

Comparative Analysis of Adhoc Routing Protocols in Wi-Fi & Wi Max Networks using QualNet 6.1

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Abstract

This paper undergoes a simulation based study of Adhoc Routing Protocols in Wi-Fi (IEEE 802.11n) & WiMax (IEEE 802.16) networks. In this paper four Routing Protocols namely AODV, DYMO & Fisheye State Routing (FSR) protocol has been compared in a multicellular, heterogeneous Wi-Fi & Wi-Max Network using QualNet 6.1 Simulator. Various metrics used for performance evaluation are Throughput, Average Jitter, Total data received, Total messages received & Average End-to End delay The results of both the Networks (Wi- Fi & WiMax) has then been compared.

Keywords: Wi-Fi, Wi-Max, AODV, DYMO, FSR, Qualnet 6.1

1. Introduction

802.11 is a set of IEEE standards which governs wireless networking transmission methods. The most commonly used today are the 802.11a, 802.11b, 802.11g, 802.11n and the newer 802.11ac versions to provide wireless connectivity in homes and businesses. Development of 802.11n began in 2002. The 802.11n protocol is now Clause 20 of the published IEEE 802.11-2012 standard. Proposed enhancements to 802.11n are under development as part of IEEE 802.11ac. Wireless Networks have huge variations ranging from Wi-Fi (802.11n) covering small areas to WiMax (802.16) that covers several miles. Wi-Fi (S. Gurjeet *et al*, 2011) is technically called as wireless LAN (WLAN) communication technology which is related to the IEEE 802.11 family of wireless networking standards. It uses microwaves in the range of 2.4 GHz and 5GHz. Ad hoc network (E. Royer *et al* 1999) is a network of mobile nodes which does not have a pre existing infrastructure. They are self organised and connected by wireless links. Each node is free to move independently and participate in routing by forwarding data to other nodes. IEEE 802.11n, is a wireless networking standard that uses multiple antennas to increase data rates. It was developed as an amendment to the IEEE 802.11-2007 wireless networking standard. The purpose was to improve the network throughput over the two standards namely 802.11a and 802.11g. The most important part was a significant increase in the maximum net data rate from 54 M bit/s to 600 M bit/s with the use of four spatial streams at a channel width of 40 M Hz. It can be used in the 2.4 GHz or 5 GHz frequency bands.

Then came the wireless network which was designed for covering large cities. The IEEE 802.16 WiMax (World Wide Interoperability for Microwave Access) standard is based on global interoperability & is an upcoming technology which delivers portable mobile broadband connectivity across cities and countries through various devices. It also provides wireless alternative cable and DSL (Digital Subscriber Line) for 'last mile' broadband access. It has been designed to be a cost-effective way and can handle high-quality voice, data and video services with a high Quality of service. IEEE 802.16 is a series of Wireless Broadband standards written by the Institute of Electrical and Electronics Engineers (IEEE). The IEEE Standards Board established a working group in 1999 to develop standards for broadband for Wireless Metropolitan Area Networks. and metropolitan area network standards committee. Although the 802.16 family of standards is officially called Wireless MAN in IEEE, it has been assigned the name "WiMAX" (from "Worldwide Interoperability for Microwave Access") by the WiMAX Forum industry alliance.

An adhoc routing protocol determines how nodes interact with each other to route packets between various nodes in a adhoc network. Many protocols are designed for adhoc networks. Though (Ian.D.Chakeres *et al*, 2006), (G.PeI *et al*, 2000), (Rajeev Paulus *et al*, 2013), (V. N. Talooki *et al*, 2006) & (J.G. Jetcheva *et al*, 2004) illustrates the performance of the protocols. This paper throws light on comparative results of AODV, DYMO & Fisheye protocols of Wi-Fi & WiMax networks using QualNet Simulator using CBR traffic. The results draw some conclusions by considering MAC & Physical layer Model metrics which can be helpful for future research work.

The rest of the paper is organized as follows:

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Section-2 Overview of Routing Protocols; Section-3 Simulation Setup; Section-4 Results and Discussion; and performance comparison graphs. Finally, Conclusion is presented in Section-5

2. Overview of Routing Protocols

2.1 Ad-hoc On Demand distance Vector routing protocol (AODV)

AODV (C. Perkins *et al*, 2003) is a reactive routing protocol. The AODV Routing protocol uses an on-demand approach for finding routes. Which means that a route is recognized only when it is required by a source for transmitting data packets? Whenever a source requires a route to a destination node for which it does not have a route; it broadcasts a route request (RREQ) packet to all its neighbors. A neighbor receiving a RREQ may send a route reply (RREP) packet if it is either the destination or if it has an unexpired route to the destination. Along the path back to the source, intermediate nodes that receive the RREP create forward route entries for the destination node in their routing tables. In order to maintain the routes, AODV normally uses link layer feedback and hello packets. When a link break in an active route is detected by the above mentioned method, the node notifies this link break by sending a route error (RERR) packet to the source node. Upon receiving the RERR packet, the source node newly initiates the procedure for route discovery.

2.2 DYMO

The DYMO (Ian D. Chakeres *et al*, 2006) routing protocol is a follow up to the popular Ad hoc On-Demand Distance Vector (AODV) Routing protocol. It has many advantages. The most important part of DYMO is that it is slightly easier to implement. And it has been designed with a futuristic approach. DYMO can act as both a proactive and as a reactive routing protocol which means that the routes are discovered just when they are required. To discover new routes the following two steps are actually implemented:

A special "Route Request" (**RREQ**) messages is broadcast through the MANET. Each RREQ keeps an ordered list of all nodes it passed through. Therefore every host receiving an RREQ message immediately records a route back to the origin of this message. When a RREQ message arrives at its destination, a "Routing Reply" (**RREP**) message immediately gets back to the starting point. Thus indicating that a route to the destination was found. On the way back to the source, an RREP message can back trace the way the RREQ message took and simultaneously it allows all hosts it passes to record a matching route back to where it started. So as soon as the RREP message reaches its destination, a two-way route was successfully recorded by all intermediate hosts, and then the exchange of data packets can commence.

2.3 Fisheye State Routing protocol (FSR)

FSR (G. Pei *et al*, 2000) is a hierarchical routing protocol. It is based on the Fish Eye technique. The basic concept of using this technique was to reduce the size of the information required to represent the graphical data. The eyes of a fish has the power to capture the pixels in high detail near the focal point. The detail decreases as the distance goes on increasing. In FSR link state packets are not flooded. Instead, nodes maintain a link state table based upon the up to date information.

It has the following features: maintaining a topology map at each node where routing information is updated at different rates depending on the distance from the source and it can be broken down into:

- Node stores the Link State for every destination in the network
- Node periodically broadcast update messages to its neighbours
- Updates correspond to closer nodes propagate more frequently

In this routing protocol, there are three major tasks

- 1) Neighbour Discovery: responsible for finding and maintaining neighbour relationships.
- 2) Information Dissemination: It is responsible for sending Link State Packets (LSP), which contain neighbour link information, to other nodes inside the network.
- 3) Route Computation: It is responsible for computing routes to each destination using the information of the LSPs. At the start, every node starts has an empty topology table and an empty neighbour list. Invoking the Neighbour discovery mechanism in order to acquire neighbours and to maintain current neighbour relationships after its local variables are initialized. By using the Information Dissemination mechanism, the distribution of LSP in the network is produced. Each node has a database consisting of the collection of LSPs originated by each node in the network. From this database, the node uses the Route Computation mechanism to yield a routing table for the protocol. This process is periodically repeated.

3. Simulation Setup

In this paper simulation is carried out on QualNet version 6.1. We have evaluated the performance variation of Adhoc Routing Protocols AODV, DYMO and FSR in a WiFi network (802.11n) and a WiMax network (802.16e)

3.1 WiFi Network (802.11n)

It consists of 6 networks having 4 nodes each and the node 25 is also a mobile station of other network, over an area of 1500×1500 m². Each network consists of a base station connected with node 25 with a wired point to point link. Among various nodes application of Constant Bit Rate is applied. Node 1 has been given mobility so as to perform handover with various networks.

3.2 WiMax Network (802.16)

It also consists of 6 networks having 4 nodes each and the node 25 is also a mobile station of other network, over an area of 1500×1500 m². Each network consists of a base station connected with node 25 with a wired point to point link. Each base station is operating on a different channel. Among various nodes application of Constant Bit Rate is applied. Node 1 has been given mobility so as to perform handover with various networks.

Table 1 Simulation parameters

Parameters	Value
Area of simulation	1500*1500 m ²
Physical layer protocol	802.16 Radio , 802.11n Radio
Mac protocol	802.16e , 802.11e
Path loss model	Two Ray
Routing protocol	AODV,DYMO,FSR
Traffic source	Constant Bit Rate
Simulation Time	500 seconds
Packet Size	512 bytes

4. Results

The network described above is studied by varying the routing protocols Adhoc on Demand Distance Vector (AODV), Dynamic MANET on Demand (DYMO), Fisheye State Routing Protocol (FSR) and then comparing the results of the respective protocols in terms of Throughput, Average end to end delay, Average jitter, Total Messages Received Wi-Fi & WiMax Networks.

4.1 Throughput

It is defined as the information in bits which is received successfully by the destination in an average time. Its unit is bps.

4.2 Average End-to-End delay

It is the time elapsed when a packet is sent from the source node and is successfully received by the destination node. It includes delays as delay for route discovery, propagation time, data transfer time, and intermediate queuing delays.

4.3 Average Jitter

It is the difference in the arrival time of the packets.

4.4 Total Data Received

It defines the total data received at the server .It is expressed in bytes.

4.5 Total Messages Received

It defines the total number of messages received at the server.

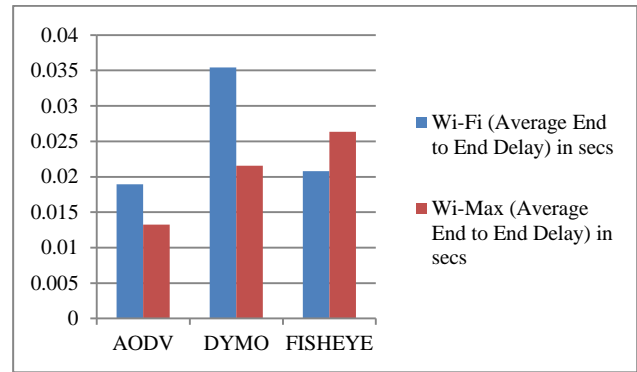


Fig.1 Average End to End Delay (in secs)

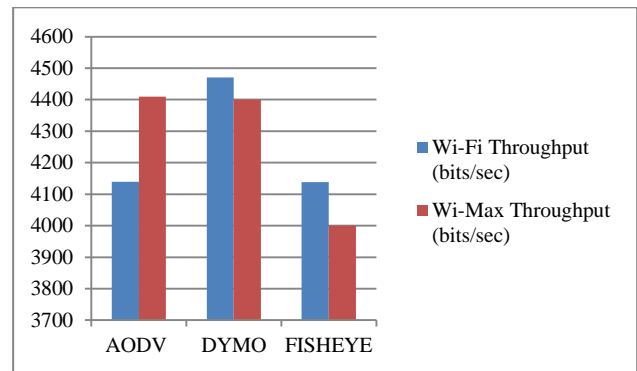


Fig. 2 (Throughput in bits/sec)

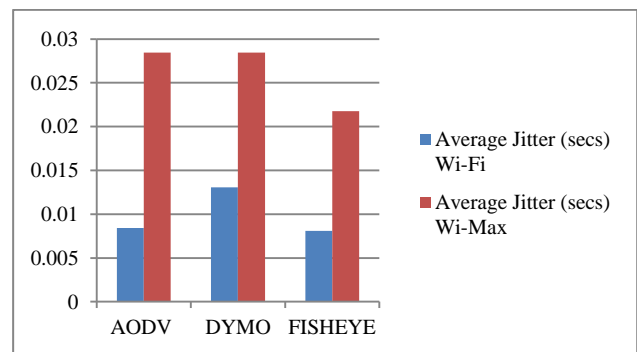


Fig. 3 Average Jitter (in secs)

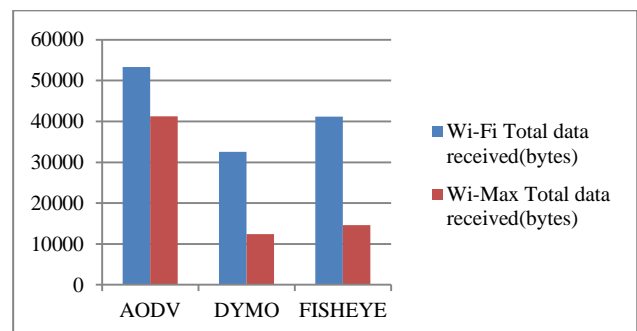


Fig. 4 Total Data Received (in bytes)

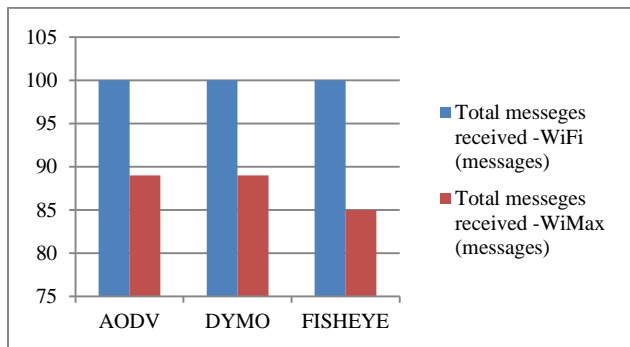


Fig. 5 Total Messages Received

5. Conclusion

This paper presents a performance difference of AODV, DYMO and FSR routing protocols in a WiFi (802.11n) and WiMax (802.16). We measured the throughput, average jitter, average end to end delay, total data received & total messages received as performance metrics. Our simulation result showed that AODV had the best throughput in a WiFi network whereas AODV and DYMO were almost equivalent in performance in a WiMax network. In both the WiFi and WiMax network, average end to end delay was the lowest in AODV. The Average Jitter was found to be the lowest for AODV and FSR in WiFi and AODV and DYMO in WiMax network. The total amount of data received in bytes is highest in AODV for both WiFi and WiMAX.

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