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Performance Analysis of AODV and DYMO Routing Protocols in Wi-Max Networks

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ABSTRACT Routing protocol is the part of network layer that is responsible for deciding the route of data packets from source node to the destination node. MANET is a network of mobile nodes with the wireless radio interface. The IEEE 802.16 Wi-Max (World Wide Interoperability for Microwave Access) standard is based on global interoperability and is an emerging technology that delivers high speed wireless broadband at much lower cost to the area covering the larger distance than the cellular services and the Wi-Fi network. Mobile Ad-Hoc & Wi-Max network are presently applicable everywhere in real life, so as to solve day to day commercial needs of civilians business, business meetings outside the offices, education by the help of virtual classrooms, in Bluetooth, the transmission of multimedia applications over networks etc. AODV and DYMO are the two protocols specifically designed for MANET network and are also frequently implemented for Wi-Max network. As DYMO is a successor to the AODV protocol hence it is interesting to investigate would the DYMO implementation is better when compared to results obtained using AODV for the Wi-Max network. In this research work observations are presented regarding the performance comparison of AODV and DYMO protocols for VBR traffic source by varying the item size of data packets in Wi-Max networks.

Keywords: Wi-Max networks, MANET, AODV, DYMO, VBR traffic source

1. INTRODUCTION

These days, as the demand for establishing connection for data transmission between the wireless nodes is increasing. Hence the demand of working wireless solutions for connecting to the Internet is also increasing. In MANET, the nodes are mobile and are connected through wireless links, each node is free to move independently and randomly. Mobile Ad-Hoc networks come into role where permanent infrastructure of network is absent. Wi-Max is designed to be a low cost way to deliver wireless broadband services over a large area.

Routing protocol is the part of network layer. Routing directs the passing of logically addressed data packets from their source node toward their destination node through intermediate nodes. Every routing protocol has its own algorithm on the basis of which it discovers and maintains the route. Routing algorithm uses a value known as routing metric to determine which route perform better. Routing metrics cover information such as bandwidth consumption, delay, and number of hop counts, path cost, load, reliability, and cost of communication. The best possible route is stored in routing table for data packet to travel through that route.

In this research analysis, comparison of two on-demand routing protocol for VBR (Variable bit rate) traffic source for different size of data packets is done using QualNet 5.0.2 network simulator.

2. WI-MAX-802.16

The Wi-Max (World Wide Interoperability for Microwave Access) architecture was designed to offer strong QoS, lower latency, and better security and thus making it an excellent platform to run VoIP, to handle high-quality data, voice, video and multimedia services. It is a wireless digital communications system that is based on wireless "metropolitan area networks" technology. This is one of the hottest emerging broadband wireless access (BWA) technology can deliver theoretically up to 30 miles (50 km) for fixed stations, and 3-10 miles (5-15 km) for mobile stations. The name "Wi-Max" was created by the Wi-Max Forum,

3. ROUTING PROTOCOL

Routing is the important concepts, because it takes care about the successful transmission of the data from source node to destination node. The routing protocols also facilitate the communication within the network as they discover routes between the nodes. The routing protocols primarily have two functions. First, is determination of routes from source to destination and second, is delivery of message to the correct destination. The performance of the routing protocol depends on the efficiency of that particular routing protocol and also on the scenarios that that they have been used in.

Routing protocols can be classified as either proactive, reactive, or a hybrid.

3.1 Proactive Routing

Proactive routing protocols are table-driven protocols. These protocols attempt to maintain correct routing information of the entire network at all times. As the network routing tables are constantly maintained and the route for data packet is known without any additional setup delay. These routing protocols are well suited for time-critical traffic. Main disadvantage of this routing scheme is that a large portion of bandwidth is used to keep the routing information up-to-date. As, in the case of fast node mobility, route updates may be more frequent than route requests, thus wasting bandwidth because much of the routing information will never be used.

3.2 Reactive Routing

Reactive routing protocols are the on-demand protocols. The on-demand routing protocols does not maintain the correct information of route on all nodes at all times. Information of route for sending data over the channel is collected only when it is required, and the determination of route depends on sending route queries throughout the network. The basic advantage of reactive routing is that the wireless transmission channel is not subjected to the data of routing overhead for routes that may never be used. Examples are AODV, DYMO, DSR etc.

3.3 Hybrid Routing

Hybrid routing protocols are the combination of both proactive routing and reactive routing. Attempt of hybrid protocol is to take advantage of strengths of purely proactive and reactive routing protocols, while minimizing the weaknesses of both the routing.

4. REACTIVE ROUTING

1. AODV (AD-HOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL) - The AODV routing is a reactive distance vector routing algorithm. There are no exchanges of routing information periodically. Only when a source node have data packets to send to some destination nodes and does not have valid route to the destination, it broadcast the route request query message to its neighbors, to discover the route for transmission of data packets. It keeps the discovered route till they are required by sources.

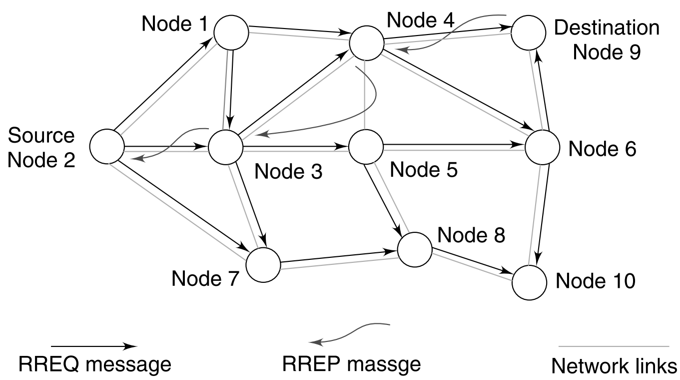


Fig. 1 AODV routing protocol route discovery

2. DYMO (DYNAMIC MANET ON-DEMAND ROUTING PROTOCOL) - Dynamic MANET On-demand (DYMO) routing protocol is a successor of the AODV and operates in similar manner as AODV. No extra features are added to DYMO neither it is an extend form of the AODV protocol, rather it simplifies the AODV protocol by retaining the basic mode of operation required for successful routing. It is built with enhancements, as it also stores routes for each intermediate hop whereas AODV only generates entries for destination node and the next hop node in the route table.

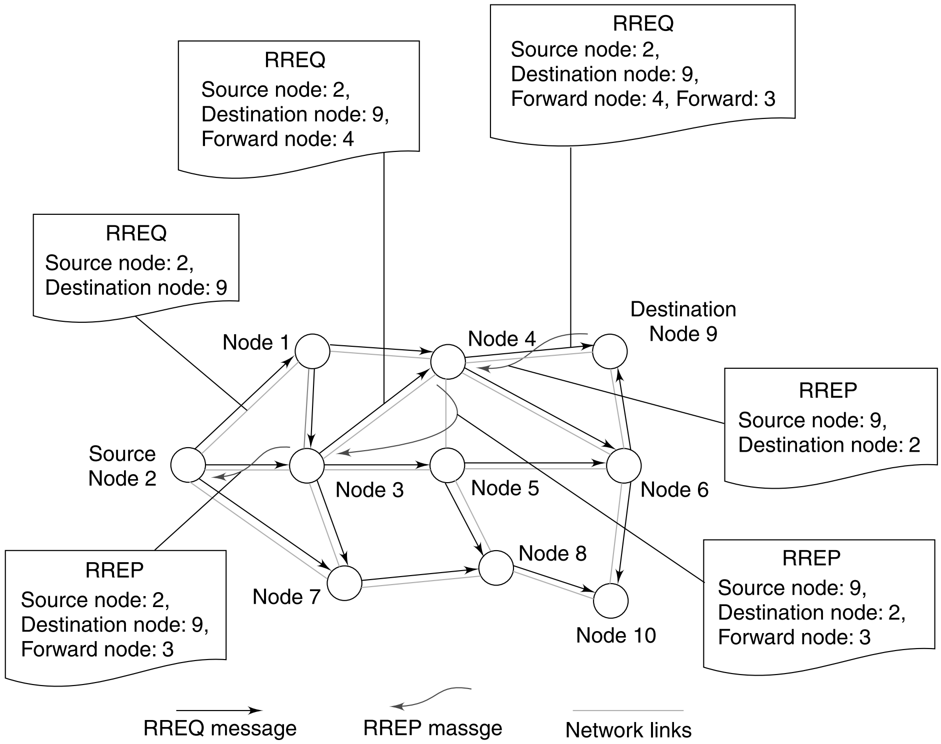


Fig. 2 DYMO routing protocol route discovery

Path accumulation feature in DYMO protocol allows intermediate nodes to append their information to the RREP message and hence it gives other nodes better knowledge about the topology of the network.

5. PROBLEM STATEMENT

As most routing protocols used in high mobility region for real time multimedia application are based on reactive routing instead of proactive. Thus, in this research the performance of two reactive routing is analyzed and comparison of the AODV and DYMO routing protocol for VBR (Variable bit rate) traffic source is done. As VBR (variable bit rate) compressed multimedia data packets are used for transmission of multimedia data to optimize the use of wireless channel. Both the protocols are tested for same simulation parameters.

6. PERFORMANCE METRICS

In order to evaluate, analyze and compare the performance of the two MANET routing protocols all simulations are executed for 100 seconds. Following quantitative metrics are chosen to evaluate the comparative performance of protocols:

Table 1 Simulation Parameters for the tested Scenarios

Parameters	*AODV/DYMO*
Wi-Max Networks	6
Mobile Nodes	25
Simulation Area	1500m *1500m
Mobile Nodes in Each Wi-Max Networks	4
Mobility Model	RWP
Path Loss model	Two Ray Model
Shadowing Model	Constant
Shadowing Mean	4dB
Channel Frequency	2.4 GHz
Physical Layer Protocol	IEEE 802.16
Traffic Generator	VBR
Item Size	256, 512, 1024 bytes
Pause Time of Node 1	0s
Simulation Time	100s
Maximum Number of Buffered Packets	100
Maximum Buffer Size	0 bytes
Temperature	290K
Noise Factor	10dB
Transmission Power	dB

- **Throughput –** It is the rate of successful transmission of data packets over a communication channel
- Throughput = $\frac{\text{Total number of data bytes received * 8}}{\text{Total simulation time (s)}}$.
- **Packet delivery ratio –**

  $$\text{Packet delivery ratio} = \frac{\text{Number of data packets received}}{\text{Number of data packets sent}}.$$

- **Average end-to-end delay –** In delay metric delays due to route discovery, queuing, propagation and transmission time taken by data packets are included.

  $$\text{Average end-to-end delay} = \frac{\text{Time of data received - Time of data sent}}{\text{Number of data packets received}}.$$

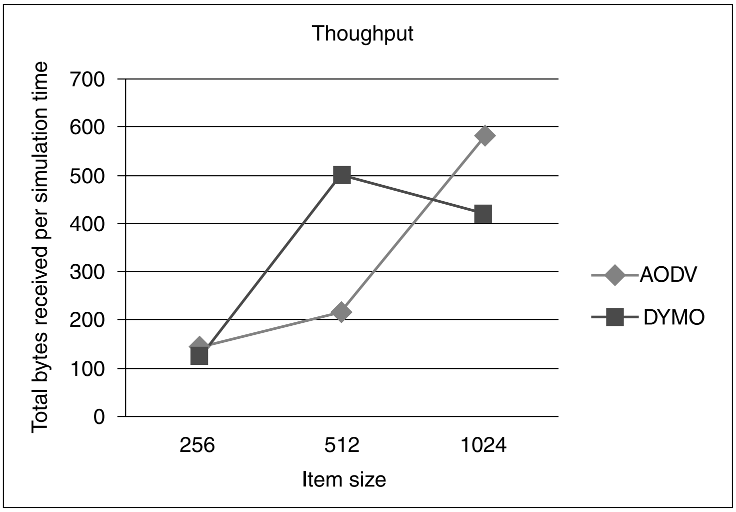
- **Normalized routing Load –** NRL is the ratio of the number of transmitted routing packets and the number of data packets that were successfully received by the destination node.

  $$\text{Normalized routing load} = \frac{\text{Number of routing packets sent}}{\text{Number of data packets received}}$$

- **Total dropped packets –** These are the number of data packets that aren't successfully sent to the destination node either when the buffer is full and can't accept additional packet or when the time that the packet has been buffered exceeds the limit.

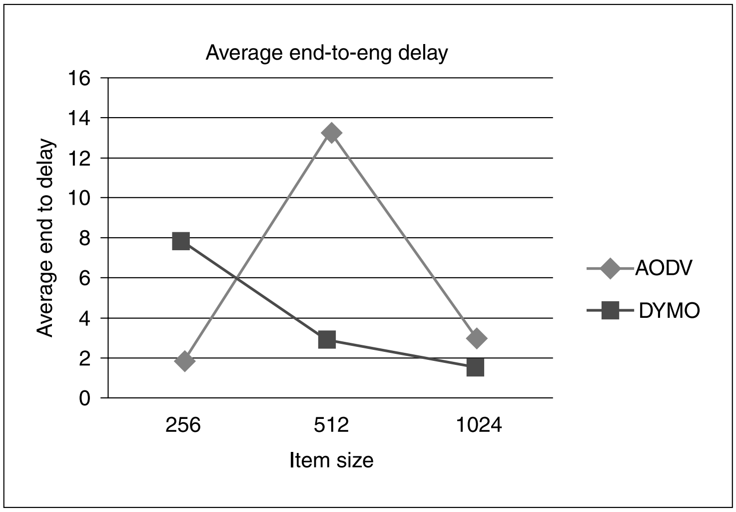
7. COMPARISON GRAPHS OF TWO ROUTING PROTOCOL

1. **Throughput:** It is analyzed that for AODV protocol with the increase in item size the throughput also increases whereas for DYMO protocol initially with the increase in item size throughput increases rapidly and as the item size further increases throughput starts decreasing.

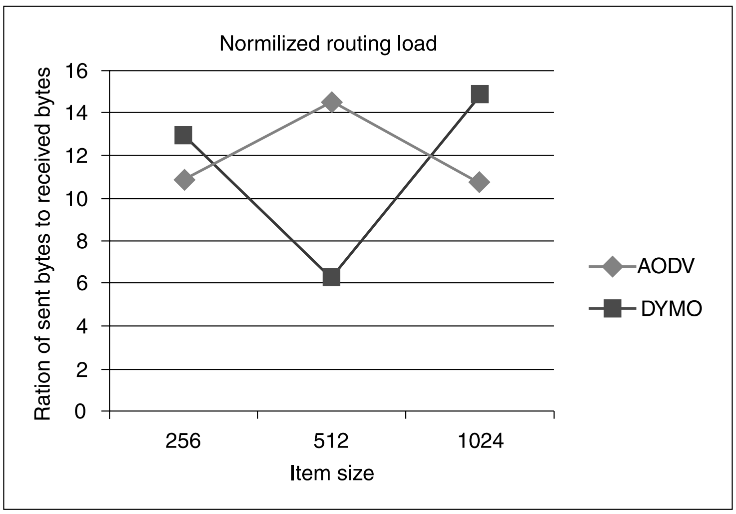


2. **Packet delivery fraction:** For the AODV protocol the PDF is good for lower and higher item size of data packets but for intermediate size of data packets PDF is less whereas for DYMO protocol for the same intermediate size of data packets the PDF is very high as compared to PDF obtained for the lower and higher item size of data packets.

3. **Average End-to-End delay:** For DYMO routing protocol as the item size increases the average of the time taken by the packets of data to reach the destination decreases. And for the item size of 512 bytes the difference in the average end-to-end delay obtained for the two analyzed protocols is very large.



4. **Normalized Routing Load:** NRL comparison graph shows, for smaller and larger data packets the performance of DYMO protocol is better whereas for the intermediate size of data packets the performance of AODV is much improved as compared to the performance of DYMO routing.



8. CONCLUSION & FUTURE SCOPE

AODV routing performed well for smaller and larger sizes of data packets, DYMO routing being the successor of AODV performed well for the intermediate (optimal) item size of data packets. Result shows that the overall performance metrics of AODV routing for smaller and larger sizes of data packets is at the higher edge. DYMO routing outperforms AODV only for intermediate (optimal) size of data packets it is the size that is generally used, but as the size of data packets vary the performance of DYMO protocol declines. Performance of these protocols for the same scenario can be evaluated by running the experiments more number of times so that the average of different performance metrics can be obtained and a threshold size of data packets for VBR traffic source can be determined. The work can be extended to the various other protocols that are applicable to MANET.

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