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SURVEY ARTICLE

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A comprehensive survey on QoS for video transmission in heterogeneous mobile ad hoc network

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Abstract

Major challenging issue in H-MANETs (Heterogeneous Mobile Ad hoc Networks) is video transmission because it gets affected due to various factors like dynamic change in topology, interference, node mobility, collusion, and so on. Periodic connection is caused by the topology dynamic change, which leads to significant packet loss. Advancements provide the technical basis for video streaming over H-MANETs in wireless networking and mobile devices. And efforts to achieve video transmission via H-MANETs have run into some barriers, which have been overcome in various ways. Nonetheless, H-MANETs are essential to provide video transmission certainty and quality provisioning. Due to the limited resources, the unreliability of wireless links, node mobility, and heterogeneity, establishing video streaming or enabling real-time multimedia applications over H-MANET with acceptable QoS (quality of service) poses several issues. The article's main goal is to survey QoS-based video transmission in H-MANETs. This study discusses the video transmission method in H-MANET and the importance of the QoS that may be used for video transmission in H-MANET. Various routing protocols and existing methodologies to improve QoS for video transmission in H-MANET are discussed. In addition, the impact of delay in video transmission over H-MANET has been discussed. Several obstacles and issues have been highlighted in providing QoS for video transmission in H-MANET. From 2013 to 2021, a systematic literature review (SLR) is done for QoS-based video transmission in the H-MANET. This survey systematically gives the technical direction for research on QoS-based video transmission and discusses potential future aspects.

KEYWORDS

heterogeneous mobile ad hoc network, media communication, mobile ad hoc network, quality of service, video transmission

1 | INTRODUCTION

With the rapid advancement in hardware and telecommunications companies, online video transmission is one of the most significant research areas. A mobile ad hoc network (MANET) is a cluster of transferable devices that define a self-organized multi-hop network.[1] These networks are mainly used for military, healthcare, disaster recovery, site monitoring, environmental monitoring, and so on. The wireless transmission takes place in MANET,[2] which transmits information from one source node to another terminus node. It is called a self-starting dynamic network that includes more mobile devices. MANET nodes have less comparable speeds in random or dynamic routes.[3] Therefore it is very difficult to trace data from one node to another with long-term security. In addition, it is used in areas such as military applications, disaster relief and surveillance of animal habitats. It wants alternative solutions because the network does not have an exact infrastructure.[4] With the help of a wireless network, communication between MANETs takes place through routing protocols effectively by sending and receiving data packets without major packet loss.[5] In order to carry out effective communication, MANET must meet certain quality of service (QoS) requirements.[6]

QoS in MANET is one of the innovative research areas and is constantly being further developed using various techniques. Different types of boundaries like packet delivery ratio (PDR), throughput, jitter and end-to-end delay (E2ED) stimulate the improvement of QoS in MANET.[7,8] Modifying the techniques, protocols, and mechanisms will improve the above parameters. For the desired network traffic, QoS can be enhanced to provide a high level of service with different types of technologies.[9] QoS routing is convincing due to the continuous QoS obligation, which ensures the route from the source to the terminus node. Due to the topology change, maintaining QoS in MANET is seen as an important problem. Establishing a safe route between the nodes is important to avoid such problems. Therefore, research in MANET has received more attention in recent years, as there is no suitable technique to create a better QoS in MANET. In order to ensure the QoS, no adequate mechanism has been discovered to calculate the available bandwidth.[10]

The MANET is basically divided into homogeneous MANET and heterogeneous MANET (H-MANET). The homogeneous MANET comprises the same node with the same capabilities, and the heterogeneous MANET comprises different nodes with different capabilities. The H-MANET contains mobile devices with different communication capabilities. For example, radio range, data transmission, battery life, and so on. Although a homogeneous network model is fundamental and easy to study, it lacks the significant qualities of numerous reasonable MANETs,[11] such as front-line military organizations. In addition, homogeneous ad hoc networks experience terrible performance and versatility. In numerous unprepared networks, various nodes coincide, and a few nodes have a higher transmission power, a higher transmission information rate, better processing capacity and greater robustness against bit errors. As a result, a heterogeneous network model makes more sense and offers numerous advantages (eg, Prompting a more effective routing protocol plan).

For example, QoS is important in information-driven video transmission applications, specially equipped conferences and games in order to achieve high-quality video transmission.[12] Various measurements such as encryption bit rate, start time, cushion delay and accessibility of the administration have a direct effect on the QoS. Because of H-MANETs and the Internet, maintaining QoS and providing high-quality video transmission from start to finish is difficult for information-driven transmission frames.[13] Through continuous execution verification and versatile broadcast, video service providers can review the presentation of information-driven video broadcast frameworks, improve real-time capabilities, and become the number of crowds through better help. Information-driven video transmission frameworks can limit business costs through advanced transmission strategies, for example, versatile video transmission. The versatile video transmission can help to reduce the buffering problem and gradually enable interference-free video transmission through competent routing methods.[14]

Figure 1 shows the heterogeneous MANET. QoS in H-MANET is improved with the help of different routing and medium access control (MAC), propagation models, resource allocation and reservation. However, it is not easy to see the researchers' relationship, as the reported efforts only discussed certain features to improve QoS in H-MANET.[15] In addition, many techniques have recently been developed to improve the performance of H-MANET; until now, they have not found the generally accepted technique or protocol to improve QoS in H-MANETs and reduce routing overhead.

Although H-MANETs are extremely adaptable and suitable for a wide range of scenarios due to their infrastructure-less and self-organized nature.[16] They have significant limitations, including variable capacity links, bandwidth constraints, energy constraints, and security threats due to various vulnerabilities. The shared nature of the wireless channel, mutual interference between close nodes, resource-constrained devices, and lack of infrastructure or centralized management impose these constraints. In addition, the changing architecture of these networks produces frequent connection failures and high error rates, making maintaining a required level of QoS much more challenging. Because of the growing popularity of mobile devices, H-MANETs are becoming more important for wireless communication. H-MANETs do not currently offer real-time video transmission or multimedia applications. As a result of the high demand for video material from mobile devices, it has become critical for H-MANETs to have effective routing and QoS procedures in place to facilitate multimedia content delivery.[17] As a result, not all routing systems can deliver the same degree of QoS that video transmission through H-MANETs requires.

The video transmission efficiency of H-MANET routing protocols varies, considering the nature of the system or the fundamentals of its functioning. Furthermore, the influence of each protocol varies depending on network situations,

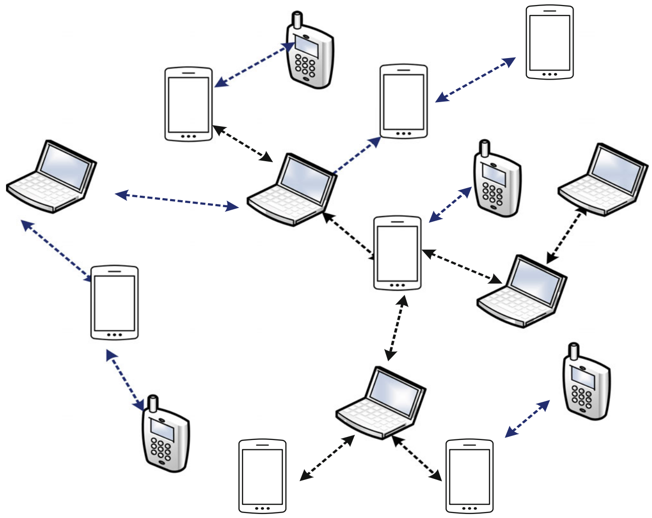

FIGURE 1 Heterogeneous MANET

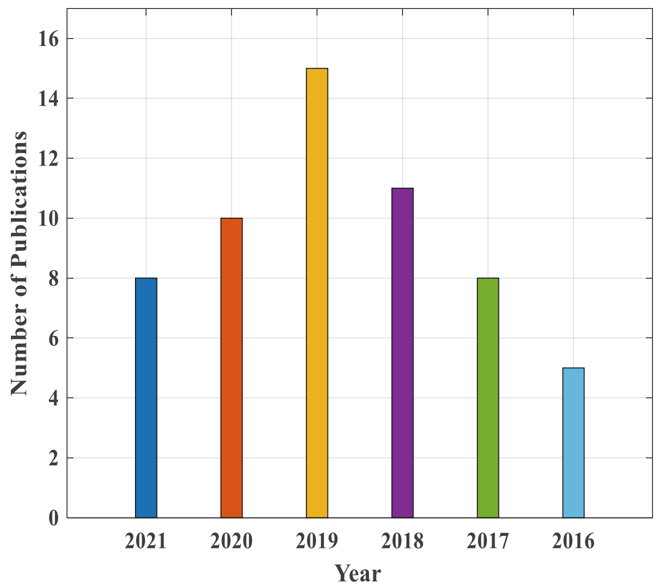

FIGURE 2 Number of publications per year

such as network expansion (expanding or network dimension scalability), high mobility speed (m/s), and network node count (node density). In addition, there are the protocol's parameters and how to customize them. According to the literature,[18] no super routing protocols can ensure the appropriate level of QoS adapts to scalability and mobility while providing security features. The majority of H-MANET routing protocols are designed to discover a reasonable route from a source to a destination without considering network resources or application requirements.

In H-MANETs, traditional routing protocols do not enable QoS, energy efficiency owing to packet sending and receiving, and acceptable levels of security at the same time. Each protocol has its routing strategy; however, no one method can work in all topological scenarios.[19] As a result, effective deployment of H-MANETs may require a combination of methods. H-MANETs, on the other hand, do not yet enable integrated strategies for efficient routing, QoS, energy consumption, and security. It can ensure the appropriate degree of QoS for video transmission, such as low (E2E-delay, jitter, network load) and high (Packet Delivery Ratio (PDR), throughput). To alleviate or reduce the constraints of H-MANETs, better techniques or processes in routing protocols might be developed to improve video transmission.[20]

The graph depicts the number of publications by year. Figure 2 shows the change in the number of publications on video transmission in H-MANET throughout time. According to the data, the number of publications was highest in 2019

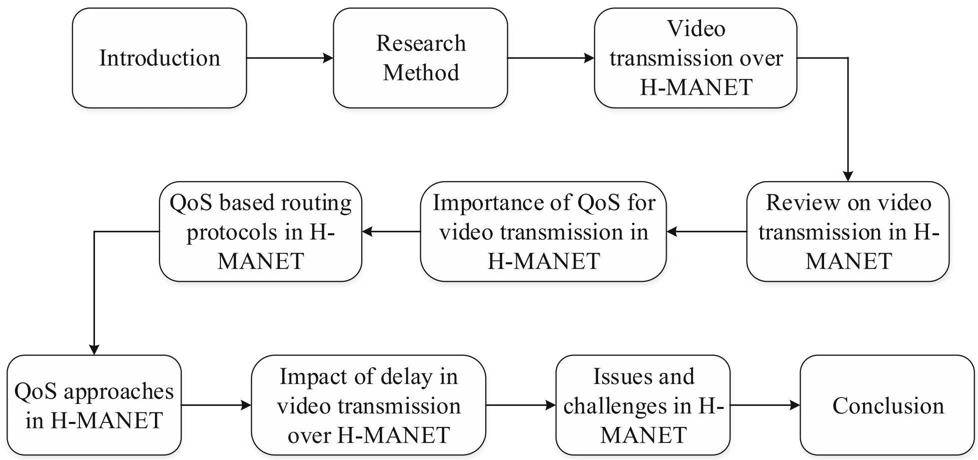

FIGURE 3 Road map of the survey

compared to past years. From 2016 to 2021, there has been a progressive increase in the number of publications. From 2016 to 2019, it reached its highest value, after which the number of publications decreased. Figure 3 shows the Road map of the survey.

1.1 | Motivation

The latest advancements and improvements of limited-cost portable devices like smartphones have sparked a surge in interest in wireless MANETs, in which any vehicle, person and appliance may interact through short-range radio. Furthermore, developing wireless technique standards such as IEEE 802.11 has grown popular and concerned a lot of courtesy from the research industry and the community. As a result of these advancements, wireless solutions have increased rapidly. H-MANET is a modern communications paradigm that offers some benefits, including minimal startup costs, quick deployment, disruption resistance, and high bandwidth. Despite the numerous benefits of H-MANETs, in present actuality, they have yet to achieve the expected influence in terms of actual positioning and manufacturing approval, generally owing to the lack of mobile architecture connectivity. Software applications such as video conferencing, video coursing, and environmental monitoring must be made available in real-time H-MANET since video material has become a driving force in our everyday lives. The total performance of H-MANET is influenced by node mobility, battery life, mobility speeds, alterations in topology, system size, safety risks, and routing procedures. As a result, achieving excellent QoS for multimedia applications is difficult with the H-MANET. In order to offer effective QoS in an H-MANET, researchers must investigate the impact of the sum of mobile nodes, mobility speed, routing procedure, and system size behaviors on QoS.

1.2 | Contribution

The key influence of our paper is to discuss the survey of QoS-based video transmission in H-MANETs. In this survey, the QoS based routing protocols that provide huge support for efficient video transmission in H-MANET are discussed. Improving QoS is considered a major contribution, as it can make the architecture user-friendly. Further, the types of delay that reduce the system performance are also discussed. The details provided in this survey are useful for the authors seeking to develop a better architecture that enhances video transmission performance in H-MANET. In this survey, the basic routing works in MANET are discussed, followed by the works that show efficient performance for video transmission in H-MANET. As recent works in this area are fewer, possible papers are surveyed in this work. The reviewed works are helpful for the authors to carry out efficient work related to video transmission in H-MANET.

In the next section, we provide the systematic literature review, search query, selection of sources and study selection. SLR provides guidelines to researchers by motivating new work. Moreover, video transmission is the most significant research area in H-MANET, which can be clearly described in the third section and section 4 reviews different video transmission approaches over H-MANET. The significance of QoS for video transmission over H-MANET is discussed in the fifth section. Different routing protocols that concentrate on improving the QoS of video transmission in H-MANET have been described in section 6. In section 7, the QoS based techniques for video transmission are discussed.

Further, the impact of delay in the video transmission on H-MANET has been clearly described for video transmission in section 8. Further, different challenges and issues have arisen while providing QoS for video transmission, as discussed in section 9. Finally, the conclusions and future possibilities have been presented in the last section.

2 | RESEARCH METHOD

The procedure of SLR is mostly established for medical investigation schemes and gives particular instructions and advice to assist researchers in executing a proper, impartial survey. Repeatable determines, evaluates, and works to respond to a managing research question. Moreover, fresh work offers a strong enthusiasm to researchers and gives a complete indication to guide decision-making. It is most valuable for researchers and needs complete and unbiased attention to examined works. The coverage of examined works in the research questions is increased by identifying the most alternative concepts, words, and synonyms. The terms are selected to design the search strings that give the most relevant interest concept. Then, a few corresponding papers are neglected when authors utilize various terms from our examination.

2.1 | Search query

Identifying the journal articles is a goal of the search process that investigated the QoS for video transmission in H-MANET. It focuses on the factor of exploration that influences their recognition. The request interaction utilizes online logical data sets for the survey. By choosing the most suitable keywords, we characterized a question string. The exploration queries are utilized to build an exploration string in the information bases. The information replication characterized the accompanying search string by tallying equivalents and elective spellings for the survey components.

The search keywords consist of the subsequent steps:

- Use research questions to categorize the most important keywords,
- Recognize other arguments and substitutes for the most important keywords,
- Setting a search string by assembling these keywords with Boolean AND operator,
- The Boolean OR operator is used for alternate words.

2.2 | Selection of sources

The search was conducted from 2013 to 2021 using the Logical Online Database for this survey. The selection of sources involves three main steps, (a) the article is searched for related keywords, (b) the articles are selected by abstract, title and quality of the editor, (c) journal and meaningful analysis. The main search engine is Google Scholar. In this way, the regular examination recognizes articles from the journal, conference articles, and volumes. The online database is mentioned in Table 1.

TABLE 1 Online databases

Online database	URL
IEEE Xplore	https://ieeexplore.ieee.org
Springer Digital Library	https://link.springer.com
ACM Digital Library	https://dl.acm.org
Elsevier Science Direct	https://www.sciencedirect.com

2.3 Study selection

Google Scholar guides the web crawler to find important articles based on keywords. Searching next to keywords will find articles in ACM's magazine, conference papers and computer library. At this point, the title of the papers was checked, and the unimportant title was removed. Our test determination measure comprises four phases: elimination depending on the branch of knowledge (computer science and data innovation), rejection depending on the title, and omission depending on eliminating unusable articles (eliminated books and articles not written in English). Avoidance depends on the substance of the theoretical and ends.

3 VIDEO TRANSMISSION OVER H-MANETS

In recent decades, video transmission and cooperating video have been the most interesting research topic in H-MANET. In 2019, according to the novel report from Cisco, 80 % of the global internet utilized video information. Traffic from mobile and wireless strategies will increase to 66% of all traffic in four centuries. Since video broadcast is severely affected by different features like resource constraints, dynamic variations in topology, mobility, and the absence of fixed architecture and mobility, video transmission is the most difficult task in H-MANET. Hence, it is most significant to appreciate the possibility of executing such facilities on H-MANET[21] and identifying the number of resources needed to offer valuable QoS. A streaming approach executes the data transferring process at a continuous and steady stream. Before playing, users do not know the essential delay for downloading the entire media file (audio, video, or animation). For example, streaming allows viewers to watch a movie while waiting for the rest to download, which might take a long time. Multimedia streaming is also used in various applications like distance learning, Telemedicine, Video-Conferencing, IP telephony, multi-player games, live sports events, and Video-on-Demand (VoD). In general, three sorts of streaming applications are employed:

- Streaming Kept Video:
  - At the time of server request, the stored video on the transmitter side is sent to the client
  - It starts playing before the arrival of the data, rewind, pushes the slide bar, fast forward, a client can pause, and so on.
  - The most important challenge is the startup delay for this type.
- Streaming Live Video:
  - Video material is transferred from a server to a client in the same way that stored video is streamed.
  - The user cannot fast onward but can reverse and pause in such cases.
- Actual Collaborating Video:
  - It permits both the transmitter and the receiver to send and receive information.
  - The most significant difficulty is the play-out delay.

4 REVIEW BASED ON VIDEO TRANSMISSION OVER H-MANET

Castellanos et al.[22] developed an AQA-AODV routing protocol to improve MANET and heterogeneous MANET interoperability. This method is mainly focused on improving the network conditions for video transmission in H-MANET. The proposed approach is implemented by video transmission, and existing methods evaluate performance. The result shows that the proposed algorithm avoids video transmission congestion and provides good video quality. Duraimurugan et al.[23] introduced consolidated throughput for different streams to expand the quality of administration in disseminated media transmission. This plan is utilized when the client gets the video bundles from numerous workers, where every association shapes an alternate stream. Through this plan, the area where at least two streams consolidate is recognized, and the transfer speed in the channel is separated similarly between the various streams, expanding the network execution and powerfully changing the transmission paces of the relative multitude of joined streams.

Khalaf et al.[24] industrialized a procedure named the least delay path estimation routing procedure. This procedure is mainly focused on efficient multimedia transmission over H-MANET. This process is employed to sense the dissimilar delays while transmitting the packet. This proposed method fulfils the QoS and discovers the path with minimum time delay. Moreover, it has been proved that this method is more efficient for transmitting high-quality video. Mantzouratos et al.[25] offered a review of 44 works in the field of MANET video streaming. The obstacles and solutions employed to address these concerns were explored in this paper. The evaluation's comparison tools, variables, and metrics are given. Some of the proposals are discussed in greater depth.

Harold Robinson et al.[26] developed a Fuzzy-enabled PSO-based energy efficient (FPSOEE) procedure. A portable node's battery life is prolonged in MANET by recognizing the shortest path. FPSOEE is exploited to forward the information packages to enhance QoS after the link failure. The source node selects the best route by promoting the way of finding a note to all its neighboring nodes in the route detection stage of FPSOEE. Data overhead and failure will transpire when any route failure happens. Therefore, node mobility is related to multipath routing in MANET. A PSO-based energy-efficient algorithm is suggested, and mobile node information is collected by the source node based on its energy efficiency value. The source node conquers this info to determine the transmission range of the mobile nodes. Multipath routing performance is optimized with the Fuzzy concept in MANET. Rath[27] developed a method for multimedia transmission. The method is enhanced by RMA (Rate Monotonic Algorithm) and EDF (Earliest Deadline First) algorithms. This method mainly focuses on the efficient service quality for the network layer by utilizing inter-layer communication. According to the algorithms, an updated scheme was utilized by this H-MANET for better performance and to estimate the optimal parameter values. The simulation outcomes enhanced the jitter and delay of the network and minimized the computational complexity.

Jai Agarwal et al.[28] have introduced the Cuckoo Search algorithm on Ad-hoc on-demand Multipath Distance Vector (CS-AOMDV) for routing in MANET. Tracks with high fitness values were considered by this technique to transfer information from starting point to the ending point. Also, hop count, energy efficiency metric, and delay have been taken to determine the best paths. At the Route Reply (RRPLY) process, the CS is combined with AOMDV. This routing technique minimized the path failure and found the optimal path for data transmission. Also, the communication overhead has been decreased using this method. Sherin Zafar et al.[29] developed a quadrated method-based QoS optimization in wireless networks. Identifying a short way between the sender and receiver was the main concern. At the same time, optimization of various QoS parameters like throughput, PDR, and delay is considered here for better optimization performance. The meta-heuristic method is considered for the analysis of network parameters.

Ramadan et al.[30] developed a memetic algorithm (MA) in H-MANET. This MA performed the multi-constrained multicast routing. Furthermore, the proposed routing approach has solved this multicast routing issue. An adaptive mutation parameter was developed for efficient routing in MANET with computational efficiency and greater searching capability. According to the statistical analysis, an updated scheme was utilized by this MA for better performance and to estimate the optimal parameter values. The simulation outcomes enhanced the jitter and delay of the network and minimized the computational complexity. Prabha and Ramaraj[31] has developed an enhanced AOMDV strategy for routing in video streaming. Node mobility, bit error rate, queuing delay of neighboring nodes, and link availability are considered for performing the routing operation. BAT meta-heuristic optimization was exploited to choose the best path. The experimental outcomes have proved that this technique was better than the existing AOMDV for routing. Moreover, the path break was minimized and required less computational cost. However, if the link availability was reduced, the path was disconnected during routing.

MANET is an attractive network as it can efficiently transfer information from one client to another at any time or place. In MANET, the most prominent protocol that shows efficient performance for transmitting videos by adjusting the traffic over the PHY IEEE 802.11g is AODV.[32] OPNET was used to develop the network model. Finally, the performance metrics like E2ED, routing overhead, PDR, and throughput were evaluated for analyzing the system performance. Self-organized clustering was developed by Aftab and Zhang[33] for mobile MANET. A combination of two soft computing methods, firefly and dragonfly algorithms, are hybridized for clustering. Cluster formation and cluster management are performed with this hybridization process in MANET. Load balancing is also covered here to give a better cluster management process.

Multiple description coding (MDC) was suggested by Fleury et al.[34] for multipath delivery in MANET. This research studies the overview methods of video streaming in MANET. This paper mainly demonstrates that the video quality and quality of the experience depend on the node and node speed in transmission. It was a reliable, effective, and greatly adaptive method for video transmission. This method decreased the communication overhead for routing. Sheltami et al.[35] investigated the Warning Energy Aware Cluster head/Virtual Base Station on Demand (WEAC/VBS-O) procedure under video traffic regarding average delay, multi-hop connectivity, and power reduction. In MANETs, all mobile device performances as a router are particularly vulnerable to these difficulties. As a result, direction-finding delay contributes expressively to general end-to-end latency. The simulated network was modelled using the H.263 and H.264 standards. The HCB concept was also used to reduce energy consumption.

Zafar and Soni[36] suggested Trust based QoS protocol (TBQP) by GA to protect the MANET. In order to offer better performance, GA was utilized to find the shortest path by maintaining QoS with the fittest value. Nowadays, QoS problems are explored by neural networks (NN) based on artificial intelligence (AI), intelligent optimization methods, or meta-heuristic procedures like GA, PSO method, and simulated annealing (SA) techniques. Unauthorized data modification impersonation was some defiance of restraining attacks faced by the Ad-hoc network. Demostences et al.[37] suggested a video quality assessment approach for video streaming. The users' profiles, which included their preferences, were saved on a film server to do this duty. Then there were subjective video superiority valuation examinations, in which assessors had varying video information favorites. According to the findings, the QoE of the assessors is substantially connected with the user's favorite video information type. According to the findings of the experiments, the Preference Factor (PF) function is created and e-enact to change the superiority index values produced by an independent video superiority metre operating in the end user's device.

Madhankumar et al.[38] introduced video observation. Moving article recognition from a video grouping is a major and fundamental work in various PC vision applications. After this methodology, in object discovery, most fundamental highlights are isolated from video edges and upgrading our acknowledgement execution breathed life into progress techniques. Finally, the ideal highlights a profound learning way to manage and recognize the item from Laparoscopic Surgery Medical Video (LSMV) outlines. The vein and a couple of items are perceived. Distinctive edge-based reconnaissance estimations are used to survey the proposed approach. Preliminary outcomes and similar assessments depict the proposed approach's adequacy (95.56% exactness). In H-MANET, a modified ACO has been suggested by Banerjee et al.[39] for routing purposes. An on-demand power-balanced routing algorithm has been introduced for finding the path among communication endpoints in multi-hop ad-hoc networks. According to ACO and swarm intelligence, this protocol has performed the routine. The solution ability of swarms was mapped with the engineering and mathematical problems using this method. It was more reliable, effective, and greatly adaptive than other methods. This method decreased the communication overhead for routing.

Mandhare and Thool[40] introduced a meta-heuristic method to improve the QoS routing in MANET. Using the on-demand protocol, the CS algorithm decreased the constraints of QoS. According to the optimal fitness value, the QoS path was chosen by this method. Hop count, residual energy, and routing load are the parameters considered for the fitness value evaluation. For RRPLY, the meta-heuristic technique was applied to the AODV protocol. Better QoS routing metrics were provided, and the QoS constraints are satisfied by this proposed protocol. Scalability, congestion, and mobility are the three conditions tested by the developed approach. The conventional AODV, Particle Swarm Optimization (PSO), and ACO are the existing approaches considered for the comparison.

Furthermore, Xu et al.[41] introduced the direct jamming issue in H-MANET, where a jammer irregularly intrudes on the correspondence channels, and the transmitter needs to figure out which schedule opening to send information to dodge the interference. Gaining on the verifiable experience, a Deep Q-Network (DQN) based methodology is proposed to produce transmission choices at the transmitter. Moreover, a variation of DQN, named versatile DQN, is acquainted with adapting to the difference in sticking conditions. The enactment results show that the proposed plan can become familiar with an ideal strategy to direct the transmitter. It is more rapidly and productively than a Q-learning gauge. Besides, the adequacy and power of the versatile DQN are additionally mathematically confirmed.

Lindeberg et al. recognized the difficulties of achieving video streaming over MANETs.[42] The distribution of combined optimization and parameter swaps was investigated. Attempts to actualize video streaming over MANETs have run into many roadblocks, which have been solved in various ways. Cross-layer optimization, reserving and repetition, and packet prioritization are some examples. To offer appropriate video quality to the recipient(s), cross-layer optimization often employs numerous portrayal video coding and multipath routing. Reserving and replication make interruptions and splitting more tolerable. Because of the importance and difficulty of evaluating procedures, the most prevalent methods were studied, revealing that the study domain has a comparability issue. Table 2 shows the review of papers based on video transmission over H-MANET.

5 | IMPORTANCE OF QOS FOR VIDEO TRANSMISSION IN H-MANET

QoS denotes the capacity to offer a facility in conventionality with bandwidth, delay, and reliability, which means the network offers few assurances or guarantees to an application. Different metrics like packet loss, jitter, throughput,

TABLE 2 Review based on video transmission over H-MANET

Reference no	Method	Objective	Merits	Demerits
22	AQA-AODV routing protocol	To expand the interoperability among MANET and H-MANET	Good quality video	Link stability and mobility are not considered.
23	Distributed multimedia transmission (DMSHN)	Expanding the superiority of administration in conveyed multimedia transmission in a heterogeneous remote system	Increase the quality of service	Limitations in combined audio/video applications
24	Least delay path estimation routing protocol	To minimize the delay in multimedia transmission	Advanced search ability and computational proficiency.	Create trouble to robust search performances.
25	Cross layer scheme	To provide the survey of various papers on the region, tool, metrics, etc.	Less congestion, less delay	The system is not efficient
26	FPSOEE	To enhance the QoS by accelerating the packet with a link failure.	The quality of mobile nodes is increased with multipath optimization.	Link breakage occurs.
27	RMA and EDF	To ensure efficient routing for video transmission	Better in terms of secure routing.	Not considered the energy efficiency while routing.
28	CS-AOMDV	To minimize the overhead during the routing process.	Satisfies the QoS parameters during the route discovery process.	Routing cannot be performed for Vehicular Ad-hoc Networks (VANET).
29	GA	To optimize QoS parameters in different networks like wireless, ad-hoc and MANET.	Achieves lower packet drop rate, lower E2ED and highest PDR.	QoS routing procedure is the maximum interesting job.
30	MO	To resolve multicast routing problem.	Advanced search ability and computational proficiency.	Create trouble to robust search performances.
31	BAT optimizer for routing.	To invent the best path based on neighboring node queuing delay and link quality.	Enhance the network performance and balance the load across the network.	E2ED is high.
32	AODV	To perform video transmission with nonstop stream and consistent	Scalable and achieves high throughput.	It shows poor and worst performance in jitter
33	Hybrid Dragonfly and Firefly.	To achieve cluster load balancing.	Avoid congestion while routing and manage the changing topology.	Energy consumption is high for the clustering process
34	Multiple Description Coding	To view video quality and quality of experience.	Efficiency video transmission	Overhead issues occurred.
35	WEAC protocol	To analyze the performance of WEAC procedure in terms of delay, multi-hop communication etc.	Reduce the power consumption	The sudden death of CH issue has been a rise
36	GA	To find the shortest route to provide better performance.	Provides more security compared to previous methods.	Isolation of malicious nodes is not implemented.
37	Video quality assessment scheme	To develop a novel video superiority metric in video streaming facilities.	Low complexity	Not applicable

(Continues)

TABLE 2 (Continued)

Reference no	Method	Objective	Merits	Demerits
38	NS3, VLC, LXC	Video transmission between the nodes through a VLC media player.	High average quality	Not applicable
39	Modified ACO	To reduce overhead for the routing process	The proposed protocol is highly adaptive, scalable and efficient.	PDR is not improved
40	CSO	To satisfy the constraints of QoS.	Avoids congestion and provides better mobility and scalability.	Not provide robustness to the system.
41	Cross layer QoS assurance fault tolerance	To present the cross layer fault tolerance routing for data communication	High throughput, the high packet success ratio	Performance is degraded due to some failures
42	Cross layer optimization method	To present the tasks of recognizing video issuing over the network.	To provide the sufficient video quality	It suffers due to comparability issue

bandwidth, end to end delay, and so on, are utilized for QoS estimation. In H-MANET, QoS is most problematic for assurance purposes because bandwidth is shared among the mobility causing system topology variations and neighboring nodes. In various structural layers, different elements are employed for a perfect QoS solution in H-MANET. The structure model of QoS will provide the possible best services,[43] and it denotes what kind of services can be provided. The challenges are overcome by the models imposed by H-MANETs, including the need to deliver complicated functionality with partial resource obtainability in a dynamic situation where linkages alteration often owing to node flexibility, affecting dependability and energy depletion limits. Due to their low cost, versatility, ease of deployment and usage, H-MANETs are rapidly being employed in multimedia streaming transmission. The range of applications such as remote environmental, surveillance, animal monitoring, rescue operations in harsh situations, telemedicine, and remote exploration drive this expanding interest in video streaming via H-MANETs. These multimedia applications have tough Quality of Service necessities in terms of latency, jitter, loss rate, bandwidth, cost, and security assurances, among other things. The support for QoS in these services is a hotly debated topic. Due to their dynamic nature (eg, node mobility), the undependability of wireless connection and partial resources devices in energy, processing and storage by providing QoS via H-MANETs faces some significant issues.

Furthermore, the network's QoS frequently involves coordination across several tiers (Mac, network, transport and application). With the huge demand for video content, an efficient routing system and QoS techniques have become critical for H-MANET. Actual video transmission is time-sensitive, requires encryption and decryption, and has the required bandwidth and quality of service.

Technological advancement in cloud computing and 5G offered a prominent enhancement for multimedia streaming in MANET. It helps achieve high QoS performance, considered the major challenging task for mobile devices. For that, 5G-cloud assisted MANET, a 3-tier architecture, was developed in Reference 44, which comprises cloudlet, MANET and cloud tiers. The node separation and clustering were initially carried out for cluster size optimization. For optimal partitioning, the improved monarch butterfly optimization algorithm (IMBOA) and the importance rate for each node were estimated for CH selection. Then, the CH broadcasts a selection message to all nodes for framing a cluster around each CH. Then, the Kuhn-Munkres algorithm was developed for d2D communication, which performs optimal device communication and enhances data transmission efficiency. Two different routing processes were followed they are cloudlet and inter-cluster routing. An improved form of Takagi Sugeno fuzzy type-2 was performed by cloudlet, and chaotic flower pollination was used by inter-cluster routing. Finally, the full interpolation and video coding method (ie, scalable) was introduced to improve the QoS of multimedia data encoding. Further, task offloading was performed to balance the cloudlet load. The performance metrics like PDR, completion time, E2ED, bandwidth consumption, and throughput were evaluated.

6 | REVIEW OF QOS BASED ROUTING PROTOCOLS FOR VIDEO TRANSMISSION IN H-MANET

Planning a competent routing procedure for H-MANET is an urgent tricky. The primary goals of an effective routing procedure are to identify the best location of the path and discover the best path between a source and an endpoint. Using the least overhead/control messages through routing protocols to achieve both goals. It is the versatility of the node and one of the major obstacles a routing protocol must overcome. A competent routing protocol should have some attributes, specifically dispersed activity, circle freeway disclosure, and request-based activity.[45] In memory of these problems, researchers have proposed routing protocols for H-MANET. These protocols react to topology changes that the H-MANET can delegate proactively and receptively.[46] The sequence data is occasionally traded between the nodes with proactive routing protocols. Each node is allowed to independently produce worldwide information via the network. Dynamic Destination Sequenced Distance Vector (DSDV) is the most common agent of proactive routing procedures. DSR and AODV are the most frequently mentioned agents of responsive routing protocols.[47] Responsive routing protocols are an important waste in data transmission with flooding techniques. A mixed and position-based routing protocol has been proposed to overcome these weaknesses.[48] An overview of studies on QoS provision in a MANET explained the problems and challenges in providing QoS in the network. Different approaches for QoS provision at dissimilar stages were discussed, comprising MAC, routing, and cross-layer levels, and the main features of different solutions and techniques were compared.[49] The most important routing protocols for video transmission in H-MANET are the geographic routing protocol (GRP), optimized link state routing (OLSR), dynamic source routing (DSR), Temporally-ordered routing algorithm (TORA) and Ad hoc on demand distance vector routing (AODV).[50]

6.1 | Dynamic source routing

The DSR is a receptive routing protocol for H-MANET. The key benefit of this procedure is that it can handle one-way connections and does not require intermittent routing packets. Route finding and route preservation are the two key operations in DSR. The route finding contains a route request (RREQ) and a route replay (RREP). The node sends the RREQ to the neighboring node in a route discovery phase. In each node, an ID is included in the RREQ for sending. Each buffer is added to the node to recognize the node. The route preservation methodology is employed when routes become unenforceable due to the unusual development of switches. Each switch checks the connections it uses to route packets. If a connection is broken, the packet route fails, and the packet quickly initiates the appropriate routes; this invalid route will be discarded immediately. To deal with the inconsistent transmission of control messages, the DSR depends on the basic MAC procedure to ensure secure transmission or resends control messages at a particular time.[51,52]

MANET is a dynamic network which does not contain fixed architecture, and the nodes in the network interact among themselves using multi-hop routing. AODV was mostly used in various works. Similarly, the AODV was introduced in Reference 53 to improve the network lifetime by improving the battery life, data rate, radio range, transmitting power, etc. The most important advantage of this method is improving power consumption performance. Further, improving cooperative communication was concentrated in Reference 54 heterogeneous MANET. To complete this objective, four different parts were used to perform cooperatively to achieve better performance. Initially, the QoS parameters were analyzed to select the perfect relay at each location. Then, the model intends to improve the E2ED performance. After that, the priority analysis was performed to conclude the demerits and merits of each QoS parameter. Finally, the gaming decision was introduced to integrate the merits of different QoS parameters. Based on that, an inference was made to determine the PDR and throughput.

6.2 | Ad hoc on demand distance vector routing

The AODV is also known as the Responsive Routing Protocol.[55] The RREQ, RREP, and Route Error (RERR) message types are employed by AODV to determine the route. When the source node directs the message to the endpoint node, the source node first checks the valid route in the routing table. When the route is withdrawn, the source node refers the packet to the endpoint node. The source node starts route detection assuming the valid route is not in the routing table. The node contains an IP address. The RREQ comprises the source node's IP statement of the endpoint node and the modern system number. The AODV protocol contains the number of hops recorded by a packet rather than a unique number of current IP addresses. During the route exposure, the connection is established using a switch. This connection sends the request. AODV is like DSR.[50]

6.3 | Temporally-ordered routing algorithm

It is a mobile routing procedure for multi-bounce systems. In addition, TORA is a transmitted process that controls and manages information about its neighbours.[56] TORA is like a pre-objective premise, like distance vector procedures. It uses one component that consolidates responsive and active routing. In an appealing mode, the sources start the route plan. At a similar period, designated objections can begin positive activities to create protocol routing tables. TORA supports a different routing and limits the correspondence overhead associated with changes in the network topology.[57] The explanation is that TORA follows different routes and does not have to find another way if the system topology fluctuations. As a cluster of routes is employed for routing, TORA allocates bearings to each connection as indicated by the status of their adjacent modifications for downstream or upstream. One connection is measured as an upstream connection for the minor adjacent controller and a downstream connection for the higher adjacent controller. TORA is an amazing algorithm in contrast to DSR. Creating routes, maintaining routes, eliminating routes and improving routes are the four activities of DSR.[58] The making routes activity is utilized to choose the appropriate statures to control the messages in the network. Maintenance of routing activity is used to arrange topology changes. TORA creates multipath routing and uses the upgrade routes' capacity to change the switches' status to improve routing.[59]

6.4 | Optimized link state routing

The OLSR is a proactive link status routing procedure for MANET. The main goal of this procedure is Multi-Point Relay (MPR).[60] During the saturating interaction, it controls the transmission of messages. Packet sending, neighbor detecting, and topology revelation are the three capacities of the OLSR. Packet sending and neighbor detecting provide links to data about the neighbors and provide an improved method of flooding messages on the OLSR network using MPRs. In order to distribute nearby data throughout the network, neighbor discovery activity allows connections. The topology disclosure is employed to decide the structure of the whole system and to refresh the direction-finding tables. The four message forms of this protocol are Network Association (HNA) messages, Multiple Interface Declaration (MID) messages, Topology Control (TC) messages and "Hi" messages.[61] "Hi" messages are used for neighbor detection. TC messages are subject to topology revelations. Interface instructions and the task of numerous interface messages are contained in MID messages. HNA messages are used for advertising-related network information. The OLSR sends a hello message to find one-hop neighbors and two-hop neighbors. All transmitters can select the multi-way relay to choose the best route based on one-hop neighbor and two-hop neighbor. The OSLR contains TC with MPR to inform the neighboring node's information in the network. In addition, the OSLR uses HNA messages for network route advertisement.[62]

6.5 | Geographic routing protocol

The GRP is position-based.[63] It used the concept of geographic routing to exchange information. The floodplain area is updated with the distance as the node moves and crosses the area. In order to distinguish their neighbors and their positions, the "Welcome" protocol is traded between the nodes. To determine the correct location of the system node with dissimilar position systems such as GP and GPRS.[64] It has two routing strategies: greedy forwarding and two routing perimeters. Once a flood in the system has ended, each node sees the underlying situation of the other available node. If the node travels a longer distance than a client has stated or if the node signs a quadrant, routing saturating happens.[65]

7 | SURVEY OF QOS METHODS FOR VIDEO TRANSMISSION IN H-MANET

QoS enhancement with a well-organized routing process[66]: This routing procedure is presented to pick an optimal route based on nodes for routing when disappointment has occurred. Suppose the disappointment of the node occurs based on the attack or power consumption of the node when such a condition occurs. In that case, there is a need to keep or seek a chosen path for information transfer and strategic distance to information loss due to disappointment. The chosen path was chosen subject to the distance and energy of the nodes. The distance vector calculation is found closest to the bombed node. From this event, the energy productivity of this node is checked. If that node's excess energy is based on the threshold mandatory for packet broadcast in progress, the node is designated for the reinforcement path.

Optimal link managed on-demand (*OLMOD*)[67]: This routing protocol is proposed to improve the quality of routing management based on the OLMOD routing protocol. This is how the information is transmitted. Neighbor Organization, Route Finding, Link the Board, and Link Chasing are the four phases of this strategy. In the neighboring management stage, adjacent nodes are found by transmitting a HI message. In the path finding stage, all node finds accessible paths to get to different nodes in the system. However, in the board stage, all nodes uphold the connection to different nodes without erasing them and in connection with how interfaces are recognized.

Enhancement of QoS of AODV routing protocol based on dynamic TTL value and varying queue length[68]: This method is proposed to improve QoS based on different line lengths and dynamic TTL estimation of the AODV routing protocol. AODV routing protocols limit direction-finding overhead and packet loss in the system. In order to build the relationship in the long term, this strategy used consistent TTL word and dynamic limit values. The varying queue length method implies the node cushion size so that there is no packet loss in transmission. The dynamic TTL value establishes the association with the long path and changes the line boundaries while the packet is unlucky.

Increasing the routing technique of AOMDV protocol based on QoS[69]: This procedure is suggested to help identify the reasons for packet loss. This technique is mainly used in the multipath routing protocol. The proposed method found the reasons for the drop and minimized the improved routing technique based on packet dropping. The main reason is that the packet was dropped because the Macintosh is busy, and the line is full. They used the SMA/CA method and applied MAC to identify the optimal path for sending packets for drop minimization.

QoS enabled ant colony based multipath routing (*QAMR*)[70]: This method is proposed for a multipath routing protocol in order to discover ideal paths from different paths based on Ant Colony Optimization (ACO) using QoS. This multipath is chosen according to the inclination path. In this way, the delay in packet transmission is recognized. This method consists of path detection and the path shield phase. Finding numerous paths is called path detection. The path shield level detects an interface occurring while the packet is being transmitted to the correct destination. It will notice this and choose the optimal path for package delivery.

Multipath QoS aware routing protocol (*MQARP*)[71]: This routing protocol is employed for multipath QoS based node-aware routing procedures. This procedure mainly focuses on choosing the optimal path for different node aware paths based on the link lifetime proportion and the average timestamp. Based on a single path-relevant measure, it determines the various node-aware paths. Each node on the path calculates the qualities of the lifetime share and the average time stamp. They determine the best path value from this opportunity and send the warning message to the sender. The sender changes the path and accesses a different path quality in the routing table.

Multi-constrained and multipath QoS aware routing protocol[72]: This method is suggested for a node-disjoint multipath routing procedure based on routing selections depending on the QoS requirements. The requirements are delay, power, and network life. These capabilities will process numerous paths, which will depend on these requirements. The paths that meet these QoS requirements are designated and kept in the direction-finding table.[73] A different path transmits additional information if any node falls short. This technique includes calculating the normal displacement, the fraction of the rated lifetime, and the energy productivity of nodes.

QoS aware adaptive multipath routing protocol[74]: This method is proposed for the QoS-based mobile multipath routing protocol. This method mainly determines the route based on the node-aware routing path. This technique is used in the RREQ message to enable the source node to communicate with the neighboring node. The creator proposed a method for an effective path strategy from multiple paths.

AODV variation to expand QoS[75]: This method is used to change the variation of AODV in order to increase the quality of administration in H-MANET by finding different routes from the source to the endpoint. This method recognizes various node-disjoint paths for the period of the path disclosure stage. As a result, numerous paths are available from the source to the endpoint. At the point when one node flops in the middle of the path, then it continues effectively. Adjusted AODV supports to lessen parcel misfortune because of way disappointment or node disappointment by giving different ways from source to the objective. The course upkeep stage incorporates the broadcast of the HELLO control message to recognize a connection's stability or accessibility.[76] So path support stage decreases the over-burden or flood of bundles after identifying disappointment. Altered AODV diminishes the parcel misfortune and over-burden in the network. Table 3 shows the overview of QoS methods for video transmission in H-MANET.

QoS enhancement for real-time video streaming using multipath routing protocol[77]: Providence of video streaming in real-time in MANET was difficult as it was time-independent regarding the channel status and service requirements. Already available protocols have improved the control overhead performance. However, they fail to perform better in communication breakdown and communication loss. Previous networks failed to cope with streaming videos. Therefore in Reference 77, an architecture that performs time-sensitive video streaming process with less latency and channel failures was developed. It applies two strategies, such as multistate video coding and two-tier zone routing, having non-overlapping and multipath propagation. Along with these, the directional antenna was also incorporated. Finally, the objective and subjective video testing processes were applied to verify the video quality obtained by this method.

Instability and limited network resources have made video transmission in MANET more challenging. Transmitting the video streams over the multipath route enhances the quality of the transmitted video. To achieve this, a fuzzy based QoS enhanced multipath OLSR (FQ-MP-OLSR), which uses 2 fuzzy systems, was introduced in Reference 78 The first fuzzy uses three QoS metrics: signal to interference plus noise ratio (SINR), delay, and throughput. The multi-constrained QoS obtained as output from the first fuzzy was used to identify the best path. Then the second fuzzy system adapted the cost functions that penalize the path determined using Dijkstra's algorithm. Followed to that, the weighted round-robin (WRR) scheduling method was introduced between the heterogeneous multiple paths for multimedia traffic scheduling. It achieves better QoE and QoS performance.

M-AODV and MDSDV based multipath routing: so streaming in MANET was challenging. The lack of dynamic resources, fixed infrastructure and dynamic topology makes the processing and execution of multimedia applications much more challenging in MANET. This challenging task was concentrated and eradicated in Reference 79 by introducing a combined video coding and multipath routing protocol architecture. Two different routing protocols, M-AODV and MDSDV, were introduced for multipath routing and achieved better QoS performance. These two protocols show more efficient results than other existing protocols.

8 | REVIEW OF IMPACT OF DELAY IN VIDEO TRANSMISSION OVER H-MANET

While establishing peer-to-peer communication is the number of complete node delays of the multitude of moderate nodes, it is time for a package to communicate from source to endpoint over a network.

$$\textit{Total delay} = \textit{processing delay} + \textit{queuing delay} + \textit{transmission delay} + \textit{propagation delay}. \tag{1}$$

Processing delay: The time analysis should be coordinated and expanded to define the packet header, known as the processing delay. When the node coordinates the bundle, it is lined within the node cushion. This postponement is restricted to not many microseconds (μs). However, the package will not be prepared unless the entirety of the parts of the package has not arrived. We will use this property when rendering packages for explicit courses. When it comes to video, it is the printing and decompression delays.

Queuing delay: The time spent in the queue until the packets arrive before transmitting a queue delay. This is zero for a bundle arriving at an unfilled cushion as it is coordinated to communicate over the link. For the two packets, the arrival at a third unfilled delay of the charging station corresponds to the transmission delay of the incoming main bundle, and the qth packet will have (Q-1) times the transmission delay.

$$QD = \sum_{q-1}^{q}(q-1)TD, \tag{2}$$

$$QD = TD\left(\frac{q(q-1)}{2}\right), \tag{3}$$

TABLE 3 Survey of QoS methods for video transmission in H-MANET

Reference No	Protocol	Base protocol	QoS metrics	Loop free	Multipath support	Proactive or reactive	Routing overhead	Merits	Demerits
66	QoS-AOMDV	AOMDV	PDR, delay	No	Yes	Reactive	Less	Bandwidth efficiency is better for perfect transmission.	Not feasible for topological changes
67	OLMOD	AODV	Link stability	No	No	Reactive	Less	The system is scalable, adaptive and efficient	Obtained low performance
68	Boosted AODV	AODV	Bandwidth, Hop count and end to end delay	No	No	Reactive	Less	High energy and less delay	Low convergence speed
69	Multiconstrained and Multipath QoS Aware Routing Protocol (MMQARP)	AODV	PDR, delay, jitter	No	Yes	Reactive	NA	Augmented QoS consideration increases the number of routing paths	Convergence speed is not maintained during link or node failure.
70	QAMR	ACO	Hop count, bandwidth and delay	No	Yes	Reactive	NA	High throughput. Efficient, scalable, and adaptive	Less parameters are considered during data transmission. The system only considered the link failure for QoS
71	MQARP	AOMDV	Lifetime Ratio, Timestamp and energy	Yes	Yes	Reactive	NA	Linear jitter variation makes it suitable for audio and video data transmission	Route discovery time is high
72	QAAMR	AOMDV	Remaining battery energy, signal strength and link stability	Yes	Yes	Reactive	NA	This method is suitable for highly dynamic and scalable MANET.	Security of the selected path is less.
74	AODV-QoS	AODV	Throughput	No	No	Reactive	NA	Achieved better energy consumption	Routing overhead is low
75	AODV	–	PDR, delay, throughput	Yes	Yes	Reactive	Less	Good performance	Time is increased

where, QD is denoted as queuing delay, q symbolize the number of packets inside the buffer and TD represents the transmission delay.

Transmission delay: The measure of time devoured to jump out the entirety of the packet bits onto the connection establishes transmission delay. This incorporates the expansion of current switch data and time for conveying the affirmation message to the parent router on the abundant transmission of the message.

$$TD = \frac{p}{dr}, \tag{4}$$

where, p is denoted as packet and dr is denoted as data rate.

Propagation delay: The time a packet travels in a wireless link through the downstream router to the upstream router. The propagation delay value is in milliseconds, and it depends on the mobility of nodes and distance.

$$PD = \left(\frac{d_g}{s}\right), \tag{5}$$

where, PD is represents as propagation delay, d_g is denoted as a geometric distance of the route and s is denoted as link speed.

Thus the delay for r router is denoted as an equation

$$D = \sum_{q=1}^{r} d_{qq}, \tag{6}$$

where, d_{qq} is denoted as node delay at qth node.

Most constraints that concentrate on improving the system performance are route establishment, QoS, data traffic integration, and so on. MANET contains different nodes that utilize different resources during data transmission. One major requirement that needs to be solved while preparing for data transmission is delay reduction. Different delay processes were analyzed in,[80] which perform the packet transmission with less delay and fewer hops. It aims to improve the QoS performance; meanwhile, it reduces the delay by selecting an exact path for data transmission. Additionally, the benefits of other paths were also leveraged; therefore, data rate degradation was reduced. Further, the packetizing concept was introduced in this, enhancing the network's utility and efficiency. It provides efficient performance for multimedia transmission through the heterogeneous network.

9 | ISSUES AND CHALLENGES WHILE PROVIDING QOS FOR VIDEO TRANSMISSION IN H-MANET

While providing video transmission based on QoS in H-MANETs, various issues are reported: insecure medium, lack of central organization, restricted resource accessibility, imprecise state of data, hidden terminal problem, and dynamically changing network topology and error-prone shared radio channel. Plenty of problems are considered unresolved; some issues are already addressed by QoS models in H-MANET.

Wireless medium: While operating in the wireless medium, the H-MANET has some traditional problems based on wireless communication. The wireless medium causes errors based on multipath fading, colliding transmission from other nodes, and other electrical equipment. Recovering from these errors may require the retransmission of data. This causes delays, impacts multimedia communication quality, and jitter.[81]

Topology variations: In node mobility, there are unceasing variations in structure. So the routers in the topology formed and broke rapidly. Due to this, a new route will be formed, and transmission will be delayed. So it will be affected the quality of video transmission. Furthermore, due to the changes in topology, introducing a bottleneck will cause a reduction in the bandwidth.[82]

Multi-hop induced challenges: The endwise path among the nodes in the H-MANET regularly consists of multi-hops. This creates some harmful challenges. One limitation is that the endwise delay is near increases with the number of hops. Thus, the upper bound occurs for the sum of hops and the low end-to-end delay for video broadcasts. Another limitation is that more than 10 hops are used for video conferencing. Many researchers specify that more than three hops cause a delay in the video transmission, which is unsuitable for video streaming.[83]

Absence of secure organization: Due to the absence of structure, the node task returns to a router in the system. This can develop big blockages. Moreover, a lot of accountability is allocated to the node with incomplete resources. This may also cause a delay in the infrastructure.[84]

Unpredictable transmission medium: The wireless medium utilized for transmission in multi-hop wireless systems is inclined to faults because of the multipath fading effects and interference noise created from video transmission of other wireless devices. So, guaranteed packet delivery is considered an important issue.[85]

Unpredictable channel access delay: MAC in H-MANET is distributed because a multi-hop wireless network does not contain any centralized controller. Real-time communication and video transmission lead to difficulty in estimating the delay bounds.[86]

Inaccurate bandwidth estimation: Due to node mobility, wireless links, traffic load, and sensing range, it is very difficult to calculate accessible wireless frequency bandwidth at a router while media transmission.[87]

Lack of centralized QoS control: Centralized controller is not available in H-MANET, so allocation of resources, client nodes location, and QoS management in multi-hop wireless networks are difficult. So, it requires dispersed QoS provisioning, which is more confusing than a centralized network.[88]

Network heterogeneity: A high heterogeneity in multi-hop wireless networks is another key problem in QoS provisioning. In terms of resource availability and level of mobility, mesh routers vary from mesh customers. Compared to single radio mesh clients, mesh routers are normally furnished with several radios.[89]

Varied QoS requirements: QoS requirements of H-MANETs are extremely different and reliant on the exact application situation, which results in problems creating one single standard for QoS supplying to shelter all these changing desires. Identification of toxic leaks in an industry is difficult due to its high reliability in which it promptly alerts the first responder and a medical assistant.[90,91]

False admission control difficulty in stateless QoS models: No consolidated QoS controller is available in a multi-hop wireless system; the current bandwidth availability is checked by sending probe messages in a multiple flow manner. Intermediate nodes will not keep track of probes and reservations due to the stateless behaviour of the QoS model. This multiple flow message may indicate false hope to the network that multiple resources are available when they might not.[79,92]

Flexibility and dynamic topology: In multi-hop wireless systems, routing in H-MANET is disturbed by the customer nodes because they are relatively portable. Because of battery enervation, battery-powered wireless clients act as relay node. In turn, it could be randomly turned off. QoS path reinstallation is required for the topological changes. When topology variation is greater than the haste of QoS track reinstallation, it is terrible to offer QoS.[93]

QoS querying problem and path selection for video transmission: Different multi-hop protocols like AODV utilize RREQ (route request) control packets for route discovery and selection. This kind of control packet has various characteristics compared to actual data packets. RREQ packets are normally provided with priority in transmission and processing at intermediate nodes. This process may lead to selecting paths grouped with congested and unstable wireless links.[94,95]

Multi-layer QoS provisioning problem: QoS provisioning in H-MANET is considered a multi-layer problem compared to wired networks. Routing and transport layers in a wired network achieve the standard QoS provisioning. But, H-MANET requires all the network layers to participate in QoS provisioning.[96,97] Wireless Channel characteristics are quickly changed with the help of the physical layer in H-MANET. MAC must reduce packet collision and safeguard reasonable network entrees and consistent information transmission in a disseminated channel allocation. The network layer fulfils QoS requirements in dynamic network topology, determining the on-demand data communication paths. Delay and packet loss must be taken care of by the transport layer of the H-MANET. To improve the QoS, the application layer must cover the delay, packet loss, and out-of-sequence delivery.[98] Table 4 shows the merits and demerits of video transmission in H-MANET.

TABLE 4 Merits and demerits of video transmission in H-MANET

References no	Protocol	Merits	Demerits
81	AOMDV	It shows efficient performance on both audio and video data transmission	High time is consumed during route discovery.
82	Energy efficient and safe weighted cluster based routing	Routing weight selection improves the performance of dynamic network topology.	Fewer parameters are considered for optimal routing.
84	Hybrid wormhole attack detection (HWAD)	Packet transmission is performed in a safe path and in less time duration.	It is found not flexible for the large topological area.
85	QoS-Aware and Social-Aware Multimetric Routing Protocol (QSMVM)	Improve the trust metric without degrading the QoS	Show a large impact on packet loss while concentrating on forwarding path selection
86	MASEMUL (Movement-Aware MANET Scheduling Strategies for Multimedia Communications)	Improves scheduling strategy using movement information.	The movement that is aware of context information is not considered.
87	Bi-torrent protocol	It is found scalable, efficient and adaptive by providing satisfactory QoS.	Medium utilization and link quality have reduced the system efficiency.
88	Energy efficient multicast video transmission protocol (EEMVT)	High PDR, high throughput and less delay	Other factors like energy status and communication distance are not considered
89	AODV, OLSR, GRP	Provide better performance for scalable and dense MANET	Traffic congestion has increased the processing time.
90	AODV and OLSR	Achieved efficient buffer size and received lifetime.	Optimal and accurate result estimation is not ensured
91	CAM-SCTP (Congestion Avoidance Mechanism—Stream Control Transmission Protocol)	Congestion is avoided, and smooth data streaming is performed over MANET.	It shows limited performance for multiple transmitters and receivers.
92	AODV and OLSR	It supports streaming videos without any fixed infrastructure.	It is not feasible for different applications.
79	M-AODV and MDSDV	With considering about the node's number, it achieves good quality and acceptable performance with small jitter.	An increase in node number reduces the video quality and PSNR.
93	Multi-threading	Provide efficient support for video transmission in a multi-hop manner.	Time taken to reach all nodes is high, which causes packet loss.
94	Topological change Adaptive AOMDV (TA-AOMDV)	It provides high potential support to achieve better QoS for high-speed MANET.	Shows poor performance for topological changes.
95	Energy aware routing	Minimum power consumption with enhanced network lifetime	High-priority packets get lost in some scenarios due to the low score allocation.
96	AOMDV, AODV	Reduces packet delay, and more streams are accommodated by improving the network ability	Selected paths fail to concentrate on time reduction
97	QASEC (QoS-Aware Secured End-to-End data Communication)	Best performance is obtained in terms of loss, delay and jitter	Run time complexity is high
98	MAODV (Multimedia-AODV)	Improve the performance of latency and normalized routing load.	Node density and path stability are not considered, and low PDR is achieved.

10 | CONCLUSION

The most challenging task in H-MANETs is to offer QoS for actual multimedia applications like video transmission. This survey presented different protocols and approaches for QoS-based video transmission in H-MANET. The significance of QoS in video transmission over H-MANET has been discussed. Moreover, here is a review of the taxonomy of video transmission in H-MANET. The challenges and issues of video transmission in H-MANETs are examined, and a survey of QoS-based routing protocols and delay reduction approaches in H-MANETs is discussed. The issues considered when developing these strategies and how they were resolved are also discussed. The development of H-MANET opens up new opportunities in numerous fields, comprising academia, defense, disaster retrieval, industrial surroundings, and healthcare. Nonetheless, numerous challenges must be addressed. These challenges necessitate the development of effective routing processes, instruments for decreasing power depletion and lengthening battery lifetime, proficient usage of partial bandwidth and communication capability, novel information security procedures, and slighter but extra authoritative mobile devices. In the future, the consequence of various traffic representations on current routing procedures will be investigated, and the three-dimensional video broadcast under a multipath structure with path collection will be investigated.

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