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Performance Evaluation of MANETs routing protocols for transmitting video

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ABSTRACT

Transmitting video over Mobile Ad hoc Networks (MANETs) is the most challenge because of the dynamic of its topology and the mobility of its nodes. These networks operate without a fixed physical infrastructure, allows wireless nodes to seamlessly connect or disconnect at any time. Additionally, the nodes in these networks are capable of self-organization. That makes routing process more difficult than traditional networks in addition to needing high bandwidth requirements to complete video transmitting process. This research investigates and assesses the performance of several commonly utilized standard routing protocols in MANETs, including AODV, DSDV, OLSR, and DSR. The evaluation is conducted across a range of wireless node quantities, spanning from 10 to 100, and tested on many performance metrics such as PDR, ETE delay, Packets Delay Variation (jitter), Data Dropped (DD), Throughput, and routing Overhead, the simulation results are analyzed to determine the most suitable routing protocols among them and overcome the video transmitting. Results shows that OLSR routing protocol is better from others tested protocols in almost performance metrics for video transmitting. Standard routing protocols have many resources constraints that may cause a link failure, when using it in multimedia applications it needs more power consumption and more bandwidth. The performance study simulated with ns3 simulator.

1. Introduction

Mobile Ad hoc Networks (MANETs) are comprised of numerous mobile nodes those act as hosts and routers, working together to establish routing paths within a wireless network. MANETs are fully dynamic networks with self-organizing nodes that randomly join or leave the network at any time. These networks can work individually or be associated with the larger internet. Routing within a MANET is

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possible between mobile nodes, enabling the network to support both single and multiple hops. This unique feature of MANETs establishes them as a multi-hop wireless ad hoc network.
MANETs routing is a challenging task due to restricted resources, and developing an effective and reliable route requires an intelligent routing strategy that can make optimum use of limited resources while adapting to network conditions like network size, traffic load, and flexibility. Efficient routing protocols are necessary to obtain a certain Quality of Service (QoS) for various MANET applications, particularly for video transmission.

The performance of the entire MANET system can be greatly affected by the choice of an appropriate protocol. Various routing techniques have been developed depending on the network's nature and resources. The evaluation of routing protocol performance should encompass a variety of scenarios to address all potential network situations, as different MANET conditions may give different results.

Our study aimed to identify the most effective MANET routing protocols for transmitting video content across different network sizes and mobile densities with varying mobility speeds. To achieve this, we conducted a comprehensive performance evaluation of five commonly used protocols, including reactive (AODV, DSR), and proactive (OLSR, DSDV), Each protocol had its own unique advantages and disadvantages when it came to transmitting video content.

In Section 2, an introduction to MANET routing protocols is presented, with a specific emphasis on proactive, reactive, and hybrid routing protocols. Additionally, a thorough explanation of the protocols examined in this paper is provided. Moving on to Section 3, a comprehensive summary of related works is presented. Furthermore, Section 4 showcases the performance metrics utilized in this study, including E2E delay, jitter, PD, routing overhead, and throughput. In Section 5, we look at simulation and results that conclude performance analysis. This section introduces the simulation tool and settings, as well as a full discussion of the simulation's outcome. Finally, the conclusion in Section 6 gives an overall observation.

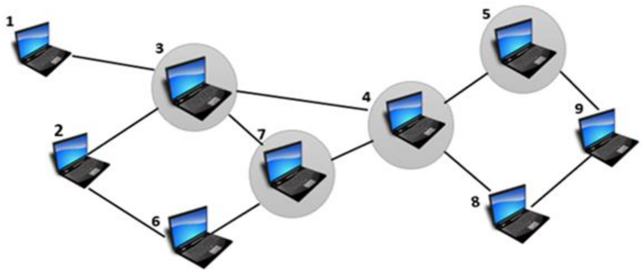
2. MANETs Routing Protocols

Routing protocols in MANET can classified dealing with route discovery into three major kinds [2,4,9]:

2.1. Proactive routing

All routes are founded and stores it the routing table before transmitting data so that called table driven; when changing network topology routing table should updating. Data can be transmitted without delay since all routes are precomputed and stored in the routing table. Two routing protocols that fall under this category are the Optimized Link State Routing (OLSR) and the Destination-Sequenced Distance-Vector Routing (DSDV).
1.1.1. Optimized Link State Routing Protocol (OLSR)

Utilizing Multipoint Relays (MPR), OLSR is a link-state protocol that has been optimized for MANETs to reduce route overhead in the network [10,15]. The MPR set is selected to encompass all nodes within a two-hop range and consists of chosen nodes that function as one-hop neighbors to forward packets. Any changes in the network's topology require every node in the entire network to select a new set of neighboring nodes for retransmitting its packets. Only nodes in the MPR set are able to transmit packets; other nodes not in the MPR set will read and process each packet but cannot retransmit it. Figure 1 illustrates OLSR multipoint relays. To determine and select the MPR set, each node periodically broadcasts hello messages to its list of one-hop neighbors. Two types of control messages are uses in OLSR routing: 1) To find the link state and neighboring nodes, the message known as "HELLO" is utilized and 2) Topology Control (TC) message includes sender list, MPR selector that always used to broadcast the information to its advertised neighbors. TC messages is forwarding by MPR nodes only. When TC messages is received from all of the MPR nodes. The nodes have the capability to construct their partial network topology. When faced with multiple options, The MPR set is chosen by selecting the minimum set. To manage the overhead of the OLSR protocol, various parameters such as the Hello-interval, TC interval, MPR coverage, and TC-redundancy parameters are utilized. Unlike the classic link-state algorithm, where all links are announced, only small subsets of links are announced in the OLSR protocol. This approach aims to reduce the number of control messages disseminated in the network and provide optimal routes with fewer hops. The MPRs technique is particularly effective in large and densely populated networks.



Nodes MPRs	Set of Selector
3	1,2,4,7
4	3,5,7,8
5	4,9
7	3,4,6

Fig.1 OLSR multipoint relays

1.1.2. Destination-Sequenced Distance-Vector Routing (DSDV)

This protocol employs a proactive routing technique that guarantees the absence of loops in paths by utilizing the Bellman-Ford algorithm [12]. Within the network, every node maintains a routing table that contains a comprehensive list of potential destination nodes, along with the corresponding number of hops required to reach them. Each entry in the table is assigned a distinct serial number by the destination node. The routing table undergoes updates through two methods: full dump (where the neighbor receives the complete routing table) and, incremental dump (the neighbor receives only the entries that require changes in the incremental update).

Path Selection: In the DSDV protocol, every entry is assigned a sequence number, which serves to identify outdated entries. This mechanism helps prevent the formation of routing loops. Periodically, each node broadcasts unique updates with a sequence number to announce its location. Upon receiving new data, a router gives priority to the most recent serial number and utilizes the path with the lowest metric if the sequence number matches the one already presents in the table. Entries that haven't been updated for a while are considered old, and both these entries and the routes they pertain to are removed during subsequent hops. Additionally, each node maintains the next-hop routing information for every reachable destination in its routing table.Fig.2 shows the routing table for node2 in a dedicated environment [7].

During each occurrence of a new route broadcast, the transmitted packet includes the following details: 1) the destination address, 2) the count of visited nodes, 3) the sequence number of destination, and 4) the unique broadcast sequence number for that destination [16]. Nodes consistently opt for the path with the most recent sequence number. In cases where two updates share the same sequence number, the path with the smallest metric is chosen, as it represents the shortest route to the destination. Additionally, nodes keep track of when routes stabilize, which denotes the average duration before receiving the route with the best metric. DSDV maintains route freshness by delaying the broadcast of routing updates during the initialization period. This allows nodes to minimize network traffic and optimize routes by avoiding broadcasts that would occur if a superior route were to be discovered shortly thereafter.

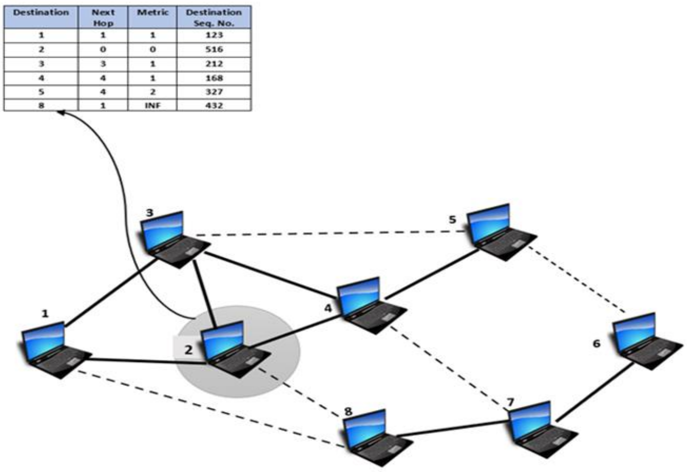


Fig.2 DSDV routing table for node 2

2.2. Reactive routing

On-demand routing operates by calculating routes as needed, eliminating the need for routing tables and periodic updating processes, as seen in reactive routing. However, this approach introduces an additional calculation delay, resulting in higher latency compared to proactive routing. This on-demand routing paradigm is utilized by protocols such as AODV and DSR [2, 4, 9].

1.2.1. Ad hoc On demand Distance Vector (AODV)

This routing protocol is an effective choice for random networks in MANETs [14]. It operates as an on-demand routing protocol, meaning it determines routes only when required. The algorithm incorporates principles from both the DSDV and DSR algorithms. The utilization of sequence numbers and the hop-by-hop routing principle in this algorithm have been adapted from the DSDV protocol. Rely on serial numbers similar to the DSDV protocol to avoid routing loops and determine the track's age or freshness. On the other hand, the path maintenance mechanism and the on-demand path discovery process in this algorithm are adapted from the DSR protocol. The most important feature of the AODV protocol is its ability to reduce network control messages by creating the path on the basis of need only, rather than maintaining a full table for each destination in the network. This on-demand routing mechanism adopted by AODV makes it a highly effective technology in MANET networks. In the following paragraphs, we will provide a detailed explanation of the two basic path exploration and path maintenance phases of the AODV routing process. In AODV, there are three types of messages used for path discovery and path maintenance: Path Request (RREQ), Response Routing (RREP), and Path Error (RERR).

Path exploration process:

When a node within the network intends to transmit a data packet to another node, it first consults its routing table to determine if there is a path to the intended destination. Once a valid route to the requested destination is discovered, the source node promptly starts transmitting the data packet to the next node along the path that leads to the target node. However, if there is no existing route, the source node initiates a route discovery process, which generates a Route Request (RREQ) message. This RREQ message contains essential information such as the Source IP address (SIP), Source Sequence Number (SSN), Destination IP address (DIP), Last known Destination Sequence Number (DSN), and Broadcast ID (BID).

Once the route request message has been broadcasted, the source node patiently awaits a response message, referred to as the route request (RREP), from a specific node within a predefined period of time. In situations where a node receives a route request message for a given target node but does not possess a valid and recent route to the mentioned node, it proceeds to rebroadcast the RREQ message.

Furthermore, it establishes a temporary reverse route to the address of the source node from which the request originated, and simultaneously maintains a temporary reverse route table. The reverse path serves the purpose of preserving the way back to the initial node that initiated the path request message, as showcased in Fig.3. The routing request progressively disseminates throughout the network until it reaches either the desired destination itself or one of the intermediate nodes that possesses an updated path towards the desired destination. Subsequently, a Route Reply (RREP) response is generated and transmitted to the source node.

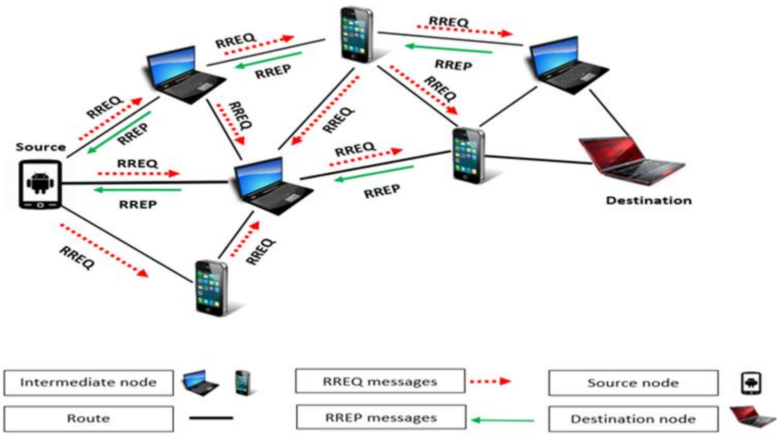


Fig.3 AODV route discovery mechanism

***Route maintenance:**

Occurs when the node detects the existence of a path for one of its neighboring nodes that is no longer valid (as a result of the movement of this node), it deletes that path from its paths table, and then broadcasts a RERR declaration that that path is not valid for all its neighboring nodes that are currently using that path. The message is transmitted from each node to its neighboring nodes until it reaches the source that initiated the packet transmission. At this point, the source can either cancel the data transmission or request a new path by sending a new path request message (RREQ). When the destination receives an RREQ from the source, the destination generates and re-transmits the RREP to the source [16].

1.2.2. Dynamic Source Route (DSR)

This protocol was designed specifically for multi-hop wireless networks, and unlike other Ad hoc protocols that not require any periodic messages to be forwarded in the network [9]. The DSR protocol establishes a route as needed, with the sending node comprehending all intermediate hops to the destination and retaining the route in a memory cache. Within the DSR protocol, the sender enumerates the entire sequence of nodes necessary to reach the destination (meaning the data packet includes all the path information to reach the target node). This protocol is characterized by two principal phases: path discovery and path maintenance. When a node intends to transmit a message, it first examines the cache for a route originating from the node itself. If the path is found, the node starts sending packets, otherwise it starts the path discovery process in order to search for a new path between the source and the destination, as shown in Fig.4. Each request packet carries a routing path. The address of the source node, the new serial number, and the id of the target node. All nodes that receive a routing request packet check the serial number and rebroadcast the packet to their neighbors if they do not have a direct path to the destination node (i.e., destination node is not one of its neighbors) after this node adds its address to the packet [15].

Two main differences can observe between the AODV and DSR protocols: first is that data packet in AODV carries only an address of a destination node, while in DSR protocol it carries the information of entire path node to the destination node, which means that the overhead in the DSR protocol is higher. The second difference is that in DSR the RREP message carries all addresses of the route nodes while in AODV it does not [7,9,17].

The DSR protocol has two main mechanisms of action:

***Route Discovery:**

It includes two messages: a Route Request RREQS message and a Route Replies RREPS message. RREQS was broadcasted by the node that wanted to send a message to specific destination by added its address. Path intended to destination when RRQS that allow all nodes to share custom routing. each one keeps its source routes in its own routing cache. Therefore, when a node intends to send packets to

another node, it first looks into its path cache to find a suitable route to the destination. Once the route is located, the sender can directly forward the packet to the destination. These routes are established as needed through a process known as path discovery.
In the route discovery process, a route request packet is generated to search for a path to a specified destination. This packet contains details about the source and destination. Upon receiving the initial route request packet, a node examines its route cache for any relevant information pertaining to the listed destinations. Subsequently, the node's identity is appended to the header of the route request packet, which is then broadcasted. Once the necessary information is obtained or the route request packet reaches its destination, a route response packet is dispatched back to the source in the reverse direction. This is accomplished by replicating the sequence of node identities gathered from the route request packet.The RREPS contains the entire path to the destination that is registered in the routing cache of the source node. If link fails, the node that detected the routing break sends the ERROR message back to the source node. In this case, every node in this sub-route including the source will delete all information about that route from their route cache and another route discovery process will be started if a route is still needed.

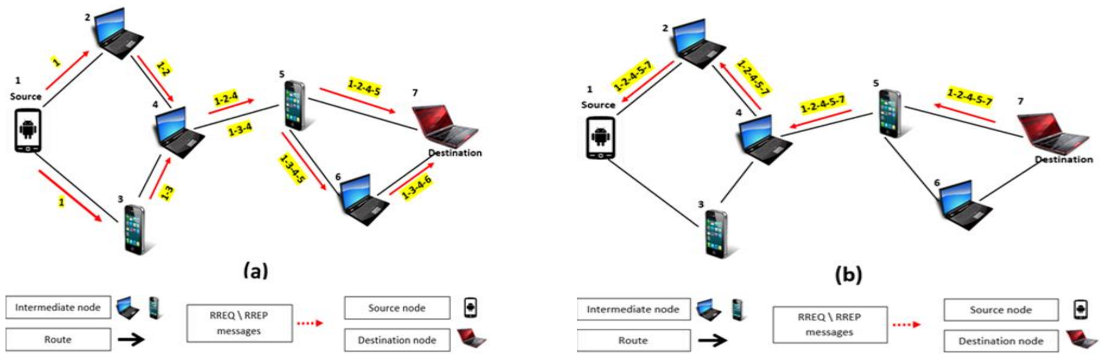


Fig.4 (a) DSR route discovery, **Fig.4** (b) DSR route replay

Route maintenance:

This uses two types of messages: Route Error RERRS and ACK Acknowledgment. The node that successfully receives the message sends a response message to the sender (CK). In the event of a problem in the network, it is inferred that there is an error in the path by sending a RERR message to the data sender. In other words, the source is not getting a response message due to some problem. So, the resource gets a RERR packet in order to reinitialize the new path discovery process. Upon receipt the RERR message, the contract deletes the path's entries. It should be noted that these two mechanisms work together and in an integrated manner to allow the contract to discover the path to the desired destination and maintain it throughout the transmission period.

2.3. Hybrid routing

This kind of routing combines the two previous type, proactive and reactive routing protocols [4].

Table 1. summarized a comparison between different MANETs routing protocols

Table 1. Comparison of MANETs routing protocols

Protocol	Route Computation	#Routs	Stored Information	Updating Period	Update Information	Update Destination	Route kind	Route Overhead	scalability	Multicast support	Energy efficiency	QoS support
AODV	Flat/ broadcast QUERY	Multiple	Next hop for desir	Event driven	Route error	Source	Reactive	Incurs moderate	Well in small & medi	Only unicast comm.	Not have specific	Limited

			ed Dest.					routing	um size		energy	
DSR	Flat/ broadcast QUERY	Multiple	Routes to desired Dest.	Event driven	Route error	Source	Reactive	High due caching	Limited due to need maintain caches	Both unicast & multicast	Consume more energy	Route selection and caching based on QoS
OLSR	Flat/ Distributed	Multiple	MPR nodes, link load, delay, bandwidth	Periodical	Hello & TC messages	Neighbors	Proactive	Low routing overhead	Well in large network	Both unicast & multicast	High energy consumption	Support QoS metrics
DSDV	Flat/ Distributed	Single	Distance vector	Hybrid	Distance vector	Neighbors	Proactive	High due Bellman Ford algorithm	Well in small networks	Hop-by-hop Unicast	High energy consumption	Very limited

3. Related works

The transfer of multimedia data, such as video, in MANETs poses a significant challenge due to routing protocols. To address this issue, various routing protocols have been developed to facilitate efficient data transfer between the source and destination nodes. These protocols, including DSR, AODV, DSDV, and OLSR, are evaluated and analyzed using appropriate simulators and under suitable environmental conditions to determine their performance metrics. Many researchers developed standard routing protocols to obtain QoS requirements and improving performance metrics evaluation for different MANETs applications. Many related works are listed below.

Padmapriya T,and Manikanthan S.V [11], examined two of MANETs routing protocol OLSR and AODV for video streaming application, the performance metric used in the job id throughput, delay, and route load only. Results of comparison explain that OLSR is the best in all performance metrics that examined.

Bbalqees AL-Hasani, and Bassam M.S. Waheed [18], used QualNet v5.2 network simulator to evaluate AODV, OLSR, and ZRP on various performance metrics such E2Edelay, jitter, throughput, and routing overhead. Evaluation was done under different condition. Results show that no one protocol outperforms the others in all scenarios. But OLSR obtain best average delay compared to AODV, also AODV has a higher amount of jitter.

Kumar, A., Shukla, R.K., Shukla, R.S. [13], present a survey study of standard routing protocols of MANET such as ZPR, AODV, DSDV, and DSR then compare their performance. Many QoS are used to classified multipath tested protocols depended essentially on bandwidths, and energy consumption.

Vu, Q., Hoai, N. & Manh, L. [19], presented a survey study for MANET routing protocols depending on saving energy and power consumption QoS parameter, the routing protocols divided on two main groups, power control, and maximum networks life. of the proposed energy-saving routing protocols in the last decade for MANET.

The Multipath Routing protocol proposed by V. Saritha and P. V. Krishna is based on many QoS performance metrics using ns2 simulator. Comparison performance metrics in both traffic cases, real time and non-real time. Tested results appears that MRQ better than other standard protocols in many performance metrics such as, PDR, Peak Signal Noise Ratio, E2E delay [20].

N. Rathod and N. Dongre [21], enhancing MANETs video streaming and compare some routing protocols AODV, and AOMDV (Ad-hoc On-request Multipath Distance Vector). Comparison includes many performance metrics likes, PDR, throughput, ang network delay.
In their study, DE. M. Ahmed, O. O. Khalifa, A. H. Hashim, and M. Yagoub [22] employed the OPNET simulator to assess and compare the performance of enhanced MANETs routing protocols, specifically focusing on AODV. Various performance metrics including end-to-end delay, throughput, overhead, packet delivery (PD), packet delivery ratio (PDR), network load, and retransmission attempts were evaluated in the context of video conferencing over MANETs across different scenarios. The findings indicated that AODV exhibited superior throughput performance.

G. Mahadevan [23] improve the performance and QoS of MANETs by proposing by design a new technology depends on cross layer. Video transmission rate was optimized by improving the QoS performance metrics.

Husham J. A. Alqaysi, and Ghassan A. QasMarrogy [24], used OPNET simulator to compere two routing protocols, AODV and OLSR with variant performance metrics such as, Delay, throughput, network load, and data retransmission. That applied on video streaming application. Results found that OLSR is very efficient for real time application.

G. Bhat and J. McNair [25] use ns3 simulator and determine a TCP as a transport layer to obtain low E2E delay with video streaming. They proposed new random coding called Variable Bucket Size Network Coding (VBNC) then studying different routing protocols. The results OLSR and AODV routing protocols are widely used in video.

3. Performance metrics

Performance metrics is a way to compare and evaluate the four chosen routing protocols. We consider the following six performance metrics:

3.1. End-to-End delay

The evaluation of real-time multimedia applications, like video and audio transmission, heavily relies on a particular metric. This metric is known as E2E delay, which measures the time taken by the network to guarantee uninterrupted packet transmission from the source node to the destination node, i.e., a successful packet delivery from the source to the destination. All possible network delays are included such as (delay of discovering route, delay on queue, processing delay, retransmission delay). Eq. (1) represent E2E delay (sec). A minimum delay represents the efficient routing protocol for reliable network.

$$DE2E = [DRDD + Dqueue + Dproc + Dtrans] = (Ri - Si) \quad (1)$$

Where $DRDD$ =Delay of Discovering Route; $Dqueue$ = Delay in the queue; $Dproc$ =process time of packet depend on device speed and network congestion;$Dtrans$ =Transmission delay by the MAC; Ri =received packets; Si=sent packets.

3.2. Packets Delay Variation (jitter)

Low value of jitter is very important performance metrics especially for real time application. Jitter can define as a time variation between packets that arrived to destination so that called Packet Delay Variation (PDV). Eq. (2) represent packet delay, and Eq. (3) represent jitter calculation (sec).

$$Di = (Ri - Ri - 1) - (Si - Si - 1) \tag{2}$$

$$Jitter = \frac{\sum_{i}^{n} Di}{n} \tag{3}$$

Where Di = packet delay; n = number of packets.

3.3. Packets Delivery Ratio (PDR)

It is a crucial metric for evaluating the efficiency and reliability of routing protocols. The Packet Delivery Ratio (PDR) % is determined by dividing the total number of packets received at the destination node by the total number of packets sent from the source node, as specified in Eq. (4).

$$PDR = \frac{total\ packets\ received}{total\ packets\ sent} * 100\% \tag{4}$$

3.4. Packet Drops (PD)

Packets dropped in many cases: when queue is limited and full, when the route of next hop is not found, when no reachable to destination after determine attempts number. Eq. (5) explain the way to calculate packet dropped (packets/sec). Minimum packets dropped is prefer for all application.

$$PD = total\ packets\ sent - total\ packets\ recieved \tag{5}$$

3.5. Overhead

Equation (6) outlines the calculation of routing overhead (bits/sec), which is obtained by dividing the total number of sent packets by the total number of packets received. Overhead of routing is very important performance metric for determine routing protocol efficiency. For instance, in a proactive routing protocols number of control packets sent is highest than reactive routing protocols due to it used a routing table. The efficiency of routing protocols reduced if the controls packets number is bigger.

$$Overhead = \frac{total\ packets\ sent}{total\ packets\ recieved} \tag{6}$$

3.6. Throughput

Throughput (bits/sec) is very important performance metric in MANETs. It can measure by dividing total byte received by simulation time, as in Eq. (7). High throughput network is more efficient.

$$Throughput = \frac{\#\ bytes\ received}{simulation\ time}\ Kbps \tag{7}$$

4. Simulations and results

4.1. Simulation Parameters

Table 2. The Simulation Parameters.

Simulation parameter	Value
Mobility model	Random waypoint model
No. of wireless nodes	10,20,30, 40…, 100
Node speed	10-25 m/s
Sink source type	UDP
Size of simulation area	1000m*1000m
Simulation time in sec	400
MAC layer protocol	IEEE 802.11

Data rate Mbps	24.11
Buffer size (KB)	32
Channel setting	Auto assigned
Transmit power (watt)	0.005
MANETs routing protocols	OLSR, DSDV, AODV, and DSR
Performance metrics	E2E delay, throughput, jitter, PDR, PD, and routing overhead

4.2. Performance results and discussion

4.2.1. End-to-End delay

When evaluating the performance of video transmitting in MANET, it is crucial to consider the E2E delay. This delay encompasses all potential delays caused by buffering during route discovery latency. The E2E delay serves as a vital metric for assessing the quality of service (QoS) in video transmitting over MANET, and it is highly desirable for this metric to be maintained at a minimal level. Fig.5 illustrates that we can observe maximum delay occurs with DSDV routing protocol followed by DSR, and AODV, while OLSR has the lowest delay ratio for different networks size.

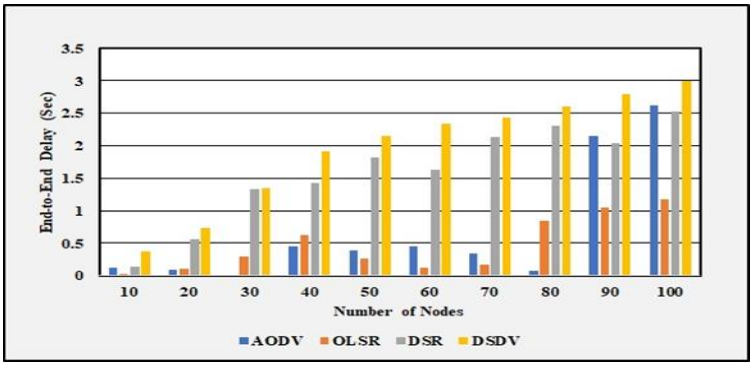


Fig.5 End- to-End delay

4.2.2. Packets delay Variation (Jitter)

The presence of network congestions and interference leads to variations in delays. To ensure the regular delivery of packets in applications like voice or video play out, it is essential to consider jitter and determine the appropriate size of play out buffers. Evaluating the quality of service (QoS) for video transmission relies on the critical metric of jitter, as explained in Fig.6. The jitter results for four selected routing protocols, each with a different number of network nodes, are discussed. The analysis reveals that AODV exhibits the highest level of jitter, followed by DSDV, DSR, and OLSR. Notably, OLSR demonstrates low jitter values, indicating more stable and predictable packet arrival times. This characteristic is particularly crucial for applications that require specially in real-time or time-sensitive data transmission.

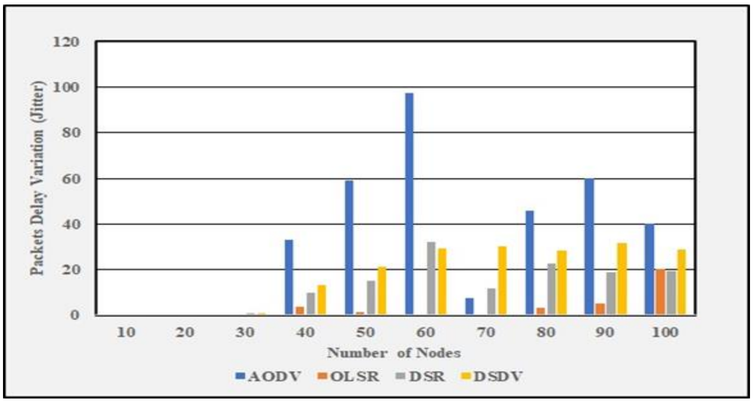


Fig.6 Packets Delay Variation (Jitter)

4.2.3. Packet Delivery ratio (PDR)

PDR is a crucial metric for measuring network reliability, especially for video traffic over MANET. However, due to buffer overflow, MAC congestion, link failure, and retransmission timeout, this value is practically unattainable. Fig.7 shows that as the network size increases, PDR gradually decreases, and AODV, DSR, and DSDV routing protocols experience a significant decline when the number of nodes exceeds 20. Although OLSR's PDR also decreases with network size, it is still better than other routing protocols.

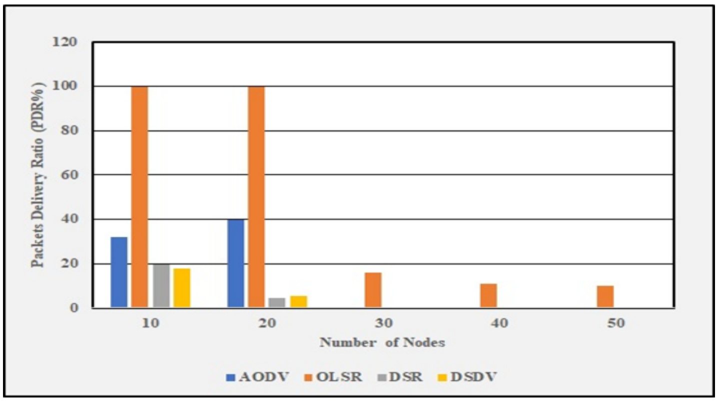


Fig.7 Packets Delivery Ratio

4.2.4. Packet Drops (PD)

The network layer receives a packet and the routing protocol determines whether to forward it based on the availability of a valid route to the intended destination. If no route is known, the packet is temporarily buffered until a suitable route is discovered. Two scenarios result in packet dropping: when the buffer reaches its maximum capacity and requires additional buffering, and when the packet has been buffered for a duration surpassing the predefined limit. The PD value increases as the number of network nodes rises. Fig.8 clearly depicts that OLSR consistently exhibits the lowest value among the examined routing protocols, regardless of the network size.

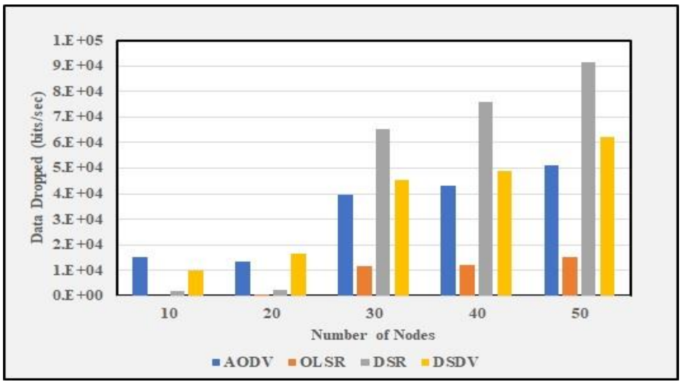


Fig.8 Data Dropped

4.2.5. Overhead

Due to the continuous movement of nodes in MANETs, links are frequently broken, leading to path failures and retransmissions. This results in an increase in overhead and a decrease in PDR, which cannot be avoided. Fig.9 illustrates that routing overhead gradually increases with the number of nodes in most routing protocols, such as OLSR, DSR, and AODV. However, OLSR consistently has the lowest value for all network sizes, making it the most suitable option.

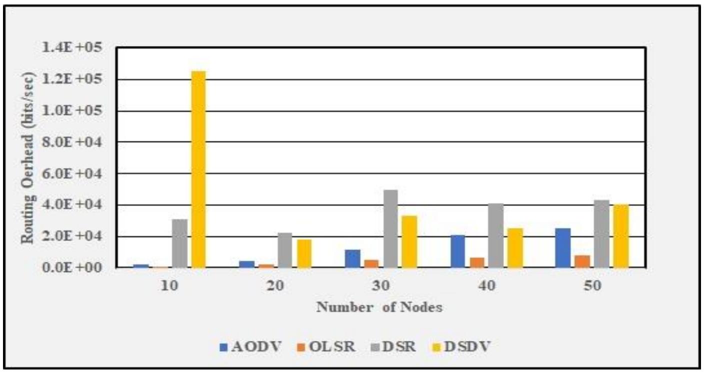


Fig.9 Overhead

4.2.6. Throughput

From Fig.10 OLSR is better throughput especially when increasing the network nodes numbers. On the other hand, AODV a good throughput in variant network size.

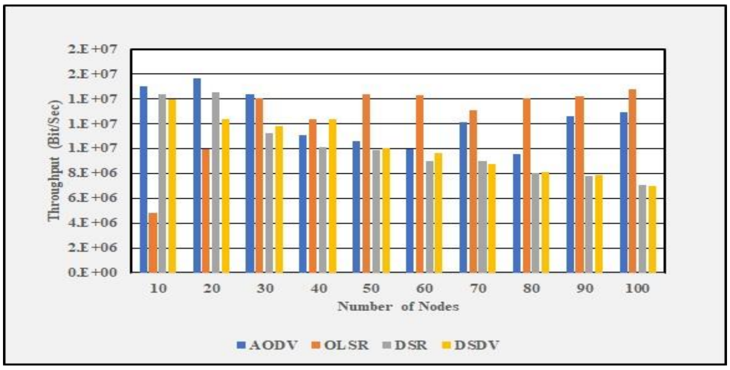


Fig.10 Throughput

The results of the study indicate that no routing protocol currently available can efficiently route any network size without modifications, regardless of the number of nodes, network load, and mobility.

Additionally, there is no single protocol that can guarantee all necessary QoS parameters for transmitting real-time video content effectively. Therefore, it is essential to enhance existing routing protocols for MANETs to achieve the required QoS parameters, which cannot be achieved without modifying the protocol's behaviour. Specifically, improving the OLSR routing protocol can extend network lifetime and reduce control message overhead, conserving node energy. Table 3. summarize the results of tested routing protocols.

Table 3. Results Summery

	MANETs Routing Protocols			
	AODV	**OLSR**	**DSR**	**DSDV**
End-to-End delay (ms)	Low	Very low	High	Very high
Packets delay Variation (jitter)/ (ms)	High	Very low	Low	low
Packet Delivery ratio (PDR) %	High	Very high	Low	low
Packet Drops (PD) (packets)	Low	Very low	Very high	High
Overhead (packets/sec)	Low	Very low	High	Very high
Throughput (bits/sec)	High	High	Low	Low

From the results in Table 2. It is clear that all performance metrics of OLSR routing protocol are superior to the rest tested protocols, which makes it the most suitable for use in multimedia applications especially video transmission applications.

4. Conclusion and future works

MANETs routing protocol consider a most challenges in video transmitting. Four of most famous standard routing protocols OLSR, AODV, DSDV, and DSR are studied and analysis of video transmitting applications over variant size of networks. The performance evaluation of various metrics, including End-to-End delay, jitter, PDR, PD, throughput, and routing overhead, clearly demonstrates that OLSR outperforms the rest of the tested routing protocols. As a result, OLSR is deemed the most suitable protocol for video streaming and transmission applications. The following points succinctly summarize the results of the performance metrics: The E2E delay of OLSR protocol was the better, while DSDV protocol was the worst, the jitter of OLSR protocol was the better, while AODV protocol was the worst, the PDR and PD of OLSR protocol was the better, while DSR protocol was the worst, the overhead of OLSR protocol was the better, while DSDV and DSR protocol were the worst, the Throughput of OLSR protocol was the better especially when increasing network size, while AODV protocol have a good throughput in case of small network, so that OLSR and AODV protocols have the best throughput compared with rest tested protocols.

The current study can be used to provide insight into potential future areas of research and development that can be expand based on the current findings, such as, using different optimization techniques and algorithms to improve OLSR protocol that make it more suitable for video transmission in terms of increasing throughput, reducing energy consumption, and improving the performance of routing protocols for MANETs networks.

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تقييم أداء بروتوكولات التوجيه لشبكات *MANETs* في نقل الفيديو

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الملخص

يعد نقل الفيديو عبر شبكات المحمول المخصصة (MANETs) هو التحدي الأكبر نظرًا لحركتها وطوبولوجيتها الديناميكية التي لا تحتوي على بنية تحتية مادية ويمكن لجميع العقد اللاسلكية الانضمام إلى الشبكة ومغادرتها في أي وقت، والعقد ذاتية التنظيم. وهذا يجعل عملية التوجيه أكثر صعوبة من الشبكات التقليدية بالإضافة إلى الحاجة إلى متطلبات النطاق الترددي العالي لإكمال عملية نقل الفيديو. في هذا البحث قمنا بدراسة
لتقييم أداء العديد من بروتوكولات التوجيه القياسية التي تستخدم عادة مع شبكات MANETs مثل (OLSR، DSDV، AODV، و DSR) على عدد متغير من العقد اللاسلكية (10، 20، 30،...، 100)، وطبقت عليها العديد من مقاييس الأداء مثل (التأخير من طرف إلى طرف، تباين تأخير الحزم (Jitter)، نسبة تسليم الحزم (PDR)، إسقاط البيانات (DD)، التوجيه النفقات العامة والإنتاجية) ثم تحليل نتائج المحاكاة لتحديد بروتوكولات التوجيه الأكثر ملاءمة فيما بينهم والتي تعتبر الأكثر مناسبة لتطبيقات نقل الفيديو. أظهرت النتائج أن بروتوكول توجيه OLSR أفضل من البروتوكولات الأخرى التي تم اختبارها في مقاييس الأداء تقريبًا لنقل الفيديو. تحتوي بروتوكولات التوجيه القياسية على العديد من القيود على الموارد التي قد تسبب فشل الارتباط، وعند استخدامها في تطبيقات الوسائط المتعددة فإنها تحتاج إلى المزيد من استهلاك الطاقة والمزيد من عرض النطاق الترددي. تمت محاكاة دراسة الأداء باستخدام محاكي ns3.

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