Ascent the Performances of Dynamic Routing Protocols in MANET

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Abstract

Mobile ad hoc network is a collection of mobile nodes communicating through wireless channels without any existing network infrastructure or centralized administration. Routing protocols used in ad hoc networks must automatically adjust to environments that can vary between the extremes of high mobility with low bandwidth, and low mobility with high bandwidth. This paper argues that such protocols must operate in an on-demand fashion and that they must carefully limit the number of nodes required to react to a given topology change in the network. This paper proves practicality of the DSR (Dynamic Source Routing), AODV(Ad hoc On Demand Distance Vector) and OLSR (Optimized Link State Routing) protocols through performance results, and it demonstrates several methodologies for experimenting with protocols and applications in an ad hoc network environment.
Keywords- MANET, DSR, AODV, OLSR, Multicast routing protocol.

I. INTRODUCTION

A Mobile Ad-hoc Network (MANET) is a temporary wireless network composed of mobile nodes, in which an infrastructure is absent. There are no dedicated routers, servers, access points and cables. If two mobile nodes are within each other's transmission range, they can communicate with each other directly. Otherwise, the nodes in between have to forward the packets for them. In such a case, every mobile node has to function as a router to forward the packets for others, forward the packets for others.
Mobile ad hoc network (MANET) is a "on the fly" network of mobile nodes. Packets are routed through mobile nodes instead of any fixed base station. In a typical ad hoc network, mobile nodes come together for a period of time to exchange information. While exchanging information, the nodes may continue to move, and so the network must be prepared to adapt continually. In the applications we are interested in, networking infrastructure such as repeaters or base stations will frequently be either undesirable or not directly reachable, so the nodes must be prepared to organize themselves into a network and establish routes among themselves without any outside support.[1] and [3]. Most research effort has been put in the

routing protocols since the advent of the MANET. They can be divided into the two basic categories: Proactive routing protocols (DSDV, WRP, OLSR, WRP, CGSR, FSR, GSR) and Reactive routing protocols (DSR, SSR, AODV, TORA).

The OLSR is the most widely used link state protocol, while AODV is the most popular distance vector protocol. Existing work gives general analysis of link state routing and distance vector routing in MANET [1] [2]. The basic routing problem is that of finding an ordered series of intermediate nodes that can transport a packet across a network from its source to its destination by forwarding the packet along this series of intermediate nodes. In traditional hop-by-hop solutions to the routing problem, each node in the network maintains a routing table: for each known destination. . If the routing tables were to contain incorrect information, then packets can be dropped. The challenge in creating a routing protocol for ad hoc networks is to design a single protocol that can adapt to the wide variety of conditions.

This paper concentrates on achieving high-performance multicast routing in multi-hop wireless ad hoc networks.

II. BACKGROUND

AODV Protocol: Ad hoc on demand Distance Vector (AODV) protocol [5] uses an on demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path. In AODV, the source node and the intermediate nodes store the next hop information corresponding to each flow for data packet transmission. In on demand routing protocol, the source node floods the Route Request packet in the network when a route is not available for the desired destination. It obtains multiple routes to different destinations from a single Route Request. The major difference between AODV and other on demand routing protocols is that it uses a destination sequence number to determine an up to date path to the destination. A node updates its path information only if the destination sequence number of the current packet received is greater than the destination sequence number stored at the node. When an intermediate node receives a route request, it either forward it or prepares a route reply if it has a valid route to the destination. If a route request receives multiple times, the duplicate copies are discarded. All intermediate nodes can send route reply packet to source if it has a valid route to the destination. An important feature of AODV is maintenance timer based states in each node, regarding utilization of individual routing table entries. A routing table entry is expired if not used recently. A set of predecessor nodes is maintained for each routing table entry, indicating the set of neighboring nodes which use that entry to route data packets. These nodes are notified with Route Error packets when the next hop link breaks

DSR Protocol: The DSR is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR [6] allows the network to be completely self-organizing and self configuring, without the need for any existing network infrastructure. When a source node has data packets to be sent to the destination node, first it initiates a Route Request packet. This Route Request is flooded throughout the network. Each node upon receiving a Route Request packet rebroadcasts the packet to its neighbors if it has not forwarded already or if the node is not the destination node. Each Route Request carries a sequence number generated by the source node and the path it has traversed. A node, upon receiving a Route Request packet, checks the sequence number on the packet before forwarding it. The packet is forwarded only if it is not a duplicate Route Request. A destination node after receiving the first Route Request packet, replies to the source node through the reverse path the Route Request packet had traversed. The major difference between AODV and DSR is that DSR [] uses source routing in which a data packet carries the complete path to be traversed. However, in AODV, the source node and the intermediate nodes store the next hop information corresponding to each flow for data packet transmission. OLSR is a proactive routing protocol, which has the advantage of having the routes immediately available when needed due to its proactive nature. In pure link state protocol, all the links with neighbor nodes are declared and are flooded in the whole network. The OLSR protocol is an optimization of the pure link state protocol for the mobile ad hoc networks. First, it reduce the size of the control packets, instead of all links, it declares only a subset of links with its neighbors that are called as its multipoint relay selectors. Secondly, in minimizes the flooding of its control traffic by using only the selected nodes, called multipoint relays of the node retransmit the packets technique significantly reduces the number of transmissions a flooding (or) broadcast procedure. The key concept used in the protocol is that of multipoint relays (MPRs). The MPR set is selected such that it covers all nodes that are two hops away. The nodes selected as a MPR by some of the neighbor nodes, announce periodically in their control messages their condition of MPR to their neighborhood. Thereby, a node announces to the network, that it has reach ability to the nodes, which have selected it as MPR. In route calculation, the MPRs are used to form the route from a given node to any destination in the network. The protocol uses the MPRs to facilitate the efficient flooding of control messages in the network. A node selects its MPR among its on-hop neighbors with symmetric link. Therefore, selecting the route through MPRs automatically avoids the problems associated with data packet transfer over unidirectional links. Each node maintains information about the neighbors that have selected it as MPR. A node obtains such information from periodic control messages received from the neighbors [2].MPR is selected such that it covers 2-hop distance thus hop-by-hop routing technique is followed here. A node's knowledge about its neighbors and two-hop neighbors is obtained from HELLO messages which are the message each node periodically generates to declare the nodes that it hears. The node N, which is selected as a multipoint relay by its neighbors periodically generates TC (Topology Control) messages, announcing the information about who has selected it as an MPR. Apart from generating TCs periodically, an MPR node can also originate a TC message as soon as it detects a topology change in the network. A TC message is received and processed by all the neighbors of N, but only the neighbors who are in N's MPR set re transmit it.[2]

III. PROPOSED TECHNIQUE

In evaluating the protocols propose in this paper, I use several sets of metrics. To characterize the basic performance of the protocols, I use a set of high-level summary metrics that are of interest to network users. To understand the internal functioning of the protocols, I used other sets of metrics: some of which are protocol specific and described as needed in the text, and some of which are general to all on-demand routing protocols and described below.

The Metrics

The following three metrics capture the most basic overall performance of DSR and the other protocols implement in this paper:

→Packet delivery ratio: The ratio between the number of packets originated by the "application layer" sources and the number of packets received by the sinks at the final destination.

→Routing overhead: The total number of routing packets transmitted during the simulation. For packets sent over multiple hops, each transmission of the packet (each hop) counts as one transmission. Routing packets are those that are originated by the routing protocol and do not also include user data. For protocols like DSR, which include both routing data and user data in the same packet, all the bytes of routing data in the packets are counted as routing overhead.

→Path optimality: The difference between the number of hops a packet took to reach its destination and the length of the shortest path that physically existed through the network when the packet is originated. Packet delivery ratio is important as it describes the loss rate that will be seen by the transport protocols, which in turn affects the maximum throughput that the network can support. This metric characterizes both the completeness and correctness of the routing protocol. Routing overhead is an important metric for comparing these protocols, as it measures the scalability of a protocol, the degree to which it will function in congested or low-bandwidth environments, and its efficiency in terms of consuming node battery power. Protocols that send large numbers of routing packets can also increase the probability of packet collisions and may delay data packets in network interface transmission queues. I did not include the number of IEEE 802.11 MAC packets or ARP packets in routing overhead, since the routing protocols I studied could be run over a variety of different medium access or address resolution protocols, each of which would have different overhead.

Measuring Route Discovery

Two additional metrics, containment and discovery cost, proved useful to evaluate the cost of on-demand Route Discovery.

→Containment: Containment is defined as the percentage of nodes that do not receive a particular ROUTE REQUEST. For a non-propagating ROUTE REQUEST, containment is equivalent to measuring the percentage of nodes in the network which are not neighbors (within transmission range) of the node originating the request. For a propagating ROUTE REQUEST, containment measures how far out the request propagates before running into either the edge of the network or a band of nodes with cached information about the target that is wide enough to stop further propagation. Values of containment approaching 1 indicate that a ROUTE REQUEST was well contained and interrupted very few nodes, whereas containment values approaching 0 indicate that most of the nodes in the network had to process the request.

→Discovery cost: The cost of a single Route Discovery is defined as

$$1 + FwReq + OgRep + FwRep$$

Where 1 represents the transmission of the original request, FwReq is the number of ROUTE REQUEST forwards, OgRep is the number of ROUTE REPLY originations, and FwRep is the number of ROUTE REPLY forwards. For each Route Discovery, this metric measures the number of routing packets (requests and replies) that were transmitted to complete the discovery. The average discovery cost is calculated as:

$$(OgReq + \sum FwReq + \sum OgRep + \sum FwRep) / OgReq$$

Where OgReq is the number of ROUTE REQUEST originations, and FwReq, OgRep, and FwRep are summed over all Route Discoveries.

➔Proposed algorithm used at every node to obtain reliability, bandwidth and delay characteristics of preferred route-

```
pkt_size = data_pkt_length;
  pkt_tr_time = pkt_size/BW;
    min_rel = 100;
  for(i=0;i<20;i++)
        {
        for(j = 0;j<10;j++)
                {
                if(node_rel[i][j] < min_rel)
                        {
                        min_rel[i] = node_rel[i];
                        }
                }
        }
          min_BW = 100;
  for(i=0;i<20;i++)
        {
        for(j = 0;j<10;j++)
                {
                if(node_rel[i][j] < min_rel)
                        {
                min_BW[i] = node_BW[i];
                        }
                }
        }
  best_rte = 0;
  for(i=0;i<20;i++)
        {
        if(min_BW[i]*min_rel[j] > best_rte)
        best_rte_num = i;
        best_rte = min_BW[i]*min_rel[j];
        }
```

IV. RESULTS

In our work experiment is carried out with the simulator by performing several experiments that illustrate the performance of the system. The simulation parameters like number of nodes, terrain range etc. as given in table 1 along with their respective values are used to examine the performance of the network. The values can be adjusted according to requirements. After adjusting the values in this file, this file is executed. An output file is used to check the various parameters to analyze the performance of network.

Parameter	Value	Description
Simulation time	120 Sec	Maximum execution time
Terrain Dimensions	1000 X 1000 Mt	Physical area in which the nodes are placed in meters
Number of Nodes	10-300	Nodes participating in the Network
Traffic Model	CBR	Constant Bit Rate link used
Node Placement	Uniform	Node placement policy
Mobility	0-10 (m/s)	Speed of node
Routing Protocol	DSR,AODV, OLSR	Routing protocol used

Table 1: Network Parameters

Network Delay-

Network delay is the total latency experienced by a packet to traverse the network from the source to the destination. At the network layer, the end-to-end packet latency is the sum of processing delay, packet, transmission delay, queuing delay and propagation delay. The end-to-end delay of a path is the sum of the node delay at each node plus the link delay at each link on the path. A higher value of end to end delay means that the network is congested and hence the routing protocol doesn't perform well. The network delay comparisons of proposed DSR scheme (red line) and existing scheme (blue line). In our mechanism network delay decreases corresponding to simulation time increases. The figure 1 described that when simulation time less than 2m (minutes) network delay is maximum. After that as simulation time is increased the network delay is linearly decreased. On the other hand existing networks delay linearly decreases corresponding to increase in simulation time. Similar is the case of AODV and OLSR.

Network Traffic-

Packet Delivery Ratio (PDR) is number of successfully delivered legitimate packets to number of generated legitimate packets. A higher value of PDR indicates that most of the packets are being delivered to the higher layers and is a good indicator of the protocol performance. On the other hand existing networks traffic linearly decreases corresponding to increase in simulation time. Similar is the case of AODV and OLSR.

V. CONCLUSION

The ability for nodes to form ad hoc networks in the absence of communication infrastructure is a critical area of current research. End to End delay for proposed DSR, AODV, and OLSR is less than existing DSR, AODV, and OLSR with the varying number of nodes and mobility. Finally from the above comparison it is concluded that the proposed technique for multicasting protocols for ad-hoc networks perform well as compared to existing techniques in terms of end to end delay and network traffic for all three protocols.

There are existing communication needs which ad hoc networks can meet, such as military and commercial applications, and the development of ad hoc network technology will enable new classes of applications. With the potential for low cost deployment and high availability, coupled with the dropping costs of wireless transceivers, ad hoc networks are becoming economically and technologically feasible right now.

VI. REFERENCE

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