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Performance Analysis of MANET (WLAN) Using Different Routing Protocols in Multi service Environments-An Quantitative Study

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ABSTRACT

A mobile ad-hoc network is a network (MANET) of wireless mobile nodes (MNs) that communicate with each other without centralized control or established infrastructure. Routing protocols are divided into Proactive and Reactive.Pro-active is a table–driven protocols. The proactive routing protocols use link- state routing algorithm which frequently flood the link information about its neighbors. Reactive or on-demand routing protocols create routes when they are needed by the source host and these routes are maintained while they are needed. This paper proposes a solution for performance enhancement of VoIP and HTTP in Ad-hoc WLANs. This paper compares the performance of VoIP and HTTP over different IEEE standards and draws a conclusion based on performance of the network over different QoS parameters. Later the suitability of different routing protocols like AODV, DSR, OLSR and GRP for VoIP and HTTP traffic is compared and OLSR is found to have highest throughput with least delay as compared to other protocols. Thus we observed that, the throughput increase of around 80% over the existing routing standard and enormous decrease in end to end delay.

Key Terms*:* HTTP, VoIP, QOS, OLSR, GRP, AODV

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1. Introduction

A mobile ad-hoc network is a network (MANET) wireless mobile nodes (MNs) that communicate with each other without centralized control or established infrastructure. Routing protocols are divided into two categories: **Pro-active** is a table –driven protocols. The proactive routing protocols use link- state routing algorithm which frequently flood the link information about its neighbors. **Reactive** or on-demand routing protocols create routes when they are needed by the source host and these routes are maintained while they are needed. Our goal is to carry out a systematic performance study of four routing protocols for ad- hoc networks, namely **AODV, DSR, GRP, OLSR**.We consider the different scenarios with the different routing protocols, By implementing the application **HTTP, VOIP.**We also focus on finding out the throughput and delay of various protocols used. **OLSR** is to build the routing information as and when they are created make them more adaptive and result in better performance (high packet delivery and lower average end-to-end packet delay).

The paper is organized as follows: In section 2 the discussion of performance of various schemes with VoIP applications and also with various codec is done. Section 3 deals with the analysis of various routing protocols and their impact on QOS parameters. In section 4 theoretical calculations are been presented to find the number of supported VoIP connections and in the other half of this section deals with further optimization of QOS for the voice data is achieved by varying contention window. Section 5 contains the simulations carried out in OPNET and followed by conclusion.

2. Analysis of QOS Based on Various Schemes for Voice Traffic:

2.1 Choice of schemes: The commonly used schemes of WLANs are 802.11a, 802.11b, 802.11g standards. From references [10], [14], it is concluded that the performance of 802.11g is superior when compared to other schemes and hence this scheme is used for further analysis of this paper. For efficient performance analysis it is found that prediction of channel estimations and number of supporting stations is vital.

2.2 Voice coding: The commonly used VoIP codecs are G.711, G.729 and G.723.1. Even if a lot of voice codecs can tolerate some small packet loss without severe degradation, voice has unacceptable performance if long delays are incurred. It is recognized that the end-to-end delay has a great impact on the perceived quality of interactive conversations with a threshold value around 150 ms. The impact of delay on voice communication quality varies significantly based on the choice of codec. The below table [8] gives a list of different codec schemes and the various parameter values:

Codec	Bandwidth	MOS
G.711	64kbps	4.195
G.729	8kbps	3.945
G.723.1	5.3kbps	3.613
G.728	16kbps	4.035

Table 1: codec parameters

Thus it is concluded that G711 has high band width, better MOS values and hence the BER value will be the least. For further analysis of VoIP in this paper G711 codec is been used.

3. PROTOCOL ANALYSIS

This section examines the routing protocols designed for Ad-Hoc networks adaptable in WLANs.

3.1 DSR:

The *Dynamic Source Routing* protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The protocol is composed of the two mechanisms of *Route Discovery* and *Route Maintenance*, which work together to allow nodes to discover and maintain *source routes* to arbitrary destinations in the ad hoc network. The use of source routing allows packet routing to be trivially loop-free, avoids the need for up-to-date routing information in the intermediate nodes through which packets are forwarded, and allows nodes forwarding or overhearing packets to cache the routing information in them for their own future use. All aspects of the protocol operate entirely *on-demand*, allowing the routing packet overhead of DSR to scale *automatically* to only that needed to react to changes in the routes currently in use.

We have evaluated the operation of DSR through detailed simulation on a variety of movement and communication patterns, and through implementation and significant experimentation in a physical outdoor ad hoc networking test bed we have constructed in Pittsburgh, and have demonstrated the excellent performance of the protocol.

3.2GRP

A geographic routing protocol is based on greedy routing and faces routing principles. The main disadvantage is obtaining the location information is difficult or expensive for example GPS, they don't work indoors. The methods to estimate locations (by the distance to certain anchors) are computation intensive, and with not good accuracy.

3.3 AODV

The Ad-hoc On-Demand Distance Vector (AODV) routing protocol is designed for use in ad-hoc mobile networks. AODV is a reactive protocol: the routes are created only when they are needed. It uses traditional routing tables, one entry per destination, and sequence numbers to determine whether routing information is up-to-date and to prevent routing loops. An important feature of AODV is the maintenance of time-based states in each node: a routing entry not recently used is expired. In case of a route is broken the neighbors can be notified. Route discovery is based on query and reply cycles, and route information is stored in all intermediate nodes along the route in the form of route table entries. The following control packets are used: routing request message (RREQ) is broadcasted by a node requiring a route to another node, routing reply message (RREP) is unicasted back to the source of RREQ, and route error message (RERR) is sent to notify other nodes, the loss of the link. HELLO messages are used for detecting and monitoring links to neighbours.

3.4 OLSR:

Optimized Link State Routing is an optimization of the classical link state algorithm tailored to the requirements of a mobile wireless LAN. The key concept used in the protocol is that of multipoint relays (MPRs). The MPRs substantially reduces the message overhead as compared to a classical flooding mechanism, where every node retransmits each message when it receives the first copy of the message. In OLSR, link state information is generated only by nodes elected as MPRs. Thus, a second optimization is achieved by minimizing the number of control messages flooded in the network. As a third optimization, an MPR node may chose to report only links between itself and its MPR selectors. Hence OLSR provides optimal routes (in terms of number of hops). The protocol is particularly suitable for large and dense networks as the technique of MPRs works well in this context. In order to investigate the QOS issues, the following assumptions are made to reduce the complexity. The effect of propagation delay and hidden node terminals is avoided and the channel is error free and all stations are in 'awake' mode. The throughput that could be obtained from the above protocols are been theoretically calculated in the next section and its values are been verified with the simulated results.

4. THEORETICAL ANALYSIS

4.1 Capacity estimation: This analysis helps to find the maximum number of VoIP connections that could be supported. The following factors determine the capacity of a network for voice: Average data transmission rate R_{avg}, Time taken for transmission of payload T_p, Over head (mainly MAC and network layer) $T_{overhead}$ **,** Codec bandwidth(G711 has 64Kbps) **,** 'n' number of stations. The maximum number of VoIP connections supported is given by [6]

R_{avg}=54Mbps, codec rate= 64Kbps,
Uplink traffic=n*64kbps,
Downlink traffic=n*64kbps,
Total channel throughput= n*128kbps
Channel throughput

$$[T_p / (T_p + T_{overhead})]$$

From the above equation T_p is found. Calculation of T_{total} is done from the header lengths that are been listed in the table below

RTP Header	12 bytes
UDP Header	8 bytes
IP Header	20 bytes
MAC Header	34 bytes
Physical Header	32µs

Table 2: Header Lengths

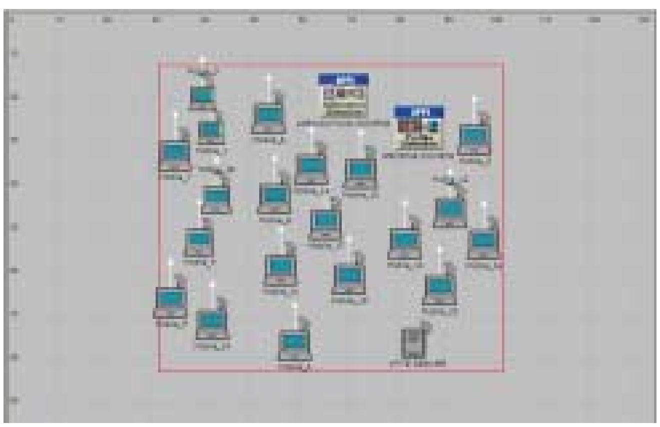
For the DIFS, SIFS, ACK specifications of the 802.11g, we get 17.9 [5] supported connections. Thus, we will be analysing the performance of the different parameters based on the optimum range from 5 to 20 stations. The traffic handling capacity can be predicted as follows

Data rate of the scheme (frame length in packets per second) × N

From the above condition the occurrence of data drop with increasing number of stations can be found, thus predicting the traffic handling capacity of the network.

5. SIMULATION, RESULTS AND DISCUSSION:

The snap shot of scenario, various attributes and setting thus designed for analysis VoIP and HTTP



performance with various protocols using OPNET is shown in the figures. Here a total of 20 stations is been selected and is designed to transmit two types of traffic VoIP and HTTP are analyzed.

Fig 1. Simulation Setup

Schemes	11g
Nodes	20 stations (large networks)
Protocols	AODV, DSR, GRP, OLSR
Simulation	1200 sec
Mobiltyrate	5 meter/sec
Data rate	54Mbps(11g)

Table 3: Attributes for protocol scenario

RESULTS:-

The following graphs were obtained after collecting statistics on OPNET. The graphs give a comparative picture of the four scenarios and show an evident improvement in performance of the AODV and OLSR scenario.

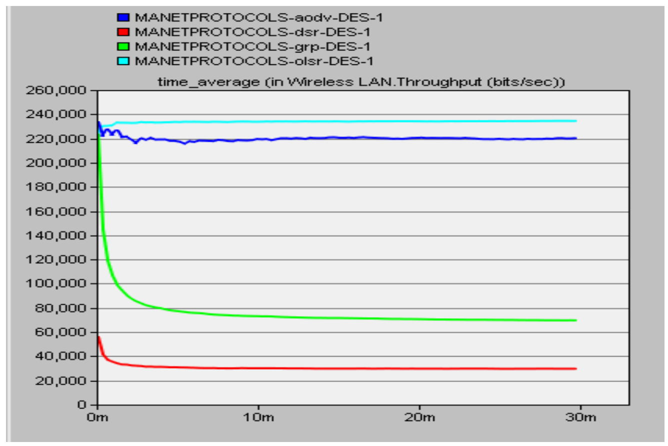


Fig 2. Wireless LAN Throughput

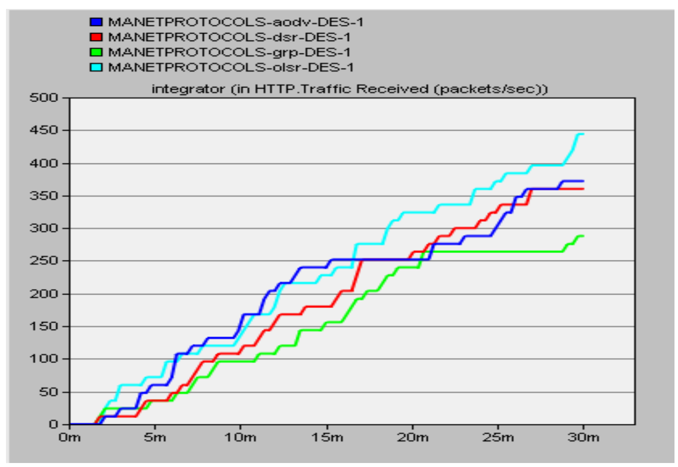


Fig 3. Http Traffic

From the fig.2and 3 we can see that there is a considerable increase in global WLAN throughput and HTTP Traffic Received.From the above two graphs for 802.11g, we draw conclusions as Highest throughput is achieved for OLSR followed by AODV. Thus it suggests that implementation of OLSR in WLANS would yield better results than the existing ones like AODV.

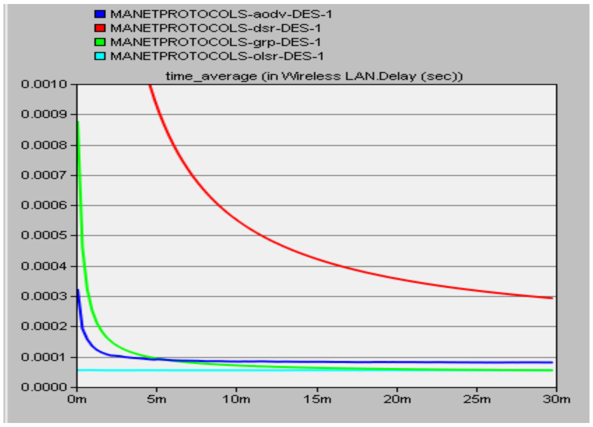


Fig 4. Wireless Lan Delay

From fig. 4 we can observe that the delay for the OLSR scenario is low when compared to the other scenarios.

6. CONCLUSION

In this paper, we analyzed the performance of various protocols such as OLSR, AODV, GRP and DSR. The simulation results shows that OLSR protocol has better performance in terms of throughput and delay, particularly for large networks. For smaller networks the performance of AODV and OLSR are the same. The same results also holds good for other networking applications like video conferencing, FTP and HTTP.

As a future scope it is been planned to implement an agent that would cause the call admission control mechanisms in the logical link control layer (LLC) thus increasing the over all performance of the network.

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