American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-6, Issue-7, pp-329-346
www.ajer.org
Research Paper Open Access

Performance Evaluation of Enhanced MANETs Routing Protocols Under Video Traffics, for Different Mobility And Scalability Models Using OPNET

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ABSTRACT: *Mobile Ad hoc Networks (MANETs) is a type of wireless networks which consist of a collection of wireless mobile nodes forming a self-configured and self-organized network without any need for using existing infrastructure or centralized administration. Recently video streaming over MANETs technology received a huge attention from the researchers and industry sectors to make them more affordable better and valuable in a communication environment. Routing becomes a curtail core problem in networks for sending data from source node to destination node. There are several routing protocols algorithms are proposed recently to overcome most of the MANETs challenges such as high dynamic topology changes, limited resources(bandwidth ,memory ,CPU), link failure caused by node mobility, limited battery power on mobile nodes, energy consumption due to routing computation and etc. The main method for evaluating the performance of MANETs is simulation. This paper provides a comprehensive study and analysis of the performance evaluation of various MANETs routing protocols such as AODV, OLSR, DSR, TORA, and GRP, under video traffic over IEEE 802.11/g. Performance evaluation under various network scenarios for video streaming performed on the basis of the performance metrics (end to end delay, throughput, packet delivery ratio (PDR), routing overhead, packets dropped, retransmission attempt and network load). The objective of the performance evaluation is to show the effect of the mobility and scalability models on the overall performance of video transmission on the MANETs routing protocols and which protocols overcome the video streaming challenges. Different mobility and scalability scenarios are evaluated after simulation of network with the help of OPNET modeler simulator.*

Keywords: *MANETs, performance evaluation, Video Streaming, AODV, OLSR, TORA, DSR, GRP, OPNET 17.5*

Date of Submission: 14 -07 - 2017 Date of acceptance: 31-07-2017

I. INTRODUCTION

Since the IEEE 802.11 technology has emerged at the end of the 1990s, the term ‘ad-hoc’ evolves and become a new popular communication paradigm and meanwhile adopted by the IEEE 802.11 subcommittee. Ad hoc network denotes that nearby nodes can communicate directly by exploiting wireless networks technologies as Zigbee (IEEE 802.15.4), Bluetooth (IEEE 802.15.1), 802.11 (Wi-Fi) or 802.16 (WiMAX). The first commercial applications of the ad hoc technology allow network devices to establishment a single-hop ad hoc network, which are the simplest form of infrastructure-less networks or self-organizing networks, by interconnecting devices that are within the same radio transmission range. However, soon emerged the multi-hop network paradigm, often referred to as Mobile Ad-hoc Networks (MANETs), which was conceived to extend the possibility of information exchange with any wireless node, without the need to develop any network infrastructure. In MANETs, nearby users directly communicate with each other due to setting their wireless network interfaces of their devices in ad hoc mode that is not only to exchange their data but also to relay the traffic of other network nodes that cannot directly communicate[1]. For this reason, in MANETs, mobile wireless devices (Phones, Laptops, PDA’s, MP3, etc...) must cooperatively offer the functionality that is usually provided by the network infrastructure (e.g., routers, switches, servers ,fixed links, etc..)[2]. Figure (1) shows a communication model of a MANETs. In many situations such as disasters, catastrophes or emergencies in which there are no infrastructures exist or they cannot be deployed because of geographical or temporal reasons, this kind of network may be an ideal solution. Recently emerged many important applications of MANETs such as Tactical networks, Mobile conferencing, Education, Entertainment, Internet-based mobile ad hoc networks (iMANETs), Smart cities and IoT (Internet of Things)[3].

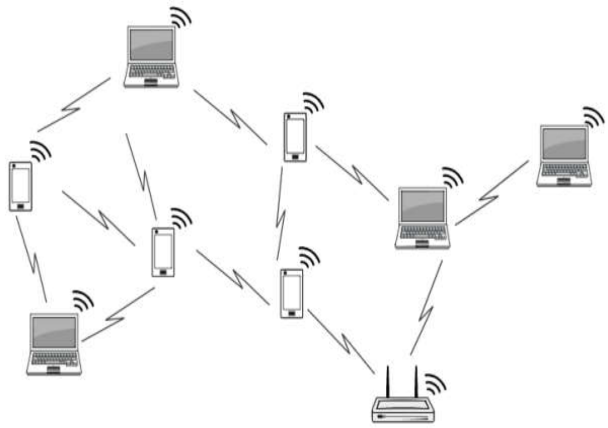

Fig (1) MANETs Communication Model[3]

The rest of this paper is organized as follows: In section (II) we highlighting on the classification of MANETs routing protocols. Section (III) provides the background and the motivations of video streaming over MANETs and their challenges .In section (IV) we follow the related works and the literature survey on the performance evaluation of MANETs routing protocols under the study. Section (V) provides the mathematical and theoretical background of MANETs mobility models. Section (VI) explains the performance evaluation mercies and the quantitative metrics. Section (VII) show experimental setup, result analysis and observations. Lastly section (VIII) concludes the paper and show the future works.

II. MANETS ROUTING PROTOCOL

MANETs are wireless networks with special characteristics due to the total absence of administrative and infrastructure support .Efficient routing protocols become a challenging task and a key component of MANETs. Routing protocols it can be classified according to the network structure into five categories[4]:

1- **Flat topology based (Uniform) routing protocols** ,and this category include subdivisions such as (reactive , proactive and hybrid routing protocols)

2- **Hierarchical Routing** which subdivided into Cluster- Based, Zone Based and Core Node.

3- **Geographic Position (*Information assisted)*** and this type of protocols include three subdivisions Greedy Forwarding (Single-path), Flooding (Multi-path) and Hierarchical.

4- **Power Aware Routing protocols** which are concern on how to minimize the power consumption and to maximize the network lifetime ,this category is subdivided into four classes :a)Load Distribution ,b)Power Management Transmission , c) Power Control and d) Sleep /Power-Down Mode.

5- **Multicast Routing Protocols** which concern on how to send the data packets to a group of users, this category includes two subdivisions: a) Tree- Based and b) Mesh-based routing protocols. In the following paragraphs we will explain the routing techniques of the routing protocols under study in this paper:

2.1 Ad hoc on Demand Distance Vector (AODV)

AODV is reactive routing protocol designed for MANETs networks. AODV is proposed by (Charles Perkins and Elizabeth Royer 1999; Charles Perkins and Elizabeth Royer 2002; Perkins et al.,2003; Chaudhry et al., 2005; Gorka Hernando et al 2009) is a unipath routing protocol has the capability to works into two modes of operations such as unicast and multicast routing. AODV is an on-demand routing protocol developed with the combination on the DSDV and DSR algorithm, it establishes routes between nodes only as needed by source nodes. AODV need not a routing table, it maintains their routes as long as they are needed by the sources. According to their structure, AODV forms trees edges which support it to connect multicast group of mobile nodes (MN). These trees are composed of the group of (MN) and the intermediate nodes required to connecting the (MN) as a group of members. AODV protocol has important advantages, a) uses sequence numbers to ensure the freshness of links ; b) guarantee loop-free, self-starting, and c) supported scalability to large numbers of mobile nodes. AODV uses flooding in order to discover the paths requested by a source node, for this purpose AODV uses route request message RREQ flooded through the entire network, where the RREQ contains the most recent sequence number for the destination node of which the source node is aware ,and from then any intermediate node that receives a RREQ must replies to it using a route reply RREP message only if it has a route to the desirable destination whose corresponding destination sequence number is greater than or equal to the one contained in the RREQ. In this case, it unicasts a RREP back to the source, otherwise RREQ is rebroadcasts. Through the RREQ's, nodes will keep track of source IP address and broadcast ID. If the nodes received a RREQ which they have already processed, in this case they discard the RREQ and do not forward it. As the RREP propagates back to the source nodes set up forward pointers to the destination. The source node once receives the RREP; it may start to forward data packets to the destination. If the source meanwhile receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop count, it may update its routing information for that destination and begin using the better route. If the route path is remains active the node will continue to maintain it. A route is considered active as long as there are data packets periodically traveling from the source to the destination along that path. At the source node stops sending data packets, the links will time out and from then will be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the now unreachable destination(s)[4, 5].

2.2 Optimized Link State Routing(OLSR)

OLSR (Jacquet et al 1998) is a proactive routing protocol (table-driven) developed for MANETs networks, in which all routes have route table for maintaining information to every node in the network. The routes are immediately available whenever needed due to the route tables. OLSR is an optimized version of pure link state protocol. OLSR uses the concept of Multipoint Relays (MPR) to reduce the control traffic overhead in the network. The set of MPRs is selected such that it covers all entire nodes that are two hops away. MPR is a node's one-hop neighbor which has been chosen to forward packets. To update the topology changes, each node in the entire network must selects a set of neighboring nodes to retransmit its packets. This set of nodes is called the MPRs of that node. Any node which is not in the set of MPRs will remain dummy that can read and process each packet but do not retransmit. To select the MPRs each node periodically broadcasts a list of its one hop neighbors using hello messages OLSR uses two types of control messages: HELLO and Topology Control (TC). HELLO message are used to find the link state and neighboring nodes (neighbor sensing and MPR selection). TC message contains the list of the sender's MPR selector .TC message is used to for broadcasting information for own advertized neighbors which includes at least the MPR selector list. Only MPR nodes are responsible for forwarding TC messages. Upon receiving TC messages from all of the MPR nodes, each node can learn the partial network topology and can build. In case there are multiple choices the minimum set is selected as an MPR set. The parameters used by OLSR to control the protocol overheads are Hello-interval parameter, TC-interval parameter, MPR coverage parameter and TC-redundancy parameter. So, contrary to classic link state algorithm, instead of all links, only small subsets of links are declared [6-8].

2.3 Dynamic Source Routing (DSR)

DSR is a reactive routing protocol is specially designed for the mobile wireless networks.DSR uses the concept of source routing, in source routing the sender node knows complete hop-by-hop route to the destination. Determining source routes requires accumulating the address of each device between the source and destination during route discovery .In DSR all the routes are maintained and stored in the route cache with route entries which are continuously updated. To perform source routing, the routed packets contain the address of each device the packet will traverse. This may result in high routing overhead for long paths or large addresses, like IPv6. DSR optionally defines a flow ID option that allows packets to be forwarded on a hop-by-hop basis. The main features and advantage of DRS is that:

a) Not requires periodic routing packets
b) Has also the capability to handle unidirectional links
c) Has two mechanisms work together for the packet transmission, i.e., Route Discovery and Route Maintenance
d) The sender of the packets selects and controls the route used for its own packets
e) Also supports features such as load balancing
f) Guaranteed to be free of loops as the sender can avoid duplicate hops in the selected routes.
g) Route Discovery mechanism is used when a source wants to send a packet to the destination but does not have a route, in this case route discovery finds a route for the packet transmission.
h) Due to the high mobility in MANET, the positions of the mobile nodes(MN) changes frequently that results in route loss and breakage, in that case, Route Maintenance is used, it finds other alternative routes that leads the packet to the destination.

i) Route Reply would be generated only if the message has reached the intended destination node.
j) To return the Route Reply, the destination node must have a route to the source node
k) In case of fatal transmission, the Route Maintenance Phase is initiated whereby the Route Error packets are generated at a node, and the erroneous hop will be removed from the node's route cache; all routes containing the hop are truncated at that point. Again, the Route Discovery Phase is initiated to determine the most viable route [6, 9, 10].

2.4 Temporally Ordered Routing Algorithm (TORA)

TORA (Park and Corson 1997) is an adaptive and a source-initiated on demand routing protocol proposed for highly dynamic mobile networking environment and multi-hop wireless networks, which uses a link reversal algorithm and provides loop-free multipath routes to a destination node. TORA establish the routes quickly and minimize the communication overhead by the aid of the location control messages which sent to a very small set of nodes near the occurrence of a topological change. Instead of using the concept of shortest path for computing routes which consume huge amount of bandwidth TORA algorithm maintains the "direction of the next destination" to forward the packets. The protocol performs three basic functions: (1) route creation, (2) route maintenance, and (3) route erasure. TORA uses a height metric during the phases of route creation and maintenance, the mobile nodes, which establishes a direct acyclic graph (DAG), rooted at the destination. Therefore, links are assigned a direction (upstream or downstream) based on the relative height metric of neighboring nodes. TORA has a significant advantages such as 1) Multipath routing, 2) Loop-free routes, 3) Distributed execution, 4) Localization of algorithmic reaction to topological changes,5) Route establishment and maintenance. It is necessary for each node in TORA, to maintain the adjacent nodes information so that whenever a packet is to be transferred, the source just searches in the adjacent nodes information table for a route which leads the packet to the destination. In the manner a route is established from source to the destination to transfer a packet in TORA. TORA supports both reactive and proactive routing [4, 6, 9].

2.5 Geographic Routing Protocol (GRP)

GRP is characterized as a position based protocol, and also classified as proactive routing protocol. In GRP each mobile nodes assisted with Global Positioning System (GPS) which is used to determine and marked the location of node and flooding will be optimized by quadrants. When a node moves and crosses neighborhood then the flooding position is updated. A 'HELLO' protocol will be exchanged between nodes to identify their neighbors and their positions. At the same time, by means of route locking a node can return its packet to the last node when it cannot keep on sending the packet to the next node. GRP divides a network into many quadrants to reduce route flooding. The entire world is divided into quadrants from Lat, Long (-90, -180) to Lat, Long (+90, + 180). Every node knows the initial position of every other accessible node once initial 'flooding' is completed in the network. When the node moves a distance longer than a user has specified or when the node crosses a quadrant the routing flooding will be occurred. Apart from actual geographic coordinates received by the GPS the other approach followed is reference points in some fixed coordinate system [6, 11].

III. VIDEO STREAMING OVER MANETS

Video streaming over MANETs becomes an active research area now a day. The most challenging tasks that affected the video streaming is caused by the properties of MANETs such as high mobility, frequent dynamic change in topology, lack of fixed infrastructure, limited bandwidth , resource constraints , interference, shadowing ,multi-path fading , Multi-hop induced challenges, collision and etc.. [12].Multimedia applications over MANETs, and more specifically video streaming, become demanded services nowadays since the mobile devices are inexpensive and capable to share , transmit and maintain the video streaming. These kinds of applications are sensitive to delay ,jitter, congestion , packets drop and has a serious requirements that must be accomplished to achieve a certain level of quality at the end user side[13]. So video streaming is the very challenging issue in MANETs. Every node in MANET is free to move dynamically in any path and a new node can join the network and leave at any time, and will thus change repeatedly its links to other devices. Node is free to move separately into the network. Recently there is growing a great interest in video communication over MANETs due to its a lot applications in the military areas, emergency situation, education ,video conferencing , disaster relief applications and other applications taking advantage of the advances in wireless communication and video coding technologies. To, providing reliable video communications over MANETs has so many challenges. The challenges begin from the dynamic topology change in the network and the weakness of compressed video to packet losses. In MANETs the transmission range is limited, this cause a multiple hops are required for a node to transmit its information to other node involved in the network for the purpose of energy saving. So, in MANETs, routing protocols are needed to set up communication paths between nodes and overcome most of the problems and improve the performance in terms of throughput , end-to-end delay , jitter and packet drops[14].

IV. RELATED WORKS

Many works have been done in the area of routing protocols in MANETs. Different protocols had been evaluated using a different kind of simulators such as NS-2, OPNET, OMNet++ and other simulation tools. The performance evaluation performed to investigate the feasibility, reliability and the quality of service (QoS). The following paragraph showed the state of art and most important studies done recently:

Hazzaa et al.(2017) [15] evaluated the performance of AODV for multimedia traffics (FTP, Voice, Video Conference) in terms of delay , throughput , network load , retransmission attempts as QoS parameters for MANET network , and they used route discovery time , routing traffic received, routing traffic sent as QoS parameters for the AODV protocol. Their simulation works implemented in the environment of OPNET modular and show that there are significant differences between the three types of multimedia traffics .They conclude that the impact of traffic type on MANET depend on the QoS requirements for each type of traffics.

Kushwaha et al. (2016) [16] compared between three MNETs routing protocols DSDV, DSR and AODV for CBR traffic using OPNET simulator .They carried out from the simulation that in all three protocols, DSDV is showing better performance than AODV and DSR, however, in exponential traffic AODV has better performance than DSDV. In addition, after analyzing all three protocols it can be observed that there are optimal values of packet size and offered load for which value of throughput and PDR values are optimal, after that their values are decreased or become constant.

Ramakant et al.(2015) in their research paper [17] performed a simulation of three MANETs routing protocols AODV, DSR and DSDV on the basis of three performance parameters packet delivery ratio (PDR),end-to-end delay and throughput via using NS-2 simulator. Their observations from the simulation works show that DSR is better for small number of nodes but for large number of nodes, DSDV is superior. Also their study show that AODV is better throughput compared to other protocols DSR and DSDV. The main disadvantages of their works they don't mentioned the simulation duration time and data rate among coverage WLAN protocol IEEE802.11. However in that study the authors can use any hybrid routing protocol such as ZRP or DDR to comparing it with reactive and proactive routing protocols used in that study.

PN Sadigale et al. (2015) in their article [18] were studied and analysis the performance of two routing protocols PUMA and OLSR on the basis of various performance metrics like throughput, PDR, end to end delay and energy consumption for multicasting multimedia data content .They were found in their study that PUMA performs better in networks considering terms of packet delivery ratio, throughput and energy consumption parameters, OLSR gives better results for end to end delay and in overall performance PUMA is better used for multimedia streaming. One disadvantage of their works is the shortest simulation time. However OLSR can perform better after a long time.

Alqaysi et al. (2015) in their paper [19] analyzed and compared two MAN ETs routing protocols AODV and OLSR with transmitting video streaming application in terms of end-to-end average delay, load, retransmission attempts, and throughput using OPNET .They found that the proactive protocol OLSR is verified to be very efficient and effective routing protocol for MANETs for real-time data transmission such as video streaming or video conferencing. The main disadvantages of their simulation work are the fixed number of mobile nodes (60) which can't represent the real live scenario in this case.

Wardaku et al. (2014) in their research paper [20] ,they analyzed the performance of multimedia traffic in MANETs with various mobile subscriber speed by using CBR and VOIP connection using Qualnet 6.1 simulator in terms of throughput, end to end delay, and total data received. They concluded that the overall performance of routing protocol for CBR and VOIP at 0 to 10 mbps is better than CBR and VOIP at 0 to 20 mbps. The disadvantage of their study is they don't show at what data rate in the PHY/IEEE 802.11/n protocol they simulate the multimedia traffics.

Gagangeet. et al. (2013) in [6] demonstrated a comprehensive investigation of the MANETs routing protocols AODV, DSR, TORA, OLSR and GRP using OPNET modular simulator. The performance evaluation done based on the quantitative metrics throughput, delay, load and data dropped. Their simulation shown that AODV is best suited protocol for video conferencing for lower number of nodes and OLSR is can be used as a replacement as its performance degrades for high number of nodes, and OLSR suits better for high number of nodes.

J. K. Joshi et al. in (2013) [21] analyzed ZRP, AODV, AOMDV and DDIFF MANETs routing protocols on the basis of average throughput, average end-to-end delay and packet delivery fraction to propose the most suitable protocol that will improve the quality of video streaming over MANETs .Their simulation works performed in NS-2 simulator and concluded that the overall performance of DDIFF and ZRP is better in term of packet delivery fraction as well as average end-to-end delay among other used protocols. While, in term of average

throughput AODV and DDIFF has produced better results with compare to others. They found that DDIFF is comparatively better to providing quality in video streaming over different used routing protocols on MANETs.
Salman Naseer et al . (2012) in [22] were performed a performance comparison of MANETs routing protocols AODV, OLSR and TORA on real-time video traffic using OPNET simulation. In their study, they conclude that OLSR outperforms AODV and TORA routing protocols in terms of higher network load and minimal delay. End-to-end delay of AODV was 35% greater in comparison with protocol OLSR. The main disadvantage of their study is the form of network structure in the simulation model. They used server in the middle of the network and all other nodes where in the coverage area of the server. That structure is not really representing the idea of MANETs network. However the authors in their study they used an important metrics to evaluate the routing performance, but they don't mentioned the simulation time and mobility model used.
Muhammad Shaffatul Islam et al.(2012) in [11] another study on comparing MANETs routing protocols on video streaming was done .The authors they concluded that it is possible to launch video streaming with acceptable quality and throughput over MANETs. The simulation results in their study show that the performances of a routing protocol vary depending on the network scenario as well as types of video traffic used. They conclude that the overall performance of TORA is the best for all QoS parameters; also the performance of AODV is poor compared to OLSR and GRP but better than DSR. However their study doesn't mentioned a concrete conclusion for which protocol performed best among the set of the protocols under the study.
George Adam et al. (2011) in[23] evaluated and compared the performance of the most well-known routing protocols AODV, DSR and OLSR in terms of the performance metrics packet delivery ratio, end-to-end delay, packet delay variation (jitter) and the routing overhead for multimedia data transmission under NS-2 simulator environment. In their study the simulation show that DSR outperformed both AODV and OLSR, in terms of end-to-end delay and packet delay variation and seemed to be the most efficient in the simulated environment. The authors show that the low jitter delay and the adequate packet delivery ratio values suggested DSR as a serious proposal for multimedia data transmission in wireless ad hoc networks. However in that study the researchers used most of the IETF quantitative metrics, but their study not mentioned the data rate used among coverage WLAN protocol IEEE802.11/g.
S. Baraković et al. (2010) in [24], they compared the performance of three MANETs routing protocols AODV, DSDV and OLSR on constant bit rate (CBR) traffic using NS-2 simulator in term of packet delivery ratio(PDR) ,end-to-end delay and normalized routing load. Their simulation results show that all three protocols react in a similar way in terms of end-to-end delay in low load scenarios, while with increasing load the protocol DSDV outperforms AODV and DSR routing protocols. The authors they don't mention at which data rate on the WLAN IEEE 802.11 protocol performed the simulation. However their study is limited because they used a constant number of mobile nodes which can not reflect the scalability effect

Gupta et al. (2010) in their paper [25] evaluated the performance of three MANETs routing protocols AODV, DSR and TORA on the basis of tow performance metrics: average end-to-end delay and packet delivery ratio. They conclude that AODV outperformed DSR and TORA. Founded that AODV has minimum overhead that makes it suitable for low bandwidth and low power network and TORA is suitable for operation in large mobile networks having dense population of nodes.
Jamali et al.(2009) demonstrated in [26] a comparative analysis of the throughput percentages through using OPNET modular to set of protocols (AODV, DSR, OLSR, TORA, and GRP) for multimedia streaming under different environments and nodes density. The objective of their study is to observe the QoS performance of those protocols. The simulation show that the protocols OLSR and GRP perform better than the other routing protocols in all simulated cases particularly in the case of network with great size and the great number of nodes. However in their study they used a single performance metric (throughput) which is not quite enough to measure the performance of MANETs routing protocols under multimedia applications, there are important metrics such as end-to-end delay, routing overhead, delay variation, packet delivery ratio and etc… were not used. The main disadvantages of that study is that using a client/server architecture through choosing one node as (server) to streams videos to others nodes , which is not required in MANETs since the processing is decentralized and distributed and all the nodes in the network structure are acts as sender/receiver in the same time.
However from the previous works we can observe that there is a great attention with video transmission via MANETs in the last decades. Most of the latest studies used OPNET modular which is the popular and optimized simulator. The performance metrics that the authors were used in their studies is sufficient in most cases but in some case the authors they used a little metrics. Two MANETs routing protocols (AODV and OLSR) only has a better performance among different routing protocols such as DSR, DSDV, TORA, FSR and GRP. Table (1) shows summery of the related works.

Table (1) : Summary of Related Works

Refer ence	Publishing Date	Routing Protocols	Mobility Model/ Node Speed	Type of Application	No. of Nodes	Simulation Area in (m^2)	Coverage WLAN Protocol	Data Rate Mb/s	Simul ation time (sec)	Performance metrics	Simulator
[15]	2017	AODV	Random Waypoint	FTP, Voice, Video Conference	50	1000*1000	802.11	11	3600	Retransmission attempts, route discovery time , routing traffic received, routing traffic sent	OPNET
[16]	2016	DSDV, DSR, AODV	Random Waypoint	CBR/UDP Video traffic	40	800x800	802.11b	NM	900	Throughput, Packet Delivery Ratio (PDR	OPNET
[17]	2015	AODV,D SR, DSDV	Random Waypoint 5m/s,10m/s, 20m/s	CBR Video Transmissi on	100 to 500	200, 400, 600, 800, 1000	IEEE 802.11	NM	NM	Packet Delivery Ratio (PDR), End-to-End delay and Throughput	NS-2
[18]	2015	OLSR PUMA	Random Waypoint Model 0-100 m/s	Multimedia Data Content (MPEG4)	5,10,15 ,20,25	1000×1000	MAC 802.11	11	15	Throughput, PDR, End to End delay and Energy consumption	NS-2
[19]	2015	AODV, OLSR	Random Waypoint Model 5 m/s	video application	60	1000×1000	PHY 802.11g	5.5	600	End-to-end delay, Retransmission Attempts , Load and Throughput	OPNET
[20]	2014	AODV, OLSRv2, FSR	Random way point 0 to 20 m/s	CBR and VOIP	50 and 100	1500x1500	802.11n	NM	500	throughput, end to end delay, and total data received	Qualnet 6.1
[21]	2013	ZRP, AODV, AOMDV, And DDIFF	Random way point	Video Streaming	25 , 75	1000x750	IEEE 802.11	NM	100	Average throughput, average end-to-end delay, PDF	NS-2.35
[6]	2013	AODV, DSR, TORA, OLSR and GRP	Random Waypoint	Video Conferenci ng (High resolution video) and e-mail (High load)	30, 60 and 90	1000 x 1000	IEEE 802.11	11	600	Throughput, Delay, Load and Data Dropped	OPNET
[22]	2012	AODV,O LSR and TORA	NM	Video Conferenci ng	24 clients and one server	500x500	IEEE 802.11	11	NM	Throughput End-to-end delay Network Load	OPNET
[11]	2012	AODV,D SR, TORA,O LSR,GRP	5 m/s and 10m/s	Video Streaming	25,85	800x800 1600x1600	IEEE 802.11a	54	10	Throughput End-to-end Packet delay variation	OPNET
[23]	2011	AODV, DSR and OLSR	Manhattan city model 0 – 20 m/sec	video transmissions	50	500 x 500	IEEE 802.11g	NM	900	Packet delivery ratio, end-to-end delay, packet delay variation (jitter) and routing overhead	NS-2
[24]	2010	AODV, DSDV and DSR	Random Waypoint 10 m/s , 20m/s .50m/s	CBR traffic with 20 kbps	50	500x500	IEEE 802.11	NM	100	Packet delivery ratio ,end-to-end delay , Normalized routing load	NS-2
[25]	2010	AODV, DSR and TORA	Random waypoint	CBR (UDP)	50	500 x 500	IEEE 802.11	NM	200	End-to-End delay and packet delivery ratio	NS-2
[26]	2009	AODV, DSR, OLSR, TORA and GRP.	NM	video streaming	25 and 81	800x800 for 25 I600xl 600 for 81 nodes	IEEE 802.1lg	11 .54	NM	Throughput	OPNET

V. MANETS MOBILITY MODELS

The mobility of nodes is the key attribute of MANETs , and the performance of MANETs needs to be studied in presence of mobility[27]. In MANETs the nodes are mobile and thus keep moving with time. The position and the direction of nodes can changes with time as it moves with random velocity and acceleration. There are several mobility models proposed which simulate the movement of the nodes in MANETs networks. The effect of routing protocols with the mobility model in combination is examined in this study. The mobility models used in this study are discussed in the next context.

5.1 -Random Waypoint Model

The Random Waypoint Model (RWPM) proposed by (Johnson and Maltz 1996) . Soon, became a one of the most popular mobility models or a 'benchmark' mobility model to evaluate the performance of MANETs routing protocols under their mobility pattern, because of its simplicity, availability and straightforward stochastic model. Most of the simulation tools supported by (RWPM) ,here in this research paper we model it by the OPNET modular .To generate the node trace model of (RWPM) using OPNET can be set and implemented as follows :

1) When the simulation starts, each mobile node randomly choosing one location in the finite continuous plane (simulation area) as the destination coordinates.
2) Then the mobile node starts to moves from their current position towards this destination with constant velocity selected uniformly and randomly from $[V_{min}, V_{max}]$, where V_{min} denote the minimum speed ($V_{min} > 0$) and the Parameter V_{max} denote the maximum allowed velocity of every mobile node.
3) When the simulation starts, each mobile node randomly choosing one location in the finite continuous plane (simulation area) as the destination coordinates.
4) Then the mobile node starts to moves from their current position towards this destination with constant velocity selected uniformly and randomly from $[V_{min}, V_{max}]$, where V_{min} denote the minimum speed ($V_{min} > 0$) and the parameter V_{max} denote the maximum allowed velocity of every mobile node.

5.1.1 Characteristics of (RWP)

1- V_{max} and T_{pause} are the two key parameters that determine the mobility behavior of nodes.

2- $\text{Topology of MANETs stable} = \text{if} \begin{cases} V_{max} & small \\ T_{pause} & long \end{cases}$

3- $\text{Topology of MANETs (HD)} = \text{if} \begin{cases} V_{max} & Large \\ T_{pause} & small \end{cases}$

Where (HD=Highly Dynamic)

5.1.2 Limitations of RWP Mobility Model

Although the RWP mobility model has been widely used in MANET simulations, it is insufficient to capture the following mobility characteristics:

• **Temporal Dependency of Velocity**: the velocity of mobile node will change continuously due to physical constraints of the mobile, which cause that velocities at two different time slots are independent.
• **Spatial Dependency of Velocity**: the movement pattern of a mobile node in RWP may be influenced by and correlated with nodes in its neighborhood, but each mobile node of this model moves independently of others.
• **Geographic Restrictions of Movement**: the movement of a mobile node in the RWP mobility model may be restricted along the street or a freeway while a geographic map may define these boundaries.

5.2 Random Walk Model

The Random Walk (RW) model was proposed originally to mimic the unpredictable movement of particles in physics. It is also referred to as the Brownian motion. In MANETs mobile nodes are move in an unexpected way, (RW) mobility model is proposed to simulate their mobility behavior. The (RW) model has similarities with the (RWP) model because the node movements have strongly randomness in both models. We can consider the (RW) model as the specific (RWP) model with zero pause time. However, in the Random Walk mobility model, the mobile node (MN) may change their direction after traveling a specified distance instead of a specified time. Speed v(t) can be chosen from the predefined ranges $[V_{min}, V_{max}]$ by each node following a uniform distribution or Gaussian distribution at every new interval t, here V_{min} and V_{max} are the minimum speed and the maximum speed, respectively. The implementation of (RW) mobility models in MANETs performed as follows:

1- Each node selects its new direction $\theta(t)$ randomly and uniformly from the ranges $[0, 2\pi]$.
2- During time interval t node moves with the velocity vector $[v(t) \cos \theta, v(t) \sin \theta]$.
3- Movement occurs for each node either in constant time interval t or in a constant distance traveled.

4- Movements completed within a certain distance at the end of which a new direction and velocity are calculated.
5- Each mobile node bounces off the simulation boundary with an angle of $\theta(t)$ or $[\pi \quad \theta(t)]$ determined by the incoming direction when the node reaches the boundary.
6- (RW) model is memory-less because the future movement is completely independent of the past movement, that mean it does not retain knowledge related to its past speed and direction, and its future velocity is independent of the current velocity, and it then continues to move along this new path.
7- Mobility of a node is analyzed by fixing the reference frame of one with respect to another as the link or connectivity between the two mobile nodes is dependent on the relative movements of the nodes, and for every movement of a node, the reference frame of the other node is translated an equal distance in the opposite direction.

VI. PERFORMANCE EVALUATION METRCIES

1- Average end-to-end delay

End-to-end delay or one-way delay (OWD) of a network is defined as the time taken by the network to transmit a packet with a unique id i from source to destination (successful packet transmission). E2E delay ($\mathbf{D_{E2E}}$) includes all possible delays in the network such as (route discovery latency, queuing delay at the interface queue ,retransmission delay by the MAC , processing delay , propagation delay ,MAC control overhead and intermediate nodes delay) as shown in Eq.(1). To calculate the average end-to-end delay ($\boldsymbol{AV_{E2E}}$) we add all possible delays for each successful data packet delivery i and divided that accumulative sum by the number of successfully received data packets (N) as in Eq.(2). A routing protocol with minimum delay represents the reliability of a network. This metric is important in delay sensitive applications such as video traffic and voice transmission.

$$\mathbf{D_{E2E_i}} = \left[\mathbf{D_{RDD_i}} + \mathbf{D_{queue_i}} + \mathbf{D_{RTD_i}} + \mathbf{D_{proc_i}} + \mathbf{D_{prop_i}} + \mathbf{D_{trans_i}}\right] = (\boldsymbol{R_i} - \boldsymbol{S_i}) \qquad (1)$$

$$\boldsymbol{AV_{E2E}} = \frac{1}{N}\sum_{i=1}^{m}(\boldsymbol{R_i} \quad \boldsymbol{S_i}) \qquad (2)$$

Where:

$\mathbf{D_{RDD}}$: Route Discovery Delay
$\mathbf{D_{queue}}$: **Queuing delay**(Queuing delay is the time a job waits in a queue until it can be executed)
$\mathbf{D_{RTD}}$: Retransmission delays at the MAC layer
$\mathbf{D_{proc}}$: **Processing delay**(The time it takes to process a packet in a network node (router, switch, hub, etc.), which is dependent on the speed of the device and congestion in the network. Contrast with propagation delay.)
$\mathbf{D_{prop}}$: Propagation delay (Propagation delay refers to the time it takes for a bit, once on the link, to reach the destination)
$\mathbf{D_{trans}}$: **Transmission delay**(Transmission delay refers to the time it takes to push the bits of data onto the link)
N : The number of successfully received packets
$\boldsymbol{R_i}$: Is time at which a packet with unique id *i* is received
$\boldsymbol{S_i}$: Is time at which a packet with unique id *i* is sent

2- Throughput

Is defined as the total amount of data received by the receiver node from the sender node divided by the time it takes for the receiver to get the last packet as shown in Eq.(3). The throughput is measured in (bit/s or bps) or packet per time slot. In MANETs throughput is considered as an important parameter to measure the robustness of the network. Some factors can affect the throughput in MANETs like unreliable communication, changes in topology, limited bandwidth and constrained energy available in mobile nodes. A network with high throughput is desirable.

$$\text{Throughput} = \frac{\text{No of Bytes Received} \;\; 8}{\text{Simulation Time} \;\; 1000}\text{kbps} \qquad (3)$$

3- Packet delivery ratio (PDR)

PDR is an important metric in networks, is defined as the ratio between all the received packets at the destinations and the number of data packets sent by all the sources Eq. (4).For multimedia application we uses UDP as the layer 4 protocol, to a void congestion may using TCP because video traffic is sensitive for high packet loss which can reduce the quality of video at the end user.

$$\textbf{PDR} = \frac{\textbf{Data Packets Received at destinations}}{\textbf{Data packets sent by the sources}} \quad \textbf{100} \qquad (4)$$

4- Routing overhead

Routing overhead in Eq.(5) is defined as the number of all routing control packets (traffic sent (pkts/s)) that every node sends in order to get the knowledge of the network and establish paths. This metric used to measure the efficiency of the routing protocol. Proactive protocols because they are use routing tables they are expected to transmit a higher number of control packets than reactive ones. If the number of routing controls packets is bigger lead to the less efficient routing protocol.

$$\textbf{Routing Overhead} = \frac{\text{Total Routing Packets Sent}}{\text{Total Data Packets Received}} \qquad (5)$$

5- Total Packet Drops

When no route is found to the destination or the next hop reachability confirmation is not received after the maximum number of attempts, the node drops the packets queued to the destination. This statistic as stated in Eq. (6) is important for video streaming applications because they are sensitive for packets dropped or loss which can affect quality of video. This metric represents the total number of application packets discarded by all nodes in the entire network.

$$\text{PD} = \text{Total Packets Sent} - \text{Total Packets Received} \qquad (6)$$

6- Retransmission Attempt (packets)

Represents the total number of retransmission attempts by all WLAN MACs in the network until either packet is successfully transmitted or it is discarded as a result of reaching short or long retry limit. For IEEE802.11e-capable MACs, the retransmission attempt counts recorded under this statistic also include retry count increments due to internal collisions. Additionally, retransmission attempts occurred when delivery of packet is dropped or lost without reaching the destination nodes in network. The increase of retransmission attempts affect directly proportional of the network due to load that is increased on entire network.

7- Network Load

Network load represents the total load in bit/sec submitted to wireless LAN layers by all higher layers in all WLAN nodes of the network. When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic so it is called the network load. The efficient network can easily cope with large traffic coming in. High network load affects the MANET routing packets and slow down the delivery of packets for reaching to the channel, and it results in increasing the collisions of these control packets. Thus, routing packets may be slow to stabilize[28].

VII. SIMULATION SETUP AND RESULTS DISCUSSION

Recently there are several simulators available and used to evaluate the performance of MANETs routing protocols like OMNET++, QualNet, OPNET and NS-2. Here, OPNET 17.5 modular is used for a comparative performance analysis of proactive routing protocols (OLSR), reactive routing protocols (AODV, TORA and DSR) and geographical routing protocols (GRP).The OPNET simulation environment described by the following tables (2-6).

Table (2): Network Simulation Parameters

Parameter	Value
WLAN Network simulation Parameters	
Network Area(Size) (m^2)	100x100 1000x1000
Wireless Nodes	5 ,10,15,20 and 30,40,50,60,70
Node Speed (m/s)	[0 , 10] and [10,25]
MAC Layer Protocol	PHY IEEE 802.11g
Data Rate (Mbps)	24 ,11
Channel Settings	Auto Assigned
Buffer Size (bits)	256000=32 KB
Transmit Power (Watt)	0.005
Link Delay Threshold (sec)	0.1
MANETs routing Protocols	AODV OLSR, DSR ,TORA and GRP
Simulation Time(sec)	400
Addressing Mode	IPv4
Simulator	OPNET 17.5

Table (3) Mobility Model Parameters

Parameter	Value
Random Waypoint Parameters	
x_max (meters)	500
y_max (meters)	500
Speed (meters/seconds)	uniform_int (0, 10) for low mobility and, uniform(10,25) for high mobility
Pause Time (seconds)	constant (100) for low mobility and constant(0) for high mobility
Start Time (seconds)	constant (10)
Stop Time(seconds)	End of Simulation
Animation Update Frequency (seconds)	1.0
Record Trajectory	Enabled

Table (4) MANETs Traffic generation parameters

Parameter	Value
MANET Traffic Generation Parameters	
Start Time (seconds)	100
Packet Inter-arrival Time (sec)	Exponential 1
Packet Size (bits)	Exponential 1024
Destination IP Address	Random
Stop Time (sec)	End of Simulation

Table (5) Routing protocols simulation parameters

Parameter	Value
AODV Protocol Parameter	
Active Route Timeout (sec)	3
Hello Interval	uniform (1, 1.1)
Allowed Hello Loss(sec)	2
Net Diameter	35
Node Traversal Time(sec)	0.04
Route Request Retries	5
Route Request Rate Limit (pkts/sec)	10
Route Error Rate Limit (pkts/sec)	10
Timeout Buffer(sec)	2
OLSR Protocol Parameter	
Willingness	Willingness Default
Hello Interval (seconds)	2.0
TC Interval (seconds)	5.0
Neighbor Hold Time (seconds)	6.0
Topology Hold Time (seconds)	15.0
Duplicate Message Hold Time (seconds)	30.0
TORA Protocol Parameter	
OPT Transmit Interval (seconds)	300
IP Packet Discard Timeout (seconds)	10
Max Retries (number of attempts)	3
Beacon Period (seconds)	20
Max Beacon Timer (seconds)	60
DSR Protocol Parameter	
Route Expiry Timer (seconds)	300
Expiry Timer (seconds)	30
Request Table Size (nodes)	64
Maximum Request Period (seconds)	10
Initial Request Period (seconds)	0.5
Maximum Buffer Size (packets)	50
Maintenance Holdoff Time (seconds)	0.25

Maximum Maintenance Retransmissions (retransmissions)	2
Maintenance Acknowledgement Timer (seconds)	0.5
Broadcast Jitter (seconds)	uniform (0, 0.01)
GRP Protocol Parameter	
Hello Interval (seconds)	uniform (4.9, 5.0)
Neighbor Expiry Time (seconds)	constant (10)
Number of Initial Floods	1
Position Request Timer (seconds)	5.0

To evaluate the overall performance of the routing protocols AODV, OLSR, TORA, DSR and GRP we designed two simulation scenarios. The objectives behind these scenarios is to develop a novel scheme of video streaming via MANETs networks through determine the effective parameters of those protocols that will enhanced the QoS of video streaming . In these scenarios we compared the five different underlay routing protocols under IEEE 802.11g for video streaming traffic using node density 5,10,15,20 with mobility speed in the interval [0,10] m/s and network size 100x100 m^2 with the addition of other parameters described in the previous tables that for the first scenario which represent low density of nodes and low mobility which is called small scale /low mobility in this paper. In the second scenario we used a network size 1000x1000 m^2 and node density 30, 40, 50, 60 and 70 mobile nodes with mobility speed [10, 25] m/s which represent high density/high mobility which is called in this study large scale/ high mobility. We evaluated the performance in terms of the End-to-End delay(sec) , throughput (bits/sec) , Packet Delivery Ratio (PDR %) , Routing Overhead (packets/sec) , Total Packet Dropped (packets) ,Retransmission Attempt(packets)and network load.

7.1 Scenario -1: small scale /low mobility

Fig (2) show the calculated average End-to-End delay of each transmitted data packets during the simulation time as a function of node density. E2E delay includes all possible delays as we mentioned before in Eq (1) and Eq(2).From the graph, we can observe that OLSR protocol has a minimum E2E-delay which is (0.00007 sec) as compared to the other protocols and TORA has a maximum delay (0.00203 sec).

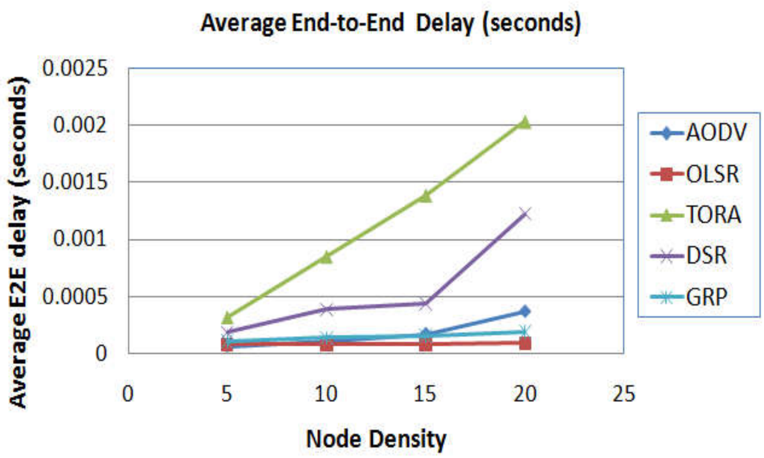

Fig (2) Comparison of average End-to-End delay (sec) Vs Node Density

However, OLSR doesn't affect by the increasing in a number of nodes, while GRP and AODV routing protocols have low delays compared to TORA and DSR. Except for OLSR, in all other protocols the delay increases if the number of nodes increased. The less value of E2E delay is desirable for delay sensitive applications such as video streaming and video conferencing.

Fig (3) demonstrates the throughput in (bits/sec) was calculated for all protocols under investigation during the simulation period as a function of node density. Also here the OLSR has a high throughput (221,087.17 bits/sec) compared to other protocols and from then AODV. The two protocols TORA and DSR has low throughput. Also from the graph, we observed that for all protocols the throughput increases with time increase and node density increased .High throughput is desirable for multimedia traffic and specifically video streaming and video conferencing.

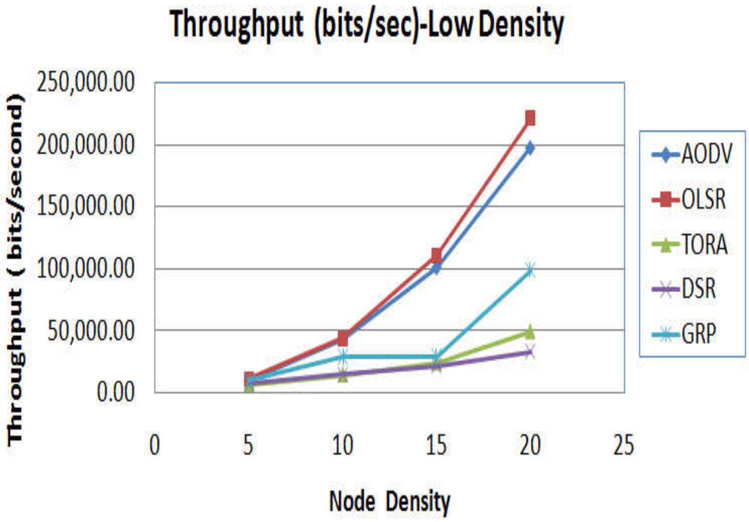

Fig (3) Comparison of throughput (bits/sec) Vs Node Density

In terms of packet delivery ratio (PDR) as a performance parameter and as described it in Eq (4) it's clear that from Fig (4) that the two protocols OLSR and DSR they have a high (PDR) and its reached to 100% in this case because there is no packet loss, no topology change, and mobility is predictable by OLSR and DSR. The GRP protocol is performed better in terms of E2E-delay compared to TORA which the worst case. AODV is moderate compared to OLSR and DSR. The protocols efficiency is measured by the routing overhead, which represents all routing control packets (traffic sent (pkts/s)) by all nodes in the entire networks to establish links between them.

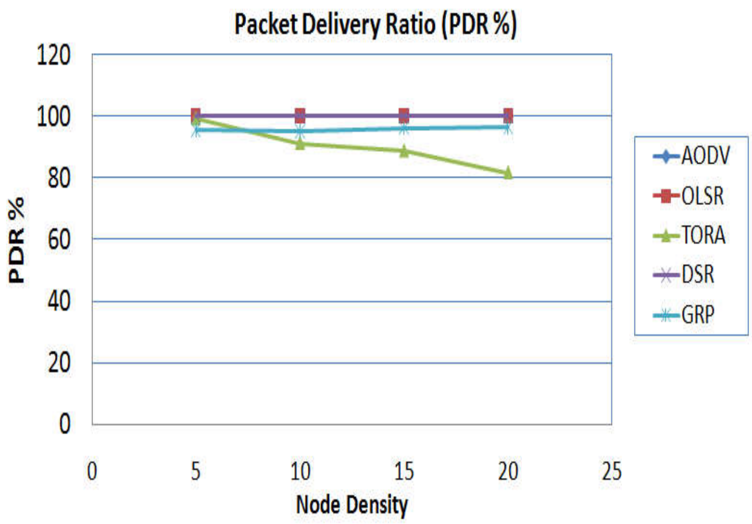

Fig (4) Packet Delivery Ratio (PDR %) Vs Node Density

The two protocols AODV and OLSR have a low routing overhead compared to the other protocols. GRP protocol has a high routing overhead and represents the worst case here. The proactive routing protocols because it used a routing table we can expect that has a high routing overhead. From Fig(5) we observed that the routing overhead increased when the node density increased and this caused by topology change after a time or as a result to the increment of routing table size.

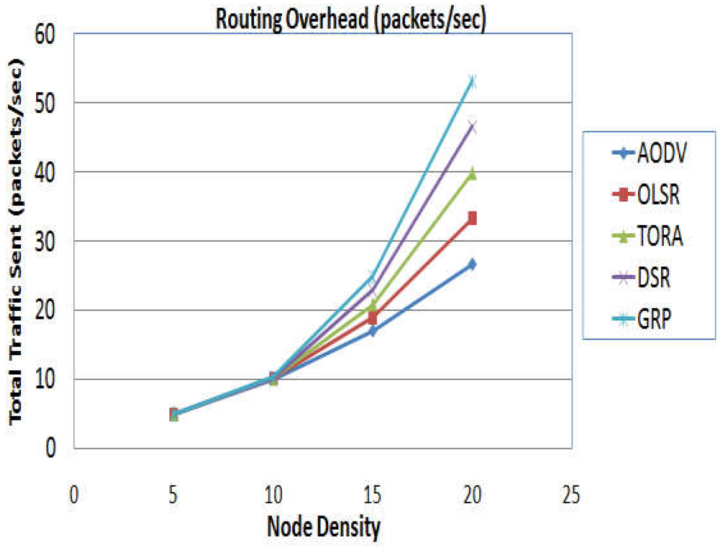

Fig (5) Total traffic sent(pkts/s) Vs Node Density

In the case of video transmission and the other multimedia applications, the packets dropped is important parameter because the packets discarded will degrade the quality of the video. The main reason for packets dropped is link breakages. Fig (6) shows that the protocols OLSR, DSR, GRP are reliable for video streaming in this case (low density of nodes). The protocol AODV is performed better than TORA in terms of packet dropped. As consequently, the retransmission attempt is high for TORA and AODV and very low for OLSR, GRP, and DSR as shown in Fig(7).

From the graph, it's clear that in terms of retransmission attempts TORA represents the worst case since it has high retransmitted data packets which are not desirable for video traffic. GRP is the better compared to other protocols. In addition, OLSR and DSR performed better and AODV is moderate. As shown in Fig(8) there is no a big variation between the routing protocols regarding the network load but TORA is performed better and from then DSR. OLSR and AODV are similar. We conclude that OLSR routing protocol is outperformed in this scenario (small scale /low mobility) and is the best suitable routing protocol for transmitting video streaming over MANETs.

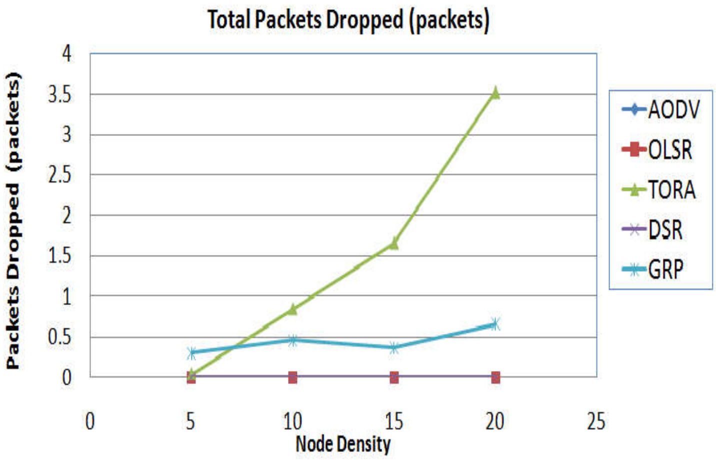

Fig (6) Total Packets Dropped (pkts) Vs Node Density

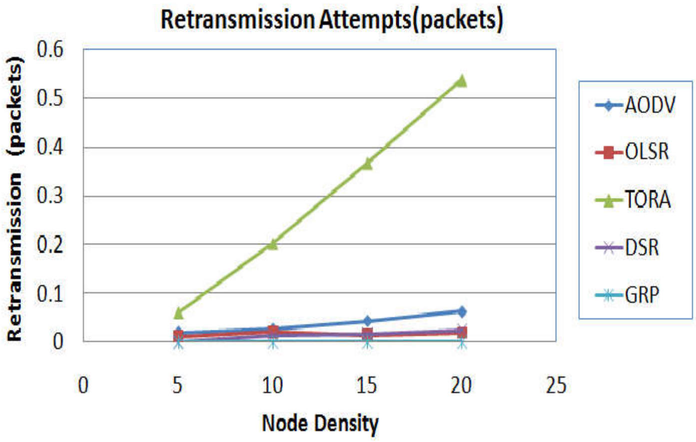

Fig (7) Retransmission Attempts Vs Node density

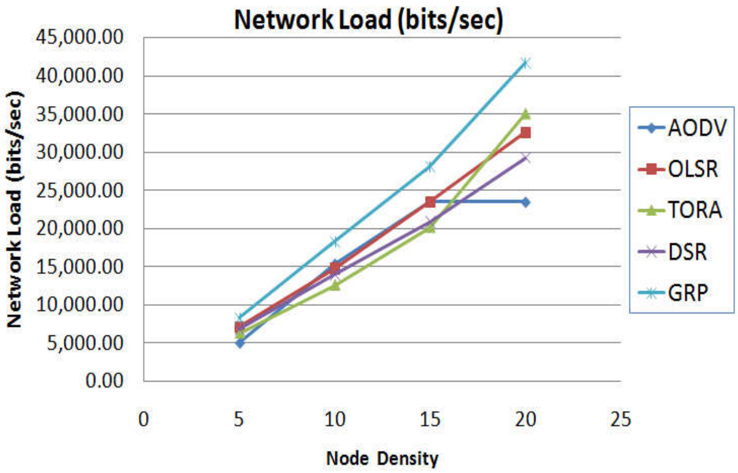

Fig (8) Normalized Network Load (bits/sec) Vs Node Density

Table (7) summery of Scenario-1

Metric \ Protocol	AODV	OLSR	TORA	DSR	GRP
End-to-End Delay (seconds)	Low	V. Low	V. High	Low	Low
Throughput (bits/sec)	High	V. High	V. Low	V. Low	Low
Packet Delivery Ratio (PDR %)	V. High	V. High	High	V. High	High
Routing Overhead (packets/sec)	V. Low	Low	Low	High	V. High
Total Packets Dropped (packets)	V. Low	V. Low	V. High	V. Low	Moderate
Retransmission Attempts(packets)	Moderate	Less	V. High	Less	V. Less
Network Load (bits/sec)	Low	High	Low	Moderate	Moderate

7.2 Scenario -2: High density/High mobility

In this scenario we used high node density 30,40,50,60 and 70 mobile nodes with ground speed [10,20] m/s with pause time equal to zero which represent a high mobility, in addition, we used a large network size 1000x1000 m2. The simulation shows that the throughput as shown in Fig(9) continues to increase as the number of nodes increased and the routing protocols AODV and DSR they have a high throughput compared to other routing protocols, that lead us to say that AODV and DSR are capable to performs better for large scale.

Fig(10) show that OLSR has a minimal E2E-delay for the large scale network model which indicates that OLSR has a high scalability, GRP also have less E2E delay compared to other protocols ,means that OLSR and GRP provides the best choice for transmitting real-time data packets related to application that has a high sensitivity to delay and jitter.

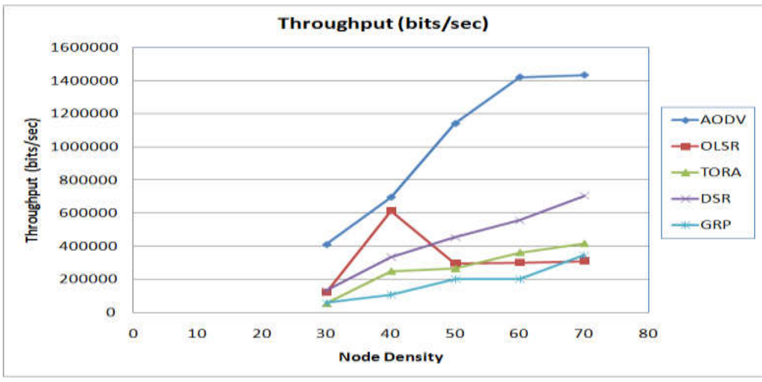

Fig (9) Throughput for scenario-2 Vs Node density

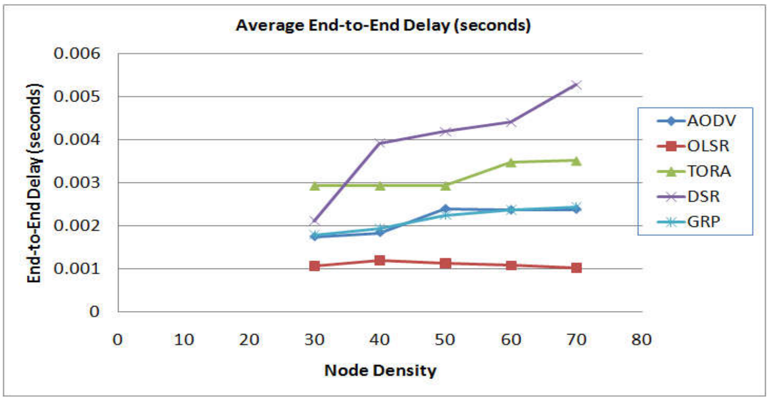

Fig (10) Average E2E delay for scenario-2 as function of node density

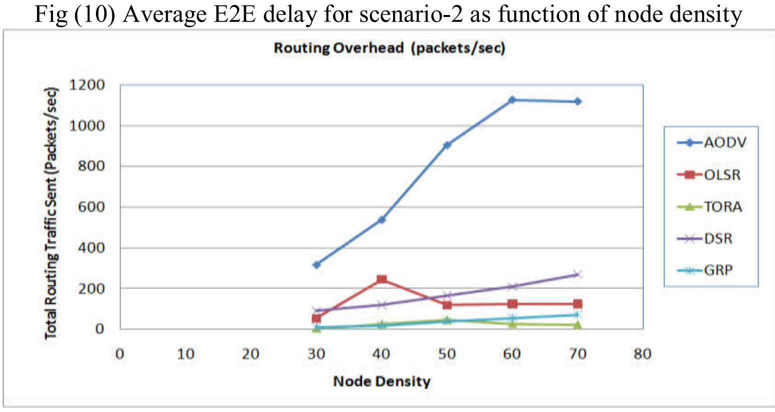

Fig (11) Total routing traffic sent entire the networks by each node Vs node density

From Fig(10) and Fig(11) depict the performance in terms of average E2E-delay and routing overhead, the figures shown that OLSR is outperform compared to the other routing protocols.GRP comes in the second turn because it's a position based protocol and overcome the high mobility and scalability due to its characteristics .Also the simulation shows that AODV does not support the scalability in terms of E2E-delay and routing overhead as a result of maintaining huge routing table and the complexity of the processes of routing discovery and maintenance. Fig (12) demonstrate the total packets dropped by the underlying routing protocols, AODV represent the worst case where the packets dropped increases when the node density increased. TORA here is outperformed in terms of packets dropped.

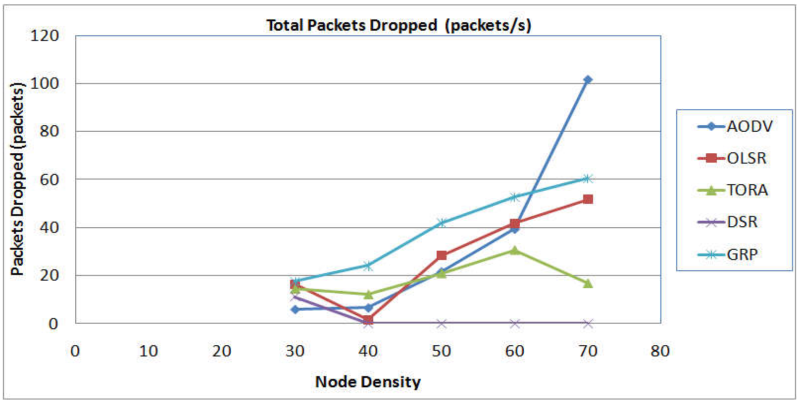

Fig (12) Total packet dropped as node density function

Regarding the packet delivery ratio in the (high scalability/high mobility) we found from the simulation and as shown in Fig(13) that DSR and AODV routing protocols performed better compared to other protocols , the worst case here is GRP .For all protocols we observed that (PDR) decreases when the number of nodes increases .

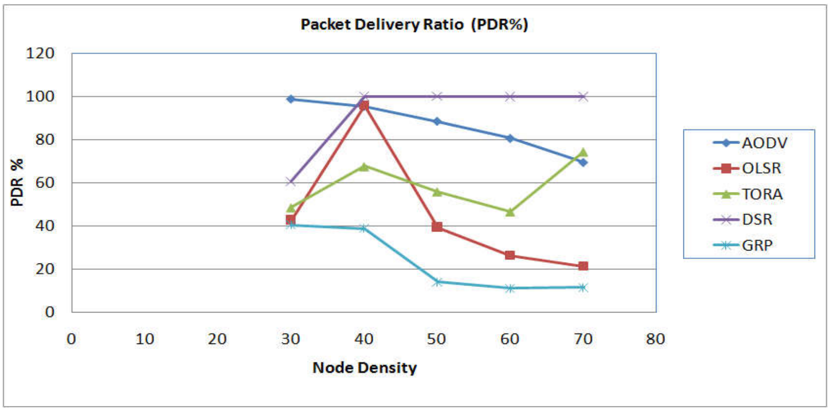

Fig (13) PDR % Vs node density

In terms of retransmission attempt and network load in this scenario as shown in Figures (14) and (15), we found from the simulation that OLSR and GRP are outperformed compared to other protocols. AODV also has a low performance in terms of those parameters but not the worst case. It's clear from this scenario that AODV has a high throughput, high routing overhead, and high network load which doesn't support scalability and high mobility. With respect to OLSR protocol, have low E2E-delay, low routing overhead, low network load, low transmission attempt and low (PDR). In this scenario also OLSR is better performance compared to other protocols. However, OLSR has outperformed the other protocols in this case in spite of having low throughput.

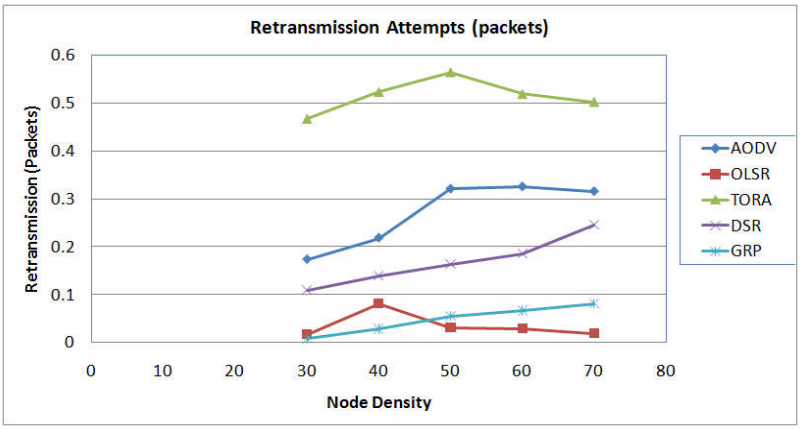

Fig (14) Retransmission attempts Vs node density

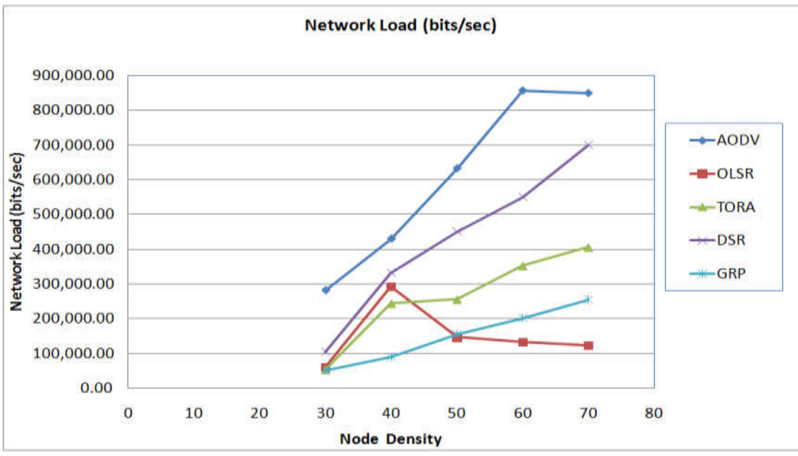

Fig (15) Network load Vs node density

Table (8) summery of Scenario-2

Metric \ Protocol	AODV	OLSR	TORA	DSR	GRP
End-to-End Delay (seconds)	Low	V. Low	High	V. High	Low
Throughput (bits/sec)	V. High	Moderate	Low	High	V. Low
Packet Delivery Ratio (PDR %)	High	Low	Moderate	V. High	V. Low
Routing Overhead (packets/sec)	V. High	Low	V. Low	Moderate	Low
Total Packets Dropped (packets)	V. High	Moderate	Low	V. Low	High
Retransmission Attempts(packets)	Moderate	Less	V. High	Less	V. Less
Network Load (bits/sec)	Low	High	Low	Moderate	Moderate

VIII. CONCLUSION

MANETs networks have received increasing research attention in recent years. There are various active research works in MANETs focuses on the enhancements of routing protocols. In this paper, we demonstrated a comprehensive performance evaluation of an enhanced MANETs routing protocols such as proactive (OLSR), reactive (AODV, TORA and DSR) and position based geographical routing protocols (GRP). The performance evaluation calculated in terms of various performance parameters such as average E2E-dealay, throughput, routing overhead, packet dropped, packet delivery ratio, retransmission attempts, and network load. We used in this study two scenarios to investigate the overall performance of the routing protocols for video streaming over MANETs. The first scenario represents (small scale/low mobility density), in this scenario as shown in Table (7) OLSR has outperformed all other protocols specifically in terms of E2E- delay, throughput, packet dropped and retransmission attempts since those parameters have a high impact on the QoS of video traffics. The second scenario represents (large scale/high mobility density), this scenario aims to test the routing protocols for high scalability and high density of mobile nodes with the addition of high ground speed, we found in this case as shown in Table (8) OLSR also outperforms in terms of E2E-delay, routing overhead, packets dropped and retransmission attempts, where in terms of throughput and network load AODV is the better one. We conclude that the two protocols OLSR and AODV are suitable for transmitting video traffic over MANETs , but they are still drawbacks for each protocol such as the low PDR and high network load for OLSR ,very high routing overhead and very high packets dropped for AODV.

Future Works

There are promising future research directions based on the current research. This suggests a potential research topic on MANET routing in which estimates of QoS parameters regarding video streaming over MANETs, including network and traffic profiles, can be used to adaptively choose different routing protocols or different modules for one protocol. Further study of node mobility is also a promising research direction to improve estimates of link and path lifetimes and improve the performance of MANET routing protocols. More extensive simulation and emulation studies can be used to analyze and to guide users when they choose routing protocols for their MANET applications and aid designers in improving protocols. A framework that characterizes these protocols can aid the design, comparison, and improvement of these protocols. Also, there is an opportunity to enhancing OLSR using PSO algorithm to overcome the low throughput and PDR for large scale MANETs.

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