Effective Routing Protocol (DSDV) for Mobile Ad Hoc Network

Jaya Bhatt, Naveen Hemrajani

Abstract- An ad hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any centralized administration. In such a network, each node acts as both router and host simultaneously, the nodes can leave or join the network anytime. The routers are free to move. DSDV is developed on the basis of Bellman Ford routing algorithm with some modifications. In this routing protocol, each mobile node in the network keeps a routing table listing all the other nodes it has known either directly or through some neighbours. Every node has a single entry in the routing table. The entry will have information about the node's IP address, last known sequence number and the hop count to reach that node. Along with these details the table also keeps track of the next hop neighbour to reach the destination node, the timestamp of the last update received for that node. Information updates might either be periodic or event driven. DSDV protocol requires each mobile node in the network to advertise its own routing table to its current neighbours. The advertisement is done either by broadcasting or by multicasting.

Keyword- Mobile Ad hoc Network (MANET), Destination-Sequenced Distance Vector Routing Protocol (DSDV).

I. INTRODUCTION

Ad hoc networks consist of a collection of wireless nodes which dynamically exchange data among themselves without the reliance on a fix base station or a wired backbone network. These networks nodes are typically distinguished by their limited power, processing, and memory resources as well as high degree of mobility. 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 an Ad hoc network. From a graph theory point of view, an ad hoc network is a graph which consists of number of vertices and edges, where an edge is an association between two vertices. Mathematically, a graph G is a triplet consists of Vertex Set V (G), Edge Set E(G) and a relation that associates two vertices with each edge. An edge between two nodes i and j is represented as (i,j) and by using usual notation, E(G) can be written as $E(G) \subseteq \{(i,j)|\forall i,j \ \varepsilon \ V \text{ and } (i,j)=(j,i)\}$. E(G) changes with time as the mobile nodes in the ad hoc network freely move around. Two vertices are said to be adjacent to each other, if there exist an edge between them. The number of edges associated with the vertex is called degree of any vertex v is denoted by d(v). The minimum degree of a graph is the least degree of a vertex of a graph denoted by $\delta(G)$ and the maximum degree of a graph is the maximum degree of any vertex of a graph denoted by $\Delta(G)$.

Manuscript Received November, 2013.

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Routing protocols in conventional wired networks are usually based upon either distance vector or link state routing algorithms. Both of these algorithms require periodic routing advertisements to be broadcast by each router. The main drawbacks of both link-state and distance-vector protocol are that they take too long to converge and have a high messaging complexity. The destination sequenced distance vector (DSDV) protocol is an adaptation of the classical Bellman-Ford routing protocols. It is specifically targeted for the ad hoc networks [1][2].

II. OVERVIEW OF ROUTING PROTOCOL

Routing protocols are classified into three categories:-

1. Reactive protocols
2. Proactive protocols
3. Hybrid protocols

The most popular packet routing protocols are categorized as link state routing and distance vector routing protocol.

A. **Link state routing protocol** sometimes called shortest path first or distributed database protocols, are built around a well-known algorithm from graph theory, Dijkstra'a shortest path algorithm. In Shortest Path First (SPF) algorithm, whenever a link's state changes, a routing update called a Link-State Advertisement (LSA) is exchanged between routers. When a router receives an LSA routing update, the link-state algorithm is used to recalculate the shortest path to affected destinations. Link-state routing always try to maintain full networks topology by updating itself incrementally whenever a change happen in network[3].

B. **Distance vector routing protocol** use the distance and direction (vector) to find paths to destinations. Distance Vector protocols use the Bellman-Ford algorithm for finding paths to destinations. Distance Vector algorithms pass routing table updates to their immediate neighbours in all directions. At each exchange, the router increments the distance value received for a route, thereby applying its own distance value to it. The router who received this update again pass the updated table further outward, where receiving routers repeat the process. The Distance Vector protocols do not check who is listening to the updates which they sent and Distance Vector protocols broadcast the updates periodically even if there is no change in the network topology. Distance Vector protocols are the simplest among three types of dynamic routing protocols. They are easy to set-up and troubleshoot. They require less router resources. They receive the routing update, increment the metric, compare the result to the routes in the routing table, and update the routing table if necessary.[4]

III. DESTINATION – SEQUENCED DISTANCE VECTOR (DSDV) PROTOCOL

The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently. We consider a collection of mobile computers,(nodes) which may be far from any base station. The computers (nodes) exchange control messages to establish multi-hop paths in the same way as the Distributed Bellman-Ford algorithm. These multi-hop paths are used for exchanging messages among the computers (nodes).Packets are transmitted between the nodes using routing tables stored at each node. Each routing table lists all available destinations and the number of hops to each destination. For each destination, a node knows which of its neighbours leads to the shortest path to the destination. Consider a source node S and a destination node D. Each route table entry in S is tagged with a sequence number that is originated by the destination node. For example, the entry for D is tagged with a sequence number that S received from D (maybe through other nodes).We needs to maintain the consistency of the routing tables in a dynamically varying topology. Each node periodically transmits updates. This is done by each node when significant new information is available. We do not assume any clock synchronization among the mobile nodes. The route-update messages indicate which nodes are accessible from each node and the number of hops to reach them. We consider the hop-count as the distance between two nodes. However, the DSDV protocol can be modified for other metrics as well. A neighbour in turn checks the best route from its own table and forwards the message to its appropriate neighbour. The routing progresses this way.

➢ ***There are two issues in this protocol :***

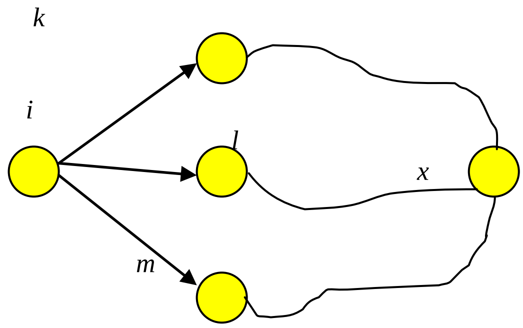
1. How to maintain the local routing tables
2. How to collect enough information for maintaining the local routing tables

A. Maintaining Routing Table:-

We will first assume that each node has all the necessary information for maintaining its own routing table. This means that each node knows the complete network as a graph. The information needed is the list of nodes, the edges between the nodes and the cost of each edge. Edge costs may involve: distance (number of hops), data rate, price, congestion or delay. We will assume that the edge cost is 1 if two nodes are within the transmission range of each other. The DSDV protocol can also be modified for other edge costs.

B. How the Local Routing Table is used:-

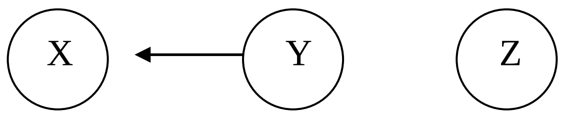
Each node maintains its local routing table by running the distributed Bellman-Ford algorithm. Each node *i* maintains, for each destination *x*, a set of distances *dij(x)* for each neighbour *j*. Node *i* treats neighbour *k* as the next hop for a packet destined for *x* if *dik(x)* equals minimum of all *dij(x)*



The message will be sent from i to l as the cost of the path to x is minimum through l. [5]

➢ ***DSDV protocol summary:-***

- Each node maintains a routing table which stores
- next hop, cost metric towards each destination
- a sequence number that is created by the destination itself
- Each node periodically forwards routing table to its neighbours
- Each node increments and appends its sequence number when sending its local routing table.
- Each route is tagged with a sequence number; routes with greater sequence numbers are preferred.
- Each node advertises a monotonically increasing even sequence number for itself.
- When a node finds that a route is broken, it increments the sequence number of the route and advertises it with infinite metric
- Destination advertises new sequence number.
- When X receives information from Y about a route to Z
- Let destination sequence number for Z at X be S(X), S(Y) is sent from Y



- If S(X) > S(Y), then X ignores the routing information received from Y
- If S(X) = S(Y), and cost of going through Y is smaller than the route known to X, then X sets Y as the next hop to Z
- If S(X) < S(Y), then X sets Y as the next hop to Z, and S(X) is updated to equal S(Y)

IV. DSDV ROUTING

A. Route Advertisement:- The DSDV protocol requires each mobile node to advertise its own routing table to all of its current neighbours. Since the nodes are mobile, the entries can change dynamically over time and maintain table consistency. The route advertisements should be made whenever there is any change in the neighbourhood or periodically. Each mobile node agrees to forward route advertising messages from other mobile nodes. This forwarding is necessary to send the advertisement messages all over the network. In other words, route advertisement messages help mobile nodes to get an overall picture of the topology of the network.

B. Route Table entry structure:- The route advertisement broadcast by

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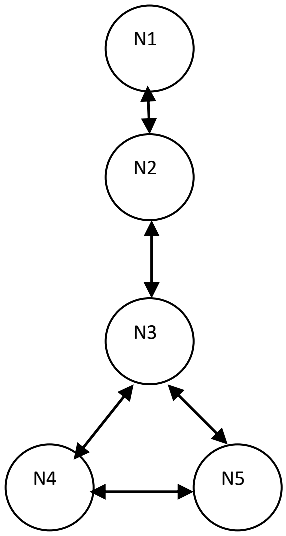
each mobile node has the following information for each new route :

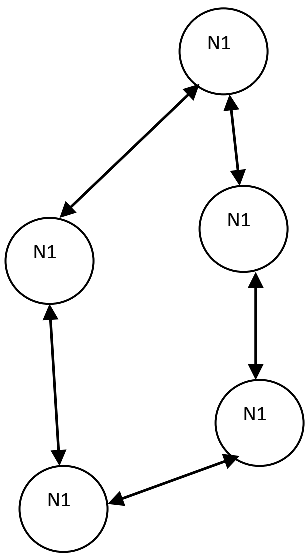
– The destination's address
– The number of hops to the destination
– The sequence number of the information received from that destination. This is the original sequence number assigned by the destination.

An Example of Route Update:-

- At the start, each node gets route updates only from its neighbour.
- For N4, the distances to the other nodes are :
- N5=1, N3=1, N2= ∞, N1 =∞
- All nodes broadcast with a sequence number



- After this, nodes forward messages that they have received earlier.
- The message that N2 sent to N3 is now forwarded by n3
- For N4, the distances are now : N5=1, N3=1, N2=2, N1=∞
- All messages have sequence number 1



- Suppose n5 has moved to its new location.
- Also, n5 receives a new message from n1 with a sequence number 2
- This message is forwarded by n5 to n4
- Two distances to n1 in n4
- Distance 3 with seqence number 1, and
- Distance 2 with sequence number 2
- Since the latter message has a more recent sequence number, n4 will update the distance to n1 as 2

C. Responding to topology changes: - Two types of packets defined for route updates

1.) full dump packets

- Carry all available routing information
- Size of multiple network protocol data units (NPDUs)
- Transmitted infrequently during period of occasional movement

2.) Incremental packets

- Carry only information changed since last full dump
- Size of a NPDU
- Transmitted more frequently

Additional table maintained to store the data from the incremental packets. When the size of an incremental dump becomes too large, a full dump is preferred.

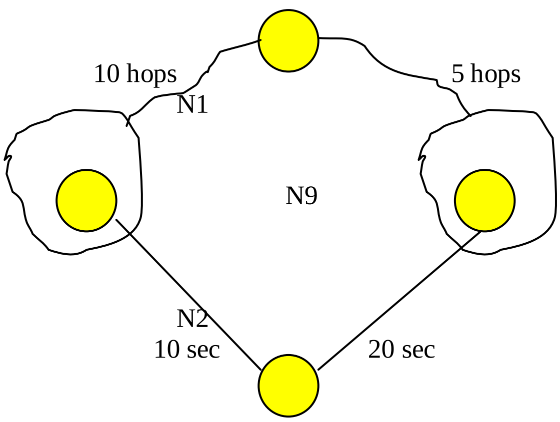
D. Route Selection Criteria:- When a node i receives incremental dump or full dump from another node j , the following actions are taken :

– The sequence number of the current dump from j is compared with previous dumps from j
– If the sequence number is new, the route table at i is updated with this new information.
– Node i now broadcasts its new route table as an incremental or a full dump.

1.) Reducing the number of updates:- A node i may receive the same update message from another node j through several different paths.

- Suppose, one of the updates has a lowest distance to j
- It is better to avoid broadcasting every new update and instead broadcast only the lower met3.ric updates.

For an example:



Node N2 should wait longer to get an update from N9

2.) Settling Before Sending an Update Message

– Each node should maintain some statistics about the average settling time of a message from another node.

– In the previous example, n2 receives several messages from n1 with the same sequence number.

– Depending on statistics about last settling time, n2 should wait until it

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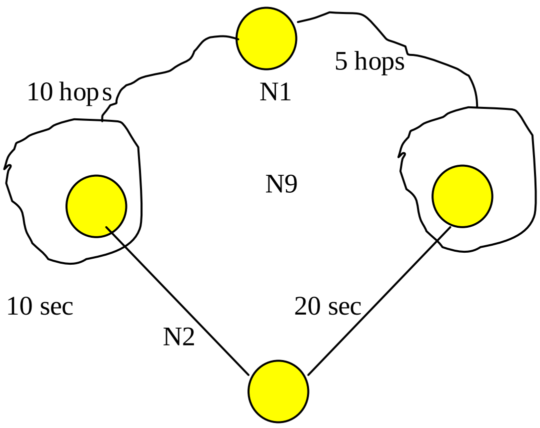
receives all messages from n1.



This reduces the number of updates sent by a node.

E. Summary: - Essentially a modification to Bellman-Ford routing algorithm. Using sequence number to guarantee loop-free paths. Relies on periodic exchange of routing information. Inefficient due to periodic update transmissions even no changes in topology. Overhead grows as O(n2) , limiting scalability.[6}

V. CONCLUSION AND FUTURE WORK

DSDV is a well-known routing algorithm proposed for ad hoc network routing, but it has many problems as mentioned in previous sections. In this work we discussed on the effective routing protocol for Mobile adhoc Network. We hope to discover good operational values for the following quantities :-

- Incremental update period
- Full update period
- Average convergence time

Note that the measurement of the convergence times may depend heavily on many interesting parameters such as the average velocity of the mobile hosts, update periods, size of the mobile host population, geographical placement of mobile hosts, existence of base stations and average processing loads at the mobile computers. It also conserves energy at the nodes. These proposed improvements can be simulated for performance analysis by using ns-2 simulator

ACKNOWLEDGEMENT

We thank the reviewers for their many valuable comments also thanks to Mr. Naveen Hemrajani for their suggestions and improvements.

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