



Performance Evaluation of Mobility Speed on Different Traffic Patterns in MANET

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Abstract— This paper evaluates the performance of two different routing protocols Ad-Hoc On-Demand Distance Vector Routing Protocol (AODV) and Dynamic Source Routing Protocol (DSR) 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 an Exponential Traffic Pattern (which is based on Exponential distribution). The results have been carried out by evaluating the value of Throughput, Normalized Routing Load (NRL) and Packet Delivery Ratio (PDR). It is found that the protocol performance may vary drastically across mobility models in different traffic patterns.

Keywords— AODV, DSR, MANET, NRL, PDR.

I. 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 behaviour 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 Exponential 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 Exponential 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 includes the simulation Setup followed by results and we conclude this paper in section 6 with some suggestions regarding for future directions.

II. 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.

A. 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].

B. 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].

III. MOBILITY MODELS

A. 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].

B. 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 behaviour. Initially each member of the group is uniformly distributed in the neighbourhood of the group leader [12]. 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.

IV. DIFFERENT TRAFFIC PATTERNS

A. 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 [13].

B. Exponential Traffic Pattern

It follows an ON/OFF packet generation pattern. This traffic pattern is followed by an Exponential distribution and the packet generation rate varies following Exponential distribution, during the ON period. In this traffic pattern we can tune the traffic generation pattern by using three different parameters which are:

- Rate at which the traffic can be generated during ON period.
- ON period.
- OFF period.

This traffic pattern also have the specific features of multimedia applications and very useful for generating multimedia traffic such as audio, video traffic etc [5, 14].

V. SIMULATION RESULTS AND ANALYSIS

Simulation has been carried out by the Network Simulator Version 2.35 (NS-2). We use Bonn-Motion [15] tool for mobility scenario generation. We have taken 60 mobile nodes moving in an area of 1000m × 1000m for period of 100sec. This section presents analysis of the performance metrics under various traffic patterns; we have used Normalized Routing Load (NRL), Packet Delivery Ratio (PDR) and Throughput.

TABLE I SIMULATION PARAMETERS

PARAMETER	VALUE
Area size of topography x(m)	1000 m
Area size of topography y(m)	1000 m
Mobility Model	RWP, RPGM
Mobility Speed	10-30-50 m/s
Number of Nodes	60
Pause Time	10
Simulation duration	100s
Simulated Routing Protocols	AODV-DSR
Transmission Range	250m
Traffic Type	Cbr-Exponential

A. Impact of speed in RWP Mobility Model

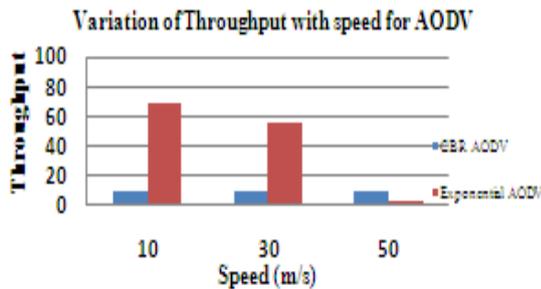


Fig.1 Throughput of RWP in AODV Routing Protocol at different node speed on different traffic patterns

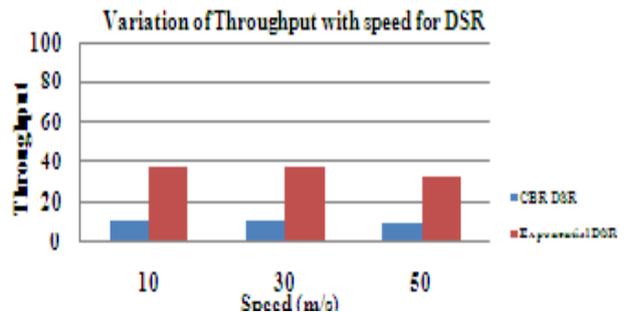


Fig.2 Throughput of RWP in DSR Routing Protocol at different node speed on different traffic patterns

The throughput of RWP mobility model for different traffic patterns with different speed of the mobile nodes is very high in AODV as compared to DSR as can be seen in Fig.1 and Fig.2. In these figures throughput of Exponential traffic is high as compared to CBR traffic in both the routing protocols.

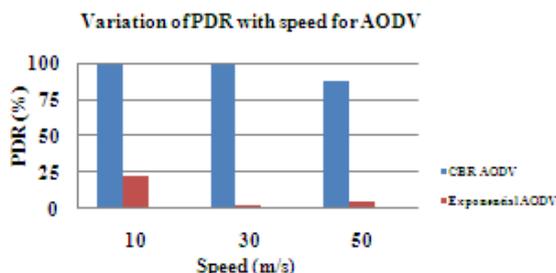


Fig.3 PDR of RWP in AODV Routing Protocol at different node speed on different traffic patterns

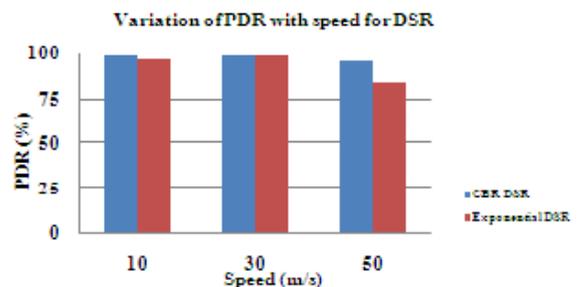


Fig.4 PDR of RWP in DSR Routing Protocol at different node speed on different traffic patterns

The PDR of RWP mobility model for different traffic patterns is varied with the variation of speed of the mobile nodes as shown in Fig.3 and Fig.4. CBR traffic is very high in both the routing protocols as compared to Exponential Traffic.

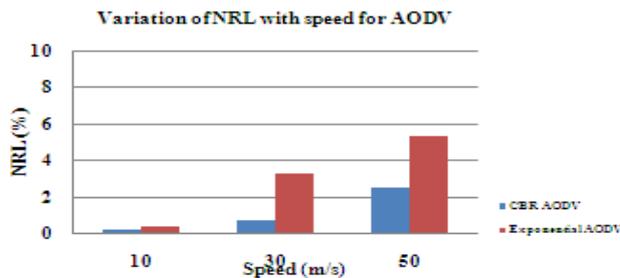


Fig.5 NRL of RWP in AODV Routing Protocol at different node speed on different traffic patterns

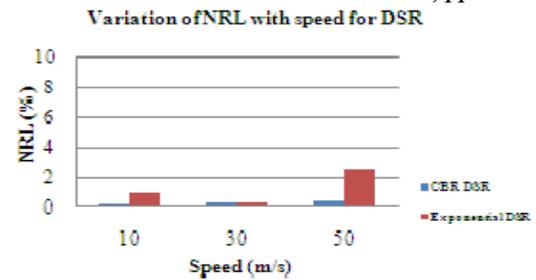


Fig.6 NRL of RWP in DSR Routing Protocol at different node speed on different traffic patterns

The NRL is increased with increasing in speed in both the traffic patterns in AODV.

B. Impact of speed in RPGM Mobility Model

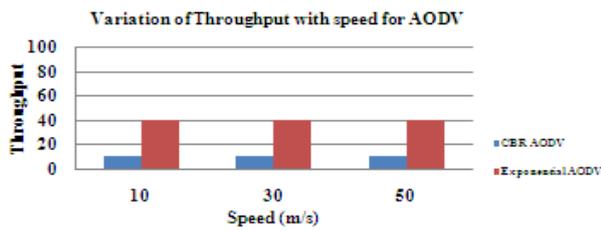


Fig.7 Throughput of RPGM in AODV Routing Protocol at different node speed on different traffic patterns

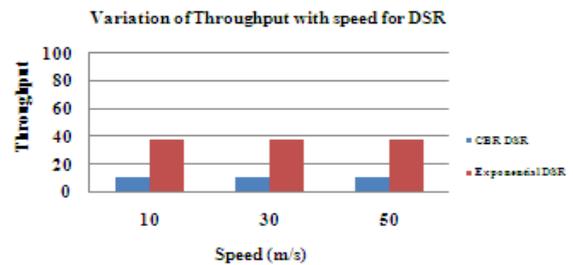


Fig.8 Throughput of RPGM in DSR Routing Protocol at different node speed on different traffic patterns

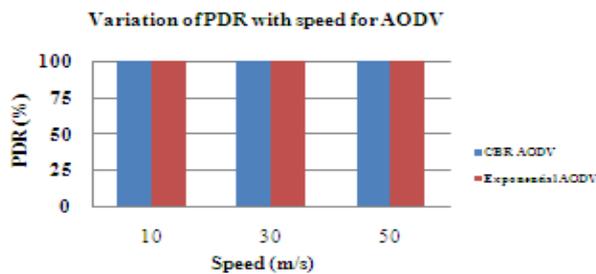


Fig.9 PDR of RPGM in AODV Routing Protocol at different node speed on different traffic patterns

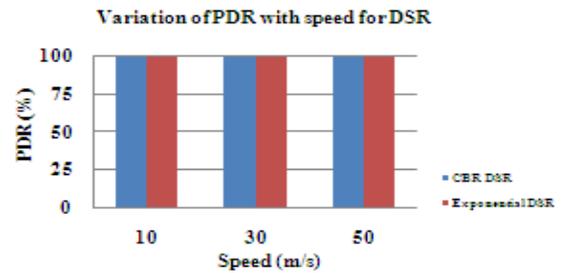


Fig.10 PDR of RPGM in DSR Routing Protocol at different node speed on different traffic patterns

The Throughput as can be seen from Fig.7, Fig.8 and PDR as shown in Fig.9 and Fig.10 of RPGM mobility model for different traffic patterns at different speed is almost same in both the routing protocols.

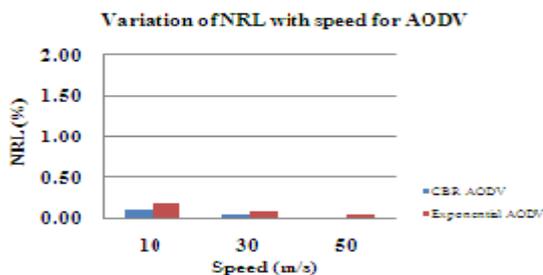


Fig.11 NRL of RPGM in AODV Routing Protocol at different node speed on different traffic patterns

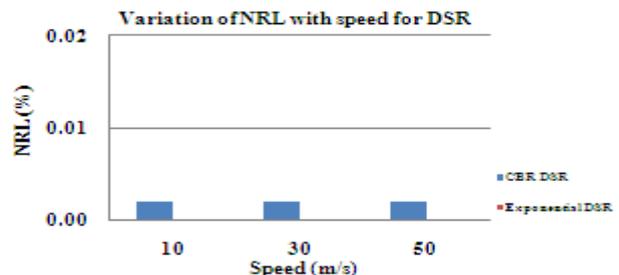


Fig.12 NRL of RPGM in DSR Routing Protocol at different node speed on different traffic patterns

The NRL of AODV in Exponential traffic pattern is greater than the CBR traffic.

VI. CONCLUSION

In this paper the performance of two different routing protocols Ad-Hoc On-Demand Distance Vector Routing Protocol (AODV) and Dynamic Source Routing Protocol (DSR) of Mobile Ad hoc Network has been evaluated. The performance has been calculated 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 Exponential. The results have been carried out by evaluating the value of Throughput, Normalized Routing Load (NRL) and Packet Delivery Ratio (PDR). We found that the Exponential Traffic Pattern performs better than CBR traffic pattern in AODV and DSR routing protocols.

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