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# PERFORMANCE ANALYSIS OF VIDEO STREAMING APPLICATION OVER MANETs ROUTING PROTOCOLS

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**Abstract: -** The advent of wireless technology is one of the biggest breakthroughs of the modern era, this technology enables the users to utilize the freedom of movement and the use of the equipment while on the move. Mobile Ad-hoc Network is a special point of focus for industry and academic researchers from all around the globe. This technology has come with its own flavour as it is easy to deploy in disaster areas and for emergency operations. MANET creates a temporary environment of mobile nodes without the need of any centralized networks. The nodes collaborate with each other to send and forward packets to destination nodes. Mobile Ad hoc Network do not rely on wired network routing protocols. It uses its own Ad hoc routing protocols that are entirely different from the tradition wired network as routing path breaks due to self-organized nodes while discovering multi hop routes through network. Video streaming applications are of various types like video Conferencing, video chat, video on demand and live video streaming. These different applications have different resource requirements which shall be met by MANET according to the availability of resources, In this paper, a comprehensive simulation based on a comparative study over MANET is performed on video streaming applications under two types of routing protocols covering reactive, and proactive routing protocols namely Optimized Link State Routing (OLSR) and Ad hoc On-Demand Distance Vector (AODV), both these protocols have been considered for investigation by using OPNET simulation, throughput, delay, Load and Data retransmission metrics have been used for measuring these protocols..

**Keywords**: - MANET, AODV, OLSR, Video Streaming, Routing Protocols

## 1. Introduction

The technologies of Networks has been changed rapidly in the previous era moving from the static wired networks to the mobile dynamic of wireless networks. The growing market of mobile devices and the service quality demands the users to shift the focus of research and innovation to the direction of wireless networks. There are different limitations techniques of wireless network such as high error rate, power restrictions, bandwidth constraints, etc. but these could not limit the rise of wireless technology [1]. Mobile Ad-hoc Network MANET is a special point of focus for industry and academic researchers from all around the globe. This technology has come with its own flavour as it is easy to deploy in disaster areas and for emergency operations. MANET is a collection of number of mobile devices that equipped with radio transmitter and receiver [2].

MANET forms a dynamic in nature temporary network of mobile nodes. The mobile nodes which are near to each other's transmission range can communicate among themselves directly otherwise, the nodes in between act as routers and forward the packets from source to destination [3] as shown in figure 1. Such networks can operate independently or can also be connected to larger networks such as internet. There are many applications such as, missions for search and rescue, collecting the data information, virtual conferences and classes using tablets, laptops, or other wireless equipment in wireless communication that make this technology needed to be used [4]. MANET cannot form without the proper routing protocol that will help the nodes to communication with each other, the leading aim for developing routing protocols for the ad-hoc networks is to conquer MANET's dynamic nature. Due to the mobility and the joining and leaving processes in a wireless network, the nodes waste high amount of energy [5]. The ad-hoc routing protocols efficiency can be specified by the consumption of the battery power. Many research studies have been carried out for the performance evaluation of routing protocols regarding different traffic types by the use of network simulators such as Equipment Training (OMNET), Network Simulator (NS-2) and Optimized Network Engineering Tool (OPNET). The studies in [6] shows that AODV protocol achieves better performance than OLSR protocol in scalable video communication over MANET. DSR and AODV routing protocols are compared in [7] for real time audio and video data, and simulation studies demonstrate that AODV has slightly better performance than DSR protocol.

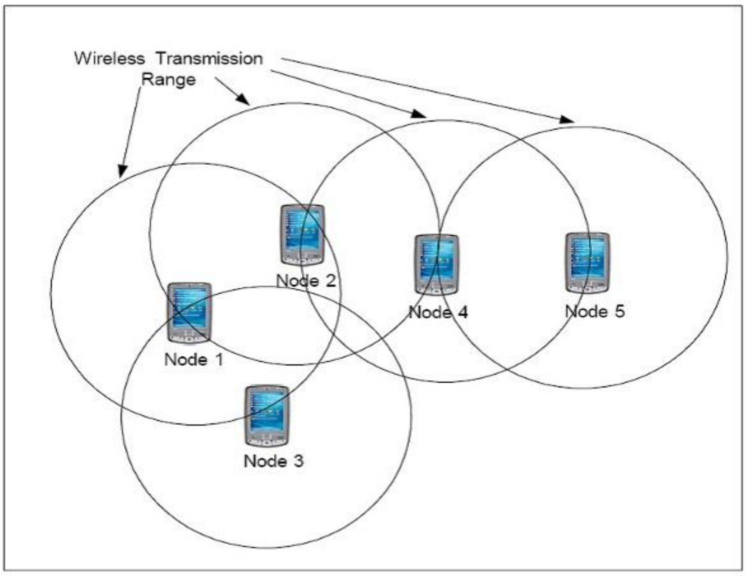


**Figure 1**: Example of MANET

The main objectives of this paper is to compare MANETs two reactive and proactive routing protocols by streaming real time traffic application such as video that has a strict delay requirement, and measuring the delay, throughput, retransmission attempts and the load of the network, The paper aims to present extensive simulation results and discuss different aspects of the network design, to find the best routing protocols behaviour for the performance.

The paper is organized as follows. In the next section information about routing protocols is presented. Section 3 discusses the performance parameters and software environment. The simulation results illustrating the performance of routing protocols are given in Section 4. Finally conclusions are presented in the final section.

## 2. MANET Routing Protocols

In MANET all the Routes between the nodes are enabled using multi-hop, which is limited by the wireless radio propagation range [8]. When the MANET's nodes are forwarding the packets between them, they are not aware of the network topology. Discovery of the network topology is done with the routing protocols, where the broadcast messages are received from the same network neighbouring nodes and comply with them. Routing protocols are categorized into three sets, reactive, proactive and hybrid which is a combination of both,

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depending on the routing information update time. In real-time applications such as video, end-to-end delay is an important factor. It is not only enough for the routing protocol to be reliable but also important to deliver data packets inside an acceptable delay borders. For exceeding the delay limits, the packets received are unusable and it cannot be used in decoding the video frames.

### *2.1 Reactive & Proactive Routing Protocols*

Reactive protocols are depending on data transmission on demand. Routes between the nodes are determined only when they are needed to forward the data packets. Reactive methods are also called on-demand routing protocols. They can significantly reduce routing overhead when the traffic is lightweight and the topology changes less dramatically, since they do not need to update route information periodically and do not need to find and maintain routes on which there is no traffic. Ad-hoc On-demand Distance Vector (AODV) is an example of Reactive Protocol [9].
On the other hand, proactive methods maintain routes to all the nodes in the network, including nodes to which no packets are sent. Such methods react to topology changes, even if there is no traffic is affected by the changes. They are also called table-driven routing protocols. Thus using a proactive protocol, a node is immediately able to route (or drop) a packet. Optimized Link State Routing Protocol (OLSR) is an example of Proactive Protocol [9].

#### *2.1.1 Ad-hoc on Demand Distance Vector (AODV)*

AODV is an on-demand approach [10] that sets up routes when the sender node needs to transmit data, where a sequence number is used to guarantee the route freshness. When AODV sender wants a route to the destination, it broadcasts a route request (RREQ) packet that includes the node's IP address, broadcast ID and the recent sequence number for the destination node. When the RREQ message is received by the destination node it unicasts a route reply (RREP) packet through the reverse route that sets up by the intermediate nodes in the route discovery process time. In link failure case, a message packet called route error (RERR) is transmitted back to the sender and receiver node. The advantage of using sequence numbers is to find and maintain new valid routes on demand.

#### *2.1.2 Optimized Link State Routing Algorithm (OLSR)*

OLSR protocol as a table-driven approach [11] uses three types of mechanisms for routing, a periodical HELLO message that is used for sensing neighbours, a flooding control packet that uses Multi Point Relay (MPR), and a path selection using algorithm of shortest path first. When using two hop neighbours, each network node selects a group of MPRs that have accessible two hop neighbours. After that nodes re-broadcast just the received messages from the nodes that have been selected as an MPR. The advantage of this mechanism is to reduce the broadcast control overhead. Therefore each node contains a part graph of the all network topology. The nodes selected as MPR send messages known as Topology Control (TC) that include the original node address and MPR selector group, to broadcast the nodes presence to the group of MPR selectors. When the routes are available to the sender node, the optimum route is selected using the algorithm of shortest path first.

## 3. Performance parameters and software environment

This paper is conducting a study by using OPNET discrete event simulator with the parameters set as in Table 1. Where a network is modelled with a size of 1,000×1,000 m2 that contains 60 nodes where one node is specified as server. The nodes are assumed to move with a speed of 5 m/s. the simulations are repeated ten times for each scenario in all categories for the routing protocols performance, with different constant seeds of the pseudo random number generator (PRNG) to get more accurate results. The connections between the nodes are established by the use of AODV and OLSR routing protocols for streaming video traffic.
Video streaming is real time data traffic that has small tolerant to delay. It is a telecommunication technology that combines video, audio or together between two or more nodes. In the simulations, the size of video frame is 352 x 240 pixels with 30 frames/s.

**Table 1**: Simulation Parameters

| Simulation Parameters | Value |
|---|---|
| Simulation time | 600 seconds |
| Routing protocols | AODV, OLSR |
| Topology size | 1,000 m × 1,000 m |
| Number of mobile nodes | 60 |
| Start and pause time | 0, 50 sec. |
| Speed | 5 m/s |
| Traffic type | video application |
| Packet size | 512 bytes |
| Address mode | IPv4 |
| Data rate | 5.5 Mbps |
| Mobility model | Random way point |
| Physical characteristics | Extended rate PHY 802.11g |
| Fragmentation threshold | None |
| Buffer Size | 256000 bits |

### *3.1 Performance Metrics*

The below parameters present the effectiveness of MANET protocols in finding the best route to the destination, such as the average throughput, load of the network, retransmission attempts and the end-to-end delay where they can be described as follows:

- End-to-end delay - The time (in seconds) required as the source/sender node to generate and transmit a data packet across the network, until it is received by the destination node. Real time traffic such as video application is sensitive to the data packet delays, and needs delay as low as possible.
- Retransmission Attempts (packets) - the total number of retransmission attempts (i.e., until the packet is successfully transmitted or is discarded due to reaching the limit of the short or long retry threshold) on this WLAN interface.
- Load - can be measured directly by calculating the amount of traffic the nodes generates and forwards.
- Throughput - The amount of the data packets (in seconds) that are transmitted over a communication channel to the final destination node successfully. In every network it is desirable to have a high throughput. In this paper throughput is defined as in equation (1):

$$\text{Throughput} = \frac{No.of\ DF\ x\ PS\ x\ 8\ bit}{TDS} \ldots (1)$$

Where, the no. of DS is the number of successfully delivered packets, PS is the packet size transferred from the source to the destination, and TDS is the total duration time for the simulation. In (1) the number of delivered packets does not only include the transmitted data but also includes routing protocol's Hello, control packets and topology information.

## 4. Simulation results and analysis

This section presents the experimental results along with the analysis of the simulations, where the most significant routing protocol metrics are the delay load, retransmission attempts and throughput of the network are measured. In this paper the performances of AODV, and OLSR routing protocols are investigated in terms of these metrics.

The result in Figure 2 shows the end-to-end average delay of the network for video traffic. Were the video traffic is higher for AODV routing protocol, because there is no appropriate flow control mechanism for such data. Each network node transmits real time data packets without knowing the acknowledgment of the buffer for the receiving node. Therefore the packets in the queue of the buffer wait for a long time [12]. AODV protocol cannot set up the node connection quickly and it creates larger delays in the network. Due to the reactive approach nature of the AODV protocol, it is highly possible that the data packets wait in the buffers, till it discovers a route on its way to the destination node. In time a RREQ packet is transmitted for the purpose of route discovery, the destination node replies back to all nodes for the same route request packet that it receives, thus, they need larger time to determine the lowest congested route. For the real-time traffic due to the larger size of video packets, it needs more time to be transmitted through the route, therefore the video traffic delay increases steadily with increasing congestion in the network, since nodes are only allowed to transmit when the available bandwidth is enough [13]. As network congestion increases, the video delay increases. This is due to the fact that video streams require a much larger bandwidth share, resulting more time needed to stream.

On the other hand, OLSR protocol set up quick connections between network nodes without creating major delays for real time traffic. This is because that the OLSR protocol do not need much time in a route discovery mechanism. The routes are always available in advance at the routing tables due to its proactive nature, which resulting lesser end-to-end packet delays. Mainly this advantage in OLSR is due to the utilization of the MPR nodes, to permit the control messages to be forwarded to other nodes, eventually this helps to decrease the delay of the network.

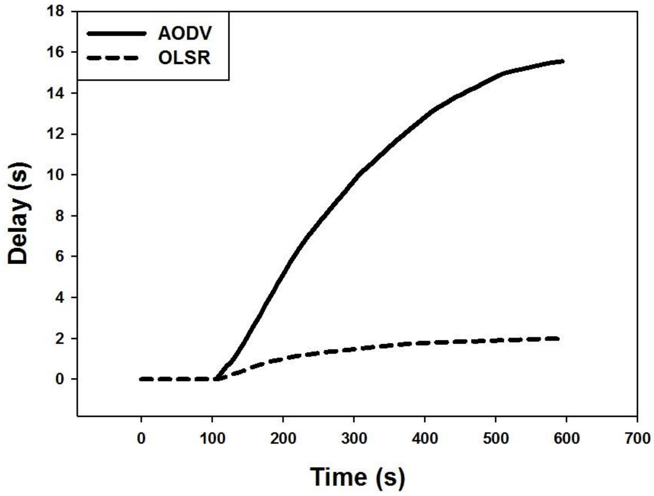


**Figure 2**: Average delay of (a) AODV, (b) OLSR protocols for video traffic

In figure 3 it can be observed that AODV has lower load than OLSR. Due to the reactive nature of AODV (on demand) routing protocol, it uses route discovery process to cope with routes on demand basis. It uses routing tables for maintaining route information. Therefore the load of the network consists of just the information of the transmitted data. It is observed that OLSR has the highest load; OLSR is a proactive routing protocol, which means that routes in the network are always ready whenever the application layer has traffic to transmit. Periodic routing updates keep fresh routes available for use. The absence of high latency induced by the route discovery processes in OLSR which explains its relatively low delay. Since throughput is the ratio of the total amount of data that a receiver receives from the sender to the time it takes for the receiver to get the last packet, a low delay in the network translates into higher load.

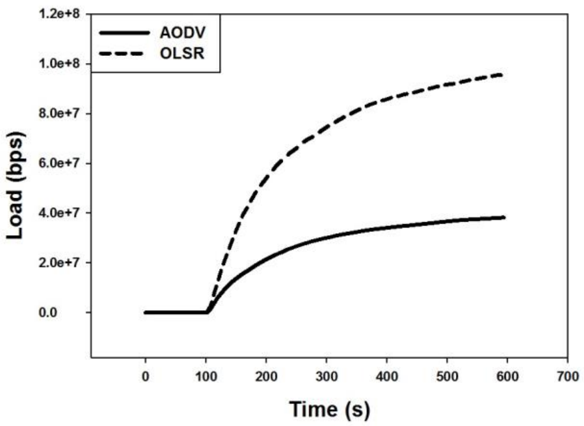


**Figure 3**: Load of (a) AODV, (b) OLSR protocols for video traffic

Fig 4 shows the result of Retransmission Attempt of AODV and OLSR for Video Conferencing application. Where the retransmission attempt for AODV increases due to the reactive approach, because each time the nodes moving it causes the network topology to be changed causing AODV to discovers a new route on its way to the destination node. In time a RREQ packet is transmitted for the purpose of route discovery, the destination node replies back to all nodes for the same route request packet that it receives, thus, they need larger time to determine the lowest congested route. Therefore more packets will be dropped in the process until it find new route to transmit. While OLSR may optimize the reactivity to topological changes by reducing the maximum time interval for periodic control message transmission. Furthermore, as OLSR continuously maintains routes to all destinations in the network, the protocol is beneficial for traffic patterns where a large subset of nodes are communicating with another large subset of nodes, and where the [source, destination] pairs are changing over time. The protocol is particularly suited for large and dense networks, as the optimization done using MPRs works well in this context.

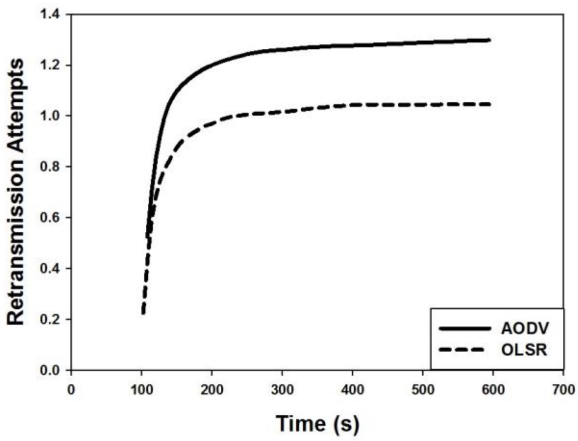


**Figure 4**: Retransmission Attempt of (a) AODV, (b) OLSR protocols for video traffic

The larger and more dense a network, the more optimization can be achieved as compared to the classic link state algorithm, therefore it has lower retransmission Attempts for data transmission.
In figure 5 the throughput rate is not controlled by congestion mechanism and the size of the packet are much larger; therefore the throughput is high [14]. However, it can be noticed that AODV protocol has lower throughput than OLSR protocol for video traffic. The amount of transmitted HELLO messages becomes larger, due to a neighbour lists included in the messages for the OLSR protocol. Therefore when increasing the HELLO interval, packets with large sample size (as video) achieve good delay. This can be explained by lower control overhead releases the bandwidth which is requested by real time traffic application [13]. Likewise, AODV protocol are also desirable when the network aims for achieving higher throughputs, the AODV protocol follows a routing mechanism known as hop by hop and removes the overhead of the sender/source routing within the network [7]. Related to above, the availability of multiple route information in the AODV assists in producing the higher amount of throughput in the network.

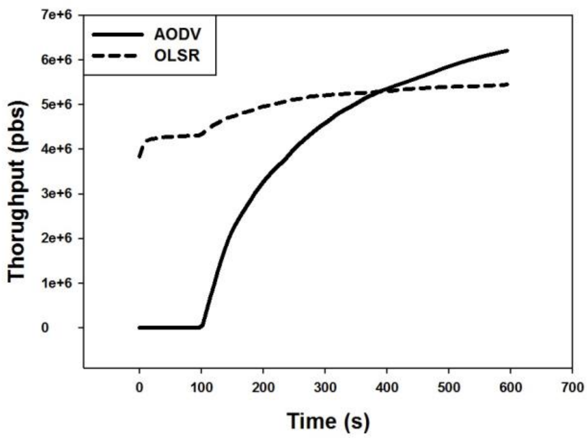


**Figure 5**: Throughput of (a) AODV, (b) OLSR protocols for video traffic

## 4. Conclusion

In this paper, the performances of two routing protocols, namely AODV and OLSR are analyzed and compared with transmitting video streaming application in terms of end-to-end average delay, load, retransmission attempts, and throughput. The lowest end-to-end average packet delay and retransmission attempts performance is achieved by the use of OLSR protocol. While the lowest load achieved by AODV, although AODV protocol gives high throughput for real time video traffic also, the delay produced by AODV is above the acceptable level for a real time data transmission. In summary, the proactive protocol OLSR is verified to be very efficient and effective routing protocol for MANETs for real time data.

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