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AMR-AODV: Performance Comparison with AODV with Reference to Varying Mobility Models

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Abstract: ***This paper studies impact of varying Mobility Models and Network Load on the performance of a reactive routing protocol AODV with its modified version AMR-AODV. For experimental purposes, initially we observed the performance of AODV with increasing Network Load from 4 packets to 16 packets with gradually increasing mobility speed from 5 to 25 m/s. The performance of AODV Vs AMR-AODV is observed considering most important parameter i.e. Packet Delivery Ratio. Our simulation results show that AMR-AODV and AODV varies extensively across diverse Mobility Models as the Network Load is increased from 4 pkts/s to 16 pkts/s.***

Keywords: AODV, AMR-AODV, MANET, Network Load, Mobility Models

1. Introduction

An ad hoc network allows wireless mobile nodes dynamically forming a temporary network without using any existing network infrastructure. A number of routing protocols like Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV) [1] and Destination-Sequenced Distance-Vector (DSDV) have been proposed. In this work an attempt has been made to compare the performance of a reactive routing protocol for mobile ad hoc networks AODV and its modified version AMR-AODV on the basis of varying number of packets with reference to mobility models. The performance differentials are analysed using varying mobility models and increasing number of packets. These simulations are carried out using the ns-2 network simulator, which is used to run ad hoc simulations. The results presented in this paper illustrate the importance in careful examination of routing protocols when evaluating an ad hoc network protocol [2][3].

2. Ad hoc Routing Protocols

Routing in Mobile Ad-hoc Network is a subject of extensive research, Because of the fact that it may be necessary to pass several hops (multi-hop) before a packet reaches the destination, a routing protocol is needed. Routing protocol has two functions, first is selection of routes for various source-destination pairs and second, Delivery of messages to their correct destination.

The second function is conceptually straightforward using a variety of protocols and data structures (routing tables). Ad-hoc routing protocols can be classified based on different criteria. Depending upon the routing mechanism employed by a given protocol, they fall in two classes.

Table Driven Routing Protocols (Proactive): Each node in table-driven routing protocols, continuously maintains up-to-date routes to every other node in the network. Periodic routing information is transmitted throughout the network in order to maintain consistency of the routing table. Transmission occurs without delay if the route already exists, otherwise, node needs to receive routing information corresponding to its destination while traffic packets are waiting in the queue. Certain proactive routing protocols are Destination- Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Global State Routing (GSR) and Cluster head Gateway Switch Routing (CGSR).

On-Demand Routing Protocols (Reactive): In on demand protocols, only when a node wants to send packets to its destination it initiates a route discovery process through the network. After a route is determined or all possible permutations have been examined, the process of route discovery is completed. The discovered route has to be maintained by a route maintenance process until either the destination becomes inaccessible along every path from the source or until the route is no longer desired [7]. Some reactive protocols are Cluster Based Routing Protocol (CBRP), Ad hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA), Associativity-Based Routing (ABR), Signal Stability Routing (SSR) and Location Aided Routing (LAR) [4].

3. Ad hoc On-Demand Distance Vector (AODV)

Ad hoc on demand distance vector (AODV) [1] routing protocol creates routes on-demand. In AODV, a route is created only when requested by a network connection and information regarding this route is stored only in the routing tables of those nodes that are present in the path of the route. AODV is a reactive protocol based upon the distance vector algorithm. The algorithm uses different types of messages to discover and maintain links. Whenever a node wants to try and find a route to another node it broadcasts a Route Request (RREQ) [1] to all its neighbours. In this protocol, each terminal does not need to keep a view of the whole network or a route to every other terminal. Nor does it need to periodically exchange route information with the neighbor terminals. Furthermore, only when a mobile terminal has packets to send to a destination does it need to discover and maintain a route to that destination terminal. In AODV, each terminal contains a route table for a destination. A route table stores the following information: destination address and its sequence number, active neighbors for the route, hop count to the destination, and expiration time for the table. The expiration time is updated each time the route is used. If this route has not been used for a specified period of time, it is discarded.

Alternate Multiple Routes – Adhoc On-demand Distance Vector (AMR-AODV)

This is modified version of AODV, called Alternate Multiple Routes – Adhoc On-demand Distance Vector (AMR-AODV). This modified routing protocol creates routes on-demand. In AMR-AODV, a route is created only when requested by a network connection and information regarding all the possible routes from Source node to Destination node is stored and shared by all intermediate nodes in their Routing Tables. This route is utilized by Source node in case of sudden link failure. This version of AODV does save Route Re-Discovery time and resumes the transmission without any delay.

4. Mobility Model

Random Waypoint Mobility Model

The Random waypoint model is a random-based mobility model used in mobility management schemes for mobile communication systems. Random Waypoint (RW) model assumes that each host is initially placed at a random position within the simulation area The mobility model is designed to describe the movement pattern of mobile users, and how their location, velocity and acceleration change over time. Mobility models are used for simulation purposes when new network protocols are evaluated. In random based mobility simulation models, the mobile nodes move randomly and freely without restrictions. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes. This kind of model has been used in many simulation studies. Two variants, the Random walk model and the Random direction model are variants of the Random waypoint model.

In this model, a mobile node moves from its current location to a randomly chosen new location within the simulation area, using a random speed uniformly distributed between [vmin, vmax]. vmin refers to the minimum speed of the simulation, vmax to the maximum speed. The Random Waypoint Mobility Model includes pause times when a new direction and speed is selected. As soon as a mobile node arrives at the new destination, it pauses for a selected time period (pause time) before starting travelling again. A Mobile node begins by staying in one location for a certain period of time (i.e. pause). Once this time expires, the mobile node chooses a random destination in the simulation area and a speed that is uniformly distributed between [vmin, vmax] [5]. The mobile node then travels toward the newly chosen destination at the selected speed. Upon arrival, the mobile node pauses for a specified period of time starting the process again. The random waypoint model is the most commonly used mobility model in the simulation of ad hoc networks. It is known that the spatial distribution of network nodes moving according to this model is non-uniform. However, a closed-form expression of this distribution and an in depth investigation is still missing. This fact impairs the accuracy of the current simulation methodology of ad hoc networks and makes it impossible to relate simulation based performance results to corresponding analytical results. To overcome these problems, it is presented a detailed analytical study of the spatial node distribution generated by random waypoint mobility. It is considered that a generalization of the model in which the pause time of the mobile nodes is chosen arbitrarily in each waypoint and a fraction of nodes may remain static for the entire simulation time.

5. The Traffic and Scenario generator

Continuous bit rate (CBR) [6] traffic sources are used. The source-destination pairs are spread randomly over the network. The simulation uses Random Waypoint, Reference Point Group, Gauss Markov and Manhattan Grid mobility model in a 1000 m x 1000 m field with increasing network load of 4 packets to 16 packets whereas mobility speed is kept at 25 m/s maximum. Here, each packet starts its journey from a random location to a random destination with a randomly chosen speed. Once the destination is reached, another random destination is targeted after a pause. The pause time, which affects the relative speeds of the mobile hosts, is kept at 10s. Simulations are run for 100 simulated seconds.

6. Performance Metrics

Results are evaluated based on Packet delivery ratio which is calculated by dividing the number of packets received by the destination through the number of packets originated by the CBR source.

7. Simulation Setup

In this simulation we wanted to investigate how mobility models and Network Load affects the behaviour AMR-AODV and AODV with increasing network load.

Table 1: Simulation Setup for varying Mobility

Parameters	*Value*
Protocols	AODV, AMR-AODV
Simulation time	100 s
No. of Nodes	100
Pause time	10 s
Environment Size	1000m x 1000m
Traffic Type	Constant Bit Rate
Maximum Speed	5, 10, 15, 20, 25 m/s
Packets Rate	4, 8, 12, 16 packets / s
Mobility Model	Random Waypoint Reference Point Group Gauss Markov Manhattan Grid

8. Results and Discussions

Empirical results demonstrate that the performance of a routing protocol varies extensively across diverse mobility models and hence the results from one model cannot be applied to other model. Hence the mobility of an application has been considered while selecting a routing protocol. The experimental results show the following important observations for different mobility models.

Manhattan Grid mobility model: AMR-AODV performs best as compared to AODV at higher Mobility Speed, while AODV is a better performer at lower Mobility Speed.

Reference Point Group Mobility Model: AODV perform best in this mobility model delivering approximately 97 % PDR at network load of 4 pkts /s and for 16 pkts / s; PDR is decreased to 95%. While, AMR-AODV offered PDR of 93 – 96 % at network load of 4 pkts /s and 93-95 % at network load of 16 pkts / s. So, comparatively AMR-AODV maintained much better PDR as compared to AODV at variable network loads.

Gauss Markov mobility model: At initial load of 4 pkts / s and Mobility Speed 5-10 m/s AMR-AODV performs better, while thereon for 4 pkts / s and Mobility Speed greater than 10 m / s AODV starts to perform better as compared to AMR-AODV. At increased load of 16 pkts / s and Mobility Speed 5-15 m/s AMR-AODV and AODV equally performs, still AMR-AODV shows better performance, while thereon for 16 pkts / s and Mobility Speed greater than 15 m / s AODV starts to perform better as compared to AMR-AODV.

Random Waypoint mobility model: The performance of AMR-AODV routing protocol is reduced with increased speed when network load is 4 pkts, while AODV performs better as the speed is increased. At network load of 8 packets, AMR-AODV performs better till the speed is 15 m/s, after that PDR of both protocols starts to degrade. Still, AODV performs better in later half. At network load of 12 packets, Initially AMR-AODV performs better and as the speed increases AODV starts to improve the performance as compared to AMR-AODV. Same happen at network load of 16 packets. In general, it is observed from the experimental result that for Random Waypoint mobility model, AMR-AODV is comparatively better when mobility speed is lower as it gets much more time to retrieve alternate routes in case of link failure, while at higher speeds AODV is a better option.

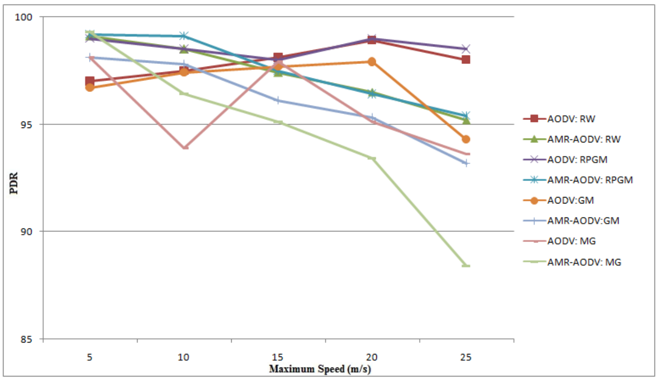

Figure 1: AODV and AMR-AODV Performance for network loads 4 Pkts

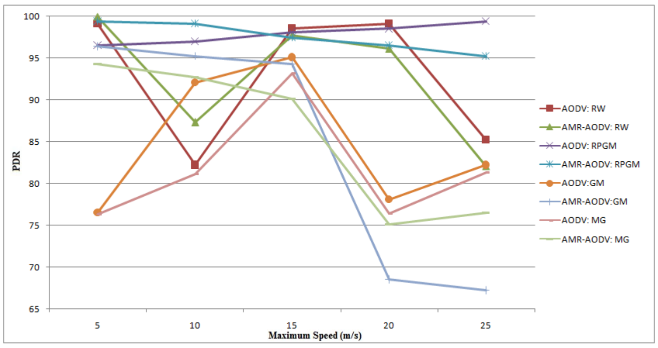

Figure 2: AODV and AMR-AODV Performance for network loads 8 Pkts

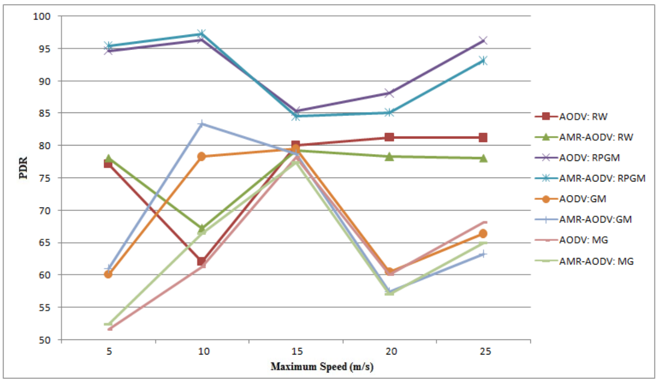

Figure 3: AODV and AMR-AODV Performance for network loads 12 Pkts

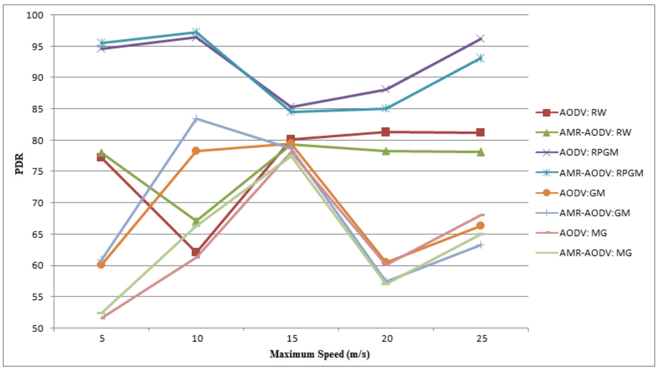

Figure 4: AODV and AMR-AODV Performance for network loads 16 Pkts

9. Conclusion and Future Work

Empirical results illustrate that the performance of AODV varies widely across different network loads, and study results from various scenarios shows that at low Network Load and low Mobility Speed AMR-AODV performs better as compared to AODV, while for higher network loads and higher Mobility Speed AODV does well.

The future scope is to find out what factors can bring more improvements in performance of AMR-AODV while the network load and Mobility Speed is increased. Further simulation needs to be carried out for the performance evaluation with not only increased mobility speed, Pause

Time, Mobility models but also Terrain Range has to be considered.

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