AODV, DSDV Performance Analysis with TCP Reno, TCP NewReno, TCP Vegas And TCP Tahoe on Mobile Ad-hoc Networks Using NS2

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Abstract - A mobile ad-hoc network (MANET) is a network that doesn’t need any infrastructure which is capable of communicating between nodes without any centralized administration. MANET is the best choice which is of less cost and can be deployed easily. In the research work, we will proceed by doing investigation on MANET protocols like Ad hoc on demand routing protocol (AODV), Destination Sequence distance vector (DSDV) protocols by using the different TCP variants like TCP Reno, TCP New Reno, TCP Vegas and TCP Tahoe using NS2. The TCP variants analysis is done based on these performance metrics: TCP Throughput, Packet Loss, Packet Delivery Ratio and Jitter.

Keywords – MANET, AODV, DSDV, TCP Reno, New Reno, Vegas, Tahoe.

1. Introduction

Mobile ad-hoc networks (MANETs) are heterogeneous mix of different wireless and mobile devices, ranging from little hand-held devices to laptops. In MANET the inter connections between nodes are capable of changing on continual basis. In MANET, nodes within each other’s wireless transmission ranges can communicate directly.

Each MANET acts as either host or router. The key issue in MANETs is the necessity that the routing protocols must be able to respond rapidly to topological changes in the network. A mobile ad-hoc networking (MANET) working group has been formed within the Internet Engineering Task Force (IETF) to develop a routing frame work for IP-based protocols in ad-hoc networks. Many different protocols have been proposed to solve the multi-hop routing problem in ad-hoc networks like AODV and DSDV. The purpose of this work is to understand the working mechanism and investigate that which routing protocol gives better performance in which situation.

OVER VIEW OF ROUTING PROTOCOLS: Ad hoc On Demand Distance Vector (AODV): Ad hoc On Demand Distance Vector (AODV) routing is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad hoc networks. It is jointly developed in Nokia Research Centre, University of California, Santa Barbara and University of Cincinnati by C.Perkins, E.Belding-Royer and S.Das. AODV is a reactive routing protocol which is also called as On-Demand protocol.

The major difference between AODV and other On-demand routing protocols is that it uses a destination sequence number (DestSeqNum) to determine an up-to-date path to the destination. AODV is capable of both unicast and multicast routing. AODV provides loop free routes even while repairing broken links. We include an evolution methodology and simulation results to verify the operation of our algorithm. The advantage of AODV is that it creates no extra traffic for communication along existing links.

Destination Sequenced Distance Vector (DSDV): DSDV is a hop-to-hop distance vector routing protocol. The DSDV protocol is a table driven algorithm based on the classical Bellman-Ford routing mechanism. The
improvements made to the Bellman-Ford algorithm include freedom from loops in routing tables. DSDV is one of the most well known table-driven routing algorithms for MANETs. The DSDV routing algorithm is based on the number of hops to reach the destination, sequence number of the classical. The main attributes of DSDV protocol are to avoid loops, to resolve the “count to infinity” problem and to reduce high routing overhead.

TCP OVER MANET: The Transmission Control Protocol (TCP) was designed to provide reliable end-to-end delivery of data over unreliable networks. In practice, most TCP deployments have been carefully optimized in the context of wired networks. Ignoring the properties of wireless Mobile Ad-hoc Networks (MANETs) can lead to TCP implementation with poor performance. The introduction of new protocols such as Bluetooth, IEEE 802.11 and Hyperlan are making possible the deployment of MANETs for commercial purposes. TCP is an essential protocol for Internet communication. Without its rate control traffic congestion would have rendered the Internet useless. In particular, TCP should not care whether the Internet Protocol (IP) is running over wired or wireless connections. TCP assumes that network congestion and no transmission errors cause packet loss. It also assumes that the Round Trip Time (RTT) is relatively constant (little jitter) and that rerouting happens very quickly. TCP performs well in wired networks, but it will suffer from serious performance degradation in a wireless network. In MANETs, the main problem of TCP lies in performing congestion control in case of losses that are not induced by network congestion. The IEEE 802.11 wireless stack is by far the most common wireless platform that is used for ad-hoc networking today.

PARAMETERS:

- Packet Delivery Ratio: Packet delivery ratio is defined as the ratio of the number of delivered data packets between the source and destination.
  
  $$\text{PDR} = \frac{\text{Total number of packets received}}{\text{Total number of Packets Sent}} \times 100$$

Throughput: Throughput is defined as the rate of successful message delivery over a communication channel.

$$\text{Throughput} = \frac{N}{1000}$$

Where N is the number of bits received successfully by all destinations.

- END TO END Delay: The average time taken by a data packet to arrive its destination.
  
  $$\text{EED} = \frac{\sum (\text{arrive time} - \text{send time})}{\text{number of connections}}$$

- Jitter: Jitter is the deviation from true periodicity of a presumed periodic signal in electronics and telecommunication. Jitter may be observed in characteristics such as frequency of successive pulses, the signal amplitude, or phase of periodic signals. Jitter is a significant, and usually undesired, factor in the design of almost all communications links.
  
  Ex: USB, PCI-e, SATA, OC-48

  $$\text{Jitter} = \frac{\text{Total Delay}}{\text{No. of Samples}}$$

TCP NEW RENO: New Reno TCP is defined by RFC 3782, which advance the retransmission during the fast recovery phase of TCP RENO. In NEW RENO TCP we will show a simple change to TCP makes it possible to avoid some of the performance problems of RENO TCP. It is able to detect multiple packet losses and thus is much more efficient than RENO in the event of multiple packet losses. It overcomes the problem faced by RENO by reducing the CWD multiple times. New RENO congestion avoidance mechanisms to detect incipient congestion are very efficient and utilize network resources much more efficiently.

TCP RENO: TCP RENO induces packet losses to estimate the available bandwidth in the network. While there are no packet losses, TCP RENO continues to increase its window size by one during each round trip time (RTT). When it experiences a packet loss, it reduces its window size to one half of the current
window size. This is called additive increase and multiplicative decrease. Additive increase and multiplicative decrease algorithm is based on the results obtained. Such an algorithm leads to a fair allocation of bandwidth. TCP RENO, however, fails to achieve such fairness because TCP is not a synchronized rate based control scheme, which is necessary for convergence. We can easily see the congestion avoidance mechanism adopted by TCP RENO.

TCP Vegas: TCP Vegas was proposed by Brakmo et al. TCP Vegas adopts a more sophisticated bandwidth estimation scheme. It uses the difference between expected and actual flows rate to estimate the available bandwidth in the network. The difference in the flow rate can be easily translated into the difference between the window size and the number of acknowledged packets during the Round Trip Time, using the equation.

\[ \text{Diff} = (\text{Expected} - \text{Actual}) \times \text{Base RTT} \]

The three major changes induced by Vegas are: New Re-Transmission Mechanism, Modified Slow Start and Congestion avoidance.

TCP Tahoe: TCP Tahoe refers to the TCP congestion control Algorithm which was suggested by Van Jacobson. The Tahoe TCP implementation added a number of new Algorithms and refinements to earlier implementations. The new algorithm includes slow-start, congestion avoidance and fast retransmits. The Tahoe cannot detect and retransmit lost packets much faster. TCP Tahoe is based on the principle of “Conservation of packets” i.e. if the connection is running at the available bandwidth capacity then a packet is not injected into the network unless a packet is taken out as well.

PERFORMANCE EVALUATION:
The simulation is performed by using NS2 tool. In this paper it is evaluated with various network environments given in below table.

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Parameter value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing Protocol</td>
<td>AODV, DSDV</td>
</tr>
<tr>
<td>Transport protocol</td>
<td>TCP—Reno,New Reno, Vegas, Tahoe</td>
</tr>
<tr>
<td>No. of Nodes</td>
<td>100</td>
</tr>
<tr>
<td>Speed</td>
<td>10 m/s</td>
</tr>
<tr>
<td>MAC</td>
<td>MAC 802.11</td>
</tr>
<tr>
<td>No. of mobile nodes</td>
<td>22</td>
</tr>
<tr>
<td>X-axis</td>
<td>1800</td>
</tr>
<tr>
<td>Y-axis</td>
<td>840</td>
</tr>
<tr>
<td>Maximum Packets</td>
<td>50</td>
</tr>
</tbody>
</table>

Figure: NAM Simulation Window

1. Packet Delivery Ratio: Here we compare the protocols AODV and DSDV in network environment and the result is shown in below diagrams and graphs, TCP Vegas provides high performance.

Figure: Packet Delivery Ratio in AODV

Figure: Packet Delivery Ratio in DSDV

Figure: Packet Delivery Ratio in TCP Vegas
2. End-to-End Delay: In End-to-End Delay, we have analyzed that Reno provides constant Delay in different network environments in both AODV and DSDV.

3. Throughput: Here we show the throughput performance against mobile nodes in three TCP variants. From the graphs we can observe that TCP Vegas outperforms among others.
3. Jitter: Here we show the performance of Jitter in both AODV and DSDV against the TCP variants. From the graphs we can observe that TCP Vegas outperforms in Jitter.

Conclusion:
In this work we have investigated on the routing protocols of manet like AODB which is called as Reactive Routing Protocol and on DSDV which is called as Proactive Routing Protocol with different TCP variants. According to obtained results the by considering the parameters like packet delivery ratio, throughput, packet loss and jitter. The performance of DSDV in all places including all TCP variants is better as compared to AODV protocol. And also among the different TCP variants it is observed that TCP VEGAS is better than TCP TAHOE, RENO and NEW RENO. Incase of packet loss TCP VEGAS perform better than TCP TAHOE. The efficiency of Vegas is best and performs well in all packets.

REFERENCES:


