The Analysis of Mobility Models based on Routing Protocols

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ABSTRACT

Mobility is an inherent charater of Ad Hoc Networks. Ad Hoc networks are characterized by node mobility and lack of infrastructer.In the past decade , a significant amount of research was devoted to develop mobility models suitable for evaluating the performance of Ad Hoc Network.The goal of this paper is to present a number of mobility models in order to offer research more experienced choice when they are deciding on a mobility models to use in their performace evaluation with the help of routing protocols. In this paper a relative analysis of mobility models exixting,are discussed on a variety of simulation setting parameter like packet delivery rate (PDR),Average End to End Delay,Throughput.

Keywords

ns2, , Routing protocols, Ad Hoc Network, Mobility Models, BONNMOTION 2.0.

1. INTRODUCTION

Wireless and self configurable behavior of Ad Hoc networks makes them compatible for many scenarios such as mobile battlefield, campus ,disaster relief, sensing and monitoring etc.The mobility of nodes is the key aspect of mobile Ad Hoc networks, and the performance of Ad Hoc netwoks needs to be studied in presence of mobility[1,3,5,8]. The real-life mobility patterns can be very complex depending on the operation objectives of mobile nodes that are a part of the independent system. The more complex the mobility pattern is, the more difficult it is to model because more details need to be integrated. The simulations are used to study the impact of the mobility in Ad Hoc netwok [2, 3]. The node mobility of Ad Hoc netwoks causes the network topology to change with time, and Ad Hoc netwoks performances should be dynamically readjusted to such changes.Therefore, the networking and application protocol performances of Ad Hoc networks are very much influenced by the incidence of network topology changes. On the other hand, the performances of Ad Hoc networks can vary significantly with unusual mobility models [5, 6]. Additionally, by varying different parameters of a given mobility model, the Ad Hoc netwoks performances are effected by a vast extent.The selection of a mobility model may require a communications traffic pattern over the network which significantly influences the network and application performances.Network simulators emerged as the most general method of evaluating the performance of large complex networking system.However,for system involving mobile nodes,the movement of the nodes has a sigificiant influence on the simulation results. Ad Hoc networks are collected of a set of mobile nodes known to communicate with one another over a general wireless channel [1, 2, 5].

A mobility model attempts to mimic the movement of real mobile nodes that vary the speed and direction with time. The mobility model that accurately represents the characteristics of the mobile nodes in an Ad Hoc network is the key to inspect whether a given protocol is useful in a particular type of mobile scenario[1,3,5]. The feasible approaches for modeling of the mobility patterns are of two types: traces and syntactic. The traces offer those mobility patterns that are realistic in reallife systems. In trace-based models, everything is deterministic. However, mobile Ad Hoc networks are yet to be deployed widely to know the traces involving a large number of participants and an acceptably long inspection period. In absence of traces, the syntactic models that have been proposed to stand for the movements of mobile nodes realistically in Ad Hoc networks.The syntactic mobility models can also be classified based on the description of the mobility patterns in Ad Hoc networks [1,16]:individual mobile movements and group mobile movements. In the former case, mobility models attempt to the expect mobile's traversing patterns from one place to another at a given point of time under different network scenarios.

In this article, we cover measured the effect of mobility models on the presentation of routing protocols DSR, AODV (Reactive Protocol) and DSDV (Proactive Protocol). For test purposes, we have chosen two mobility scenarios: City section and Manhattan models. These two Mobility Models are selected randomly and represent the possibility of its practical application in the future. Performance assessment has also been conducted across unstable node densities and the number of hops. In before experiment performed by some researcher's exposed exponential range of performance of the mobility models using routing protocols, node densities and span of data paths.

In the second section, we will study about the routing protocols for Ad Hoc wireless networks can be right for use in our study. In the third section, we will study mobility models used for simulation. In the Fourth Section, we will run numerous simulation scenarios for mobility models in the network. We will present the outcome and calculate the performance of each tested mobility models using protocols, based on the simulation results In the fifth section the parameters are used for performance analysis result for simulations and finally, in sixth section we will conclude the paper.

2. PROTOCOL USED FOR SIMULATIVE STUDY

2.1 Destination Sequenced Distance Vector (DSDV):

The Destination-Sequenced Distance-Vector Routing protocol (DSDV) described in [1,17] is based on the conventional Bellman-Ford routing mechanism [1,15,17]. The improvements made to the Bellman-Ford algorithm contain freedom from loops in routing tables. Each mobile node in the network maintains a routing table in which all of the probable destinations contained by the network and the quantity of hops to each destination are recorded. Each entry is marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops. The node looks up for destination in the routing table and forwards using next hop information given the routing table and Routing table updates are periodically transmitted during the network in order to maintain table consistency. These updates are done as infrequently as possible i.e., when the link situation is changed. As the nodes in the network are mobile the links break regularly, triggers a lot of updates and clogs the entire the entire network with update packets even at lower mobility.

DSDV has certain advantages that cannot be ignored. First, the simplicity of the protocol is very similar to the classic Distance Vector, with only small modifications to avoid loops, with the use of destination order numbers. DSDV also presents low latency, as each node constantly has a route to any destination in the network. However, DSDV does not extent well in networks with high mobility, as the busted links create a "storm" of route updates. This situation may harshly corrupt network performance, in which the available bandwidth is limited. Another disadvantage , it does not hold a sleeping mode, as every node in the network must periodically broadcast changes or full updates of its routing table. Those regular and periodic route updates in the network will also result in high-energy using up.Finally, DSDV does not support multicasting routing.

2.2Dynamic Source Routing Protocol(DSR):

It is an on-demand protocol designed to restrict the bandwidth devoted by control packets in Ad Hoc wireless networks by eliminating the periodic table update messages required in the table-driven approach. As its name tells, this protocol use source routing algorithm to determine routes the major difference between this and the other on-demand routing protocols is that it is inspiration less and hence does not require periodic hello packet transmissions, which are used by a node to inform its neighbors of its presence. The fundamental approach of this protocol during the route creation phase is to set up a route by flooding route request packets (RREQ) in the network. The destination node, on getting a route request packet, responds by sending a route reply packet (RREP) back to the source, which carries the route traversed by the route request packet received [14,17]. This is called route discovery and is one of its two major phases along with route maintenance.For the Route discovery and maintenance, source node that does not have a route to the destination. When it has data packets to be sent to that destination, it floods a RREQ throughout the network. Each node, upon receiving a RREQ, rebroadcasts the packet to its neighbors if it has not forwarded it previously, provided that the node is not the destination node and that the packet's time to live (TTL) counter has not been exceeded. To return the route reply, the destination node must have a route to the source node. If the route is in the Destination node's route cache, the route would be used. Otherwise, the node will reverse the route based on the route record in the RREP message header. Nodes can also learn about the neighboring routes traversed by data packets if operated in the promiscuous.This route cache is also used during the route construction phase in the way that if an intermediate node that receives a RREQ has a route to the destination node in its own route cache, and then it replies to the source node by sending the RREP with the entire route information from the source node to the destination node.As each node can odd the other with a RREQ it seems that loops could be formed as well as multiple transmissions of the same RREQ, for example by an middle node that receives it through multiple paths. To prevent this, each RREQ carries a sequence number generated by the source node and the path it has travelled. A node, upon receiving a RREQ, checks the sequence number on the packet before forwarding it, so it is forwarded only if it is not a duplicate RREQ. In the event of serious transmission, the Route Maintenance Phase is initiated where by the route error packets (RERR) are generated at a node. That node sends to the others so they will remove the routes that uses that hop, so all routes containing it are truncated at that point [5,6,7]. Again, the Route Discovery Phase is initiated to determine the most viable route.

2.3 Ad-Hoc On Demand Distance Vector(AODV)

The Ad Hoc On-Demand Distance Vector protocol (AODV) was designed to improve the performance of the Destination-Sequenced Distance Vector routing protocol (DSDV). The main goal of AODV is to broadcast discovery packet when necessary and to distinguish between local connectivity and topology maintenance. In AODV overhead is reduced as number of broadcast is minimized [16,18]. In case of Path Discovery Process, the path discovery starts when a node needs communication with other node by sending route request packet (RREQ) packet [16,17,18] which hold broadcast id, source address, destination address, source sequence number, destination sequence number, hop count. When an intermediate node receives RREQ it checks that it had received over bidirectional link. If this has already processed then RREQ packet is discarded. Otherwise, it checks for route entry for destination. The reply is send to source only if the destination sequence number in RREQ is greater than target series number in its route table. A route reply packet (RREP) [18] is send by middle node as a response to RREQ packet. As RREP travels back to source all information are updated. Finally, RREP reaches source and route entry is modified. In case of maintaining routes Process the AODV each node maintains a routing table with its entries. An active route entry is one in which is in use by active neighbours. Path which is followed by packets from source to destination with active route entries is called an active path. To transmit data from source to destination each time route entry is used[16,17,18].

3. MOBILITY MODELS USED IN SIMULATIVE STUDY

These segment presents the mobility models used in the simulation studies are presented, compared and explained City Section Mobility Model and Manhattan Mobility Model. Mobility models can be differentiate according to their measure of how two nodes are dependent into their movement. If two nodes are moving in the same direction then they have a maximum spatial dependency and a measure of how present velocity, magnitude and direction are related to previous velocity. Nodes having same velocity have high temporal dependency. The descriptions of mobility models given below.

3.1 City Section Mobility Model :

This mobility model are uses a simulation area that represents street network of a city. A node is not permitted to opt any point on the graph. It should choose a position that is on some street network of the city. After selecting ,destination point, the journey path is determined by an algorithm, which calculates the shortest journey time between source to destination. After reaching to the destination point, node waits there for a defined pause time and randomly chooses another destination on the street network and repeats the process. In addition to this behavior, in City Section Mobility model, a mobile node should obey some pre-defined driving characteristics, such as "speed limit" and "minimum distance allowed between any two nodes". These rules and the use of pre-defined paths (street network) make the movement behavior of the mobile node similar to a vehicle movement in a city central [15,16].

3.2 Manhattan Mobility Model:

It define the movement pattern of mobile nodes on the streets and it can be useful in modeling movement in an urban area.The scenario is composed of a number of horizontal and vertical streets. [8, 14]. The Manhattan mobility model [2] emulates the movement pattern of mobile nodes on streets defined by maps. It uses a grid road topology. This mobility model was mainly proposed for the movement in urban areas, where the streets are in an organized manner. In this mobility model, the mobile nodes move in horizontal or vertical direction on an urban map. The Manhattan Mobility Model employs a probabilistic approach in the selection of node movements, since, at each intersection, a vehicle chooses to keep moving in the same direction. Although this model provides flexibility for the nodes to change the direction, it imposes geographic restrictions on node mobility.

4. SIMULATION

The network simulations have been carried out using Network Simulator ns2.35 and its related tools for animation and study of results. We chose a Linux platform i.e. UBUNTU 12.04 LTS, as Linux offers a number of programming development tools that can be used with the simulation method. We have generated mobility scenarios of Mobility Model using BONNMOTION2.0, so that they can be incorporated into TCL scripts. Random traffic associates of CBR can be setup between mobile nodes using a traffic-scenario generator script [5,6]. BONNMOTION is java based tool for generating mobility secienario for several mobility models,developed by University of Bonn,Germany.

Table 2: Performance Parameters

Parameter	Value
Channel type	Wireless channel
Simulator	NS 2 (Version 2.35)
Protocols	AODV, DSDV, DSR
Simulation duration	400s
Number of nodes	25,50,75
Transmission range	260m
Movement Model	City Section, Mahattam
MAC Layer Protocol	802.11
Pause Time (s)	15 ± 4 s
Maximum speed	25
Minimum speed	0.5
Packet Rate	4 packet/s
Traffic type	CBR (Constant Bit Rate)
Data Payload	512 bytes/packet
Max of CBR connections	10,20,40
Environment Size	700m * 700m

5. PERFORMANCE PARAMETERS AND RESULTS ANALYSIS

5.1 Performance Parameters:

The management of routing protocols is with the following significant Quality of Services (QoS) metrics for regular measures:

5.1.1 Packet Delivery Ratio (PDR): It is defined in [9,10] as the ratio between the number of packets originated by the application layer.It is the ratio of data packets delivered to the destination to those generated from the sources. It is calculated by dividing the number of packets received by destination through the number packet originated from the source.

PDF = (Pr /Ps)*100, where Pr is total Packet received & Ps is the total Packet sent.

5.1.2 Throughput

It is the average number of messages successfully delivered per unit time number of bits delivered per second [10].

Throughput = $\frac{\text{Total Received Packets}}{\text{Total Simulation Time}}$ (Kbits/Sec),where N is the number of data sources.

5.1.3 Average End-to-End Delay:

It defined as the time taken for a data packet to be transmitted across an Ad Hoc from source to destination.

D = (Tr –Ts), where Tr is receive Time and Ts is sent Time.

5.2 Result Analysis:

Here in the case of performance analysis we have considered above performance parameters. In Figure 1, 2,3,4,5,6 the simulations are focusing on analyzing the performance on routing overhead, throughput and packet delivery ratio. The results also compared with two mobility models that we had chosen .The result will show the performance of mobility models with respect to protocols that had been selected. Under different mobility models, which is given as below-

5.2.1 Average end to end delays:

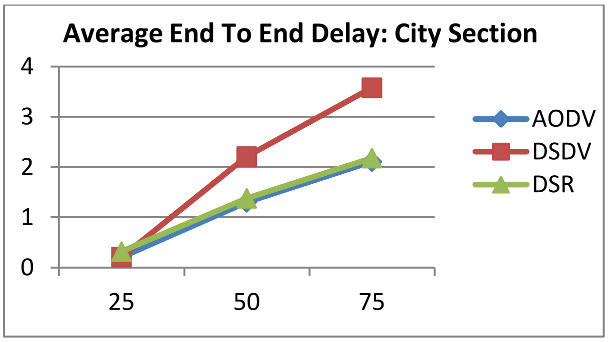

Figure 1: Average End to End Delay Vs Number Nodes for City Section Mobility Model

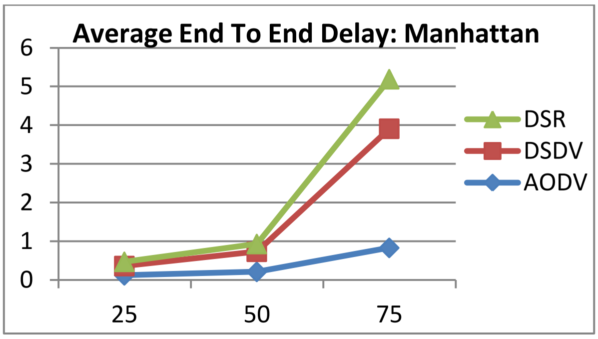

Figure 2: Average End to End Delay Vs Number Nodes for Manhattan model

5.2.2. Packet delivery ratio (PDR):

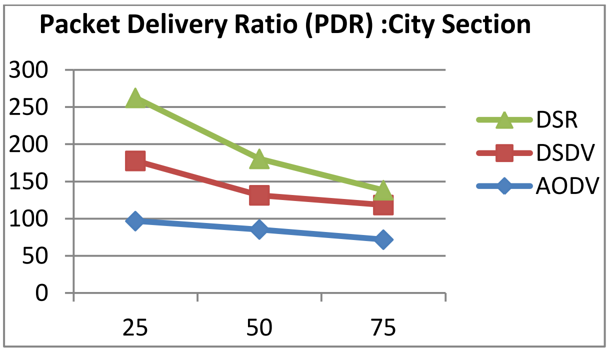

Figure3: Packet Delivery Ratio Vs Number Nodes for City Section Mobility Model

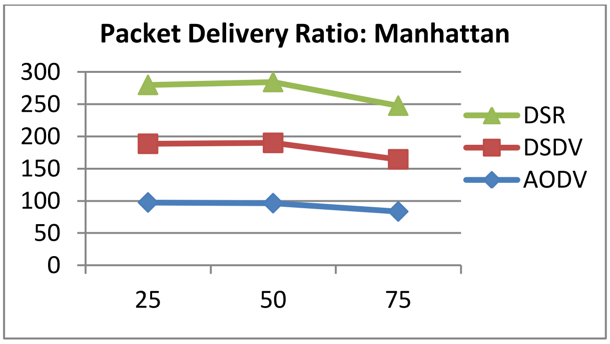

Figure 4: Packet Delivery Ratio Vs Number Nodes for Manhattan Mobility models

5.2.3.Throughput:

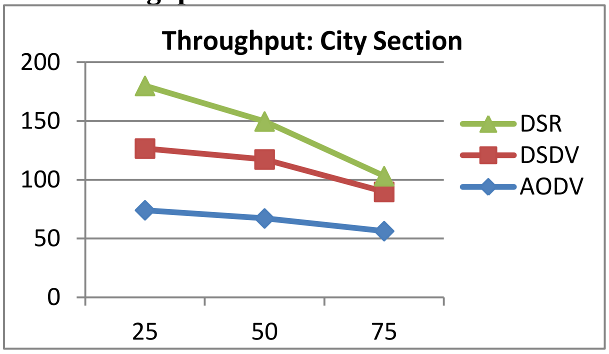

Figure5: Throughput Vs Number of Nodes for City Section Mobility Model

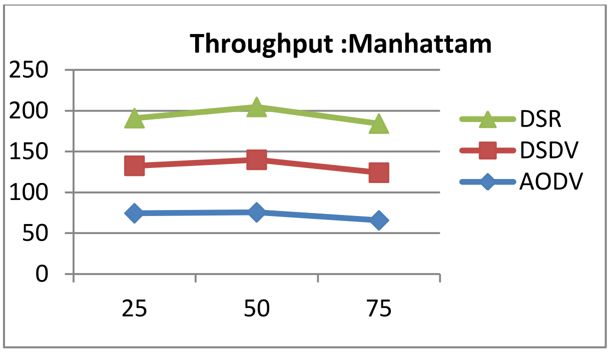

Figure 6: Throughput Vs Number of Nodes for Manhattan mobility models

6. CONCLUSION

In this section we have visualized the application of Mobile Ad Hoc Routing protocols like AODV, DSDV and DSR for nodes. We have considered Manhattan and City section mobility models. The performance of a mobility model can vary significantly with different Ad Hoc network protocols. The above Figures demonstrate the performance of Ad Hoc network mobility models with different routing protocols. As shown , the performance of the protocol is greatly affected by the mobility of the nodes. The performance of mobility models should be evaluated with the help of Ad Hoc network protocols. In this paper comparison has been made on three parameters PDR ,Throughput ,Average End to End delay. The City section model and the Manhattan model yield a relatively larger number of hops for minimum-hop routes and a relatively smaller lifetime for stable routes.The Manhattan mobility model is performed improved as city section mobility model.

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