A Study of Performance Comparisons of Simulated Ad hoc Network Routing Protocols

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Abstract

Security has become a prime concern so as to present protected communication in Wireless as well as wired environment. Ad hoc networks are illustrated by multi-hop wireless connectivity and recurrently changing network topology which have made them infrastructure less. The wireless links in this network are very error prone and can go down frequently due to mobility of nodes, interference and less infrastructure. A routing protocol is needed whenever a packet needs to be transmitted to a destination via number of nodes and numerous routing protocols have been proposed for such kind of ad hoc networks. It is advantageous to know the performance of various protocols under different scenarios for various metrics. This paper describes a simulation evaluations conducted of several routing protocols tailored specifically for mobile ad hoc networks.

Keywords: Ad hoc Networks, Routing Protocols, Performance metrics

1. Introduction

Security has become a primary concern in order to provide protected communication in Wireless as well as wired environment. An adhoc network is a temporary infrastructure less network, formed dynamically by mobile devices without turning to any existing centralized administration. Ad hoc networks are characterized by multi-hop wireless connectivity and frequently changing network topology which have made them infrastructure less.

A routing protocol is needed whenever a packet needs to be transmitted to a destination via number of nodes and numerous routing protocols have been proposed for such kind of ad hoc networks. These protocols find a route for packet delivery and deliver the packet to the correct destination. Each mobile node operates not only as a host but also as a router and forwards packets for other mobile nodes in the network that may not be within direct transmission range of each other. The wireless links in this network are highly error prone and can go down frequently due to mobility of nodes, interference and less infrastructure. Therefore, routing in MANET is a critical task due to highly dynamic environment. In recent years, several routing protocols have been proposed for mobile ad hoc networks. Different routing protocols are suitable for different network characteristics. For this purpose different types of protocols for MANET have been designed such as DSDV, AODV, TORA, DSR, ZRP, and OLSR and many others.

Generally, routing protocols are classified into two main categories: Table-driven routing protocols and source initiated on-demand driven routing protocols. The table driven routing protocols maintain consistent and up-to-date routing information from each node to the rest of the nodes in the network in one or more routing tables regardless of the need of such routes. The source initiated on-demand routing protocols are developed and employed in mobile ad-hoc networks and initiates routing activities only when needed. In another classification these protocols generally fall into one of two categories: proactive or reactive. Proactive routing attempts to maintain optimal routes to all destinations at all times, regardless of whether they
are needed. To support this, the routing protocol propagates information updates about a network’s topology throughout the network. In contrast, reactive or on-demand routing protocols determine routes to given destinations only when there is data to send to those destinations. If a route is unknown, the source node initiates a search to find one. Proactive routing protocols have the advantage of having short routes available at all times, thereby avoiding the delay of searching for a route on demand. Reactive routing protocols have the advantage of only generating routing overhead to find routes when routes are needed, independent of network topology changes.

This paper describes a simulation evaluations conducted of several routing protocols tailored specifically for mobile ad hoc networks. The intended readers for this paper are those who are looking for the effects of various ad hoc networking protocols on performance metrics. The various performance metrics to be considered while evaluating the protocols are also listed. In order to make a selection of simulator, the comparative studies are also quoted.

The paper is organised as follows. The section 2 presents a tabular visualisation of the studies. The section 3 lists down the performance metrics. The section 4 is about the Simulators. The section 5 gives the analysis of the studies. The section 6 provides the conclusion and future work.

### 2. Review of Literature

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3. Performance Metrics

Routing Overhead

Average routing overhead is the total number of routing packets divided by total number of delivered data packets. This metric provides an indication of the extra bandwidth consumed by overhead to deliver data traffic. It is crucial as the size of routing packets may vary. The routing overhead describes how many routing packets for route discovery and route maintenance need to be sent in order to propagate the CBR packets.

Packet Delivery Ratio/ Packet Delivery Fraction/Throughput

Packet delivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated. It specifies the packet loss rate, which limits the maximum throughput of the network. The better the delivery ratio, the more complete and correct is the routing protocol.

Average End-To-End Delay

Average End-to-End delay (seconds) is the average time it takes a data packet to reach the destination. This metric is calculated by subtracting “time at which first packet was transmitted by source” from “time at which first data packet arrived at destination”. This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, propagation and transfer times.

Packet Loss/Drop

Packet loss describes an error condition in which data packets appear to be transmitted correctly at one end of a connection, but never arrive at the other. There might be different reasons like corrupted packets will be dropped by nodes; the link/route between nodes is not working, insufficient bandwidth, etc.

Latency Rate

When source node sends a data packet towards destination node, it takes some time to deliver and this time is called latency rate/delay or transmission time.

Normalized routing load

The number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one transmission.
Route acquisition time

The time it takes a source node to find a route to a destination node.

Expected Transmission Count

The expected transmission count metric (ETX) [4], which finds high-throughput paths on multi-hop wireless networks. ETX minimizes the expected total number of packet transmissions (including retransmissions) required to successfully deliver a packet to the ultimate destination. ETX calculates the probability of successful transmissions in both directions over a wireless link. To determine these statistics, every node periodically broadcasts a configured number of probes. Receivers calculate the number of probes received; against the number expected. As links are asymmetric, it is important to measure the success rate of probes in both directions. To obtain this information, each node will place its own ETX values in the probes sent.

4. Simulators

Simulations play a vital role in the development and testing of ad-hoc networking protocols. However, the simulation of large networks is still a tedious task that consumes a lot of computing power, memory, and time.

The study [8], compare protocols and models implemented in SWANS to the corresponding implementations in ns-2. Using identical input parameters show results are comparable and analyze reasons for differences. By showing that results achieved with JiST/SWANS are equivalent to those of ns-2, support the usage of JiST/SWANS. As ns-2 performance problems when simulating hundreds or thousands of nodes and the complex mixture of Tcl and C/C++ code in ns-2, JiST/SWANS could be an interesting alternative. In the paper [20] reported a performance comparison study by implementing an identical simulation set-up in five simulators, namely ns-2, OMNet++, ns-3, SimPy and JiST/SWANS.

5. Analysis

The studies revealed that AODV, DSR, TORA and OLSR protocols are under study. The performance metrics like packet delivery function, Average end-to-end delay, throughput and routing load are used for comparisons. Some of the studies even contradict in results. The reason for that seems to be different simulation environment in these studies as the metrics used for comparison are almost same. Most of the studies use ns-2 for simulation purposes. But some recent studies show other simulators better than ns-2 as it is complex mixture of Tcl and C/C++ code. Even ns3 outperform ns2. OPNET modeler and QualNet which is commercial version of GloMoSim also very much in use for simulation purposes. JiST/SWANS performed well but it is not much in use, this might be due to non-graphical interface.

6. Conclusion and Future Work

The overall performance of AODV is better than the other protocols, but every protocol has its better in some domain. The future work is to compare simulators for different protocols.

References


