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Implementation of an Autonomic Active Queue Management to Improve the Multimedia Video Flow Delivery Quality

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Abstract: QoS requirements for multimedia applications are intrinsically different from simple network applications as multimedia services require more bandwidth and lossless delivery. Current QoS frameworks treat all real-time traffic in same manner but these networks must have some mechanism to differentiate traffic into different classes with different QoS provisions. In order to provide better quality of service to the multimedia applications in Mobile Ad Hoc Network (MANETs), where its resource is limited and changed dynamically, in this work we introduce an Active Queue management mechanism with autonomic attributes, named Autonomic Active Queue Management (AAQM).This work proposes an effective queue management mechanism to reduce the packet loss in MANET's. It also proposes that the relation between the video quality and the packet loss is not a simple, thus even a small packet loss may cause many successively delivered packets with no use in practice.

Keywords: Queue management, QoS, Autonomic features, Multimedia applications, MANET's.

I. INTRODUCTION

Now a day the autonomic network is the hotspot for future network architectures. This is to solve the increasing complexity of network management and control of the network is capable of introducing people autonomic features. DiffServ architecture, due to its simplicity and scalability, are common research. Therefore, the real-time status information dynamically optimize network performance by adjusting the network behavior, DiffServ is a reasonable way to introduce mechanisms of autonomic components. With common applications of wireless devices and multimedia technologies, is expected to provide QoS for multimedia applications in MANETs. Nevertheless, the existing IP network to meet the requirements of real-time video stream does not have the ability to provide QoS. Packet loss causes a serious impact on the compressed video stream. Packet losses, QoS packet loss was widely discussed topic in the video data [1]. But this control technology using the current packet dropping is difficult to restrict a very low level of packet loss. Moreover, even a very small video quality, packet loss, severe damage [2]. The wireless network is a basic problem for the delivery of streaming video on how to protect despite the perceived video quality of existing packet loss.

To provide QoS for video applications, two major approaches are proposed. These are network-based approach to end-system-based approach and are. In recent system-based approach, which is responsible for final system provide QoS. These methods have widely research. But at the end of greatly increased system complexity and overhead. Network-based approach, are responsible for the provision of QoS routers. On DiffServ technologies applied to network video are presentative to carry out technical buffer management. Congestion control as well as a mechanism to support the intermediate routers, active queue management network is a hot pot of research. SallyFloyd [2] In 1993, the first Random Early Detection (RED) has suggested. Active research new network at the same time a direction Queue Management (AQM), which is suggested. IETFRFC2309 [3] was a research hotpot routers accept the suggested minimum AQM mechanism.

The basic idea is to avoid AQM congestion before the buffer is filled with pre-packaged leaving. This queue management mechanism is very effective in reducing packet loss randomly dropping packets. But MPEG4 encoded multimedia applications, packet loss is detected at the receiver, and there is no simple relationship between image qualities. Due to the dependence between video frames, even a small packet loss severely affect the video quality is no use in practice, can cause many packets delivered repeatedly. In MANETs resources are limited and a large bandwidth is required for video applications, because it is changing, it is inevitable that you have to leave a lot of video packets. Reduce the loss of image quality and efficient delivery of the video stream to drop packets, according to the information by taking dynamic network environment and operation of the video feature by setting the queue management mechanism will introduce autonomous mechanism. The rest of the paper is constructed as follows, Chapter II discusses the related works, Section III will describe in detail the proposed AAQM; Chapter IV presents the results of simulation analysis and section V concludes the paper.

II.RELATED WORKS

Autonomic network architecture of future internet research area. Autonomous concept of autonomic computing and communications network is derived from the [4] [5]. HOME present, many research projects such as, in this area is carried out [6], BIONETS [7], Negotiated [8] and EFIPSANS [9]. The main objective of the study, simplifying network management and control, autonomous features to add to the network elements. This self-management, self-configuration, self-optimization, self-awareness, self-adapting autonomic properties is carried out based on the feedback control loop. Autonomic mechanisms of network behavior based on the dynamically changing network environment, you can adjust and optimize the performance of the overall network. Autonomic mechanism is suitable for the future heterogeneous and complex network. AQM Loss packets are widely studied in the wireless network easily. This end-system-based approach to improve the quality of the video stream is preferable to choose. The last system-based approach is quite effective, but in the end systems greatly increases the complexity and overhead. The tail is expected to accept a very simple and effective by the method of network-centric management approach to provide QoS.

The research focuses of active queue management mechanism in order to improve the quality of video distribution are rarely exploited. Most AQM mechanisms drop packets at random without having to recognize the importance. Packs' without taking into account the importance of the traditional multimedia streaming queue management seriously damage the quality of the video stream, is not suitable. RIO queue management algorithms that can be used include the priorities of different packets are able to [13], Weighted RED (WRED) [14], and similar thresholds (WRT) [15] and WRED. But the priority Video packets' attention is not divided. [10], the Rb-RIO RIO's rate-based algorithm is proposed. The three primary classes, packets frame I, P, and B frames classifies frames. I frame packet drop probability is small compared with other packets. [11] I paired the frame, leaving a priority mechanism, the proposed hierarchical REDN3 MPEG4 video streaming architecture, called the Pframes and Bframes WRED packet drop different priorities,.

III.AUTONOMIC ACTIVE QUEUE MANAGEMENT MECHANISM

Video package considering the importance of the frame type to distinguish the difference between the methods is usually only. But only by the type of frame dropping and the related priorities of the packets for priority mapping is different from the fixed parameters setting may not achieve the best performance. We feature information packet queue management from the operation of video coding in order to optimize the process should make full use. We introduce the mechanism of autonomic queue management design. This self-configuration autonomic features such as and self-alignment is carried out based on the feedback control loop. Context, based on information collected from the feedback loop, And services within the framework of the mechanism used in the context of the network and provides the context information. We are dynamic context information to set up, configure, and use the packet dropping process.

Dynamic network environment, the conditions will change over time. Traffic speed and bandwidth of the connection node depends on the length of the tail. Congestion management mechanism to judge the situation as it will collect information from the network connection. Network connection information is followed by wireless nodes. And at the end of a source of information in the context of service according to its video compression packet header is saved. Goes packet network, the packet directly to the title of the abstract nodes are able to service context information. Service context information, for example, the frame type, frame such as frame size, video compress the situation and character information, abstracted from the IP packet header and queue management mechanism will determine the configuration parameters. Autonomous self-configuration and self-alignment is carried out based on a feedback loop characteristics. Feedback loop, in the context of the network and the service is collected during collection. Then, according to the information is evaluated in the context of the level of network congestion. And the context is determined by the configuration service. Finally, configuration, and setup carryon. Network behavior adaptive feedback loop to adjust and optimize the overall network performance.

A. Encoding

MPEG4 encoded video stream, different encoding methods Pictures (GOP), a group has a distinct impact the quality of each frame, the receiver video again. MPEG4 video data compression codes are three types of frames, they frame, Pframes and Bframes, respectively, I have. I-frame coded frames, so it can resolve independently. Inter-frame coded P and B frames, so it must frame according to solve. You can compare the result of the importance of each frame GOPI have a frame of reference for all the frames in the GOP frame, so the frame is of the highest importance. P-frame at the rear of the front part of each GOP has a higher importance than P frames. And B-frames are encoded with predictive coding, Bframe and the estimated amount of data between the frame approaches reflects almost. Therefore, a smaller grain size is more important to have a large Consider B Frame. In summary, each GOP square frame, Pframe at the front of the rear part Pframe, B frame with large size and small size, respectively, with the importance of the B frame I in which ordered from high to low.

Service information as part of the video frame type, the number of frames, frame size, and so on, including character information by means of video compression. The source video code created by the packet header information is saved in this character. We f_type respectively, f_seq, PN, BS is f_size and frame type, the GOP, the maximum number of frames P P frames, the B frame size and a maximum size B frame into several areas, including the IP header, add. F_typefiled, 0refers to the I frame, one Pframe and B frame means 2 vehicles. Pframes GOP frame of P1 and PN sequence number prediction. And the Bframe sizef_size records.

TABLE1
PACKET PRIORITY MAPPING

Priority	**Packet type**	**Priority index**
Class1	Packet carrying I frame data	001
Class2	Packet carrying former part P frame data in GOP	010
Class3	Packet carrying latter part P frame data in GOP	011
Class4	Packet carrying larger size B frame data	100
Class4	Packet carrying smaller size B frame data	101

According to the information source end of the video compression characteristics of video packets divides into five priorities. Also we have PI's IPheader (priority index) add a drop into Priority division Table I. The importance of packaging is reduced to class 5 from class 1are shown.

B. Queue management operation

Autonomous loop network congestion status of the collection process followed to estimate the length of the tail. Average tail length and tail length in real-time is used as a congestion metric. Video design a FIFO queue for packets that the wireless node's interface queue. But the structure of the internal queue, priority packets to the source by the end of the recorded index (PI) based on five virtual queues (VQ) for the match. Increases the VQ5 VQ1 drop the packet priority. The algorithm uses the method of dropping the highest drop priority. Packet dropping, if necessary packet from the corresponding virtual queue priority virtual queue will be the first packet is discarded and the highest decrease. RED and WRED queue management algorithms, static parameters. Maxp parameter is set to a constant value. But the design, it is possible to set maxp according to the information package service context. Original I, P and Bframes, respectively, for the maxp maxp_i, maxp_p and are maxp_b. But maxp_p can be adjusted according to the number of Pframes. The maxp is adjusted according to P number as

$$maxp = maxp\_i + (maxp\_p - maxp\_i) * a * (No./PN) \quad \textbf{(1)}$$

in which, a is a small const. And the maxp_b is adjusted according to the B frame size, as

$$maxp = maxp\_p + (maxp\_b - maxp\_p) * b * PS/size \quad \textbf{(2)}$$

in which, b is another small const.

Th_min average tail length is less than the threshold q as mall, then enter the order packet arrival. Greater than the largest threshold th_maxQa, then enter the queue and the first drop packet arrival the highest priority virtual queue packet drop. Qa between the two thresholds, then calculate a drop probability. The advent of packet drop target, and possibly take your package. Most likely to fall in the calculated virtual queue priority is the first packet drop probability. The pseudo-code of the AAQM algorithm is shown in Table II:

C. Pseudo code for AAQM algorithm

Calculate the average queue length qa and get the current queue length qc mapping the arrival packet to the corresponding virtual queue According to PI

//adjust the maxp parameter
If the arrival packet carrying I frame data
Maxp=maxp_i

Else if the arrival packet carrying P frame data
maxp = maxp_i + (maxp_p – maxp_i) * a * (No./PN)

else

maxp = maxp_p + (maxp_b – maxp_p) * b * PS/size

//calculate the drop probability

If(qa>=th_max)||(qc=qlim)
Enter the arrival packet into its corresponding virtual queue

Drop the packet with highest priority

Else If(qa<th_min)
Enter the arrival packet into its corresponding virtual queue

Else
P=maxp*(qa-th_min)/(th_max-th_min)

Randomize a number u

If(u<=p)
Enter the arrival packet into its corresponding virtual queue

Drop the packet with highest priority

Else
Enter the arrival packet into its corresponding virtual queue

IV. PERFORMANCE EVALUATION

This section gives the complete illustration about the performance evaluation of the proposed approach. It also gives the comparative analysis for the proposed AAQM with the WRED by evaluation of PSNR for the recovered video using AAQM and WRED. In this part, we use simulation to compare the performance of the proposed AAQM algorithm with WRED in Manet's scenario. The queue management algorithm is applied on the wireless interface queue. There are 30 wireless nodes move randomly in a given 1000x1000 m^2 square. We use the matlab to generate the MANET scenario. Video sequences are in the .avi format. The simulation operation follows Doctor Chih-HengKe's method [12]. We encoded the video into MPEG4 formatted file, and transmitted through the network shown below. Finally compare the file after transmission with the original file, and calculate the PSNR(Peak Signal-to-Noise Ratio) value. PSNR is one of the most widespread objective metrics to assess the application-level QoS of video transmissions. The wireless bandwidth is set as 11Mb. Node communication radius is set as 300m. The length of interface queue is set 100. The two queue management algorithms are simulated using the same parameter value. WRED is used as [11] described, video packets are divided into three priorities according to their frame type.

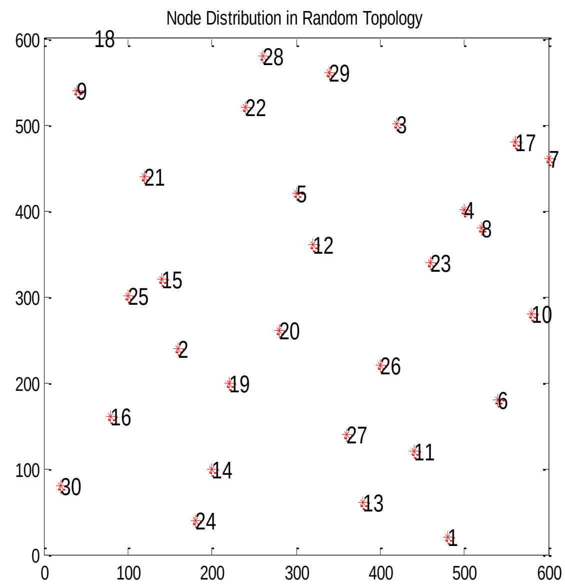

Fig1.Random topology of Manets

In this work to evaluate the proposed approach we had considered a network having 30 nodes. The area of the network considered is 600 m^2. In this network the nodes are distributed in random fashion. The x-axis denotes length of the network along horizontal direction and the y-axis denotes the length along the vertical direction.

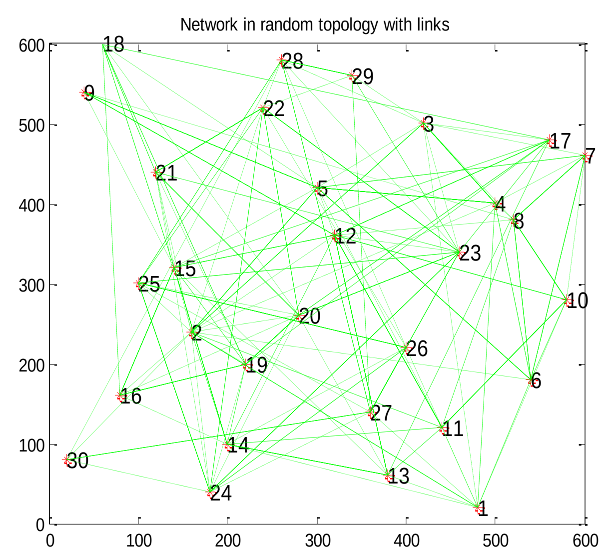

Fig2. Network in random topology with links

The above figures shows the complete links provided from each and every node to each and every node. For this purpose the distance from node to node has to be evaluated. Then only the links are going to be plotted by comparing it with the network range. Thus to provide a link between two nodes the distance between that two nodes should be less than the network range.

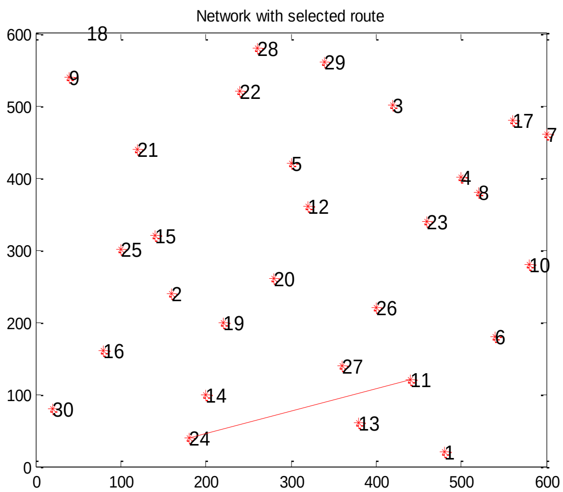

Fig.13. Network with the selected route for communication.

The above figure shows the path established between two nodes. Here the node 21 is considered as source node and the node 11 is considered as destination node. To establish the path between these two nodes first the source node has to send the request packet to destination node then the destination node has to be acknowledge an acknowledgement to source. If the source receives the acknowledgement from the given destination node then the path is said to be established. Then only the communication for information transfer is going to be occurred between those two nodes.

Original Video sequence

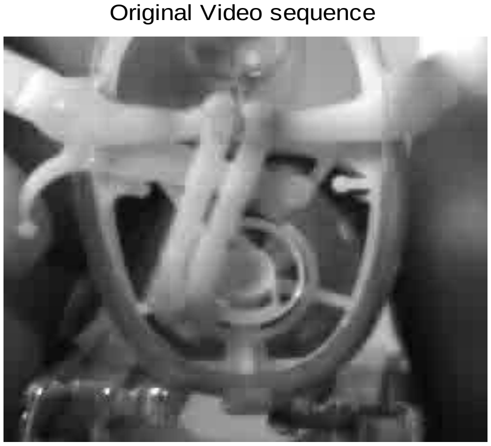

Fig4. Original video sequence.

The above figure represents the original video sequence taken to process through the selected path between source node and destination node. The given video file format is qcif.yuv. The two algorithms are applied on this video one by one and the performance is analyzed by evaluating the PSNR for obtained video at destination

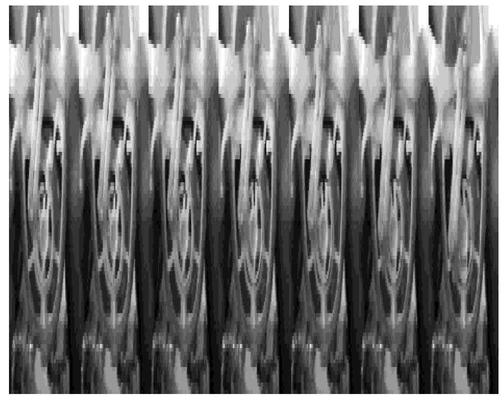

Fig5. Extracted frames.

Generally a video file is considered as a group of images (frames). So to process any operation on an video in the first stage we have to extract the frames from it. The above figure denotes the extracted frames for the given video sequence in the fig2. The these frames are divided into Iframe, Pframe and Bframe respectively and these are processed through the selected path between source node and destination node by applying the both weighted random early detection and AAQM one by one. The recovered video sequences after processing through the selected path using AAQM and WRED is shown in fig14 and fig5.

Recovered Video sequence using AAQM method

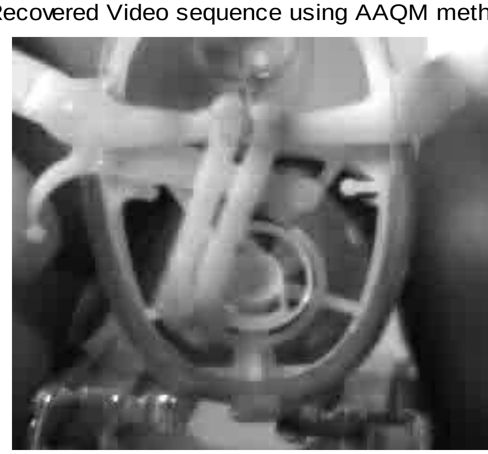

Fig6. Recovered video sequence using AAQM method.

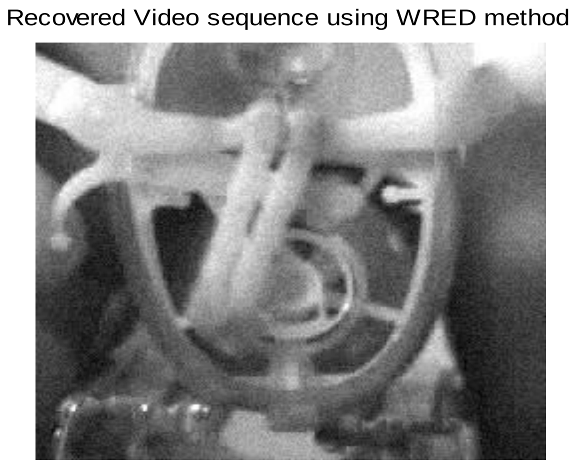

Fig7.Recovered video sequence using WRED method.

The above figure denotes the recovered video sequence using WRED method. From the figure it is clear that the recovered video sequence by WRED has some distortions compared to the video in the fig14, recovered using AAQM. From this visual analysis we can conclude that the proposed approach is efficient.

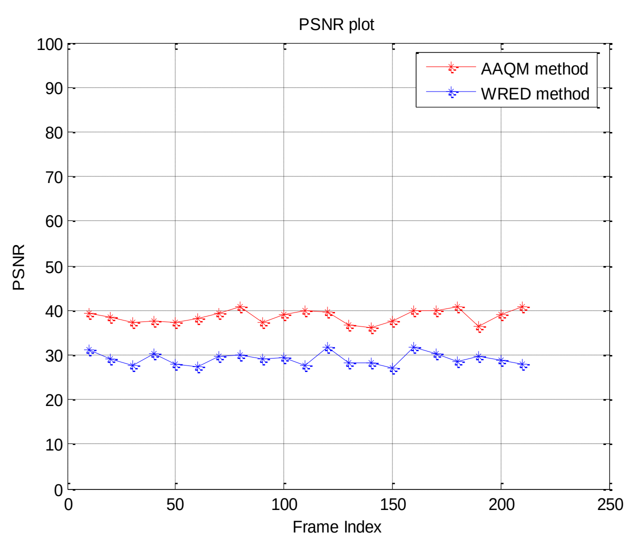

Fig8.PSNR plot

The above figure denotes the PSNR plot for the proposed approach and also for previous approach. First to evaluate the numerical analysis we have to evaluate the mean square error between the original video and recovered video. Then the PSNR can be evaluated by applying the logarithm for that MSE. The formulae for MSE and PSNR evaluation are shown below.

$$MSE=\frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2 \qquad (1)$$

Where $\hat{y}_i$ the recovered video is sequence and y_i is the original video sequence.

$$PSNR=10*\log(MSE) \qquad (2)$$

V.CONCLUSION

In this work a new queue management scheme is proposed to improve the multimedia flow delivery quality in mobile Adhoc networks. For such purpose we introduced the autonomic attributes to queue management algorithm. The mechanism is capable of configuring and adjusting dynamically according to network and service context information. In AAQM, multimedia video packets are divided into several drop priority levels according to their service context, further taking into account the video compression characteristic information. The simulation performed in Mat lab is compared the performance of the proposed AAQM with WRED when transmitting MPEG4 formatted video flow. The result shows that AAQM can protect important video packets and reduce the impact of packet loss on video quality effectively.

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