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Performance Evaluation of Different Routing Protocols in IPv4 and IPv6 Networks on the basis of Packet Sizes

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Abstract

IPv6 is the next generation internet protocol which will eventually replace IPv4, but till then both the protocols need to coexist for a long time. The main issue is of compatibility; both the protocols are not compatible with each other. A different set of routing protocols is required for IPv4 and IPv6. These protocols have different performances for different scenarios. Routing is a very challenging task especially in case of wireless networks. In this paper the performance is evaluated for different routing protocols like RIP, RIPng, OSPFv2 and OSPFv3 for IPv4 and IPv6 networks over Mobile Adhoc Networks. Simulations are carried out on Exata Cyber 1.1 Simulator. The performance of networks is measured on the basis of following parameters: throughput, end-to-end delay, jitter and packet delivery ratio with varying packet sizes of 256, 512, 1024 and 2058 bytes.

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Keywords: Adhoc Network; OSPF; OSPFv3; Packet size; Routing; RIP; RIPng.

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1. Introduction

IP is the most widely used protocol used over the internet, and with the advent of wide variety of devices and applications the demand of IP is highly increased in the last few decades. IPv4 is a 32 bit addressing scheme and hence forth can address up to 2^{32} devices (4.3 billion addresses)[1]. It has been observed in early 90's that very soon the IP addresses will be depleted and there will be a need of new addressing scheme. In order to meet the demand of IP addresses a new addressing scheme, IPv6 protocol came into existence. IPv6 is the next generation internet protocol, with 128 bit addressing scheme i.e. it can address 2^{128} devices which is much more than IPv4 [2]. Main problem with both the protocols is that IPv4 is not backward compatible with IPv6 and vice versa.

Mobile Adhoc Networks (MANET's) are self-organizing networks capable of forming a communication network without relying on any fixed infrastructure [3]. Each node acts as router in MANET's and the nodes are mobile, they can freely move anywhere in the network [4]. Resources in very limited in wireless networks as compared to wired networks. Also wireless networks are subject to high bit error rate (BER), high round trip time (RTT) and error prone. Fig-1 shows Mobile Adhoc Network.

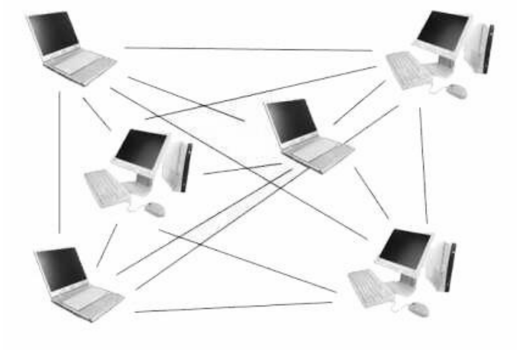

Fig 1: Mobile Adhoc Network

Routing is the very challenging task in wireless networks due to high degree of mobility of nodes, the network topology is frequently changing. This routing becomes more complex with IPv4 and IPv6 networks. As these two protocols are not compatible, different set of routing protocols are required for both the networks. For example: RIP[5], OSPFv2[6], BGP [7] etc for IPv4 networks and RIPng[8], OSPFv3[9], BGP+[10], etc for IPv6 networks.

In the current scenario one of the factors that degrade the performance of network is packet size. As the packet size increases, the throughput of the network decreases, being reason that after crossing dedicated packet size, it will allocate double the required packet size and fill up garbage in the unallocated packet space, thus decreasing the throughput [11]. In this paper the performance of these protocols over IPv4 and IPv06 networks is tested on the basis of packet size. Simulations have been performed on wireless networks with 100 nodes. And their impact on the network is analyzed.

The rest of the paper is structured as follows: Section-2 discusses about Routing. Section 3 discusses about Simulation Scenario, Section 4 discusses about results and discussions, Section 5 concludes the paper.

2. Routing

Routing is the process for making a decision for which path to follow, and to select best path. Different routing protocols like have been proposed from the past based on different criteria, uses different metrics like next hop, cost, etc. The main issue is different set of protocols is required for IPv4 and IPv6 networks. Same protocol does not support both the networks. The main problem arises here is that the backbone routing table is largely based upon IPv4 addresses, and still it will take time to change the values in the routing table.

3. Simulation Test bed

Simulations play a very important role in the development and testing of network protocols and network performance. However, the simulation of large networks is still a cumbersome job that consumes a lot of computing power, memory, and time. In order to check the performance of IPv4 and IPv6 networks, simulations have been carried out using EXata Cyber 1.1 Simulator. Fig 2 specifies the scenario for 100 nodes over mobile ad-hoc network.

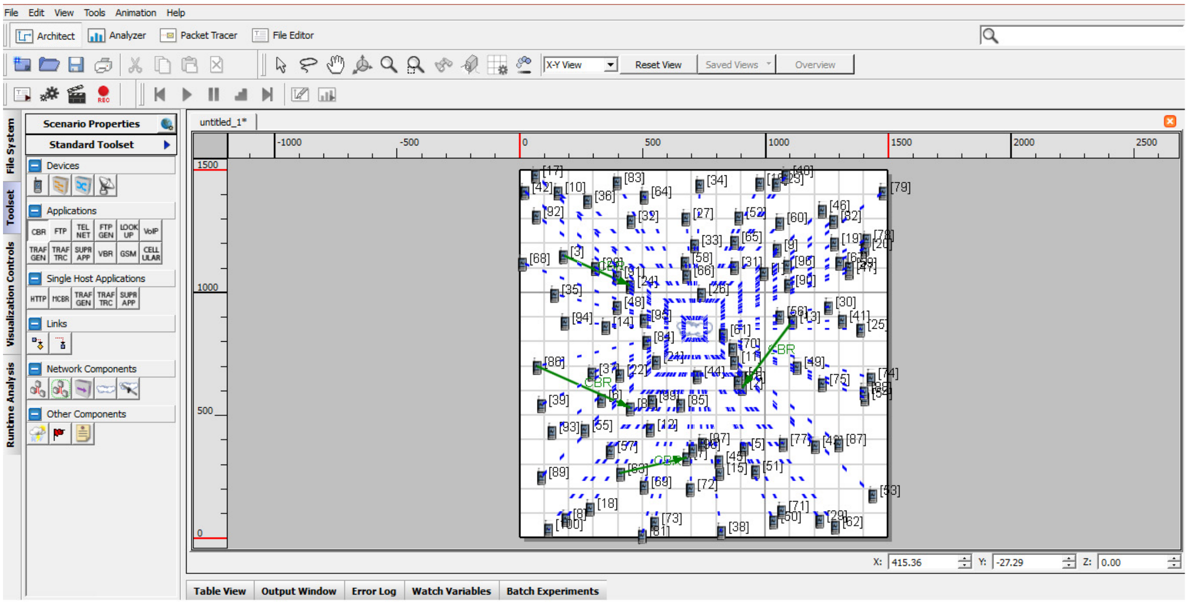

Fig 2: Scenario for 100 nodes

The following Table 1 specify the simulation parameters. The performance of IPv4 and IPv6 routing protocols is carried out on the basis of different sizes and results are compiled.

Table 1: Simulation Parameters

Parameter	Value
Simulator	EXata CYBER 1.1 Simulator.
Studied Protocol	RIP, OSPF for IPv4 Networks. RIPng, OSPFv3 for IPv6 Networks.
Area	1500m x 1500m.
No. of nodes	100 nodes.
No. of Applications	04
Type of sources	CBR
MAC protocol	802.11
Packet size	256,512,1024,2048 Bytes
Traffic Rate	1 packet per second
Mobility model	None
Simulation time	100 seconds
Channel type	Wireless Channel

Antenna model	Omni Directional
Energy model	MicaZ
Access Model	DCF (Distributed Coordinated Function) with CSMA/CA

4. Results & Discussion

The **EXata CYBER 1.1 Simulator/ Emulator** [12] has been used to analyze the parametric performance of Routing Information Protocol (RIP), Routing Information Protocol for IPv6 (RIPng), Open Shortest Path First (OSPFv2), Open Shortest Path First for IPv6 (OSPFv3). The metric based analysis is shown in table 2 to 5 and Fig. 3 to 6. We have done simulation on 100 nodes using 4 CBR applications on varying packet sizes of 256, 512, 1024 and 2048 bytes. It has been observed that as the packet size increases, the network performance improves.

4.1 Throughput:

The throughput can be defined as percentage of the packets received by the destination among the packets sent by the source. The throughput is measured in bits per second. The throughput is analyzed with varying of packet size. According to our simulation results better performance is shown by RIPng with packet size of 2048 bytes. Performance of OSPFv4 is very less compared to other protocols. It is shown in Fig 3.

Table 2: Throughput

Throughput				
Packet Size	RIP	RIPNG	OSPFv4	OSPFv6
256	2142.25	2140	1477	1757.75
512	4285.25	4280.5	3279.75	3855
1024	8571.5	8562.75	5364.25	7752
2048	16726	16944	8445.25	15060.5

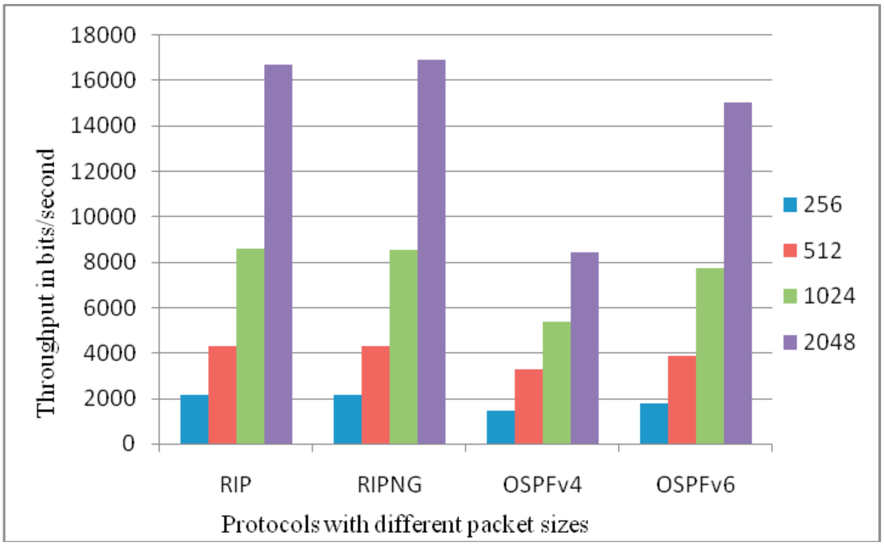

Fig 3: Throughput

4.2 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. From the results of end to end delay, the delay of OSPFv4 is highest as compared to other protocols. Delay is very less in RIPng and is showing minimum delay with all packet sizes. It is shown in fig 4.

Table 3: End-to-End Delay

End-to-End Delay (s)				
Packet Size	RIP	RIPNG	OSPFv4	OSPFv6
256	0.007163	0.006071	1.0646	0.411329
512	0.010321	0.008551	0.62687	0.779055
1024	0.015439	0.013105	0.389349	0.61928
2048	0.031797	0.025588	1.11988	0.650724

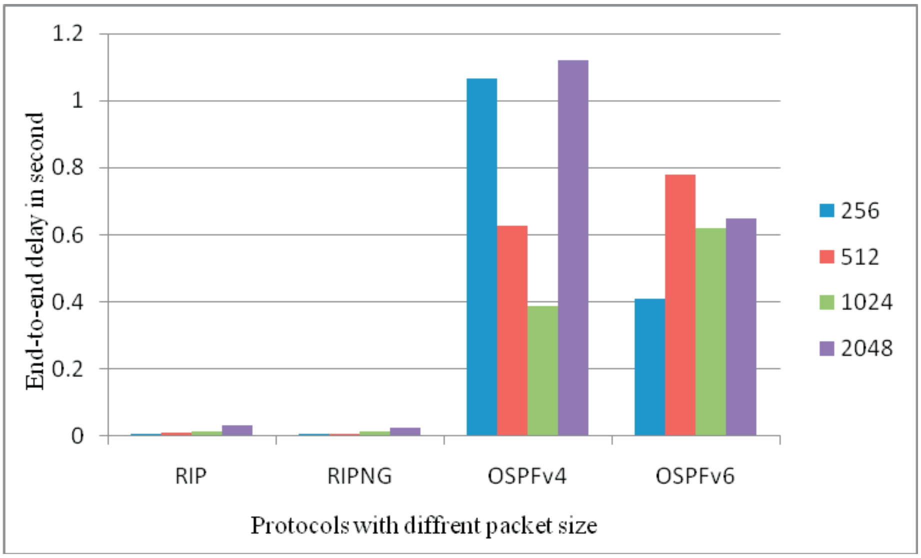

Fig 4: End-to End Delay

4.3 Jitter

It is the variation in time between arrivals of packets. It is the deviation from the ideal delay or latency. It is caused by network congestion, a sudden network topology change or route changes. It is observed from the Fig. 5 that Jitter in case of RIPng protocol is too less as compared to RIP, OSPFv4 and OSPFv6.

Table 4: Jitter

Jitter (s)				
Packet Size	RIP	RIPNG	OSPFv4	OSPFv6
256	0.001729	0.00238	0.170691	0.47958
512	0.003605	0.003556	0.124217	0.342339

1024	0.004307	0.006548	0.108059	0.303963
2048	0.005234	0.006429	0.167733	0.359601

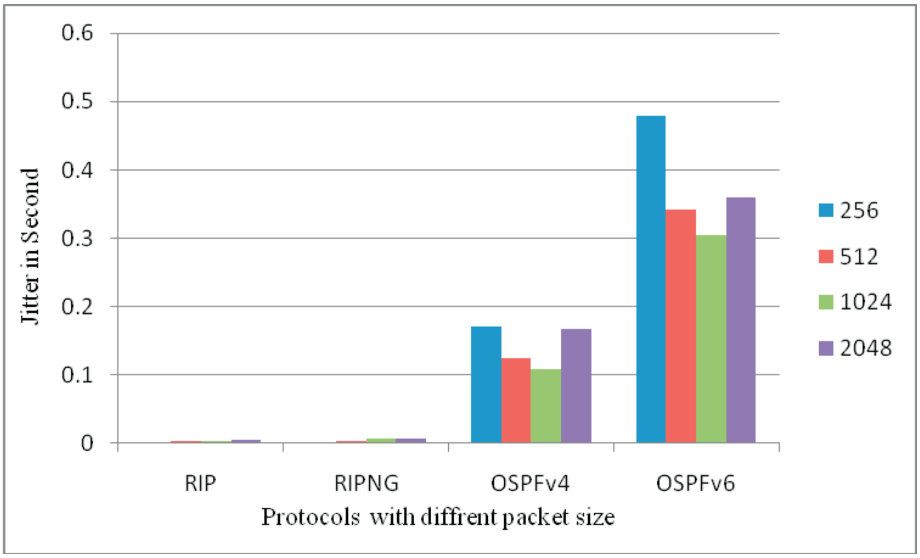

Fig 5: Jitter

4.4 Packet delivery ratio (PDR)

It is the ratio of number of packets received by the destination to the number of packets originated by the source. It specifies the packet loss rate, which limits the maximum throughput of the network. From Fig. 6 RIPng shows highest packet delivery ratio as compared to other protocols. RIP also performs better in this case. PDR is very low for OSPFv4.

Table 5: Packet Delivery Ratio

	Packet Delivery Ratio			
Packet Size	RIP	RIPNG	OSPFv4	OSPFv6
256	94.79167	96.875	58.33333	79.16667
512	94.79167	96.875	61.45833	85.41667
1024	94.79167	96.875	54.16667	87.5
2048	92.70833	95.83333	44.79167	84.375

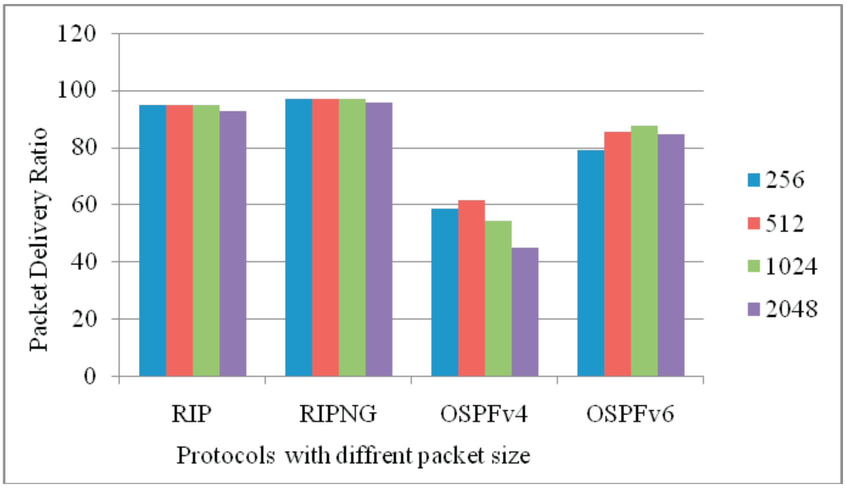

Fig 6: Packet Delivery Ratio

5. Conclusion

In this paper, routing protocols is tested for IPv4 and IPv6 networks on the basis of different packet sizes. From the results it has been observed that as the packet sizes increases the overall performance of the network increases. Due to small size of packet the number of packets increased on the source node whereas as the of packet increases the number of packets decreased and the control overheads also decreases. Out of the four protocols the performance of RIPng is best among all the protocols. It is having the maximum throughput and packet delivery ratio with minimum delay and jitter. OSPF for IPv4 networks is not performing well in this case. In future we want to evaluate all these protocols on wired and infrastructure based networks. Further we also want to test BGP protocol over such networks.

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