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Performance Analysis Of The Mobility Model Various Routing Protocol In Manet Using Ns3

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ABSTRACT

This paper performs a comprehensive analysis of the results from NS-3 simulations for testing various mobility models with MANETs and configures different node numbers. The purpose of the study is to determine which mobility model is more effective for MANETs. The research will evaluate them in terms of key metrics. Simulations are run on different node counts with varied mobility models within a 50x50 unit area. The analysis shows that the Gauss-Markov Mobility Model shows better performance than the other non-realistic mobility models for scenarios with 50 nodes. A fundamentally important lesson of this study is that for achieving optimal MANET performance under given conditions, an optimal mobility model needs to be selected. This paper also provides future work on various dimensions: use of other mobility models, alternative traffic generators, change in packet inter-arrival duration, and differing speeds of nodes. These improvements are aimed at expanding the scope and applicability of results to more diversified MANET scenarios. Invaluable aspects for designers and researchers in networks attempting to achieve optimal performance for MANETs in dynamic environments are provided through this research.
Keywords: NS-3 simulation; Mobile Ad-hoc Networks, MANET; Gauss-Markov Mobility Model; mobility models; performance metrics; node configuration; traffic generators; packet inter-arrival duration; dynamic environments.

1 INTRODUCTION

Wireless networks generally operate in one of two configurations, commonly referred to as topologies: ad-hoc or infrastructure-based. An ad-hoc network enables devices to communicate directly with one another without relying on a centralized access point. A Mobile Ad-hoc Network (MANET) is a dynamic, self-configuring, infrastructure-less network composed of mobile devices that connect wirelessly. These networks allow devices to move freely in any direction, leading to frequent changes in their communication links [1].

The performance of MANETs heavily depends on critical parameters such as mobility models and routing protocols, given the inherent limitations of wireless transmission ranges. Establishing fixed access points and backbone infrastructure is not always feasible in such networks. MANETs are IP-based and rely on intermediate nodes to transmit information from the source to the destination, with each node acting as both a host and a router. Routing in MANETs refers to the process of efficiently moving information across the network from a source node to a destination node.

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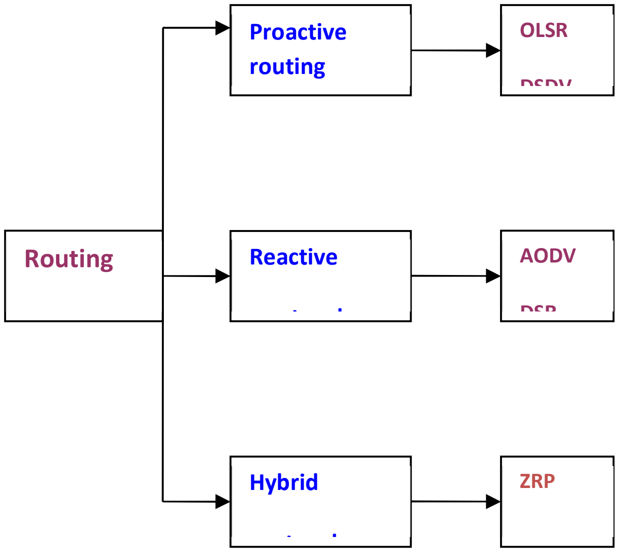

Fig2 - Classification of Routing Protocols

2. ROUTING PROTOCOLS IN MANETS

Mobile Ad-hoc Networks (MANETs) utilize a variety of routing protocols to manage dynamic and decentralized network environments. These protocols are broadly classified into **Proactive Routing Protocols** and **Reactive Routing Protocols**, based on their route discovery and maintenance mechanisms.

2.1 Proactive Routing Protocols

Proactive routing protocols, also known as table-driven protocols, maintain fresh routes to all possible destinations at all times by periodically updating routing tables in every node.

Protocol	Description
Destination-Sequenced Distance Vector (DSDV)	DSDV updates routing tables periodically or when a change in topology occurs. It prevents routing loops by incrementing sequence numbers during updates, ensuring accurate path computations.
Optimized Link State Routing (OLSR)	OLSR uses multipoint relays to minimize the overhead of control messages, optimizing it for dynamic mobile environments. It proactively maintains up-to-date routing information.

2.2 Reactive Routing Protocols

Reactive routing protocols, also known as on-demand protocols, discover routes only when data needs to be transmitted, minimizing overhead but introducing latency during route discovery.

Protocol	Description
Ad hoc On-Demand Distance Vector (AODV)	AODV enhances the Dynamic Sequence Distance Vector protocol, dynamically establishing multi-node routes. Sequence numbers ensure loop-free routing and provide timestamps for packet freshness.
Dynamic Source Routing (DSR)	DSR enables nodes to dynamically discover source routes for multi-hop communication. Each packet carries a complete, ordered list of intermediate nodes, ensuring loop-free and efficient routing.

3. MOBILITY MODELS IN MANETS

Mobility models simulate the movement patterns of nodes in a Mobile Ad Hoc Network (MANET). These models are critical for evaluating the performance of network protocols under different movement scenarios. They can be broadly categorized into **Homogeneous Mobility Models** and **Heterogeneous Mobility Models**.

3.1 Heterogeneous Mobility Models

Heterogeneous mobility models account for diverse, unrestricted, and often random movements of nodes. They do not consider environmental constraints such as buildings or predefined movement paths. Various models under this category simulate random mobility behavior.

Model	Description	Characteristics

3.1.1 Random Walk 2D Mobility Model	In this model, nodes move in random directions and speeds. After traveling a set distance or for a specified time, the node chooses a new direction and speed from pre-defined ranges. Movements are continuous with no pause times.	- Simple and predictable.

3.2 Homogeneous Mobility Models

Homogeneous mobility models, also referred to as **group or trace-based models**, simulate uniform movement patterns across nodes. These models are often used for scenarios where nodes behave in a coordinated or similar manner, such as in military or disaster relief operations.

Model Type	Description
Homogeneous	All nodes follow identical movement patterns, often moving as a group or in predefined traces. Example: Group mobility.

3.3 Comparison of Heterogeneous Mobility Models

Aspect	Random Walk 2D	Random Direction	Random Waypoint	Gauss-Markov
Node Movement	Unrestricted, continuous	Direction-specific until boundary	Destination-oriented	Correlated, smooth paths
Speed Selection	Random within a defined range	Constant until boundary	Random within $[0, V\text{max}]$	Smooth transitions
Pause Time	None	Defined at boundaries	Random at destinations	Not applicable
Realism	Low	Moderate	High	Very high

These mobility models are essential for performance analysis in MANETs, providing insights into how network protocols behave under different movement patterns. Selecting the appropriate mobility model depends on the specific application or scenario being simulated.

4. Network Simulators

Network simulators are essential tools for evaluating and analyzing network protocols and systems in a controlled virtual environment. For this study, **Network Simulator-3 (ns-3)** was utilized to compare the performance of AODV, DSDV, and OLSR routing protocols in a MANET environment.

Aspect	Details
Simulator	**Network Simulator-3 (ns-3)**
Version Used	3.22
Purpose	Comparison analysis of **AODV**, **DSDV**, and **OLSR** routing protocols in MANETs.
Design Orientation	- Discrete-event network simulation.

- Primarily focused on **Internet-based systems** for network research and education. | **Key Features** | - Successor to the popular **ns-2 simulator**.
- Incorporates modern network design principles.
- | **Programming Languages** | - Core simulations are written in **C++**.
- Extensions and simulation scripts can also be created in **Python**, offering flexibility to researchers. | **Applications** | - Modeling and simulation of Internet protocols.
- Performance evaluation of wired and wireless networks. | **Advantages over ns-2** | - Better scalability and support for modern network technologies.
- Improved modularity and extensibility in simulations.
- Simplified debugging and simulation processes.

Why Choose ns-3 for MANET Simulations?

1. **Advanced Protocol Support**: ns-3 provides built-in support for evaluating MANET routing protocols like AODV, DSDV, and OLSR.
2. **Flexibility in Scripting**: Support for both **C++** and **Python** scripting enhances usability and integration with other tools.
3. **Realistic Modeling**: The discrete-event simulation framework ensures accurate representation of protocol behavior.
4. **Active Development**: ns-3 is actively maintained, with frequent updates to address modern networking challenges.

5. SIMULATION RESULTS

As already outlined we have taken three On-demand (Reactive) routing protocols, namely (AODV) and DSDV and OLSR We have used NS3 network simulator,

Parameter	Value
Terrain Region	**50X50**
Routing Protocol	**AODV, OLSR, DSDV**
Mobility Model	**Random Way Point Mobility Model ,Random walk 2D,Random Direction mobility, Gauss-Markov mobility, constant position mobility model**
Simulation Time	**200 sec.**
Pause Time	**1.0 sec.**
No. of Nodes	**10,20,30,40,50**
Traffic	**UDP**
Slink	**5,10,15,20,25**
Simulator	**NS -3.22**
O.S.	**Ubuntu**

According to AODV protocol

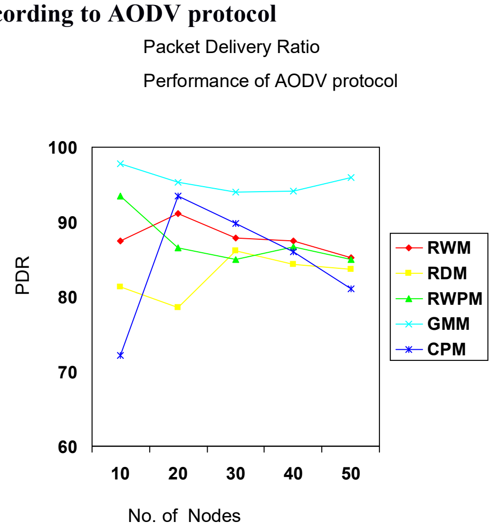

Fig a packet delivery ratio

Figure (a) shows the variation on PDR by varying the number of nodes. From the above figure, result shows that, for 50 no of nodes AODV protocol in different type of mobility model gives the better packet delivery ratio as compare to other Mobility Models.

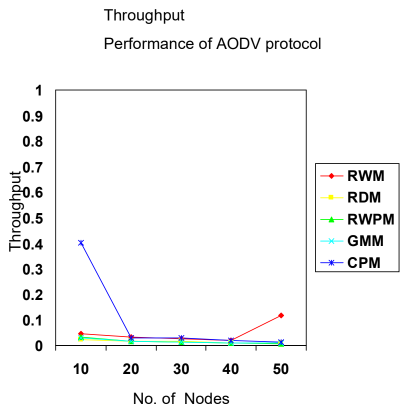

Fig b Throughput

Figure (b) shows the variation on throughput with varying the number of nodes. From the above figure, result shows that, for 50 no of nodes Random walk mobility gives the better throughput as compare to other Mobility Models.

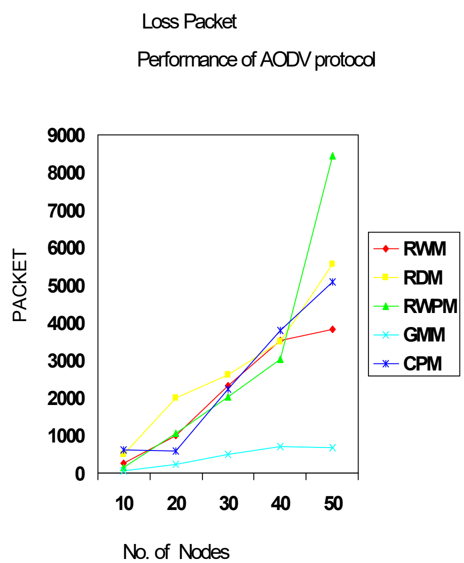

Fig c Throughput

Figure (c) shows the variation on packet loss with varying the number of nodes. From the above figure, result shows that, for 50 no of nodes Random Way point give the better packet loss as compare to other Mobility Models.

According to OLSR protocol

- Packet Delivery Ratio (%)

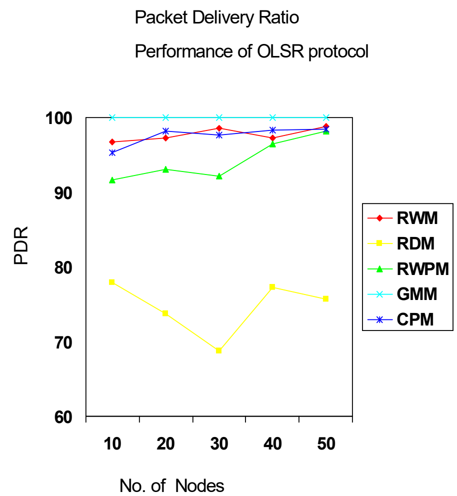

Fig a packet delivery ratio

Figure (a) shows the variation on PDR by varying the number of nodes. From the above figure, result shows that, for 50 no of nodes OLSR protocol in Gauss markova mobility model gives the better packet delivery ratio as compare to other Mobility Models.

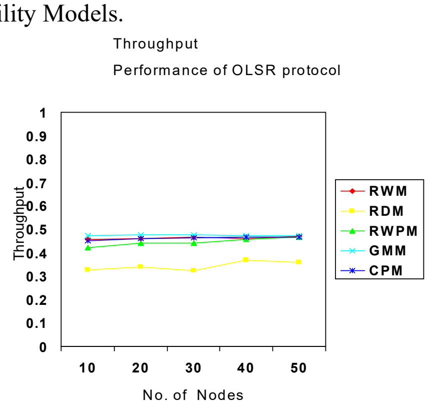

Fig b Throughput

Figure (d) shows the variation on throughput with varying the number of nodes. From the above figure, result shows that, for 50 no of nodes Gauss Markov mobility gives the better throughput as compare to other Mobility Models.

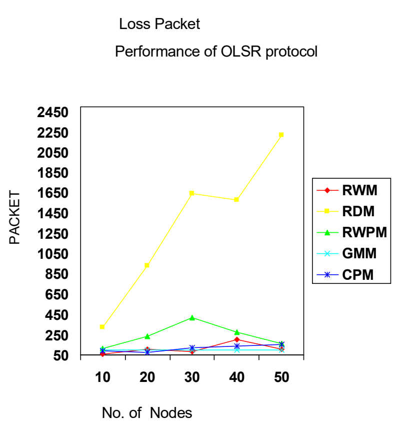

Fig cpacket loss

Figure (c) shows the variation on packet loss with varying the number of nodes. From the above figure, result shows that, for 50 no of nodes Random Direction mobility gives the better packet loss as compare to other Mobility Models.

According to DSDV protocol

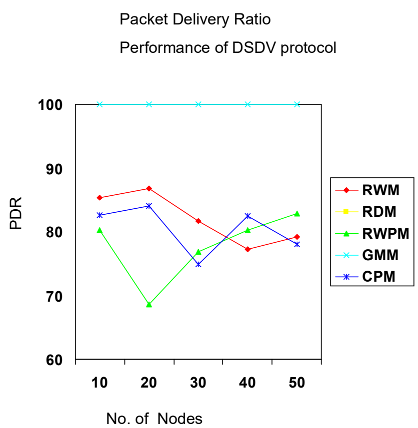

Fig a packet delivery ratio

Figure (a) shows the variation on Packet delivery ratio with varying the number of nodes. From the above figure, result shows that, for 50 no of nodes Random walk 2Direction mobility gives the better PDRt as compare to other Mobility Models.

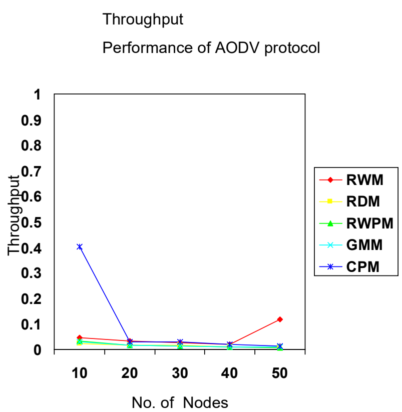

Fig b Throughput

Figure (b) shows the variation on throughput with varying the number of nodes. From the above figure, result shows that, for 50 no of nodes Gauss Markov mobility gives the better throughput as compare to other Mobility Models.

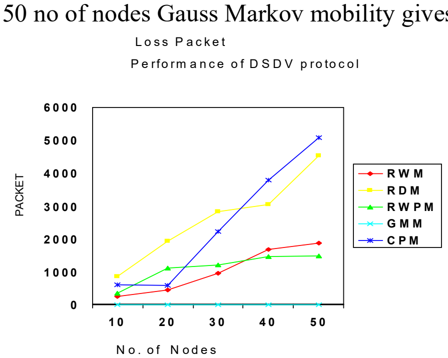

Fig c packet loss

Figure (c) shows the variation on Packet loss with varying the number of nodes. From the above figure, result shows that, for 50 no of nodes Gauss Markov mobility mobility gives the better packet lossas compare to other Mobility Models.

6. CONCLUSION

In this paper we analyzed all the testing results of NS-3 simulation with their different no of nodes and different Mobility Models. Overall aim of this paper is find out the best result of different Mobility Model on Mobile Ad-hoc network in NS3. After analyzing the results we find out the final conclusion of the present work is Gauss Markova Mobility Model gives the better performance for 50 no of nodes in 50 * 50 area as compare with other nonrealistic Mobility Mode. We have evaluated the performance of Mobility Model on the base of performance Metrics. In future, this work can be enhanced with other Mobility Models of MANET. We can also extends performance be considering other scenarios like other traffic generators, packet interracial duration, speed etc.

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