Performance Analysis of AODV and WRP in MANET

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ABSTRACT

The Mobile ad hoc networks (MANET) is a wireless networks which have no central bridge, and where each node acts as a destination as well as a router. The MANETs are dynamic networks because the network topology keeps on changing because of the mobility of the nodes. There are many protocols that have been developed to aid in routing in these types of networks. Each of these protocols is designed with some certain mobility scenarios in mind. To achieve effective routing in a given scenario, the right protocol must be chosen. Choosing the right protocol involves evaluating many interdependent performance metrics that define the effectiveness of a routing protocol, and this often poses a challenge to application designers.

This research endeavoured to model a simulation platform on which various protocols could be evaluated under various mobility scenarios to determine their suitability. The GloMoSim[1] was used as the simulation platform and two MANET protocols namely wireless routing protocol WRP[4] and ad hoc on-demand distance vector AODV[5] evaluated. Our results demonstrated the usefulness of this modelled platform as it was able to establish that the AODV outperformed WRP in four out of the five of the measured performance metrics. The AODV is thus a better protocol for MANETs compared to WRP. The same simulation platform could be used test other protocols.

Keywords: AODV, MANET, WRP

1. INTRODUCTION

Routing protocol play important role to any Networks. In Mobile Ad Hoc Network MANET wireless mobile nodes that communicate with each other without centralized control or established infrastructure. Therefore, routing in MANET is a difficult task due to highly dynamic environment. Wireless routing protocol WRP and Ad Hoc On-Demand Distance Vector Routing AODV are good examples of Ad hoc protocols that are proposed and implemented in MANET. By analyzing how a protocol performs under certain environment, the shortcomings of the protocol could be discovered and more research could be done on removing those shortcomings.

However, this paper proposes to undertake comparison of these two protocols in specific scenarios with MANET in order to help in choosing the best protocol suited to particular conditions by highlighted the pros and cons of these two tested protocols.

2. ROUTING PROTOCOLS

A routing protocol[3] is desirable whenever a packet needs to be transmitted to a destination via number of nodes and many routing protocols have been planned for such kind of ad hoc networks. MANET routing protocols can be categorize into:
- Proactive routing protocols
- Reactive routing protocols

2.1 PRO-ACTIVE OR TABLE DRIVEN ROUTING PROTOCOLS

Proactive MANET protocols are based on periodic exchange of control message and maintain routing table and will dynamically determine the layout of the network. Through a regular exchange of network topology packets between the nodes of the network, a complete path of the network is maintained at every single node. Hence minimal delay in determining the route to be taken. Some Proactive MANET Protocols include: WRP[4] , DSDV, DBF, GSR.

2.2 REACTIVE OR ON DEMAND ROUTING PROTOCOLS

In Reactive protocol, a route is discovered only when it is necessary. The protocol tries to discover a route only on-demand, when it is necessary. These protocols generate much less control traffic at the cost of latency. Some Reactive MANET Protocols include DSR, AODV[5] and TORA.

2.3 DESCRIPTION OF PROTOCOLS
2.3.1 WIRELESS ROUTING PROTOCOL WRP

The Wireless Routing Protocol WRP is a proactive, distance vector based protocol designed for ad hoc networks. WRP modifies and enhances distance vector routing in the following three ways. First, when there are no link changes, WRP

periodically exchanges a simple HELLO packet rather than exchanging the whole route table. If topology changes are perceived, only the 'path-vector tuples contain the destination, distance, and the predecessor (second-to-last-hop) node ID. Second, to improve reliability in delivering update messages, every neighbor is required to send acknowledgments for update packets received. Retransmissions take place if no positive acknowledgements are received within the timeout period. Third, the predecessor node ID information allows the protocol to recursively calculate the entire path from source to destination.

2.3.2 ON DEMAND DISTANCE VECTOR ROUTING PROTOCOL AODV

AODV is a simple, efficient, and effective routing protocol for Mobile Ad-hoc Net-works which do not have fixed topology. AODV is a distributed algorithm using distance vector algorithms, such as the Bellman Ford algorithm. Routes are created on Demand but maintained in tables. only the routing information for the routes which is currently in use is maintained in tables. To find a path from source to the destination, the source broadcasts a route request packet. The neighbors in turn broadcast the packet to their neighbors till it reaches an intermediate node that has recent route information about the destination or till it reaches the destination. A node discards a route request packet that it has already visited.

When a node forwards a route request packet to its neighbors, it also records in its tables the node from which the first copy of the request came. This information is used to construct the reverse path for the route reply packet. AODV uses symmetric links because the route reply packet follows the reverse path of route request packet. As the route reply packet traverses back to the source, the nodes along the path enter the forward route into their tables.

Since source moves in MANET then it can reinitiate route discovery to the destination. If one of the intermediate Routing Protocols for MANET nodes move then the moved nodes neighbor realizes the link failure and sends a link failure notification to its upstream neighbors and so on till it reaches the source upon which the source can reinitiate route discovery if needed.

3. SIMULATION ENVIRONMENT

All simulations have been carried out using the GloMoSim 2.03[1] simulator programme under Windows platform.

GloMoSim is a scalable simulation environment for wired and wireless network systems built using the PARSEC simulation environment. Currently it only supports protocols for a purely wireless network. The modules have been developed using VC++ programming language. It

is also built in a layered approach; such as OSI layer network architecture. GloMoSim is designed as a set of library modules, each of which simulates a specific wireless communication protocol in the protocol stack. The library has been developed using PARSEC, a C-based parallel simulation language. New protocols and modules can be programmed and added to the library using this language. GloMoSim's source and binary code can be downloaded only by academic institutions for research purposes. Commercial users must use QualNet, the commercial version of GloMoSim.

Our simulation considered a network of 35 wireless nodes placed randomly within a 1500 x 1500 m^2 area and transmission range of each node is 250 meters. CBR data sessions are chosen. Only a specified number of nodes out 35 will be engaged in data transfer which we specify as offered load. This is done to see the impact of varied load on various performance metrics. Five runs with different seeds have been conducted for each scenario and collected data is averaged over these runs. A summary of salient simulation parameters are given in Table 3.1.

Table 1 Simulation Parameters

Parameter	Value
Simulation Time	20 min(1200 sec)
Terrain Area	1500x1500 m^2
Number of Nodes	35
Node Placement strategy	Random
Propagation Model	Two-Ray Model
Mobility Model	RANDOM-WAYPOINT
Radio Type	Accumulated Noise Model
Network Protocol	IP
MAC Protocol	IEEE 802.11
Routing Protocol	AODV,WRP

4. NETWORK SCENARIOS

In the MANET, we have simulated the following 3 different scenario:
- Offered Load (number of source destination pairs)
- Pause Time
- Node Speed

4.1 OFFERED LOAD (NUMBER OF SDPS)

Offered load refers to the number of source destination pairs engaged in data transfer. i.e. if 7 SDPs amongst 35 nodes, 7 source nodes and 7 destination nodes (i.e. 14 nodes in total) will be engaged in data transfer. However, during this data transfer process, all of the 35 nodes (including the above 14 nodes) will operate in the background for providing necessary support (i.e. routing/forwarding) to the ongoing communication process in the network. In our simulation we considered 10 m/s as

an average speed and 0s pause time with offered load (i.e. number of SDPs) varied as 10,20,30,40 pairs.

4.2 PAUSE TIME

Pause time refers to the rest time of the node. random waypoint mobility model RWMM[2] includes pause times between changes in direction and/or speed. A node begins by staying in one location for a certain period of time (i.e. a pause time). Once this time expires, the node chooses a random destination in the simulation area and a speed that is uniformly distributed between [MIN SPEED, MAX SPEED]. The node then travels towards the newly chosen destination at the selected speed. Upon arrival the node pauses for a specified time period before starting the process again. In our simulation, we considered 10 m/s as an average node speed, 10 SDPs as offered load, random waypoint as mobility model and 0,300,600,900,1200 seconds as pause time. Where, 0s pause time represent the continuous node mobility and 1200s pause time represents static network environment.

4.3 NODE SPEED

Node speed refers to the average speed with which nodes move in the simulation area. We have used random waypoint mobility model .In RWMM, nodes move at a speed uniformly distributed in [MIN SPEED, MAX SPEED]. In our simulation, we have considered 10 SDPs for data transfer and average node speeds considered are 10,20,30,40,50 m/s. Each node begins the simulation by moving towards a randomly chosen destination. Whenever a node chooses a destination, it rests for a pause time. It then chooses a new destination and moves towards the same. This process is repeated until the end of the simulation time.

5. PERFORMANCE METRICS

The following performance metrics were compared:

- Mean end-to-end packet latency, defined as the time elapsed from the moment a packet leaves the source to the time the packet is received at the destination.
- Packet delivery ratio (PDR), the total number of packets delivered to the destination to the total number of data packets generated.
- Throughput, the number of packets delivered per unit time.

6.SIMULATION RESULTS

For the simulation, we will take constant bit rate (CBR) traffic into consideration.

6.1 OFFERED LOAD (NUMBER OF SOURCE DESTINATION PAIRS) SCENARIO
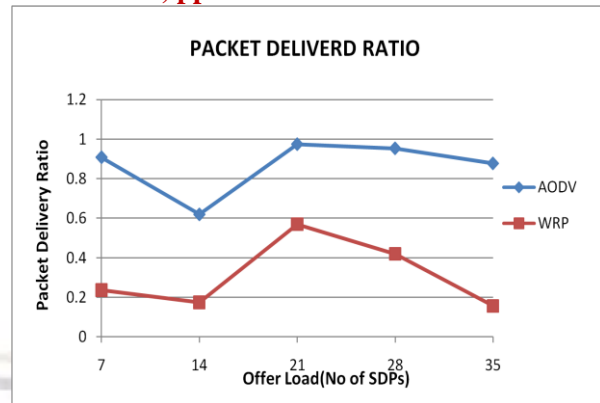#### 6.1.1 PACKET DELIVERY RATIO

Fig. 1 *PDR versus Offer Load(CBR Traffic)*

Fig..1 shows the impact of offered load (i.e. number of source destination pairs) on the packet delivery ratio in a network of 35 nodes randomly placed with 0s pause time. The results show that for reactive protocols AODV and Proactive protocol WRP, the delivery ratio degrades and then raise and then again degrades with increase in load. The AODV, having a delivery ratio of more than 90% at load of 7 SDPs and the same 90% at load of 35 SDPs. While proactive protocol WRP having the least delivery ratio between the two protocols there is a slight decrease in the delivery ratio with load. It has a delivery ratio of 25% at a load of 7 SDPs which decrease to less than 17% at a load of 35 SDPs.

6.1.2   . THROUGHPUT
6.1.3

FIG 2 T*hroughput versus Offer Load(CBR traffic)*

Fig.2 shows the impact of offered load on the Throughput in a network of 35 nodes randomly placed with 0s pause time. The results show that for reactive protocols AODV and Proactive protocol WRP, the delivery ratio degrades and raise and then again degrades with increase in load. The AODV, having a Throughput of more than 90% at load of 7 SDPs and the same 90% at load of 35 SDPs. While proactive protocol WRP having the least Throughput between the two protocols there is a slight decrease

in the delivery ratio with load. It has a Throughput of 20% at a load of 7 SDPs which decrease to less than 15% at a Throughput of 35 SDPs.
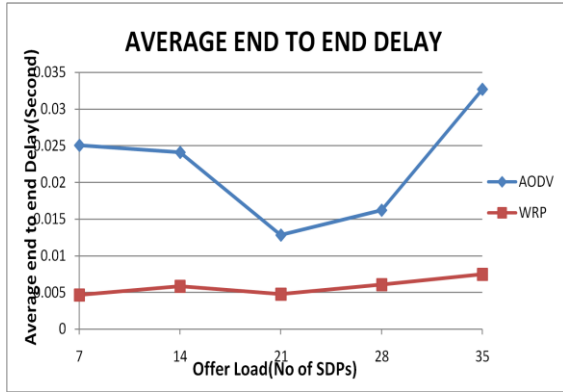
6.1.3.   AVERAGE END TO END DELAY

Fig.3 *Average end to end delay versus Offer Load(CBR Traffic)*

Fig. 3 shows the impact of offered load on the Average end to end delay in a network of 35 nodes randomly placed with 0s pause time. The results show that for reactive protocols AODV and Proactive protocol WRP,   For AODV , with increasing load , it can be seen that the end-to-end delay decreases and then increase with increasing load, the delivery ratio degrades and then raise and then again degrades with increase in load. For Proactive protocol WRP it is seen that average end to end delay slightly   increase with increasing load.

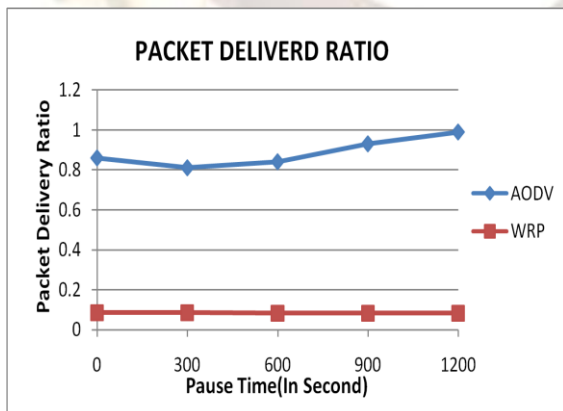### 6.2.   PAUSE TIME SCENARIO
6.2.1.   PACKET DELIVERY RATIO

Fig.4 *PDR versus pause Time(CBR Traffic)*

In Fig. 4 we observe the impact of pause time on packet delivery ratio for CBR Traffic. The results show that the packet delivery ratio is maximum when the pause time is equal to the simulation time (i.e. when the nodes in the network are static). The protocol AODV shows the best

performance with 98% packet delivery at 1200s pause time. The WRP protocol has lesser packet delivery ratio i.e. approximately 60% less delivery ratio than AODV.
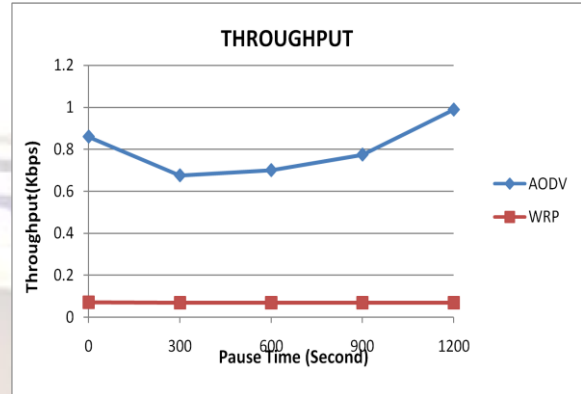
6.2.2.   THROUGHPUT

Fig. 5 *Throughput versus Pause Time(CBR Traffic)*

In Fig. 5 we observe the impact of pause time on Throughput for CBR Traffic. For AODV protocol first Throughput decrease and then increase with increase with pause time, while for WRP protocol it will constant with pause time. The protocol AODV shows the best performance with 99% packet delivery at 1200s pause time. The WRP protocol has lesser Throughput i.e. approximately 90% less delivery ratio than AODV.

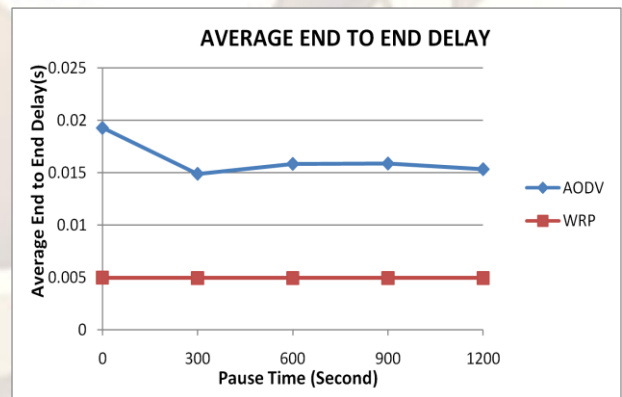### 6.2.3.   AVERAGE END TO END DELAY

Fig.6 *Average end to end delay versus Pause Time(CBR Traffic)*

In Fig..6 we observe the impact of pause time on average end to end delay for CBR Traffic. After a certain pause time, it can be seen that the end-to-end delay decreases and then constant for AODV. This can be attributed to the fact that beyond 300 seconds, packets are either delivered quickly (due to longer lifetimes) or packets are timed out and dropped (due to higher network partitions).

The WRP protocol has constant end to end delay with increase pause time.

6.3. NODE SPEED SCENARIO
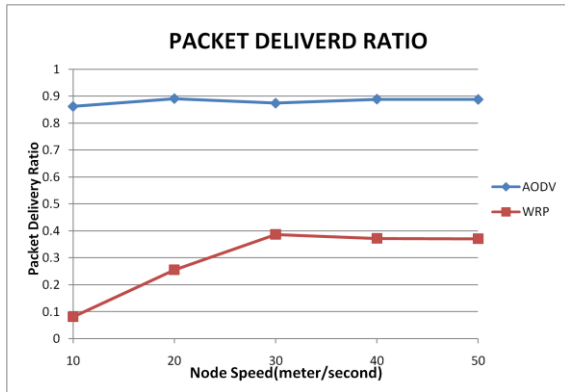### 6.3.1. PACKET DELIVERY RATIO

Fig.7 *PDR versus Node Speed(CBR Traffic)*

The Fig.7 shows the impact of changing the speed, with which nodes move in an ad hoc network, on the packet delivery ratio. Packet delivery ratio decreases with increase in average node speed in AODV, While packet delivery ratio increase in average node speed in WRP protocol. The packet delivery ratio for AODV is approximately 90% which remains almost same for all node speed. The WRP shows a increase of 30% in delivery ratio when the average node speed increases from 10 m/s to 50 m/s.
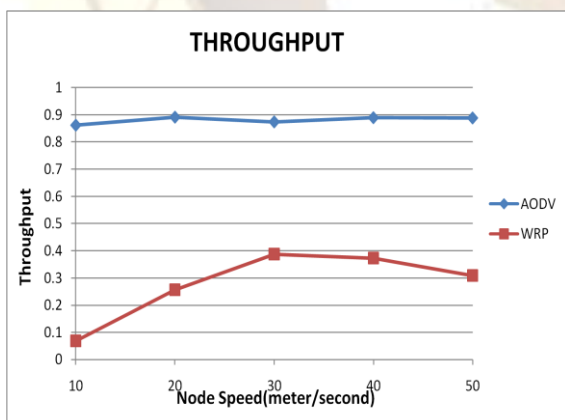
6.3.2. THROUGHPUT

Fig.8 *Throughput versus Node Speed(CBR Traffic)*

The Fig 8 shows the impact of changing the speed, with which nodes move in an ad hoc network, on the Throughput. Throughput have constant with increase in average node speed in AODV, While Throughput increase constantly in average node speed at 30 m/s after it decrease slightly at 50 m/s in WRP protocol. The Throughput for AODV is approximately 90% which remains almost same for

all node speed. The WRP shows a increase of 20% in Throughput when the average node speed increases from 10 m/s to 50 m/s.
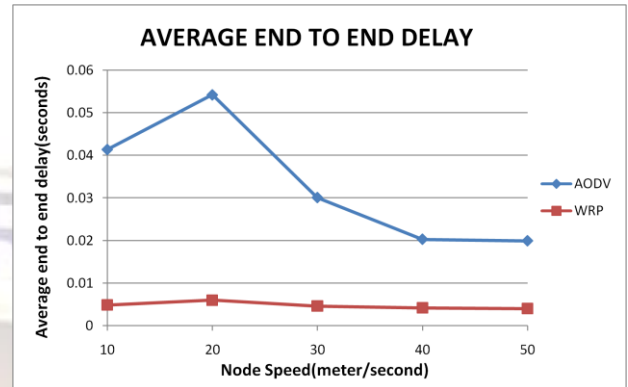
6.3.3. AVERAGE END TO END DELAY

Fig.9 *Average end to end delay versus Node Speed (CBR Traffic)*

The Fig.9 shows the impact of changing the speed, with which nodes move in an ad hoc network, on average end to end delay. Average end to end delay of packet Packets first increase and then decrease rapidly with increase in average node speed in AODV, While packet delivery ratio remains constant with increase in average node speed in WRP protocol.

7. CONCLUSIONS AND FUTURE SCOPE
The performance of both routing protocols evaluated by detailed simulation result.
We used performance metrics are packet delivery ratio, throughput and average end to end delay. We have used three different scenario, offer Load, pause Time and average node speed.

In the terms of packet delivery ratio, throughput and end to end delay in pause time scenario AODV performs better than WRP . WRP exhibits the worst performance in terms of packet delivery ratio, throughput and routing message overhead.

From analysis we observed that packet loss is very less in case of AODV in comparison to WRP. So, we can conclude that if the MANET has to be setup for a small amount of time then AODV should be prefer due to low initial packet loss and WRP should not be prefer to setup a MANET for a small amount of time because initially there is packet loss is very high.

7.1 FUTURE SCOPE
We can evaluate the performance for web server pages like the HTTP traffic, Multimedia traffic and other different real time scenario. We can comparison other routing protocols with using these scenarios.

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