	Route Table
Loop	No	Yes	No	Yes	No	Yes
Route Philosophy	Flat	Flat	Flat	Flat	Flat	Flat
Multiple Path	No	No	Yes	Yes	Yes	Yes
Multicast	No	Yes	Yes	Yes	No	No
Message Overhead	Medium	Low	Low	Moderate	Moderate	Moderate
Periodic broadcast	Possible	Possible	No	Possible	Possible	Possible
Requires sequence	Yes	No	No	Yes	No	Yes

VI. PERFORMANCE ANALYSIS OF DIFFERENT ROUTING PROTOCOL

For comparing the performance of all the six protocols, two scenarios have been taken. First scenario is low mobility and low traffic and second scenario is high mobility and high traffic.

TABLE II. ROUTING PERFORMANCE IN LOW MOBILITY

Low Mobility and Low Traffic					
Protocol	End to End delay	Packet delivery ratio	Throughput	Packet Jitter	Routing Overhead
DSDV	Least and remains constant as the number of nodes increase in the networks	High	Least very low when compared with DSR and AODV	Low	High
OLSR	Low	High	High when compared with other link state protocols	Low	Average
DSR	Degrade when number of nodes increase in the networks	High	At speed 30 m/s throughput increases better than DSDV	Very High	Increases with an increase in the number of nodes
AODV	Performance Degrade with number of nodes increase in the networks	High	Best	High	Increases proportionally with an increase in the number of nodes
TORA	Low	High	Low	Medium	Medium
ZRP	Low	High	Average	Low	Low

TABLE III. ROUTING PERFORMANCE IN HIGH MOBILITY

High Mobility and High Traffic					
Protocol	End to End delay	Packet delivery ratio	Throughput	Packet Jitter	Routing Overhead
DSDV	High	Average	High	Low	Very high for a Slight increase in the number of nodes
OLSR	Low	Average	Good	Low	Increases with an increase in the nodes
DSR	High	Low	Average	High	Increases with an Increase in the Number of nodes
AODV	Average	Average	Average	High	Low

VII. CONLCUSION

This paper presents the comparative study and performance analysis of various ad hoc routing protocols (DSDV, OLSR, DSR, AODV, TORA and ZRP) on the basis of end-to-end delay, packet delivery ratio, throughput, routing overhead, jitter performance metrics. By observing the table II and III, it is found that AODV has maximum throughput under low traffic and DSDV has maximum throughput under high traffic. As network becomes dense OLSR, DSR and DSDV perform well in terms of Throughput than AODV and TORA. TORA performs well in dense networks in terms of packet delivery fraction but at the same time Normalized Routing load of TORA is maximum among all the protocols in both the networks. Most evaluations and comparisons of protocols for ad-hoc networks skip ZRP. The reason is usually that ZRP is aimed for larger networks than the test comprises, or that ZRP is not an independent protocol but rather a routing framework. Further, any evaluation of the ZRP version with support for unidirectional links could not be found. It is especially well adapted to large networks and diverse mobility patterns. DSDV has least Normalized Routing load in both low and high traffic. OLSR and DSDV give the least Jitter and Average Delay in both networks Low delay and low jitter are mainly required in voice applications and real time applications, so OLSR and DSDV can be used there. The applications like voice and video conferencing need more BW, so in this case DSDV can be used. The applications like video telephony, web games, etc. require high throughput, so in this case AODV can be used under low mobility and low traffic and DSDV can be used under high mobility and high traffic. There is high mobility of users and network nodes at the time of emergency and military operations. We have observed that as the mobility increases there is an improvement in the throughput of OLSR, DSR and DSDV. So these three protocols can be used in emergency and military applications.

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