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A Study of Mobility Speed on Different Traffic Patterns in MANET

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Abstract – In this work we are studying the performance of three different routing protocols Ad-Hoc On-Demand Distance Vector Routing Protocol (AODV), Dynamic Source Routing Protocol (DSR) and Wireless routing protocol (WRP) of Mobile Ad-hoc Network based upon two different Mobility Models: Random Waypoint Model (RWP) and Reference Point Group Mobility Model (RPGM) with varying Speed of the mobile nodes in different Traffic Patterns. We have considered CBR and FTP Traffic Pattern. The studies have been carried out by evaluating the value of Throughput, Average end to end delay and Packet Delivery Ratio (PDR).

Index Terms – AODV, DSR, PDR, RWP, RPGM.

1. INTRODUCTION

The rapid technology advancement has provoked great growth in mobile devices connected to the Internet. Mobile ad hoc network is the one consisting of a collection of wireless mobile nodes (MNs) sharing a wireless channel without any centralized control or established communication backbone [1]. The nodes themselves are responsible for creation, operation, maintenance of the network and also self-organize to form a network over radio links. Usually, these nodes act as both end systems and routers at the same time. The goal of MANETs is to extend mobility into the realm of autonomous, mobile and wireless domains, where a set of nodes form the network routing infrastructure in an ad-hoc fashion. Routing protocols will need to perform four important functions of determination of network topology, maintaining network connectivity, transmission scheduling and channel assignment, and packet routing. Routing protocols in MANETs were developed based on the design goals of minimal control overhead, minimal processing overhead, multi hop routing capability, dynamic topology maintenance and loop prevention [2]. The statistical behavior of physical motion of mobile nodes is described by different mobility models: Random Waypoint Model (RWP) [3] and Reference Point Group Mobility Model (RPGM) [4] provided with varying Speed of the mobile nodes. The two different traffic patterns: Constant Bit Rate (CBR) and FTP perform an important role in the performance of a routing protocols concerned. In these traffic patterns CBR traffic which generates data packets at a constant rate is very well known traffic model in the area of ad-hoc network but this type of traffic pattern is not good so for multimedia applications. Multimedia applications are followed by some idle periods. For these applications we used the FTP Traffic Pattern which is very useful for generating multimedia traffic such as audio, video and text traffic etc [5].

Section 2 contains the overview of Routing Protocols. Section 3 contains a description of different Mobility models. Section 4 contains introduction of different traffic patterns. Section 5 contains the performance metrics and we conclude this paper in section 6 with some suggestions regarding for future directions.

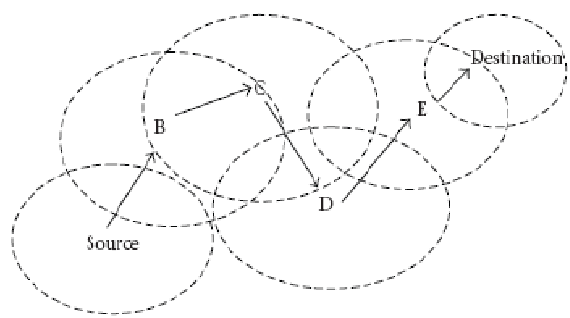

Fig. 1 Ad hoc networking example

2. OVERVIEW OF ROUTING PROTOCOLS

Routing is the process of selecting paths in a network along which data to be sent. In an ad-hoc network, mobile nodes communicate with each other using multihop wireless links. There is no stationary infrastructure; each node in the network also acts as a router, forwarding data packets for other nodes. A central challenge in the design of ad-hoc networks is the development of dynamic routing protocols that can efficiently find routes between two communicating nodes. The routing protocol must be able to keep up with the high degree of node mobility that often changes the network topology drastically and unpredictably [6].

Routing protocols are divided into three categories namely proactive, reactive and hybrid:

- In proactive routing each node continuously maintain route between pair of nodes. Hence, route creation and maintenance is accomplished through some combination of periodic and event-triggered routing updates derived from distance-vector or link-state method. In this routing protocol each node has one or more tables that contain the latest information of the routes to any other node in the network. Various table-driven protocols differ in the way how the information propagates through all nodes in the network when topology changes.
- In Reactive or on-demand routing routes are only discovered when they are actually needed. Hence, a node that wants to send a packet to another node, the reactive protocols searches for the route in an on-demand basis and establishes a connection to transmit and receive a packet. The route discovery typically consists of network wide flooding of request message. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery occurs by flooding the route request packets throughout the network.
- Proactive protocols have large overhead and less latency while Reactive protocols have less overhead and more latency. So, Hybrid Routing Protocols combines the merits of proactive and reactive routing protocols by overcoming their demerits.

2.1 Ad-hoc On-demand Distance Vector Routing protocol (AODV)

Ad-hoc On-Demand Distance Vector is a routing protocol in which each node maintains a routing table, one entry per destination which records the next hop to the destination and its hop count. AODV also uses a sequence number to ensure the freshness of routes. AODV discovers a route through network-wide broadcasting. It does not record the nodes it has passed but only counts the number of hops. It builds the reversed routes to the source node by looking into the node that the route request has come. The intermediate nodes checks for fresh routes according to the hop count and destination sequence number and forwards the packets that they receive from their neighbours to the respective destinations. AODV utilizes periodic beaconing (HELLO packets) for route maintenance. If a node does not receive a HELLO packet within a certain time, or it receives a route break signal that is reported by the link layer, it sends a route error packet by either unicast or broadcast, depending on the precursor lists (i.e. active nodes towards the destination), in its routing table. AODV avoids the stale route cache problem of DSR and it adapts the network topology changes quickly by resuming route discovery from the very beginning [7].

2.2 Dynamic Source Routing protocol (DSR)

DSR is a simple and efficient routing protocol designed specifically for use in multihop wireless ad-hoc networks of mobile nodes [8]. It allows nodes to dynamically discover a source route across multiple network hops to any destination in the ad-hoc network. Each data packet sent then carries in its header the complete ordered list of nodes through which the packet must pass, allowing packet routing to be a trivially loop free and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded. With the inclusion of this source route in the header of each data packet, other nodes forwarding or overhearing any of the packets may easily cache this routing information for future use. It is a beacon-less protocol. During route construction phase, RREQ is flooded in network. The destination nodes respond by RREP, which carries the route traversed by the RREQ packet. Each RREQ carries a sequence number generated by source which is used to prevent loop formation and to avoid multiple transmission of the same RREQ by intermediate node that receives it through multiple paths. Main advantage of this protocol is that it is beacon-less, thus bandwidth consumption is less and each packet carries full routing information [9].

2.3 Wireless Routing Protocol (WRP)

The Wireless Routing Protocol (WRP) is a proactive unicast routing protocol for MANETs. WRP uses an enhanced version of the distance-vector routing protocol, which uses the Bellman-Ford algorithm to calculate paths. Because of the mobile nature of the nodes within the MANET, the protocol introduces mechanisms which reduce route loops and ensure reliable message exchanges.

The wireless routing protocol (WRP), similar to DSDV, inherits the properties of the distributed Bellman-Ford algorithm. To solve the count-to-infinity problem and to enable faster convergence, it employs a unique method of maintaining information regarding the shortest path to every destination node and the penultimate hop node on the path to every destination node in the network. Since WRP, like DSDV, maintains an up-to-date view of the network, every node has a readily available route to every destination node in the network. It differs from DSDV in table maintenance and in the update procedures. While DSDV maintains only one topology table, WRP uses a set of tables to maintain more accurate information. The tables that are maintained by a node are the following: distance table (DT), routing table (RT), link cost table (LCT), and a message retransmission list (MRL).

3. MOBILITY MODELS

3.1 Random Waypoint Model (RWP)

The Random Waypoint Mobility Model is widely used mobility models. This model assumes that each host is initially placed at a random position within the simulation area [3]. As the simulation progresses, each host pauses at its current location for a determinable period called the pause time. RWP model assumes the possibility of setting cut-of phase, scenario duration, width and height of the area (x, y), minimum and maximum speed (v_{min} and v_{max}), as well as maximum pause time. RWP model includes pause times between changes in direction and/or speed. Pause is used to overcome abrupt stopping and starting in the random walk model. Upon expiry of this pause, the node arbitrary selects a new location to move towards and a new speed which is uniformly randomly selected from the interval [v_{min}, v_{max}] [10].

3.2 Reference Point Group Model (RPGM)

Reference Point Group Mobility (RPGM) model, is a group mobility model which represents the random motion of a group of mobile nodes as well as the random motion of each individual node within the group [11]. It can be used in military battlefield communication. Here each group has a logical centre (group leader) that determines the group's motion behavior. Initially each member of the group is uniformly distributed in the neighborhood of the group leader [9]. Group movements are based upon the path travelled by a logical centre for the group. The logical centre for the group is used to calculate group motion via a group motion vector. The motion of the group centre completely characterizes the movement of its corresponding group of mobile nodes, including their direction and speed. Individual mobile nodes randomly move about their own pre-defined reference points, whose movements depend on the group movement.

4. DIFFERENT TRAFFIC PATTERNS

4.1 Constant Bit Rate (CBR) Traffic Pattern

It is the most popular traffic source in network simulation. In this traffic, the data rate remains constant during the packet transmission. It does not accommodate the specific features of multimedia applications and not useful for simulation of real time multimedia traffic generated on demand and video-conferencing services.

4.2 FTP Traffic Pattern

FTP uses tcplib to simulate the file transfer protocol. In order to use FTP, the following format is needed:

FTP <src> <dest> <items to send> <start time>

where

<src> is the client node.

<dest> is the server node.

<items to send> is how many application layer items to send.

<start time> is when to start FTP during the simulation.

EXAMPLE:

a) FTP 0 1 10 0S

Node 0 sends node 1 ten items at the start of the simulation, with the size of each item randomly determined by tcplib.

b) FTP 0 1 0 100S

Node 0 sends node 1 the number of items randomly picked by tcplib after 100 seconds into the simulation. The size of each item is also randomly determined by tcplib.

5. PERFORMANCE METRIC

We will take three performance parameters for study on AODV, DSR and WRP which are End-to End delay, Packet Delivery Ratio, and Routing Overhead which are described as below:

5.1 End-to-End Delay

The average end-to-end delay of data packets is the interval between the data packet generation time and the time when the last bit arrives at the destination. A low end-to-end delay is desired in any network.

The average time required for transmitting a data packet from source node IP layer to the destination IP layer, including transmission, propagation and queuing delay.

Average End-to-End Delay = Σ (Time when Packets enters in the Queue) - Σ (Time when the Packet is received)

5.2 Packet Delivery Ratio

Packet Delivery Ratio (PDR) is the ratio between the number of packets transmitted by a traffic source and the number of packets received by a traffic sink. It measures the loss rate as seen by transport protocols and as such, it characterizes both the correctness and efficiency of ad hoc routing protocols. A high packet delivery ratio is desired in any network.

Packet Delivery Ratio = Σ (No. of Received Packets) / Σ (No. of Delivered Packets)

5.3 Throughput

Throughput is the number of packet that is passing through the channel in a particular unit of time. This performance metric show the total number of packets that have been successfully delivered from source node to destination node and it can be improved with increasing node density.

6. CONCLUSION

In this paper we have studied the performance of three different routing protocols Ad-Hoc On-Demand Distance Vector Routing Protocol (AODV) and Dynamic Source Routing Protocol (DSR) and WRP of Mobile Ad hoc Network. The performance has been studied for different Mobility Models: Random Waypoint Model (RWP) and Reference Point Group Mobility Model (RPGM) with varying Speed of the mobile nodes in different Traffic Patterns such as CBR and FTP.

In future work we can simulate the above mentioned routing protocols with the same performance metrics with varying the mobility model and varying the size of data packets and conclude their performance that how they behave with mobility model and packet sizes.

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