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Comparative Performance Evaluation Using OPNET for OLSR in OFDM (802.11a) & Extended Rate PHY (802.11g) at 54 Mbps Data Rate

Ruchita[1], Mamta Sachdeva[2], Jonish[3]

[1]M-Tech Department of CSE, SITM, Sonepat, Haryana, India

[2]Department of CSE, SITM, Sonepat, Haryana, India

[3]Department of CSE, Sonepat, Haryana, India

ABSTRACT

In this paper analysis and performance of OLSR in OFDM (802.11a) & Extended Rate PHY (802.11g) at 54 Mbps Data Rate. We used OPNET Simulation tool we created a network containing 25 mobile nodes for data rate 54 Mbps with transmission power 0.005 watts and buffer size 256000 bits each node moves randomly in the network and simulation time was 1500 sec. OLSR is compared in terms of OFDM (802.11a) and Extended Rate PHY (802.11g) for different QOS's using OPNET. According to the resulted performance we can say that 802.11g might do a better job of satisfying requirements for mobile applications. The simulation result of the research has practical reference value for further study.

Keywords : OLSR, OFDM, MANET, QOS, OPNET

I. INTRODUCTION

Mobile ad hoc Network is a dynamic distributed network. Due to the dynamic nature the network topology keep changes randomly. The mobility of nodes in MANETs results in frequent changes of network topology making routing in MANETs a challenging task. The Optimized Link State Routing Protocol (OLSR) is developed for mobile ad hoc networks (MANET's). It operates as a table driven, proactive protocol, i.e., exchanges topology information with other nodes of the network regularly. Each node selects a set of its neighbor nodes as "multipoint relays" (MPR). In OLSR, only nodes, selected as such MPR's, are responsible for forwarding control traffic, intended for diffusion into the entire network. MPRs provide an efficient mechanism for flooding control traffic by reducing the number of transmissions required. [1].

This approach is widely known as hybrid routing protocol, because it can simultaneously use the strengths of reactive routing and proactive routing protocols. The source node computes the best route according to collected information and then immediately starts to transmit data packets. Wireless LAN is the major issue in data communication's performance of MANET. Hence, Wireless LAN required is to be effective and accurate so as to handle mobility of nodes and to give best utilization to technology. Routing protocol is a standard that determines how nodes find the way to forward packets between devices in the network. In this paper performance of IEEE 802.11a /g WLAN Standard is evaluated. [2]

TABLE I

IEEE 802.11 CLASSIFICATIONS

Standard	**IEEE 802.11a**	**IEEE802.11g**
Release	Sept 1999	Jun 2003
Bandwidth(MHz)	20	20
Frequency(GHz)	0.5	2.4
Data	6,9,12,18,24,36,4	6,9,12,18,24,36,4

Rate(Mbit/s)	8,54	8,54
Modulation	OFDM	OFDM,DSSS

II. RELATED WORK

Jonish [1] analyzed the performance of TORA and GRP routing protocol with the use of OPNET simulation tool, they created a 50 mobile nodes network on data rate 1 and 2 Mbps and transmission power 0.005 watts with buffer size 256000 bits the time of simulation was 1500 sec. TORA and GRP routing protocols were compared in terms of Download Response Time, Upload Response Time, Delay, Load and Media Access Delay in scenario for the simulation analysis and performances.

Anjali [2] analyzed the performance of AODV, OLSR and GRP routing protocols is evaluated for FTP based application traffic on IEEE 802.11 WLAN Standard and 48 Mbps data rate. The network performance is evaluated by using OPNET simulator based on various quantitative metrics- Network Load, Throughput, Retransmission Attempts and Media Access Delay by varying physical characteristics and number of nodes. A comparative performance analysis of these protocols have been carried out in this paper and in the last conclusion will be presented which demonstrate that performance of routing protocols differs by varying the network and selection of accurate routing protocol according to the network ultimately influences the efficiency of the network in a magnificent way.

Kuldeep vats [5] analyzed the performance of DSR, OLSR and GRP routing protocols. They used OPNET simulation tool. They created a network containing 150 mobile nodes with the data rate of 18 mbps and transmit power of 0.11 watts. Each node moves randomly within the network range 10,000 sq m and Simulation time was 1000 sec. According to their simulation result OLSR presented the best performance and GRP presented low to OLSR and high to DSR or finally DSR presented the low performance (DSR<GRP<OLSR) is analyzed.

III. MANET ROUTING PROTOCOLS

With recent performance advancements in computer and wireless communications technologies, advanced mobile wireless computing is expected to see increasingly widespread use and application, much of which will involve the use of the Internet Protocol (IP) suite. The vision of mobile ad hoc networking is to support robust and efficient operation in mobile wireless networks by incorporating routing functionality into mobile nodes. Such networks are envisioned to have dynamic, sometimes rapidly-changing, random, multi-hop topologies which are likely composed of relatively bandwidth-constrained wireless links.

A number of routing protocols are created to be implemented on MANET categorized in three different types according to the functionality

A. Proactive Protocols

In networks utilizing a proactive routing protocol, every node maintains one or more tables representing the entire topology of the network. These tables are updated regularly in order to maintain a up-to-date routing information from each node to every other node. To maintain the up-to-date routing information, topology information needs to be exchanged between the nodes on a regular basis, leading to relatively high overhead on the network. One the other hand, routes will always be available on request. Many proactive protocols stem from conventional link state routing, including the Optimized Link State Routing protocol (OLSR).

1) OLSR

OLSR is a proactive routing protocol for mobile ad-hoc networks (MANETs). [1][2] It is well suited to large and dense mobile networks, as the optimization achieved using the MPRs works well. The larger and more dense a network, the more optimization can be achieved as compared to the classic link state algorithm. OLSR uses hop-by-hop routing, i.e., each node uses its local information to route packets. OLSR is well suited for networks, where the traffic is random and sporadic between a larger set of nodes rather than being almost exclusively between a small specific set of nodes. As a proactive protocol, OLSR is also suitable for scenarios where the communicating pairs change over time: no additional control traffic is generated in this situation since routes are maintained for all known destinations at all times. [6][7]

B. Reactive Protocols

Reactive routing protocols do not make the nodes initiate a route discovery process until a route to a destination is required. This leads to higher latency but lower overhead. Reactive Protocols are bandwidth efficient. Route is determined when a path is required by a node to forward packets. Therefore, overhead routing is decreased because search for the route is not required on which packet is not sent.

C. Hybrid Protocols

It combine characteristics of both pro-active and re-active routing in order to find effective and reliable routes, without large control overhead, by locally using pro-active routing and inter-locally using re-active routing. One approach is to divide the network into zones, and use one protocol within the zone, and another between them. In this method communication in MANET is possible when nodes are near to each other and the supposition that changes in topology are only important if they happen in the vicinity of a node.

The primary IEEE 802.11 standards in use today are 802.11a and 802.11b, which both use radio waves for transferring information wirelessly over a network. Few people realize, however, that the 802.11 standard also includes the 802.11 Infrared (IR) Physical Layer 802.11 IR defines 1Mbps and 2Mbps operation by bouncing light off ceilings and walls to provide connectivity within a room or small office. The reason that 802.11 IR is unheard of is that there are no known vendors that sell products compliant with 802.11 IR. Some offer infrared-based wireless LANs that come close to the standard. For example Spectrix, once the chair of the 802.11 IR group, offers wireless LAN products that implement diffused optical technologies very similar to 802.11 IR. The primary difference between infrared and radio wireless LANs is the frequency of the transmitted signal. Don't become complacent with radio frequency (RF) technologies, such as 802.11a and 802.11b, as the only option for wireless LANs. An infrared wireless LAN might do a better job of satisfying requirements for mobile applications.

IV. SIMLATION SETUP

This research used software known as OPNET Modeler, Which is a tool provided by the OPNET Technologies in order to undertake the experimental evaluation; the version named OPNET Modeler 14.5 has been adopted for study [12]. It is easy to work with GUI interface and the OPNET provides us the GUI interface to work. And it is easy to built model of working in GUI Virtual environment. OPNET is one of the most extensively used commercial simulators based on Microsoft Windows platform, which incorporates most of the MANET routing parameters compared to other commercial simulators. It simulates the network graphically and gives the graphical structure of actual networks and network components.

TABLE II
SIMULATION PARAMETERS

Simulation Parameter	**Value**
Simulator	OPNET Modular 14.5
Area	1500*1500
Network Size	25 Nodes
Data Rate	54 Mbps
Mobility Model	Random waypoint
Simulation Time	1500 sec
Address Mode	IPV6
Standard	IEEE 802.11a, 802.11g
Routing Protocol	OLSR

TABLE III
OLSR PARAMETERS

Attribute	**Value**
Willingness	HIGH
Hello Interval(sec)	2.0
TC Interval(sec)	5.0
Neighbor Hold Time(Sec)	6.0
Topology Hold Time(Sec)	15.0
Duplicate Message Hold Time(Sec)	30.0
Addressing Mode	IPV6

TABLE IV
WIRELESS LAN PARAMETERS

Attribute	**Value**
Physical Characteristics	OFDM & EXTENDED RATE PHY
Data Rate	54 Mbps
Short Retry Limit	7

Long Retry Limit	4
Max Receive Lifetime (sec)	0.5
Buffer Size(bits)	256000
Roaming Capability	Enabled

Fig. 1 shows the simulation environment of scenario containing 25 WLAN mobile nodes, one fixed WLAN Server, Application definition, Profile definition and Mobility config. We configure the nodes in the scenario to work with 54 Mbps data rate.

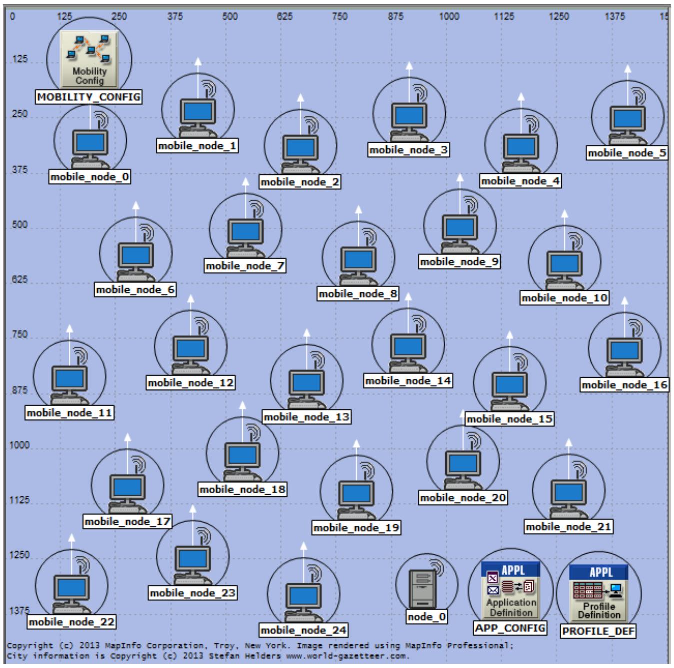

Fig. 1 Network Model for 25 Nodes scenario

V. PERFORMANCE MERICS

A. Hello Traffic Sent (bits/sec)
B. MPR Count (sec)
C. TC Traffic Sent (bits/sec)
D. Total TC Message Sent
E. Topology Changes

VI. SIMULATION RESULTS AND ANALYSIS

Figure (2 - 6) below shows **Hello Traffic Sent (bits/sec), MPR Count (sec),TC Traffic Sent (bits/sec), Total TC Message Sent, Topology Changes** in 25 mobile nodes scenario for IEEE 802.11a & 802.11g standard at 52 Mbps data rate with OLSR. The color scheme is showing the protocols behavior in different graphs which gives the average values.

A. Hello Traffic Sent (bits/sec)

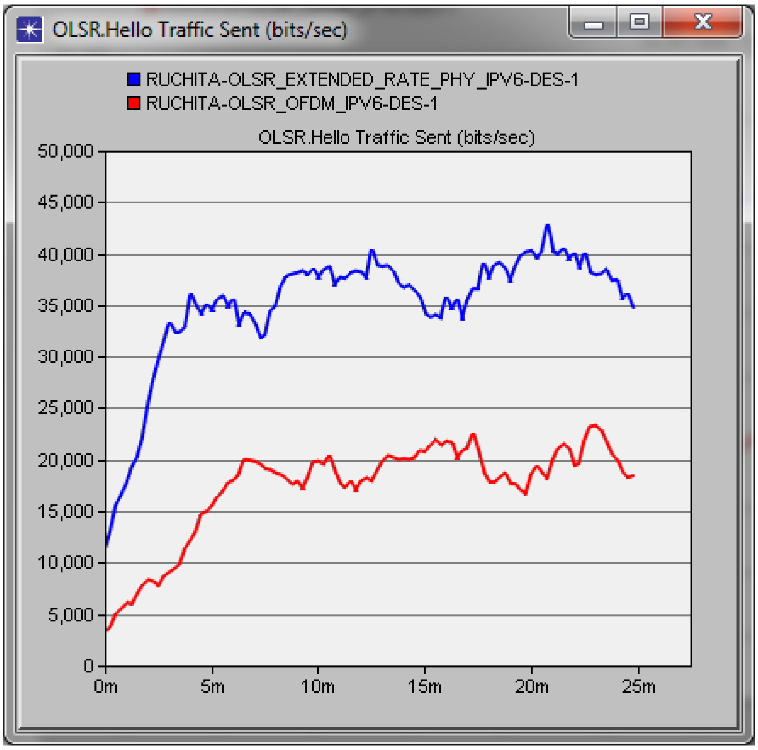

Fig. 2 Sample Sum for Hello Traffic Sent (bits/sec) in IEEE 802.11a & 802.11g

According to simulation, as we can see in Fig. 2, in IEEE 802.11a & 802.11g standard at 52 Mbps data rate with OLSR for Hello Traffic Sent (bits/sec).

B. MPR Count (sec)

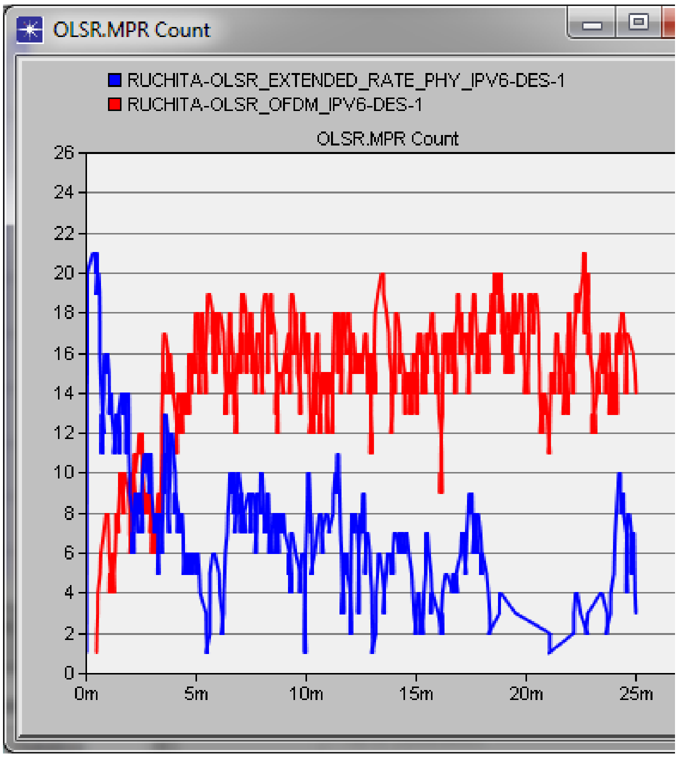

Fig. 3 Sample Sum for MPR Count (sec) in IEEE 802.11a & 802.11g

According to simulation, as we can see in Fig. 3, in IEEE 802.11a & 802.11g standard at 52 Mbps data rate with OLSR for MPR Count (sec).

C. TC Traffic Sent (bits/sec)

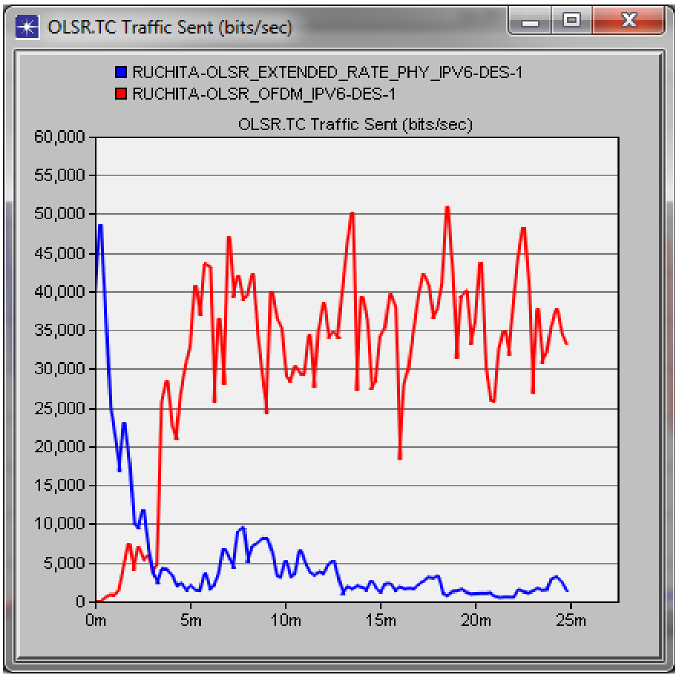

Fig. 4 Sample Sum for TC Traffic Sent (bits/sec) in IEEE 802.11a & 802.11g

According to simulation, as we can see in Fig. 4, IEEE 802.11a & 802.11g standard at 52 Mbps data rate with OLSR for TC Traffic Sent (bits/sec).

D. Total TC Message Sent

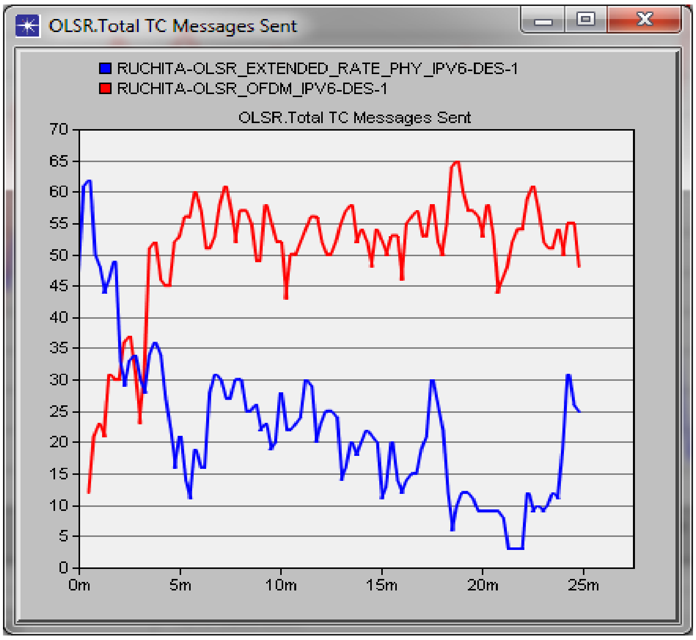

Fig. 5 Sample Sum for Total TC Message Sent in IEEE 802.11a & 802.11g

According to simulation, as we can see in Fig. 5, IEEE 802.11a & 802.11g standard at 52 Mbps data rate with OLSR for Total TC Message Sent.

E. Topology Changes

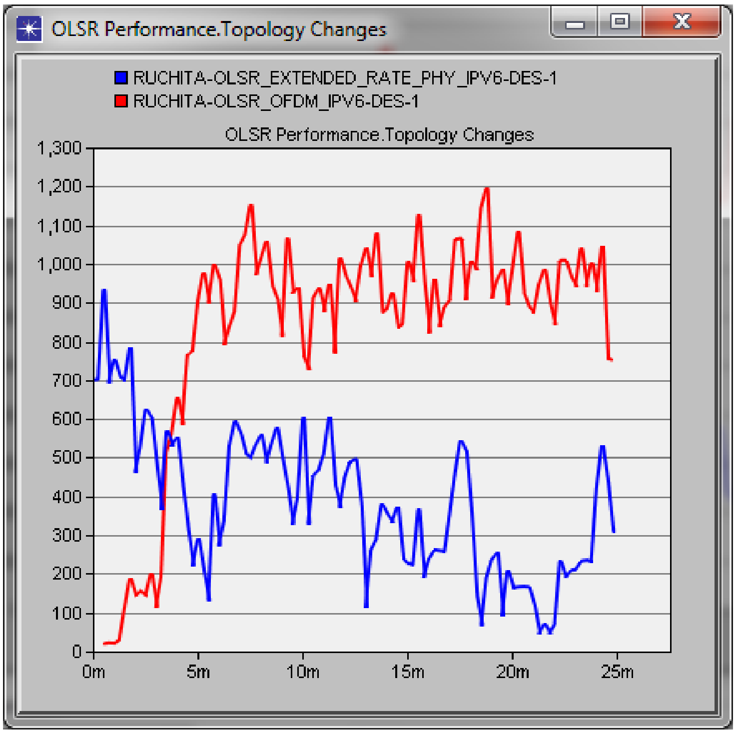

Fig. 6 Sample Sum for Topology Changes in IEEE 802.11a & 802.11g

According to simulation, as we can see in Fig. 6, IEEE 802.11a & 802.11g standard at 52 Mbps data rate with OLSR for Topology Changes.

VII. CONCLUSION

In this paper performance of OLSR Protocol for metrics like **Hello Traffic Sent (bits/sec), MPR Count (sec), TC Traffic Sent (bits/sec), Total TC Message Sent, Topology Changes** by using 25 nodes scenario with IEEE 802.11a & 802.11g for 52 Mbps is evaluated. From the above discussion we find out below tabled results.

TABLE IV
RESULTING VALUES

S. No.	Performance Metrics	OFDM_802.11a	EXTENDED Rate PHY_802.11g
1	**Hello Traffic Sent (bits/sec)**	LOW	HIGH
2	**MPR Count (sec)**	LOW	HIGH
3	**TC Traffic Sent (bits/sec)**	LOW	HIGH
4	**Total TC Message Sent**	LOW	HIGH
5	**Topology Changes**	LOW	HIGH

OLSR have large no of possibilities to be worked on. OLSR does a better job of satisfying requirements for mobile applications with EXTENDED Rate PHY_802.11g. The simulation result of the research has practical reference value for further study.

VIII. REFERENCES

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