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Performance Evaluation of MANET through NS2 Simulation

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Abstract

Mobile ad hoc network (MANET) is an autonomous system, where nodes are connected with each other through wireless links. Mobile ad hoc network [1] topology is dynamic that can change rapidly because the nodes move freely and can organize themselves randomly therefore in a Mobile Ad-hoc Network usually seek the help of other intermediate nodes to establish communication channels.
As a result network needs to have routing protocols which can adopt dynamically changing topology. To accomplish this, a number of ad hoc routing protocols have been proposed and implemented, which include Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV) and ad hoc on-demand distance vector (AODV) routing. In this paper, different routing algorithms are to be discussed and measure the performance in Packet Delivery Fraction, Throughput and Round Trip Time with constant mobility. For the implementation purpose we have used Network Simulator-2 (NS-2).

Keywords*:* DSR, AODV, DSDV, NS2, Window Size, Throughput, RTT, MANET.

1. Introduction

Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two types.

1.1 Infrastructure Networks

Infrastructure network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the network (called base station) within its

communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. This is called handoff. In this approach the base stations are fixed.

1.2 Infrastructure Less (Ad hoc) Networks

In ad hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. As the range of each host's wireless transmission is limited, so to communicate with hosts outside its transmission range, a host needs to enlist the aid of its nearby hosts in forwarding packets to the destination. So all nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network. Ad hoc Networks are very useful in emergency search-and rescue operations, meetings or conventions in which persons wish to quickly share information and data.

MANET is a type of Ad-hoc network, is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas other nodes need the aid of intermediate nodes to route their packets. These networks are fully distributed, and can work at any place without the help of any infrastructure. This property makes these networks highly flexible and robust.

2. MANET Routing Protocols Description

MANET protocol is mainly of three types proactive, reactive and hybrid protocol. Hybrid protocol is mainly combined form of proactive and reactive protocol. Zone routing protocol is example of hybrid protocol.

2.1 MANET Protocol

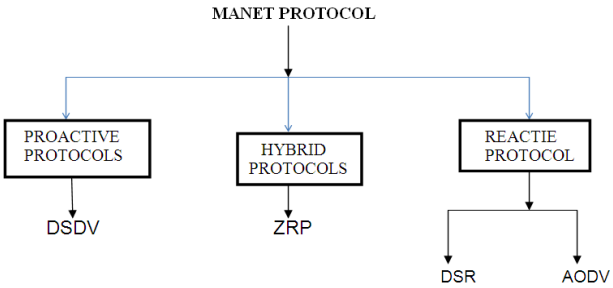

Fig. 1: MANET protocol classification.

2.2 Proactive Routing Protocols

Each node in the network has routing table for the broadcast of the data packets and want to establish connection to other nodes in the network. These nodes record for all the presented destinations, number of hops required to arrive at each destination in the routing table. The routing entry is tagged with a sequence number which is created by

the destination node. To retain the stability, each station broadcasts and modifies its routing table from time to time.

Example of Proactive Routing Protocol is Destination Sequenced Distance Vector (DSDV).

2.3 Reactive Routing Protocol

Reactive Protocol has lower overhead since routes are determined on demand. It employs flooding (global search) concept. Constantly update of route tables with the latest route topology is not required in on demand concept. Reactive protocol searches for the route in an on-demand manner and set the link in order to send out and accept the packet from a source node to destination node. Route discovery process is used in on demand routing by flooding the route request (RREQ) packets throughout the network.

Examples of reactive routing protocols are the dynamic source Routing (DSR), ad hoc on-demand distance vector routing (AODV).

2.4 Destination Sequence Distance Vector (DSDV)

The Destination-Sequenced Distance-Vector (DSDV) [3] Routing Algorithm is based on the Bellman-Ford Routing Algorithm with certain improvements. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbours. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven.

2.5 Dynamic Source Routing (DSR)

Dynamic Source Routing (DSR) [4] is a reactive protocol. It computes the routes when necessary and then maintains them. The key distinguishing feature of DSR is the use of source routing. In source routing the sender knows the complete hop-by-hop route to the destination. These routes are stored in a route cache. The data packets carry the source route in the packet header. When a node in the ad hoc network attempts to send a data packet to a destination for which it does not already know the route, it uses a route discovery process to dynamically determine such a route. Route discovery works by flooding the network with route request (RREQ) packets. Each node receiving an RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a route reply (RREP) packet that is routed back to the original source.

If any link on a source route is broken, the source node is notified using a route error (RERR) packet. The source removes any route using this link from its cache. A new route discovery process must be initiated by the source if this route is still needed.

2.7 Ad Hoc On-Demand Distance Vector Routing (AODV)

It is a reactive protocol implying that it requests a route when needed and it does not maintain routes for those nodes that do not actively participate in a communication. An important feature of AODV [2] is that it uses a destination sequence number, which corresponds to a destination node that was requested by a routing sender node. The destination itself provides the number along with the route it has to take to reach from the request sender node up to the destination. If there are multiple routes from a request sender to a destination, the sender takes the route with a higher sequence number. This ensures that the ad hoc network protocol remains loop-free.

3. Software Description

Network simulator-2 [5] is popularly used for ad-hoc networking community. It is the open source software for evaluating the performance of the existing network protocols and evaluates new network protocols before use. Use NS2 simulator to simulate a variety of IP networks. The main goal of the NS2 simulator is to provide support to education and research in networking. It is one of the best programmed in terms of comparing different routing protocols and designing new ones. NS2 has been written in two languages: Object oriented variant of Tool Command Language (OTCL) and object oriented language C++.

3.1 NS-2 Components

1. NS: Simulator
2. NAM (Network Animator): visual demonstration of NS output
3. Pre-processing: Handwritten TCL
4. Post analysis: Trace analysis using X-graph

The Routing protocols were compared based on parameter metrics given below:

Throughput and Packet Delivery Fraction (PDF) are used to define the performance of network. Round-Trip-Time is the time required for a single packet to travel from a specific source to destination and back again. Window Size is the number of data packets that can be sent without waiting for an acknowledgement.

Window Size = Throughput * RTT

Throughput = Window Size / RTT

Packet Delivery Ratio (PDR) [6] is the ratio between the number of packets transmitted by a traffic source and the number of packets received by a traffic destination. It measures the loss rate as seen by transport protocols and as specific to both the correctness and efficiency of ad hoc routing protocols.

Throughput defined as the ratio of the total amount of data that reaches a receiver from a sender to the time it takes for the receiver to get the last packet.

X axis: Round Trip Time

Y axis: Window Size

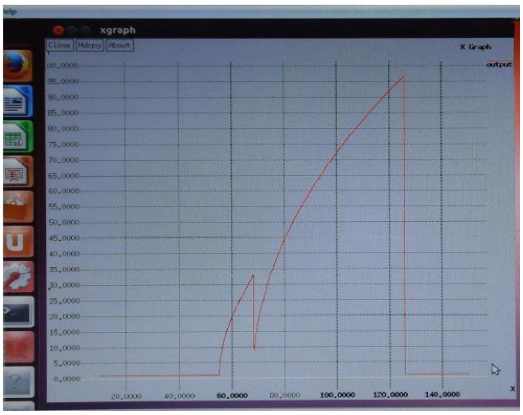

Fig. 2: X-graph representation of DSDV

Fig. 3: X-graph representation of AODV

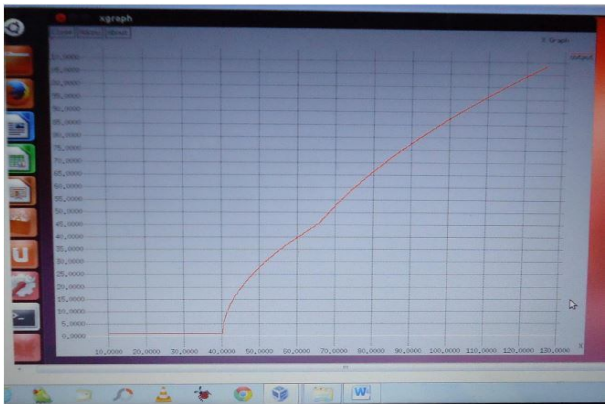

Fig. 4: X-graph representation of DSR

Table 1: Comparison table between protocols.

RTT (m-sec)	DSR	AODV	DSDV
40	0	0.25	0
60	0.667	0.70	0.316
80	0.837	0.725	0.55
100	0.867	0.73	0.72

4. Conclusion

Our simulation work illustrates the performance of three routing protocols AODV, DSR and DSDV. The paper presents a study of the performance of routing protocols AODV and DSR perform better under high mobility simulations than DSDV. In DSR uses source routing and route caches, and does not depend on any periodic or timer-based activities. While AODV uses routing tables, destination sequence numbers, a mechanism to prevent loops and to determine freshness of routes.

Therefore by observing the performance of these routing protocols, we can say DSR shows higher throughput than DSDV and AODV.

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