Impact of Various Propagation Models on Performance of On- Demand Routing Protocols

Er. Simerpreet Singh and Prof. Narwant Singh Grewal
1,2 Guru Nanak Dev Engg. College/Department of ECE, Ludhiana, India
1 Email: s.simerpreet@gmail.com
2 Email: narwant@gndec.ac.in

Abstract—Mobile Adhoc Network (MANET) routing protocols facilitates the creation of dynamic reconfigurable networks without any centralized infrastructure. Due to very limited transmission range of wireless network interfaces, multi hop networks are required by node to exchange data with other nodes in the network. In recent years, large number of protocols were developed and targeted specifically at this development. In multihop system, it is assumed that all the routes in a nodes is active and available for routing at any time during transmission. Hence many performance parameters improved as compared to single path routing as there is no need to update the routing tables periodically and hence the control traffic is reduced for entire networks. The Quality of Service depends upon various parameters. The performance of MANET depends upon certain parameters like by varying the nodes mobility, propagation model or traffic scenario. Performance of these networks can be analysed by measuring various performance parameters like Packet Delivery Ratio, End to End Delay, Instant Jitter, Throughput, Energy Consumption etc. In this work the the performance measure of three on-demand routing protocols (AODV,AOMDV,DSR ) are done by varying number of nodes and propagation models in network simulator 2.35. Simulation studies show that AOMDV performs the best when mobility is high and consume lesser energy as compared with other two protocols and at low mobilitly all the three protocols are closely matched each other.

Keywords: - AOMDV, AODV,DSR,MANET

I. INTRODUCTION

A mobile ad-hoc network or MANET is a collection of mobile nodes sharing a common wireless channel without any centralized control. There are no permanent and fixed links are present in this scenario and all nodes are having ability to move in the network dynamically. These nodes can act as both transreceivers as well as linkers at the same time as as per acharjgee et al [1]. Hence performance of ad-hoc network rely on the transmission power of the nodes and the temporary location of the mobile nodes which are dynamically present in the circuit.

Routing in Manets :- Routing is defined as an act of moving information across an internetwork from a source node to the destination node. The route production is done by routing that meet the service requirements of the traffic session. The requirement characteristics of routing techniques are correctness, simplicity, robustness, stability, efficient, flexible, rapid convergence etc. The routing protocols are designed

DOI: 03.AETS.2013.3.168
© Association of Computer Electronics and Electrical Engineers, 2013
to find the best suitable shortest path between two nodes. The shortest path is usually in terms of number of hops, link utilization or queuing delay as according to Vivian et al [16]. The routing task in an Ad Hoc network is more complex than in wired networks, because this depends on many factors including topology, routing selection type, request initialization and specific underlying characteristics that can serve as heuristics to find quickly and efficiently the route for which the packages should be sent according to Bakshi [3]. Major challenges in mobile ad hoc networks are routing of packets with frequently mobile nodes movement, there are various issues like energy and power consumption, storage capacity and there are also wireless communication issues. As Manets consist of wireless networks having wireless dynamic hosts which causes change in routes. This movement results in a route variation. Various routing protocols are required hence whenever delivered data packets needed to be handover several nodes to arrive at their receiving ends. Routing protocols have to discover efficient routes for packet delivery and make sure the packets are received at the correct destinations as per wadhwa [17].

**Manet Routing Protocols**: We can categorised the routing protocols in three types as shown in figure 1.

### Figure 1 MANET Structure

**Proactive Protocol**: In this type of routing protocol, every node in a wireless network maintains one or multiple links which are updated time to time regularly. Each node sends an acknowledge message to the entire node network if there is a change in the network topology. However, it results in an extra overhead cost due to maintaining up-to-date scenario and as a result parameters like throughput of the network may be affected but the actual information is provided of the network.

**Reactive Protocol (On-Demand)**: In this type of routing protocol, as the name suggests routing will be maintained only as per requirement unlike proactive where routes are maintained all the time. In reactive protocols, every node discovers or maintains a route purely on-demand basis. A control message is floated by broadcast during finding a route and when route is discovered or found then we use bandwidth for data transmission. The main benefit is that this type of protocol requires less information size but the disadvantages are that it produces very large control packets due to route discovery during topology changes which occurs very often in MANETs results in higher latency according to Marina et al [10].

**Hybrid Protocol**: It is a combination of proactive and reactive protocols taking the best features from both worlds. In this work the performance of AODV, AOMDV and DSR is analysed.

**Adhoc On-Demand Distance Vector (AODV)**: AODV is derived from DSDV because it typically minimizes the number of required broadcasts by creating routes on requirement basis, rather than maintaining a complete list of routes as in the previous algorithm. The AODV works as a reactive protocol system, since in this system any node which is not selected or not on a selected routing path need not to maintain routing updation or information and not participate in routing table exchanges. During communication when a source node desires to send a message to some destination node and does not already have a valid route to that destination, a path discovery process is initiated to locate the other node.

**AOMDV (Adhoc On-Demand Multiple Distance Vector)**: Multipath routing is a technique provides multiple alternative paths between each source and destination in a network. The various advantages of such technique are fault tolerance, increase in bandwidth and improvement in network security. Overlapping, looping (infinity loop) and optimum disjointed paths or node disjointed are the main issues in such algorithms according to Ibrahim et al[8]. Adhoc On-demand Multipath Distance Vector Routing
(AOMDV) protocol according to Biradar et al.[5] is derived from AODV protocol for computing multiple loop-free and disjoint link paths. The entries of routing for each destination end contain a list of the next-hops along with the corresponding hop counts. The same sequence number is awarded to all next hops. This helps in keeping track of a route. The advertised hop count is maintained by a node for each destination, which is defined as the maximum hop count for all the paths as per Sanghi et al. [13], which is used for sending route advertisements of the destination.

**Dynamic Source Routing (DSR)**: The key distinguishing feature of DSR is the use of source routing. In this type of routing, the sender knows the complete hop-by-hop route to the destination. Source route is carried by the data packets in the packet header. When a node in the adhoc network attempts to send a data packet to a destination for which it does not already know the route, route discovery process is initiated dynamically to find such a route as per Amjad et al. [2].

**Radio Propagation Models**: In order to estimate the signal parameters accurately in mobile systems, it is always necessary to estimate propagation characteristics of a system through a medium. The analysis of propagation provides a good initial introduction of the signal and its characteristics. The prediction of accurate radio propagation for wireless adhoc networks is becoming very necessary and crucial. The main characteristics of Radio Propagation System is to detect Path Loss, Fading and time delay spread according to Hekmat et al. [7].

**Two Ray Ground Model**: This radio propagation model is highly preferred in MANET and is also used in maximum research studies for protocols performances in MANET scenario. This model assumes that the received energy is the sum of the direct line of sight path and the reflected path from the ground. It takes no account for obstacles and sender and receiver have to be on the same height.

**Shadowing Model**: In Shadowing Model there is no direct Point to Point communication is there. In this case Shadow phenomena in which fading occurs is used. Fading refers to the fluctuations in signal strength when received at the receiver. Fading can be classified into two types: fast fading and slow fading. In Fast fading, it refers to the sharp variations in the amplitude, multipath delays or phase of the received signal, due to the interference between different multiple versions of the similarly transmitted signal arriving at the receiving end at slightly different times. It occurs when objects involve in the transmission placed between the transmitter and receiver. In Slow fading, it may occur during receiver is inside a building and the radio waves must pass through the some interceptions like walls of a building or when the receiver is shielded temporarily from the transmitter by a building. This is also called as shadow fading (shadowing) since, it interrupts the direct transmission path from the source to the destination.

**Nakagami Model**: In various urban areas, signal fading occurs rapidly as several obstacles and reflectors are there and most of the time there is no direct point to point link path exists between the transmitting and receiving node in a channel. If a line of sight exists, multi-path still occurs due to reflection from different the ground and the surrounding objects. The incoming radio waves arrives from different directions with different propagation delays. There may inclusion of randomly distributed amplitudes, angle of arrival and phases at any point in space during signal reception. These multipath components combined vectorially cause the fading or distorting effect at the receiving end even when the receiver is stationary. The factor involves for fading the signal in stationary object is the movement of nearby surroundings parts in the radio channel. Fading is purely spatial phenomena, mobile nodes are moving and objects are stationary as per Haenggi [6]. The spatial variations of the resulting signal are seen as temporal variation by the receiver as it moves through the multipath field. At various points in space in a very small period of time, due to the constructive and destructive effects of multipath waves passing through several fades. In a more serious case, a receiver may stop at a particular location at which the received signal is in a deep fade. The Nakagami distribution matches some empirical data better than other models. For Nakagami fading, the expression is given as below. where \( G(m) \) is the gamma function, with \( G(m + 1) = m! \) for integer shape factors \( m \).

\[
\tau_c (\eta) = \frac{1}{\Gamma (m)} \left( \frac{m}{\eta} \right)^{m+1} \exp \left\{ \frac{-m}{\eta} \right\}
\]

**II. Related Work**

According to Vivian et al. [16] the performance of secure protocols decreased with increase in traffic. The
performance of on-demand and table driven protocols is analysed by varying number of nodes and jitter. The difference between performance of various on-demand protocols is larger than table driven protocols. The largest challenge in Manet are efficient as well as secure routing and data transmission. The advantage of multipath routing protocols are their link disjoint path options and due this advantage, it works better when compare with single-path or multi-path routing protocol having node disjoint option, in the presence of selfish nodes and by consider that link disjoint configuration of AOMDV, it can be a good choice to work with feedback mechanism stated by Basgani et al [4].

Acharjee et al [1] demolish the simulation study to compare AODV, DSR and DSDV under different scenarios like by varying mobility, load traffic and size and it was found that at initial stages the delivery ratio for AODV and DSR are closely same regardless of mobility changes but the delivery ratio of DSDV is very low as compare to DSR at very high mobility levels. Also as the pause time increases the delivery ratio also increases. But DSR shows very low overhead as compared to DSDV and AODV. By considering all the metrics, it was concluded that AODV was better than DSR and DSDV. Security and QOS (Quality of Service) are the most potential area of Ad-hoc networks will be considered in future and analysis of the performance of GPS (Global Positioning System) based reliable routing algorithms for Ad-hoc networks according to Acharjee et al [1]. According to Qasim et al [12] AODV is reactive protocol and construct route on demand and aims to reduce routing load. It uses on-demand routing framework and destination sequence numbers for routing the packets to destination mobile nodes and has location independent algorithm.

AODV shares DSR’s on-demand characteristics in that it also discovers routes on an as needed basis via a similar route discovery process. But AODV adopts on-demand single path routing mechanism having traditional tables for route and single entry per destination as compare to DSR in which it maintains multiple entries for route cache for each destination which is a very different mechanism to maintain information. The use of multipath minimizes performance scenarios signal. To make efficient system, DSR reverts to all the request reaching at destination from one cycle request. Therefore, the source experienced many alternate routes to the destination, which will be useful in the case that the primary (shortest) route fails. As there are many alternate routes which saves route discovery mechanism. Which is a edge over another protocols. However, there may be a possibility of a massive route reply. In AODV, on the other hand, the destination replies only once to the request arriving first and rest remains in queue. Single entry per destination is maintained in this type of routing given by Kartik et al [9].

Biradar et al [5] evaluated the performances of AODV and AOMDV using ns-2.34. Comparison was based on PDF, average end-to-end delay, Routing Overhead packets dropped and concluded that AOMDV performs better than AODV. AOMDV outperforms AODV due its ability to search for alternate routes when a current link breaks down. Though AOMDV incurs more routing overheads while flooding the network and packet delays due its alternate route discovery mechanism, it is more efficient when concluded for PDF for the same scenario. Under Nakagami-m fading model, received packet may not be clearly understood by the receiving node, which affects the routing protocol as well as the medium access control protocol of a network by Mohammad and Tanvir [11].

Verma et al [15] observed Energy efficiency as one of the main problems in a mobile ad hoc network, when we design a routing protocol. This work offered an energy efficient routing scheme in adhoc networks which uses the node energy effectively and also discovers the best route and increases the efficiency of the network. At the time of route selection, the proposed algorithm takes care of various crucial things such as source status of the routing path and numbers of drained nodes across the path.

Singh Punardeep [14] explained about propagation models. Two Ray Ground model as generate line of sight links so it does not involve obstacles present in communication scenario. As in this model communication depends upon direct interaction between source and destination, therefore signal fades away as the distance between sender and receiver increases. In obstacle environments strength fades also because of antenna position, transmission power and attenuation due to buildings. For better communication in wireless scenario signal strength must be strong but in obstacle presence signal strength gets low. In Two Ray Ground as there is no concept to model fading, Nakagami model is well suited model to analyze the performances in the urban scenario as it allows to model real traffic scenario.

### III. Methodology

From Literature survey it is clear that at lower mobility models i.e. number of nodes, pause time, start and stop time, the response by various protocols closely match each other but the performance varies as the
complexity increases. In this thesis the performance of various protocols under various scenarios as shown in Table 1, i.e. by varying propagation models and number of nodes is done with CBR traffic module. The purpose of the present research is to analyze the performance of AODV, AOMDV and DSR by varying number of nodes and propagation models. The assumed propagation models are Nakagami, Shadow and Two Ray Model. To achieve these objectives, the Network Simulator version 2.35 software has been used which is compatible with Linux based windows plateform and various steps have been followed for their implementation.

<table>
<thead>
<tr>
<th>Simulation Parameters</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software used</td>
<td>NS-2.35</td>
</tr>
<tr>
<td>Routing Protocols</td>
<td>AOMDV, AODV and DSR</td>
</tr>
<tr>
<td>Pause Time</td>
<td>50 secs</td>
</tr>
<tr>
<td>Propagation Models</td>
<td>Shadow, Two Ray and Nakagami</td>
</tr>
<tr>
<td>Simulation time</td>
<td>2060 Secs</td>
</tr>
<tr>
<td>Traffic Type</td>
<td>CBR</td>
</tr>
<tr>
<td>Antenna Model</td>
<td>Omni Directional</td>
</tr>
<tr>
<td>MAC</td>
<td>IEEE 802.11</td>
</tr>
<tr>
<td>No. of Nodes</td>
<td>50, 100, 150, 200, 250</td>
</tr>
<tr>
<td>Channel Type</td>
<td>Wireless</td>
</tr>
</tbody>
</table>

IV. PERFORMANCE METRICS

There are various performance metrics are used to evaluate and analyze the performance of various routing protocols. In this work we are analyzing the performance of routing protocols by evaluating PDF, Gentrthroughput and energy consumption described as follow:-

**Packet delivery fraction:** - It is the ratio of the received packets by the CBR sink at the destination over the sent packets by constant bit rate source. This metric actually tells us how much reliable the protocol is. It also explains the packet loss rate of the transport protocol during communication which in turn affects the efficiency and maximum throughput the adhoc network can support as given by Ibrahim et al [13].

\[
\text{PDF} = \frac{\text{number of received packets at destination}}{\text{number of sent packets from source}} \times 100
\]

**Energy Consumption:** - energy consumption in a Mobile Adhoc wireless network as total energy consumed by communication system during packet transfer from node I to node n where I is initial node and n is maximum node number as according to Verma et al [15]. Energy is converted in joules when power is multiplied by time. Transmitted Energy: \(\text{Tx Energy} = \frac{(\text{Tx Power} \times \text{Packet Size})}{2 \times 106}\)

Receiving Energy: \(\text{Rx Energy} = \frac{(\text{Rx Power} \times \text{Packet Size})}{2 \times 106}\) Sum of transmitted and received packets can be defined as total energy consumption.

**Gen Throughput:** - It is a data transmission measure that determines the amount of data moved from one node to another in a certain period of time according to Vivian et al [16].

V. RESULTS

![Figure 2: PDF v/s Nodes in Nakagami Model](image)
In Figure 2, as shown the Packet Delivery Fraction is calculated and compared by varying the number of nodes i.e. 50, 100, 150, 200, 250 for routing protocols AODV, AOMDV and DSR in nakagami propagation model. From above graph it is clear that as the complexity of communication increases i.e. number of nodes increases the multipath protocol i.e. AOMDV works efficiently than the other two although initially at 50 nodes the fraction is same. The performance of AODV and DSR are fractionally same but simply AODV is then preferred due to its On-Demand single path activation. Similar results are there when we assume same parameter scenario in two ray model as shown in figure 3 in which AOMDV leads again with closely ideal for 150 nodes but other two i.e. AODV and DSR go downwards in scale.

Compared with DSR, as it initiates better but as the node complexity increases the performance graph decreases as compared to other two protocols.
In Figure 5, 6 and 7, throughput is calculated and analysed with respect to node variation in different propagation scenarios (Nakagami, Two Ray and Shadow) and it is observed that DSR protocol initiates well as compared to AODV and AOMDV at low mobility level but as soon as Mobility goes high the performance of DSR decreases due to increase in overhead of DSR.
Similarly as shown in figures 8,9 & 10 Energy Consumption is calculated and compared under different propagation scenarios and concluded that the energy consumption difference by DSR increases with increase in mobility due to its multiple route cache property and increase overhead and other two protocols closely match other but simply due to multiple path route discovery ability gives AOMDV an edge over AODV.

VI. CONCLUSION

By studying and analyzing the outputs appeared in graph it is concluded that AOMDV must be preferred over AODV and DSR for the packet delivery fraction as it is outperformed well due its ability to search for alternate routes when the current links breaks down for all the different scenarios of propagation which are Nakagami, Shadow and Two Ray models while in terms of Energy Consumption, again AOMDV performed well having least energy consumed from the other two routing protocols and in terms of Gen Throughput AOMDV performs better than other two routing protocols for all the different scenarios. So it is concluded that AOMDV must be preferred over other routing protocols for Packet delivery ratio, Gen Throughput and Energy Consumption.
VII. Future Scope

More work can be possible with different traffic models and in different mobility scenarios. Also further research is also possible in hybrid protocols and in complex homogeneous nodes where best of Active and Proactive protocols are present.

REFERENCES


593