Video Streaming issues and Techniques over MANETs

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ABSTRACT

Video streaming in MANETs is most Challenging issue and it mainly affected by these factors like node mobility, dynamic change in topology, multi path shadowing and fading, collusion, interference and many more. The dynamic change in topology causes periodic connectivity which results in large packet loss. Video streaming in real time requires special techniques that can overcome the losses of packets in the unreliable networks. Developments in mobile devices and wireless networking provide the technical platform for video streaming over mobile ad hoc networks (MANETs). And efforts to realize video streaming over MANETs have met many challenges, which are addressed by several different techniques. Here in this paper we have studied and reviewed many issues and different techniques present for video streaming over MANETs. This paper contain work done in the field of video streaming in MANETs and guide newcomers who are willing to work in video streaming in MANETs field.

Keywords-**Video streaming ,MANETs , cross layer design, MDC, Multipath routing.**

I. INTRODUCTION

Mobile Ad-hoc networks (MANETs) are composed by a set of independent mobile nodes which "cooperate" without any type of infrastructure[5], so the mobile nodes are free to move within a network which results in dynamic change of network topology. Other MANETs issues are limited bandwidth, lack of centralized monitoring, cooperative algorithms, limited physical security, energy constrained operations, etc. Ad-Hoc networks are categorized into two types of routing protocols, i.e. Table-driven routing protocols and On-demand routing protocols. Table-driven routing protocols are also known as pro-active routing protocols. These protocols attempt to maintain an updated routing table with routes to all known destination nodes in the network. This has the advantage of minimizing the delay during routes lookup and the disadvantage of these protocols is that it consumes a lot of network bandwidth. Whereas On-demand routing protocols only update the routing table in response to a routing request. This has the advantage of minimizing network traffic overhead and disadvantage of these protocols is increased delay[1].

Motivating application domains for such networks include data communication during emergency response in remote areas, or where a disaster (e.g., an earthquake) has fully or partially destroyed the existing infrastructure. Another application domain is battlefield communication. Given that an increasing amount of handheld devices now are capable of capturing and presenting video content, it is most likely that this will represent a significant percentage of the network traffic that in the future will be transmitted over MANETs. [3][4].

Video streaming in MANETs [1] is one of the most challenging issues. Video streaming in MANETs is mainly affected by these factors like node mobility, dynamic change in topology, multi path shadowing and fading, collusion, interference and many more. The dynamic change in topology causes periodic connectivity which results in large packet loss. Packet loss has the largest impact on the quality of the video. Video streaming in real time requires special techniques that can overcome the losses of packets in the unreliable networks [2].

Compared to the transport of discrete, non-real time data (e.g., file transfer), streaming of video across MANETs introduces many new challenges. The overall challenge is to provide the consumer with a satisfactory perceptional quality, i.e., quality of experience (QoE), sustainable throughout a multimedia session. This means providing sufficient bandwidth in the network, while preserving an upper bound on delay and jitter. It should be noted that constraints on acceptable end-to-end delay is much stricter for streaming of live or conversational content (e.g., television broadcasting, voice over IP and video conferencing), as opposed to streaming of stored content[3]. These challenges have been addressed for video transmission over wired networks for many years. When moving streaming video onto wireless networks, wireless links have far stricter bandwidth limitations. Moreover, the shared nature of the medium imposes a major challenge of getting all participating nodes to collaborate in meeting the aggregate requirements of all simultaneous video streams, in addition to other network traffic. The medium is exposed to harsh physical conditions involving background noise, multipath fading, shadowing and interference. These effects result in time-varying link characteristics and frequent link disruptions, which are not well suited for the stringent requirements of video streams. While a high

node density leads to packet collisions, a low density leads to decreased signal strength. While packet drops in a wired network almost always can be attributed to network congestion, wireless network links inhibit random packet losses much more frequently[3].A range of different solutions have been proposed to address the above-mentioned challenges. These are in turn spread across all layers, and most of them violate the strict layering approach constituting the Internet protocol stack [6]. In general, the techniques try either to improve efficiency or add redundancy, often dynamically throughout the video session.
Examples of efficiency improvements include:
• optimizing video coding so that bitrate matches the network and the decoded video quality matches the receiver(s);
• optimizing routes for sufficient quality, often through
multiple routes that match the number of sub streams from the video coder;
• allowing packet prioritization at the MAC layer, and setting the MAC layer re-transmission limit optimally to match the required end-to-end delay[2,3].

The paper is organized as follows. Section 1 discusses the introduction to MANETs and video streaming. Section 2 presents video streaming issues for MANETs. Section 3 presents different Technique for video streaming. Section 4 presents the conclusion and future work.

II. VIDEO STREAMING ISSUES

Instead of routing traffic across a well-engineered network consisting of interconnected routers, MANETs rely on all participating nodes to take on the task of routing and forwarding peer traffic. This is in addition to producing and consuming their own traffic. The nodes can move arbitrarily. As a result, discovering and maintaining optimal routes is a central challenge to MANETs, because the node mobility can cause links to break and re-establish arbitrarily. For this purpose, whole ranges of routing protocols have been developed [7, 8]. Research on MANET routing protocols mainly focuses on discovering the shortest paths in terms of the number of hops. However, performing video streaming over MANETs introduces a whole range of additional challenges due to the strict bandwidth and delay requirements. Initial problems occur as we move video streaming from the wired onto the wireless medium, as wireless links generally have much higher error rates and unpredictably time-varying characteristics. The most significant challenges nevertheless occur as we try to stream across Multihop wireless networks with mobile nodes, due to the problem of discovering and sustaining reliable paths. Furthermore, MANET's characteristics and properties vary significantly in literature, e.g., scenarios vary in size, density and link characteristics. One reason for this is the broad range of scenarios in which they are deployed. Therefore, researchers often focus on different challenges in their work toward realizing video streaming over MANETs [1, 3].

Wireless medium

Operating [1]on a wireless medium, MANETs are susceptible to the traditional problems with wireless communications. Wireless transmissions are susceptible to various transmission errors, caused by interference from other electrical equipment, multi-path fading, or colliding transmissions by other nodes. Recovering from such errors may require retransmission of data. This leads to an increase in delay and jitter, impacting the quality of the multimedia stream. Each node has a limited transmission range. This range is dependent upon many factors, such as the wireless transmission protocol, antennae size, energy use, obstacles and weather conditions. This limited range means that data must be routed through several other nodes to reach the destination. Each hop adds processing delay and increases the possibility of introducing bottleneck into the network path. For each hop, there is also the added possibility of a transmission error occurring, which adds delay and increases jitter [9].

Topology changes

The node mobility leads to continuous changes in topology, which means that routes may be formed and broken rapidly. When a route breaks, the discovery of a new route will most likely introduce delays, which will affect the quality of an ongoing media stream. In addition, the topology change may introduce new bottleneck links in the network path, leading to a reduction in bandwidth. In the worst case, parts of the network may even separate in such a way that there is no route from one part of the network to another. This is known as partitioning. If source and destination nodes wind up in separate partitions, the media stream will be broken [1, 3]. Findings in [10] suggest that route instability caused by link signal variations induced by mobility, is of big concern, affecting both packet drop ratio and jitter.

Multihop-induced challenges

The end-to-end paths between nodes in MANETs often consist of multiple hops, cause a handful of challenges. One such challenge is that end-to-end delay increases almost linearly with the number of hops. Thus there exists an upper bound for the number of hops while still providing a sufficiently low end-to-end delay, especially for live streaming. This limitation is demonstrated in [11]. With ten hops for video conferencing, images in their test-bed is bad. Other findings indicate that more than three hops cause delay above 250 ms, which is not acceptable in case of live streaming [3].End-to-end packet loss rates are also significantly increased in multi hop wireless networks, where each error-prone wireless link adds to the overall packet loss probability.

Another challenge introduced with multiple hops is the increased interference between nearby links, as outlined in [12]. Here, it is shown that if the inter-departure time of multimedia packets is lower than the end-to-end delay on the path, subsequent packets compete for the channel media and may collide. Additionally, there are also competing nodes from separate, but close-by paths[3]. The presence of interference is visible in Fig. 1, outlining a MANET example consisting of eight nodes. The figure shows the network topology at times t1 and t2. Here, the video camera S1 sends a live video stream to the receiving PDA R1 across a single route, while at the same time the multimedia server S2 streams stored multimedia content to the laptop R2 across two disjoint paths. The gray areas surrounding each node represent their wireless transmission range. Darker areas indicate that both intra- and interpath interference occurs during streaming of several simultaneous streams across the same MANET.

In such areas, each individual node experiences a decreased bandwidth, higher packet drop rates and increased transmission delays due to the required retransmissions. In Multihop networks, optimal routing is a big challenge. The routing protocol should ensure that each session is provided with a route satisfying its QoS requirements (e.g., bandwidth, delay and jitter). Additionally, the routing protocol should avoid network congestion by load balancing between routes in order to utilize the resources optimally. Many existing routing protocols use single metrics for each end-to-end route and select the route that according to the metric calculation offers the best value. For video streaming through Multihop networks, a single common metric may not be sufficient to meet the QoS requirements of the session. As an example from the scenario in Fig. 1, we see that in terms of achieving the lowest possible hop count, the best route at time t1 from S1 to R1 goes through the nodes B and C. However, the large link distance between S1 and B may result in an unsatisfactory bandwidth capacity. Thus, in this case the optimal route goes through A as it better complies with the QoS requirements of the stream, by providing for instance a higher bandwidth[3,12].

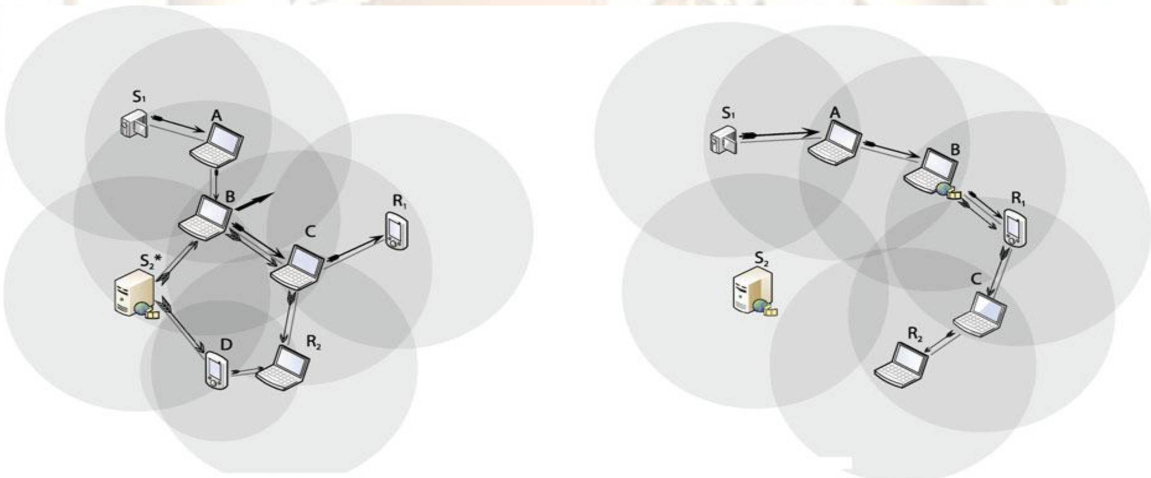

Fig. 1 Example of streaming scenario over a MANET[3]

Resource constraints

The devices [1]participating in a MANET will predominantly be small devices, which imply limited processing power, memory and storage capacity. Being small mobile devices, they will normally be battery powered, which means energy consumption must be kept at a minimum. Wireless communication will often mean limited bandwidth, and as mentioned, the nature of wireless communications means that this bandwidth is shared by all devices in the surrounding area. Additionally, an increase in network traffic places additional load on the nodes in the network, which in turn increases energy consumption. It is therefore important to keep network traffic overhead at a minimum.

Lack of fixed infrastructure

The lack of a fixed infrastructure[1] requires that nodes function as routers in the network. This can introduce large bottlenecks, if a lot of responsibility is assigned to a node with very limited resources.

III. TECHNIQUE FOR VIDEO STREAMING

In this section, we survey existing techniques for video streaming over MANETs.

3.1. MULTIPLE DESCRIPTION CODING

Multiple Description Coding (MDC) has been proposed as source a coding technique that is robust to channel errors for video transmission. MDC encode a media source into two or more sub-bit streams. The sub-streams, also called descriptions have equal importance in the sense that each received description alone can guarantee a basic level of reconstruction quality and additional description can further improve the quality because the loss of one description does not influence other description, a lost packet in any path does not need to be retransmitted. Because each description has equal importance, MDC usually does not require prioritized transmission. Therefore, MDC is considered as a promising technique to enhance the Error flexibility of a video transport system by Transmitting the video over multiple independent Channels like MIMO[1,13,14,18]. Apostolopoulos in [15].Propose multiple state video coding (MSVC) which is for high degree of correlation between the neighbouring pixels/lines/columns in a frame and the lost description can be recovered based on the correctly received ones. In MSVC, even if one description is completely lost, the other one can be independently decoded, and the reconstructed video can be rendered at half of the frame rate. It has also been suggested to recover lost frame in a damaged representation by utilizing temporally adjacent frame in another description, and use these recovered frames for future prediction. Ivana Radulovic et al in[16]propose MVSC-RP here they build on the popular MSVC scheme [15],and we propose to use redundant pictures (RP) in order to attenuate the error drift in case of loss. MSVC-RP scheme in terms of average PSNR, stability of reconstructed picture quality over time, and robustness to unknown network conditions. In MSVC-RP, it appears that at lower loss rates relatively small number of bits should be spent on redundant pictures (by using coarser quantization), while at high loss rates the redundant pictures should be almost as finely quantized as the primary ones. Mao et al. [17], an propose using MDC alone for streaming over MANETs is presented. This scheme is based on motion compensation such that for each frame n, it produces two predictions: one from the linear superposition of both previous frames n - 1 and n - 2 (central prediction), and one only from frame n - 2 (side prediction). From this, combining residuals from central and side predictions from even frames yields one description, while those for odd frames yields the other. Shiwen Mao et al. [19], proposed three MCP-based video transport techniques for mobile ad hoc networks. These schemes take advantage of path diversity to get better performance. These three schemes are based on the block-based hybrid coding framework using MCP and discrete cosine transform (DCT), which is selected by all existing video coding standards. The three techniques are (1) Feedback Based Reference Picture Selection (2) Layered Coding with Selective ARQ. In Feedback Based Reference Picture Selection, the reference frames are selected based on feedback and predicted path status, the last frame that is selected to be correctly received as the reference frame. In this technique the coded frames are sent through the separate paths. The mapping of frames depends on the bandwidth available on each path. Decoder is assumed to send a feedback message. If any packet in a frame is lost, the decoder sends a negative feedback (NACK). Otherwise, it sends a positive feedback (ACK). An encoder receives the feedback message for frame n- RTT when it is coding frame n, where round-trip time (RTT) is measured in frame intervals. Once a NACK is received form one path for a delivered frame, the path
is assumed to be "bad" until an ACK is received. Similarly, we assume that the path is in "good" status until NACK is received. While encoding a new frame, the encoder assume the last accurately decoded frame, depend on the feedback messages received till this time, and uses that frame as the reference frame. In Layered Coding with Selective ARQ This scheme makes the use of layered video coding. In this scheme, a raw video stream is coded into two layers, a Base Layer (BL) and an Enhancement Layer. A Base Layer frame is encoded using the standard predictive video coding technique. That's why Base Layer has a lower coding efficiency than a standard single layer coder. This loss in coding efficiency is, however, justified by increased error resilience: a lost Enhancement Layer packet will not affect the Base Layer pictures. Good quality is guaranteed if the Base Layer packets are delivered error-free or at a very low loss rate. Although this approach is optimal in terms of coding efficiency for the enhancement layer, error propagation can occur in the Enhancement Layer pictures.

3.2.MULTIPATH ROUTING TECHNIQUE

Routing is responsible to establish and maintain one or more end-to-end paths from source to destination. The main issue in video streaming is concerning route of video streams is to recognize the routes that guarantee the video to be delivered with a satisfying perceptional quality. In general, Multipath routing can improve QoS by providing: (i) Accumulation of bandwidth and delay: breaking the capacity of more than one route. (ii) Route load balancing: balance the traffic load in higher number of nodes.(iii) Fault tolerance: by adding redundancy, to reduce the effect of network failures onto affected video quality, it is important that the paths are disjoint. In case the

Multipath routing protocol offers multiple paths with sufficient path Diversity, it is less probable that a link failure affecting one of the paths simultaneously affects one of the other paths. Frias et al. [20] state that for MPEG-2 coded video streams, the optimal number of routes are three, in which I,P and B frames can be sent across separate paths (one path for each type of frame). Dalei Wu et al.[21] propose an application-centric routing framework for real-time video transmission in Multihop wireless networks, they investigated the multi hop routing problem by developing a novel application-centric cross-layer approach. The proposed routing approach enables to compute an optimal routing path to minimize the expected end-to-end video distortion within a given video packet delay deadline. Within the proposed quality-driven framework, video source coding has been integrated into the path routing to enhance the feasibility of Multihop routing and the utilization of network resources. Experiments are conducted with the H.264 codec and different sizes of Multihop wireless networks. Jiazi YI et al.[22] proposed a method to deliver H.264/SVC video stream over MANET using a multipath routing protocol MP-OLSR(Multipath Optimized Link State Routing)[23], With Unequal Error Protection (UEP) scheme in order to improve a simple Quality of Experience (QoE) measurements i.e PSNR.,and the data with higher priority can be better protected over the packet loss networks. The SVCEval is built as an evaluation framework for H.264/SVC video network transmission. Monica et al. [24,25] proposed a multipath multimedia dynamic source routing (MMDSR) technique. In this technique Initially the source sends a Probe Message (PM) packet to destination through each one of the paths discovered by DSR. A time-out is triggered upon the arrival of the first PM packet at destination. The PM packets received after timeout are discarded, because these packets arrived through a path having too much delay. After time-out, a Probe Message Reply (PMR) packet generated by destination node contains a set of sampled values of the QoS parameters collected from all the PM packets that arrived in time. The PMR message is sent back to the source through each one of the paths through which a PM arrived. This information will be analyzed at the source, where paths as categorized as best path, medium path, wrost path. Then, the packets are sent according to their priorities as highest priority packets through best path, medium priority through medium path and lower priority through wrost_path. Vaidya et al. [26],propose AODV with multiple alternative paths (AODV-MAP) is a multipath version of AODV. The routing technique is based on the establishment of multiple paths with three different qualifications. The labels used are (1) primary path, (2) node disjoint path, and, (3) fail-safe path. The base layer stream is sent on the primary path, while enhancement layer streams are sent on paths of lower quality.

3.3.CROSS LAYER PROPOSAL TECHNIQUE

A layered architecture, like the seven-layer of OSI model , divides the overall operation of the network into layers and defines a hierarchy of services to be provided by the individual layers. Stringently layered network architecture forbids direct communication between nonadjacent layers, and communication between adjacent layers is limited to procedure calls and responses. on the other hand, protocols can be designed by violating the reference architecture such as by allowing direct communication between protocols at nonadjacent layers or sharing variables between layers. Such violation of a layered architecture is the cross-layer optimization approach, which refers to protocol design by exploiting the dependence between Protocol layers to obtain a better system performance. In cross layer technique, instead of considering a layer as a completely independent functional entity, information can be shared among layers in both senses: upper to lower layers and lower to upper layers. This information exchange can be used to optimize the overall performance of the system[28,27]. George Adam[27] propose a cross-layer design for improve the performance of video transmission using TCP Friendly Rate Control (TFRC). It provide priority to video packets and exploited information from the MAC layer (SNR) in order to improve the TFRC performance. and it show that cross layer design involving the Application, Network and the MAC layers can improve QoS in MANETs by sharing information between non-adjacent layers. Andreopoulos et al. [29] propose an integrated cross-layer optimization algorithm aiming at maximizing the decoded video quality of delay-constrained streaming. The key principle of their algorithm lies in the synergistic optimization of different control parameters at each node of the network across the protocol layers. Gomathi et al. [30] propose a novel method for enhancing the quality of multimedia applications in MANETs. The enhancement is achieved via the Connectionless Light Weight Protocol (UDPLite) that supports multimedia applications. In addition to implementing the transport layer protocol, parameters of MAC layer are also considered to propose an approach that achieves a reduction in delay, jitter and increase in PSNR. Delgado G et al[31] present ViStA-XL, a cross-layer architecture design for QoS-provisioning to video-streaming applications over MANETs. A module referred to as cross-layer optimized (XLO) is the main module of the design, which periodically obtains information from all layers and allows real-time optimization jointly across the protocol stack.. it is also able to provide load-balancing and unequally protection to different types of video sub-streams. In [32] P. A. Chaparro et al. propose QoS framework supporting scalable video streaming in mobile ad hoc networks based on distributed admission control which is DACMESV (Distributed Admission Control for MANET's – Scalable Video), relies on a periodic probing process to measure the available bandwidth and the end-to-end delay on the path. DACME-SV adopts a cross-layer approach to determine the optimum number of video layers to transmit at any given time, thus avoiding network congestion and guaranteeing an acceptable video quality at the destination and also check the performance of throughput and delay. Sastry Kompella et al.[33] a Branch- and- Bound method for solving problem of optimization specially in discrete and combinatorial optimization. This method use RLT to reformulate and linearize OPTMR into an LP relaxation L-MR. Since such LP relaxation is usually yields an infeasible solution to the original problem, a local search algorithm should be employed to obtain a feasible solution to the original problem. The resulting feasible solution then provides an upper bound UB for the original problem. Under branch-and-bound framework, the original problem OPT-MR is partitioned into subproblems, each having a smaller feasible solution space, based on the solution provided by the LP relaxation. New sub-problem are organized as a branch-and-bound tree, while this partitioning is carried out recursively to obtain two new sub-problems at each node of the tree. In this manner, the branch-and-bound process can fathom certain nodes of the tree, eliminating them from further exploration. The effectiveness of the branch-and-bound procedure depends strongly on that the working strategy.

IV. CONCLUSION AND FUTURE WORK

Video Streaming is recently very important research area in the MANETS. In This paper we provides a classification and specification of the issues involved in video streaming over MANETs and the techniques proposed to tackle them. We seeing as most solutions are based on cross-layer design, we give an overview and analysis of the combinations of layers and the exchanged parameters that are generally used. This survey is shows that general, currently existing techniques begin dynamicity and stringent resource constraints by mutually optimizing transmission parameters at various layers of the protocol stack. Stringent constraint in resources, high amount of dynamicity and frequently occurring transmission and path errors make MANETs a challenging environment over to realize video streaming. Frequent path and transmission errors are handled by adding redundancy by utilizing redundant network routes. To select most advantageous transmission parameters, it seems extensively accepted that cross-layer parameter exchanges are essential. Our analysis unveils that 65% of the surveyed solution are utilize cross layering of some sort. Typically, the application layer adapts the video stream bit rate according to path characteristics obtained at the network layer. on the other hand, the network layer discovers routes with end-to-end characteristics that best suit the requirements of the video stream. It is beneficial to combine MDC with multiple routes. Congestion is no longer handled entirely at the transport layer, primarily because rate adaptation should be handled by a flexible video codec. Our survey concludes few papers include enough information for the experiments to be repeatable. Experimental results are often difficult or impossible to compare, due to the high variability of experiment parameter values. There are still certain problems, which are up till now properly addressed. In MANETs, however, the probability of the existence of such a path may be low at any given point in time. Furthermore, mobility can cause this connectivity to disappear and appear frequently and unpredictably.

More research is required to provide delay-tolerant streaming solutions for MANETs incorporating the above-mentioned mechanisms. In general, realizing video streaming over MANETs, there already exist many different types of techniques to handle video streaming issues in MANETs. Until now, there are many unsolved issue are addressed in future research.

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