Traffic Estimation in Mobile Ad Hoc Network

Using Probe Packets

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Abstract - This paper presents a new method for estimating traffic in mobile ad hoc by using probe packets. Probing based approaches involves sending test transactions over the network to monitor the path and performance of network. These test transactions are called probes. Probes are used to monitor a wide array of performance parameters including delay, loss, available bandwidth, traffic composition, routing behavior. It relies on Self-induced congestion, and repeatedly samples of traffic in network path with sequence of probe packets, Send randomized rates. This method requires little computation at each iteration, and add small of probe traffic. It maintains current estimates, which is incrementally improved with each new measurement with each new measurement of inter packet time separation in sequence of probe packet pairs and also provide quality of service by transferring data on path with best available bandwidth. We compare the performance of traffic estimation with that of Ad Hoc Distance Vector Routing Protocol in OMNET 3.3 network simulators.

I. INTRODUCTION

Mobile Ad-Hoc Network (MANET) is one of the most important technologies that have gained interest due to recent development in both in hardware and software technologies [1]. MANET allows set of mobile user equipped with radio interface dynamically form communication network. MANET incorporates routing functionality into Mobile nodes so that they became capable forwarding data on the behalf of the intermediate and effective becomes the infrastructure.

In a communication network, traffic that transits through the network has a source where that particular traffic flows enter the network and destination where it exits the network. Traffic estimation reflects the volume of traffic that flows between all possible paths between source and destination in Mobile Ad-hoc Network. In this paper we present analytic model for estimation of traffic in MANET using of probe packet. Traffic estimation reflects the amount the traffic that flows between all the possible paths between source to destination.

Probe packets are classified into two types passive and active probe packet [2].

Passive probing uses local information or by observing the behavior of the whole network. Implementation of passive probing in principle would be possible, if could access all the network nodes in path. However, in Practice this is typically not possible and Traffic estimation in only feasible by active probing of the Network path. By injecting probe traffic into the network, and then analyzing the observed effects of probes, we can estimate the traffic. This kind of active measurement only requires access to the sender and receiver hosts.

This method provides the convenient measure inter-packet separation strain of consecutive probe packets. When there is no congestion, this strain is zero on average. When the total load starts to become larger than the path’s bottleneck capacity, the strain becomes proportional to the overload.

II. RELATED WORK

A number of papers have appeared in recent years in the field of traffic estimation.

Somarriba and Robertazzi [3][4] have proposed traffic estimation in which the traffic load that can be expected to flow in each link is based on the number of routes that the link use one of the shortcoming of this work was it assumes traffic on each route is equal. Calculation of traffic estimation for each individual node by summing up load of all the outgoing links of that node. In order to estimate traffic over different links was proposed [5].

In this work of traffic estimation exponential filter is used to generate an estimate based on the size and intensity of arrival of the transmission by measuring inter arrival time two packets Δt seconds and size of packet ΔL as shown in figure 1.

Fig. 1. Inter-arrival time between two packets and size of packet. one of the shortcoming of this method is that it pays equal importance all the packets over specified window size. In exponential decrease function packet tn that arrived at most recent is given more weight compared to packet that have arrived earlier as shown in figure 2.

Fig. 2. Total Time for n packets to be received.

Melander et al. Trains of packet pairs (TOPP) [6]. Uses probe Packets sent at various rates and attempt to estimate point of Congestion, i.e probe rate where delay...
starts increasing. TOPP Fits data to a straight line in order to arrive at an estimate. This Method uses substantial time for measurement and analysis before producing an estimate, and not suitable for real-time traffic Estimation.

Ribeiro have developed pathChrip [7], pathChrip uses probe trains with internally varying inter packet separation, in order to scan a range of probe rates with each train. By analyzing the internal delay signature of each chrip, an estimate of traffic is Produced. Estimates are smoothed by averaging over sliding window.

### III. PROPOSED WORK

In this proposed technique source initiates process of finding a path to destination when it has data to send. Source first sends the route request packets to all its immediate neighboring nodes with source id and destination id. Once source node obtain path to required destination source nodes initiates probing is divided into two phases the data collection phase and the analysis phase.

In the data collection phase, a probe generator i.e source node injects probe packets along the path to be measured. The probing scheme (i.e. the dispersion or separation between probes) is predefined by sender. The initial probe packet dispersion is proportional to the probe rate. The dispersion between successive probe packets changes when the probe packets traverse the network path. It either changes due to limited link capacity or due to congestion. Limited link capacity will increase the dispersion between probe packets while packet interactions may increase as well as decrease the dispersion. The probe packets are received by a probe receiver. Upon reception, the probe packets are time stamped. Using these time stamps the probe packet dispersion at the receiver is calculated.

The second phase, the analysis, uses the dispersion values obtained from the data collection phase to produce an estimate. The difference between the initial probe packet dispersion and the received probe packet dispersion is used to produce an estimate of the path capacity or the available bandwidth. The data collection and the analysis phases combined is called a measurement session.

Consider the size of probe packet is P, Rin is the rate of transmission of probe packets so the input probe packet gap is Tin. The total input probe packet pair gap TIG can be calculated by the following formulas: where ‘K’ is the number of probe packets and Tmeg is the output probe packet gap. ‘V’ is the ratio of total output gap and total input gap, it decides the current iteration transmission rate, if the ratio is greater than 2 then current iteration rate reduced to ‘V’ times of its last iteration rate, and if the ratio is equal to or less than 1 then the iteration rate increases to double of its last iteration rate. The total difference between the total output gap and total input gap, D, where DPP is the difference between each probe packet pair at destination side and PDPP is the percentage of difference between each probe packet pair at destination side.

### IV. PERFORMANCE ANALYSIS

The simulation is carried out in OMNET 3.3 network simulator. The setup of the simulation depicts an ad hoc network that consists of a varying number of Mobile
Hosts (MHs) that move randomly in a square field free of obstacles.

<table>
<thead>
<tr>
<th>Routing</th>
<th>AODV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Bandwidth</td>
<td>2500Kbits/s</td>
</tr>
<tr>
<td>Channel Delay</td>
<td>0.0001 sec</td>
</tr>
<tr>
<td>Channel Error Rate</td>
<td>0.000001</td>
</tr>
<tr>
<td>Channel Data Rate</td>
<td>250Kbits/s</td>
</tr>
<tr>
<td>Node Placement</td>
<td>Random</td>
</tr>
<tr>
<td>Mobility Model</td>
<td>RWP</td>
</tr>
<tr>
<td>Message Packet Size</td>
<td>512 bytes</td>
</tr>
<tr>
<td>Simulation Area</td>
<td>650 x 650 m</td>
</tr>
<tr>
<td>Mobility max, min speed</td>
<td>2 m/s</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>10-35</td>
</tr>
</tbody>
</table>

Simulation Set up.

In our simulation, we simulated a scenario of 20 nodes in square area of 650m x 650m. The mobility model is random waypoint model. At the beginning, each node has random initial location, it will move to random destination with random speed. Simulation runs for 100 seconds. Metrics used for the performance of network are

1. Packet Delivery Ratio is defined by a factor of number of packets received by number of packets transmitted.
2. Network throughput is number of packets received.
3. Latency is the amount of time that is required for a packet to travel from source to destination.

Simulation Outcome.

Now we shall compare each and every simulation parameter for both proposed traffic estimation best path routing (TEB) and present ad hoc on demand distance vector routing (AODV). By plotting graph for both method.

Figure 4: Pause time versus PDR.

Figure 5: Pause time versus Latency.

Figure 6: Node versus PDR.

Figure 7: Packet rate versus PDR.

From the above graph it is clear that proposed traffic estimation as the better packet delivery ratio when compared to AODV with nodes ranging from 10 to 30. Packet delivery ratio drops when there is increase in number of nodes because there might be increase in level of congestion as well as bottleneck. And even when there is change in packet rate traffic estimation based method performs better than AODV. One of the reason why TEB method performs well it selects path with best available from obtained multipath which is least congested and has better throughput and less latency.
V. CONCLUSION AND FUTURE WORK

Traffic estimation and traffic dependable QOS routing are important aspects of QOS provisioning in Mobile Ad hoc Network. In this work we have proposed unique traffic measured technique by generating probing packet through obtained path. Generation and measurement of probing packet is varied depending upon previous measurement. Once the source obtains multiple paths source node selects the path with best available bandwidth. Information is incorporated in route discovery process and multipath are acquired bandwidth of the route are updated periodically. Results show that the system produces better results than the normal multiple or QOS routing. The system can be further improved, if the probe packets are sent by the destination only, the source node could still correctly estimate how busy the paths are because the information needed is still in the received probe packets. However the overhead and consumed network resources are reduced to half.

REFERENCES


