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A COMPARATIVE STUDY OF ROUTING PROTOCOLS BASED ON OPNET

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Abstract: With the expansion of the existing wireless networks and the emergence of new applications that require a real-time communication with low-cost, higher efficiency and less complexity. The routing protocols contribute in making the decisions in the design of these networks. This paper represents a broad study on the comparison distance vector protocol and link state protocol which aims at analyzing the performance based on the metrics such as end to end delay, throughput, packet delivery, Routing by using the simulation tool OPNET.
Keywords: Adhoc Networks, OPNET, WLAN, RIP, OSPF, IGRP, EIGRP, Routing Protocols.

I. INTRODUCTION

Nodes communicate with one another by using multi hop wireless link in Adhoc network. Routing plays an important role of moving the data from source to destination that is it takes place in the network layer of open system interconnection (OSI) reference model. Routing is divided into static and dynamic routing. In static routing, routing is done manually whereas in dynamic routing, we use interior and exterior protocols. WLAN provides high speed data transmission which can be accessed from any location[1]. A routing protocol includes procedure and guideline to select the best path on the basis of attainable information it has and for documenting this information in a routing table[2]. In regard to select the best path, routing metric will be applied and it is computed by routing algorithm. In this paper, various routing protocols like Routing Information Protocol (RIP), Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF), and Interior Gateway Routing Protocol (IGRP) are used and compared for testing the performance. In addition to this, most of the routing protocols is based on the Bellman- Ford algorithm and Ford-Fulkerson algorithm in order to choose the best shortest path. It is necessary that the router informs its successive and predecessor nodes of topology changes periodically.Whereas link state routing protocols build a complete topology of the entire network and later the best path is chosen from this topology out of all the networks.

II. ROUTING PROTOCOLS

In computer networks, the routing protocol specifies the way in which routers communicate with each other to find the routes for information or data transfer. The Routing protocol informs or shares the information with theirassociative neighbors and then throughout the network, in which topography is determined.

The protocols that are being compared here are Routing Information Protocol (RIP), Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF), and Interior Gateway Routing Protocol (IGRP).

Routing Information Protocol (RIP)

RIP is a kind of vector distance routing protocol which uses a metric hop count. It is called as a distance vector. RIP avoids routing loops by inhibiting the hop count number allowed in paths between source and destinations. Generally, the maximum number of hops granted for RIP is 15. Nonetheless, by accomplishing this routing loop avoidance, the size of supporting networks is given up. Considering the maximum number of hop counts allowed for RIP is 15, as long as the number of hops goes beyond 15, the route will be acknowledged as elusive [3]. When first developed, updates used to get sent every 30 seconds. Network traffic used to be ignored since the routing tables used be small [4]. As and when the network grows in its size, traffic burst as well as the frequency of updates in the 30 seconds time period becomes crucial. Because of this random initialization, it is commonly understood that the routing updates would spread out in time, but that is not the case in real practice.

Enhanced Interior Gateway Protocol (EIGRP)

EIGRP stands for Enhanced Interior Gateway Protocol which grants router to contribute information with the neighbouring routers which are held in the same area [5]. Rather than sending the entire information to the successive router, the information which is of more value are shared which in turn reduces the workload and amount of data that is required to be transmitted over the network. EIGRP (Enhanced Interior Gateway Protocol) designed by CISCO system which can be used only in CISCO routers[4], but in 2013 it was open for others since it became an open source, so it can be used in other routers. Neighbour table and Topology table are maintained by the EIGRP (Enhanced Interior Gateway Protocol) [6].

Open Shortest Path First (OSPF)

OSPF stands for Open Shortest Path First which uses link-state routing algorithm. Using the link state information which is accessible in the routers, it composes the topology in which the topology resolves the routing table for routing decisions [7]. It backs up both variable-length subnet masking and classless inter-domain routing addressing models. Since it uses Dijkstra's algorithm, it figures out the shortest path tree for each route [8]. The important gain of OSPF (Open Shortest Path first) is that it knobs the error detection by itself and it uses multicast addressing for routing in a broadcast domain.

Intermediate-System to Intermediate - System (IS-IS)
IS-IS stands for Intermediate-system to Intermediate - system which uses link-state routing algorithm for high speed data transmission [9]. IS-IS (Intermediate-system to Intermediate system) uses Dijkstra's algorithm in which self-reliant database assembled by each IS-IS router for gauging the best path for transmission in a network [6].
Interior Gateway Routing Protocol (IGRP)
IGRP stands for Interior Gateway Routing protocol which uses distance vector protocol (interior) to commerce data within a system [14]. It guides several metrics for each node which incorporates delay, load and bandwidth, in order to correlate the 2 routes which are coupled into single metrics. The port number for IGRP is 9 which are used for communication and by default every 90 seconds it updates the routing information [11].

III. PERFORMANCE METRICS

End to End Delay: Sum of the node delay at each node plus the link delay at each link on the path. It is calculated as the ratio of sum of difference of sent time and received time to the received time [12].
Throughput: Absolute size of packets received at destination nodes which measured in Kbps (kilo bits per second)
Packet delivery: Ratio of data packets delivered to the destination generated by CBR [13]. It is calculated as the percentile of sent and received set of packets.
Routing: Ratio of routing protocol to the total number of packets generated by the source. It is calculated as the ratio of routing packets received to the received packets in that interval.

IV. COMPARISON OF ROUTING PROTOCOLS

Table 1 depicts the comparison of different protocols. It can be concluded that EIGRP is the best choice for both large and small networks since it has the fastest convergence and EIGRP uses the bandwidth efficiently. But the research shows that EIGRP is not implemented to companies other than CISCO (2013) [15], and the structure is complicated. Based on EIGRP"s attributes, OSPF will be the second choice for large networks. RIP has the worst performance in large networks so it is suitable for small, simple networks [16].

Metric	RIP	IGRP	OSPF	IS-IS	BGP
Interior/ Exterior	Interior	Interior	Interior	Interior	Exterior
Type	Distance vector	Distance vector	Link state	Link state	Path vector
Default Metric	Hopcount	Bandwidth/ Delay	Cost	Cost	Multiple attributes
Hopcount limit	15	255	None	None	EBGP Neighbours: 1(default) IBGP Neighbours: None
Convergence	Slow	Slow	Fast	Fast	Average
Update timers	30 seconds	90 seconds	Only when thereis change	Only when there is change	Only when there is change
Updates	Full table	Full table	Only changes	Only changes	Only changes
Classless	No	No	Yes	Yes	Yes
Supports VLSM	No	No	Yes	Yes	Yes
Algorithm	Bellman-Ford	Bellman-Ford	Dijkstra	Dijkstra	Best path algorithm
Update Address	Broadcast	224.0.0.10	224.0.0.5		Unicast

Table 1: Comparison of different protocols.

V. OPNET SIMULATION

In this section, the agenda for assortment of demography and the beheading achievement are illustrated which is amassed from respective nodes i.e. node demography and global statistics [5]. The following results like simulation sequence diagram, delay, throughput, packet delivery, Ethernet delay, traffic send /receive are analysed [17].
Sequence simulation: Below figures represent the simulation of different protocols on OPNET simulator [18]. Figure 1 through 4 represents the sequence simulation of IGRP, OSPF, RIP and EIGRP respectively.

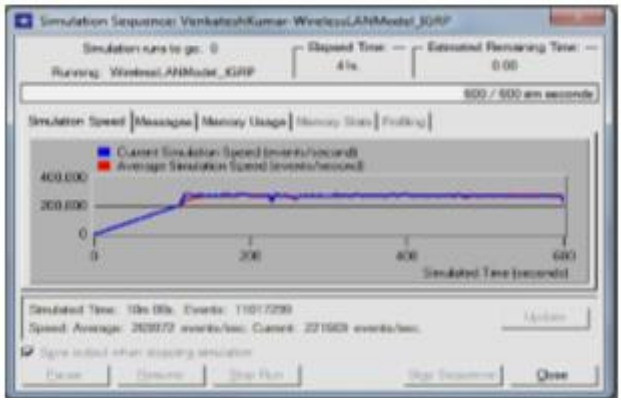

Fig 1: Sequence simulation of IGRP

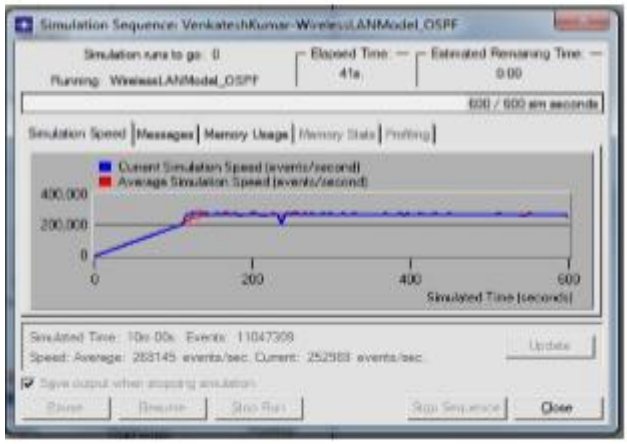

Fig 2: Sequence simulation of OSPF

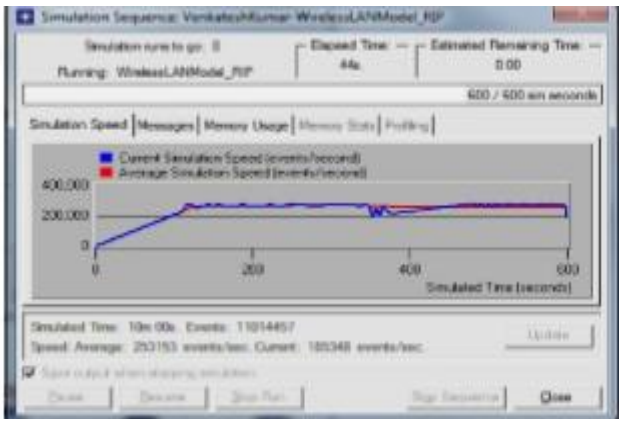

Fig 3: Sequence simulation of RIP

Fig 4: Sequence simulation of EIGRP

Ethernet Delay

It serves as the end-to-end delay of all packets received by all the nodes. The mediocre time Ethernet delay as shown in the figure 5and 6 of the whole network for separate values percentages is recognised. We can analyze that the mediocre time delay increases as the back utilization increases [19].

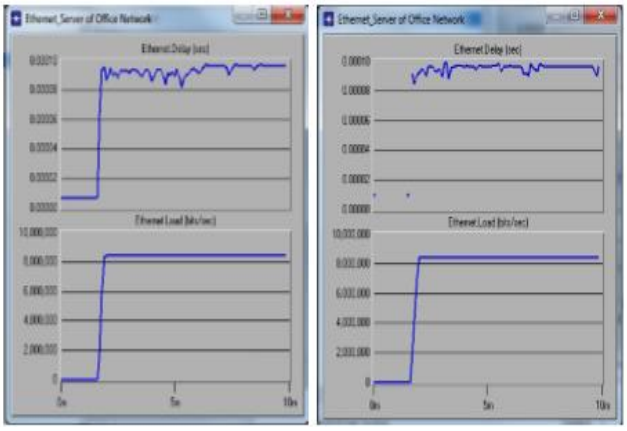

Fig 5: Ethernet delay of EIGRP (Left), IGRP (Right)

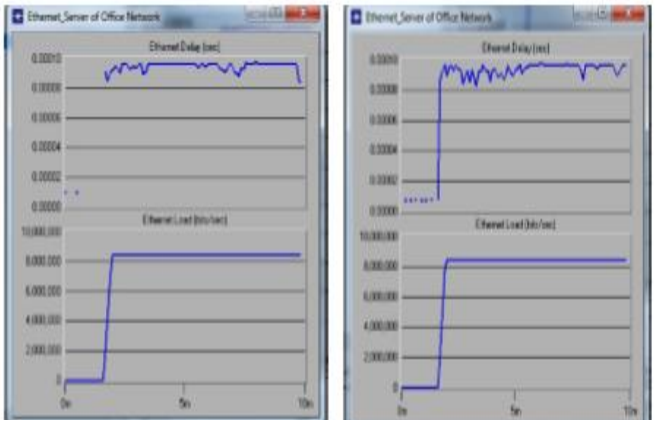

Fig 6: OSPF (Left), RIP (Right)

Load and Throughput

The origination rate of data is 1Mbps bestowed to the recommended system and the liaison between the load and throughput is examined in this section. Load is defined as the total load contributed to the WLAN nodes in (bits/sec) whereas, [20] the throughput is absolute number of bits forwarded from wireless LAN to all WLAN nodes in the network. The figure 7 depicts the load is higher than the throughput for different routing protocols and the load is constant, so that the throughput is progressed at different data rates.

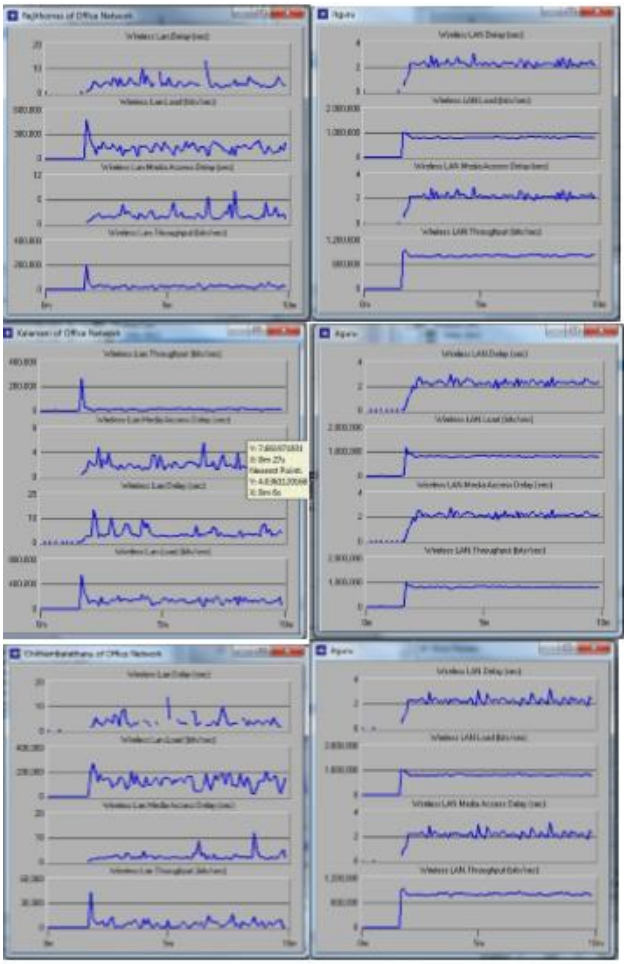

Fig 7: Load & Throughput

VI. CONCLUSION

The main goal of this paper is about the WLAN (Wireless Local Area Network) and their technologies, routing protocols and operation modes. In this paper, the achievement of WLAN is appraised by using OPNET simulator and performance metrics like load, delay, throughput, packet delivery were gained for different routing protocols like EIGRP, RIP, IGRP and OSPF. From the result, we concluded that the delay is improved by escalating the transmission rate [10]. EIGRP and OSPF is more adequate than other routing protocols in terms of throughput and load. An analogy between different protocols were analyzed and we can advise that markets like big enterprises, educational institutes, industrial sites can implement EIGRP and OSPF routing protocol for better performance and key catalyst like 802.11a, 802.11g can accelerate the WLAN(Wireless Local Area Network) with the speed upto 54Mbps [21].

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