Reliable Video Streaming in Mobile Adhoc Networks using Enhanced WEAC Protocol

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Abstract— In recent years Mobile adhoc network (MANET) an infrastructureless network has gained popularity and lot of research is being done on different aspects of MANET. Routing protocols in MANET are classified as proactive protocol where in every node maintains routing table which contains information about the network topology even without requiring it and reactive protocol where route is discovered wherever it is needed. The Warning Energy Awareness clusterhead (WEAC) is one of the reactive protocol wherein a mobile node is elected from a set of nominees to act as a temporary base station for a period of time within its zone. In each cluster, a token is used to assign the channel among contending Mobile Terminals (MTs). After one or more transmissions, if the energy level of the base station gets low, then it will give warning to conduct another Election. The advantage of WEAC Protocol is the clusterhead which supports multiple classes of services and also manages to minimize collisions. It adopts well to large networks of mobile station and in non-real time traffic. Video transmission over MANET is very challengeable when compared to other wireless network, due to bandwidth fluctuation, frequency difference, channel fading etc. WEAC protocol is more suitable for video transmission. In this research work, the performance of video transmission through WEAC protocol has been enhanced using different methods. In the first method, Virtual Base Station (VBS) is designed to run on top of the WEAC Protocol to speed up packet delivery and improves throughput. In the second method the WEAC-VBS method is improved through zone routing approach to reduce the time. In the next method Automatic Repeat reQuest (ARQ) mechanism is proposed in the WEAC protocol to reduce the errors. In order to achieve the required quality of service in video transmission, Priority Queuing mechanism is proposed in the WEAC protocol. Compression of data using Huffman code is proposed in the WEAC Protocol to reduce the storage space and to increase the speed of transmission. The performance evaluation of the proposed methods proves the efficiency of the algorithms developed. The significant results obtained in this research work ensures the improvement of WEAC Protocol for video transmission in MANET.

Key words: Mobile Adhoc Network, WEAC Protocol, Video Transmission

I. INTRODUCTION

In recent years Mobile adhoc network (MANET) an infrastructureless network has gained popularity and lot of research is being done on different aspects of MANET. Routing protocols in MANET are classified as proactive protocol where in every node maintains routing table which contains information about the network topology even without requiring it and reactive protocol where route is discovered wherever it is needed. The Warning Energy Awareness clusterhead (WEAC) is one of the reactive protocol wherein a mobile node is elected from a set of nominees to act as a temporary base station for a period of time within its zone. In each cluster, a token is used to assign the channel among contending Mobile Terminals (MTs). After one or more transmissions, if the energy level of the base station gets low, then it will give warning to conduct another Election.

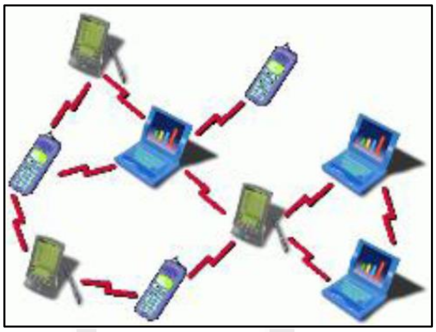

Fig. 1: WEAC

The advantage of WEAC Protocol is the clusterhead which supports multiple classes of services and also manages to minimize collisions. It adopts well to large networks of mobile station and in non-real time traffic. Video transmission over MANET is very challengeable when compared to other wireless network, due to bandwidth fluctuation, frequency difference, channel fading etc. WEAC protocol is more suitable for video transmission.

In this research work, the performance of video transmission through WEAC protocol has been enhanced using different methods.

In the first method, Virtual Base Station (VBS) is designed to run on top of the WEAC Protocol to speed up packet delivery and improves throughput. In the second method the WEAC-VBS method is improved through zone routing approach to reduce the time. In the next method Automatic Repeat reQuest (ARQ) mechanism is proposed in the WEAC protocol to reduce the errors. In order to achieve the required quality of service in video transmission, Priority Queuing mechanism is proposed in the WEAC protocol. Compression of data using Huffman code is proposed in the WEAC Protocol to reduce the storage space and to increase the speed of transmission.

II. REVIEW OF LITERATURE

Tarek R. Sheltami et.al, (2010) have proposed Video Streaming application over WEAC protocol in manet using H.263 and H.264 video standards. H.263 standard performs better for video data in applications like video conferencing, motionless video communication in MANET. H.264 provides high impression digital video codec standard written by ITU-T Video Coding Experts Group (VCEG).

David Oliver Jorg et.al,(2002) have compared the performance of Manet Routing protocols in different network sizes. Various routing protocols have been analyzed based on network size. It is explained that Zone Routing Protocol (ZRP) divides the entire network into overlapping zones of variable size and uses proactive protocols for finding zone neighbors as well as reactive protocols for routing purposes between different zones.

Hang Liu et.al,(2007) have proposed H.263 video transmission over wireless channels using Hybrid ARQ(Automatic Repeat Request). The hybrid ARQ error control scheme based on the concatenation of Reed-Solomon (RS) code and Rate-Compatible Punctured Convolution code for low-bit rate video transmission over wireless channels have been explained in detail.

Hsien-Po et.al,(2007) have proposed Multi-User video streaming over multi-hop wireless networks using a distributed, cross-layer approach on priority queuing approach.

Dan Grois et.al,(2013) have compared the performance of H.265/MPEG-HEVC, VP9, and H.264/ MPEG-AVC Encoders. The comparison of the two latest video coding standards H.264/MPEG-AVC and H.265/ MPEG-HEVC (High-Efficiency Video Coding) as well as the recently published proprietary video coding scheme VP9.

Dmitriy Vatolin et.al,(2012) have compared the MPEG-4 AVC and H.264 Video Codecs. The main task of the comparison is to analyze different H.264 encoders for the task of transcoding video. In the same way H.265 video quality also analyzed.

III. OBJECTIVES

The objective of the Research is to improve the performance of Video Transmission over mobile adhoc network using WEAC Protocol. The proposed methods have been developed for

– Increasing packet Delivery Ratio
– Minimizing Time delay
– Reducing Error rate
– Decreasing Bandwidth fluctuation
– Avoiding Unnecessary Transmission
– Increasing Throughput
– Improving the performance of Transmission by Priority Queuing

IV. DESIGN AND DEVELOPMENT OF ENHANCED WEAC PROTOCOL

A. WEAC Protocol with modified VBS Algorithm

The concept of a Virtual Base Station (VBS) election is to ensure that the routing and the Resource Reservation are achieved and managed through the connection. The VBS node is designed to be a central coordinating point to act as the host mobile device as well as the routing device. A mobile node is elected from a set of nominees to act as a VBS for a period of time within its zone. In each cluster, a token is used to assign the channel among contending Mobile Terminals (MTs).

The proposed technique of broadcasting the neighbor list, used by WEAC protocol, speeds up even more packet delivery and improves the throughput. If an MT wishes to send a packet first it looks up its neighbor_list, if the destination is not found, it looks up the neighbor_lists of its neighbors. If it has more than one access to the destination, it checks their batter power level, if it is more than minimum energy level required for transmission, it send the packet to the one with the least number of neighbors, otherwise it sends the packet to the one with the highest battery power. This reduces the Media Access Control (MAC) contention, balances the load, minimizes the energy wasted by the network, and as a result, enlarges the lifetime of the network, Moreover this reduces the delay time of packets delivery between neighboring nodes in the network.

B. WEAC Protocol with Zone Routing Algorithm

Zone routing approach is proposed in WEAC with modified VBS protocol to improve the performance while transmitting video packets.

Zone Routing is based on the concept of zones. Each node is defined with a separate routing zone and zones of neighboring nodes overlap. The routing zone has a radius, r, expressed in hops. The zone thus includes those nodes whose distance is at most r hops from the center node. The nodes of a zone are divided into peripheral nodes and interior nodes.

Zone Routing partitions the whole network area into squares in advance. Each mobile host knows this partition, so they know their own zone. There are two kinds of routing update in this protocol: IntrAzone Routing (IAR) and IntErzone Routing (IER). Local position change within a square triggers only local link state routing update in the square, while change of connectivity between squares triggers global routing update.

In the proposed method the source checks its IAR packets which are sent periodically to all the nodes within its zone. If the routing information for any of the address is found using IAR packets, then search is stopped and IER route reply packet is sent from the destination address to the source. The data packets are sent from the source to the destination via the information received from the Route Reply Packet. If the destination address is not found within its zone, then IER packets are bordercast to all border nodes of the source. If the destination address is also not found within the previously bordercast nodes, then IER packets are again bordercast to all border nodes.

C. WEAC Protocol with ARQ (Automatic Repeat reQuest)

The ARQ mechanism in Wireless network enables a connection to resend data at the MAC level, if an error is detected. The ARQ feedback type is used to build block sequences, a scheduling of the ARQ feedbacks and retransmissions, the ARQ block rearrangement, ARQ transmission window and ARQ block size. The automatic repeat request (ARQ) is the mechanism by which a receiving end of a connection can request the retransmission of MAC protocol data unit (PDU), generally as a result of having received it with errors.

1) GOBACK N Algorithm

GBN is designed to operate without a re-ordering buffer at the receiver. Whenever a frame is missing or erroneous, the receiver simply discards all subsequent frames and sends no feedback for these discarded frames. So the transmitter has to retransmit all frames, starting with the erroneous one. If the error rate is high, the GBN protocol is inefficient.

In the proposed method the sender sends frames one by one. If any frame undergoes transmission error, then receiver ignores that frame and all subsequent frames. Sender eventually reaches maximum number of outstanding frames, and takes following action:

Go Back N=Ws frames and retransmit all frames from erroneous frame.

D. WEAC Protocol with Priority Queuing

If there is vast amount of transfers in the network, then using multipath routing cannot give the required quality for the video Data. So, an extra mechanism such as Priority Queuing will be desired. The task of such an extra mechanism is to provide proper priority to each video frame in combination to the other data to keep away from frame losses while achieving QoS (Quality of Service) for video Transmission.

Packet scheduling mechanism is used for transmission of video packets through multiple paths in the network based on the type of the vide packets. This mechanism has three parts: A) Packet scheduling, B) Queue scheduling, C) Path scheduling.

1) Packet Scheduling

Reference frames would have the most priority compared with the other video frames. So the highest priority is given to that packets containing frames with type of I-frame (Intra coded picture) and P-frame (Predictive coded picture) then B-frame (Bidirectional predictive coded picture), respectively. Further, the packets containing I-frames must be sent through the most reliable paths in the network.

2) Queue Scheduling

In queue priority scheduling, nodes' buffer is divided into four queues and a round robin scheduling is executed for them. Each arriving packet to a node is placed on one of the queues according to following rules:

A packet that contains I-frame is placed in the first queue. A packet that contains P-frame is placed in the second queue. A packet that contains B-frame is placed in the third queue. A packet with no video data is placed in the fourth queue.

In the proposed method, for each node, if the physical buffer length is greater than the sum of the lengths of four queues, then the packet is placed in the queue based on the type of packet. Otherwise the packet is dropped. This will be continued for all the nodes.

In the proposed method, for Queue Scheduling for each node if any three queues have video frames then Round Robin Scheduling (RRS1) is performed. If there is no packet in three video buffers then one packet is sent from fourth queue. Otherwise previous steps are continued.

3) Path Scheduling with Device Queuing mechanism

Among the common queue methods vice versa FIFO-First in First out; PQ- Priority Queuing; WFQ: Weighted Fair Queuing, and Combination of the methods; Priority Queuing (PQ) based on priority server is used in the proposed method.

E. WEAC Protocol with Video Compression using Huffman Coding

In the proposed compression technique, data is separated into a hierarchy of layers. From the top the first layer is known as the video sequence layer, which is any self-contained bitstream. The second layer down is the group of pictures, which is composed of one or more groups of intra (I) frames and/or non-intra (P and/or B) pictures. The third layer is the picture layer itself, and the next layer beneath it is the slice layer. Each slice is a contiguous sequence of raster ordered macroblocks, most often on a row basis in typical video applications, but not limited to this by the specification. Each slice consists of macroblocks, which are 16x16 arrays of luminance pixels, or picture data elements, with two, 8x8 arrays of associated chrominance pixels. The macroblocks can be further divided into distinct 8x8 blocks, for further processing such as transform coding. Each of these layers has its own unique 32 bit start code defined in the syntax to consist of 23 zero bits followed by a one, then followed by 8 bits for the actual start code. These start codes may have as many zero bits as desired preceding them.

1) Huffman coding Algorithm

In the proposed Huffman compression algorithm all the symbols are sorted according to their probabilities from smallest to largest and then a binary tree is built from left to right. Two smaller nodes are connected together. The left branches of the tree are labelled with 0 and right branches with 1. Thus Huffman code is created which is in compressed form.

V. Performance Evaluation

The comparison of results obtained by the proposed method with the existing approach are shown below.

From the results the following are the summary of the findings in this research work.

A. Packet delivery ratio

In the existing WEAC protocol with VBS the packet delivery ratio is 92.88 in H.264 format where as in modified VBS algorithm it is 93.94 in H.264 format and 96.44 in MPEG4. The proposed WEAC protocol with Zone Routing increases the packet delivery ratio from 96.44 to 97.62 in MPEG4. Further using ARQ technique the packet delivery ratio obtained is 99.60 in MPEG4 format.

B. Time delay

Time delay for 100 nodes is reduced from 200ms to 75ms while using the proposed WEAC protocol with modified VBS and zone routing. Using ARQ technique in MPEG4, the time delay is minimized to 50ms and in H.264, the time delay is reduced to 85ms.

C. Error rate

The Error Control overhead is increased upto 5GB/s using the proposed Automatic Repeat reQuest (ARQ) technique. Using ARQ technique the bandwidth problem is solved and the error rate is reduced.

D. Bandwidth fluctuation and unnecessary transmission

Bandwidth fluctuation and unnecessary transmission of packets have been eliminated by adopting Block rearrangement of ARQ technique.

	WEAC Protocol with VBS algorithm	WEAC Protocol with modified	WEAC Protocol with zone routing	WEAC Protocol with ARQ Technique	WEAC Protocol with Priority Queuing	WEAC Protocol with Huffman compress-ion

		VBS algorithm				
Data Format	H.264	H.264	H.264	H.264	H.264	H.264
Link speed	5 Mbps	5Mbps	6.2 Mbps	6.5 Mbps	6.5 Mbps	6.5 Mbps
Data rate	56 to 64 kbps	1 Mbps	3.3 Mbps	4Mbps	4Mbps	4Mbps
No. Of Packets send	253	253	253	253	253	253
No. Of Nodes	200	400	400	400	400	400
No. Of Packets received	235	240	245	250	250	250
Packet delivery	92.88	93.94	97.23	98.81	98.81	98.81
Time delay(ms) for 100 nodes	200ms (milli seconds)	200ms	85ms	65 ms	65 ms	65 ms
No. Of Packets dropped	18	13	8	3	3	3
Dropping Ratio	0.07	0.05	0.03	0.01	0.01	0.01
CRC/ARQ	Off	Off	Off	On	On	On
ARQ feedback	-	-	-	standalone	standalone	standalone
ARQ feedbacktype	-	-	-	Cumulative +sequence	Cumulative +sequence	Cumulative+ sequence
ARQ block rearrangement	Off	Off	Off	On	On	On
ARQ deliver in order	Off	Off	Off	On	On	On
Priority Queuing	-	-	-	-	used	used
PSNR value using Huffman compression	-	-	-	-	-	38(for bit rate 1000)
Loss rate using Huffman compression						0.30 for 40 frames
Time delay for compressing						40 s for 40 frames

Table 1: Overall comparison of existing WEAC protocol and the proposed methods in H.264 format.

	WEAC Protocol with modified VBS algorithm	WEAC Protocol with zone routing	WEAC Protocol with ARQ Technique	WEAC Protocol with Priority Queuing	WEAC Protocol with Huffman compression
Data Format	MPEG4	MPEG4	MPEG4	MPEG4	MPEG4
Link speed	6 Mbps	6.3 Mbps	6.5 Mbps	6.5 Mbps	6.5 Mbps
Data rate	3 Mbps	3.5 Mbps	4.5 Mbps	4.5 Mbps	4.5 Mbps
No. of Pkts send	253	253	253	253	253
No. of Nodes	400	400	400	400	400
No. of Pkts received	244	247	252	252	252
Pkt_delivery	96.4427	97.6284	99.60	99.60	99.60
Time delay(ms) for 100 nodes	100 ms	75ms	50ms	50ms	2ms
No. of Pkts dropped	9	6	1	1	1
Dropping Ratio	0.03	0.02	0.003	0.003	0.003
CRC/ARQ	Off	Off	On	On	On
ARQ feedback	-	-	standalone	standalone	standalone
ARQ feedbacktype	-	-	Cumulative+ sequence	Cumulative+ sequence	Cumulative+ sequence
ARQ block rearrangement	Off	Off	On	On	On
ARQ deliver in order	Off	Off	On	On	On
Priority Queuing	-	-	-	used	used

PSNR value using Huffman compression	-	-	-	-	-	42 (for bit rate 1000)
Loss rate using Huffman compression	-	-	-	-	-	0.10 for 40 frames
Time delay for compression	-	-	-	-	-	1s for 40 frames

Table 2: Overall comparison of existing WEAC protocol and proposed methods in MPEG4 format.

1) Packet Dropping Ratio

The packet dropping ratio of WEAC protocol is 0.03 in the modified VBS approach, 0.02 in zone routing approach using MPEG4 and a value of 0.003 has been achieved using ARQ technique.

2) Increasing Throughput

The Link speed of WEAC protocol has increased from 5.5 Mbps to 6.5 Mbps and data rate has increased from 56 kbps to 4.5 Mbps using modified VBS and Zone routing approach and ARQ technique in MPEG4 video. This increases the throughput.

3) Improved performance by priority Queuing and compression

The proposed priority Queuing algorithm provides preference to urgent packets during transmission and improves the performance of WEAC protocol. The proposed compression technique reduces storage space of video data and increases the speed of transmission.

4) Quality

Using Huffman coding the size of video packet is reduced more than half of its original size. The loss rate is minimum and PSNR value is maintained high up to 42 to preserve the quality of the video.

This research has delivered an Enhanced WEAC protocol in Mobile Adhoc Networks which increases packet delivery ratio, throughput and decreases time delay, error rate, dropping ratio to satisfy the desired objectives. It also provides effective video transmission by improving the quality of service using priority queuing and compression technique.

VI. CONCLUSION AND FUTURE ENHANCEMENTS

This research work has proposed efficient methods to enhance the Warning Energy Awareness Clusterhead (WEAC) protocol for video transmission in MANET. Modified VBS (Virtual Base Station) is designed to speed up packet delivery and to improve the throughput. Zone routing approach reduces the time delay. Automatic Repeat request (ARQ) mechanism reduces the errors. Priority queuing technique enhances quality of service. Compression technique reduces the storage space of video data and increases the speed of transmission. In future this work may be extended to all 3G and 4G networks. Decentralized management for remote monitoring and control can be included. Cross layer support can be added to improve the protocol performance.

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