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An Approach of Handling Packet Loss for Delay Sensitive Video Streaming in MANETs

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Abstract: ***Wireless communication networks became ubiquitous. Mobile ad hoc networks (MANETs) have become an exactly right option that can be chosen for on-demand infrastructure less communications. Besides the enhancements in Mobile ad hoc networks (MANETs) communications, more research can be done on these networks, if they have to be used for video streaming. The reason behind this is that, the Mobile ad hoc networks (MANETs) devices are resource constrained and thus efficient methods to support multimedia communications supporting video streaming is a defiance problem. This is because videos are delay sensitive and thus good quality streaming is inevitable. In the proposed work we use AODV protocol and an idea of Dynamic congestion detection and routing. In this work we define Signal to noise ratio threshold at nodes in all the previously visited paths from source to destination in order to identify the congestion level at the nodes dynamically and construct an optimal path for the transmission of video packets in Mobile ad hoc networks (MANETs) . This decreases the traffic which occurs due to multiple feedback messages from nodes in the network. Hence this approach decreases the loss of packets and this leads to the improvement in the performance.***

1. Introduction

Mobile ad hoc network (MANET) is a wireless network of mobile devices and can be used in situations where there are limited resources and less infrastructure. Mobile ad hoc networks (MANETs) have become more essential for wireless communications as the requirement of mobile devices is increasing rapidly. Mobile ad hoc networks (MANETs) have a capacity of healing themselves. As the name itself indicates that they are infrastructure less, they have more scope in critical applications such as military operations, in the areas where entire infrastructure is destroyed and in various emergency conditions where there is lack of infrastructure. Though Mobile ad hoc networks (MANETs) have their widespread applications, there are certain limitations when we use them in multimedia applications. According to [1], to overcome the latency that occurs because of the control measures of TCP, the applications of video streaming use UDP for their transport. But it leads to other problems such as bandwidth limitations, as uncontrolled video packets i.e. the video packets without congestion control and flow control are transmitted and this leads to loss of packets.

Hence we propose a method which overcomes the above issues and makes video streaming , a promising application in Mobile ad hoc networks (MANETs). In this regard we define an SNR (Signal to noise ratio) threshold [1] at nodes in all the previously visited paths to the given destination address. This threshold will be evaluated by comparing it with the SNR value[1] at nodes which is obtained by exploiting information from MAC layer [2]. By this we can know the traffic level at nodes i.e. how much congested is the link near the node, nodes whose corresponding links are congested are ignored and those whose are not congested are considered for the construction of a path which is an optimized one. Thus we can reduce loss of packets and fasten the delivery of video content in Mobile ad hoc networks (MANETs).

2. Literature Survey

To address the congestion control issues, the research community has implemented a cross-layer design [1] which is on the basis of attitudes of voice and video streaming applications and their characteristics in terms of end-to-end delay. The cross-layer design is implemented with an aim of improving video streaming performance and for this purpose TCP friendly rate control (TFRC)[3] is used, it is a mechanism for controlling congestion. In comparision with TCP, TFRC provides higher throughput, so in many cases it is more suitable for multimedia applications. A real time service, like video transmission, requires much less delay than for example an application of transferring a file. At the MAC layer[2], they have differentiated the access of various applications with the use of the IEEE 802.11e protocol[2]. At the network layer they have utilized SNR information for improving the routing performance. They have used the AODV protocol[4] which is among the most popular ad hoc routing protocols and which better facilitates the multimedia transmission mechanisms. AODV is a routing protocol which is on the basis of Bellman-Ford algorithm[4]. It uses sequence numbers of source as well as destination to avoid the problems of looping and count to infinity that may occur during the routing calculation. AODV routing table maintains the record of all routes those had been recently used, so a node can send packets to any of the destinations that are available in its routing table without requesting route messages that may lead to the traffic in network. At the application layer they are using the information of TFRC[3] for controlling congestion with enhanced functions to improve the estimations of it and to make better utilization of the bandwidth. A TFRC feedback message is transmitted from all nodes in the network[2]. The SNR measurement that comes along the feedback report is the latest one as it is assumed to be the final[2]. The feedback message will be having the timestamp of the data packet that is received lastly , the delay that has occurred after receiving the last data packet and before the feedback report is generated , the rate which is estimated by the receiver on the basis of the data was received since the last feedback report was sent , the receiver's current estimate of the loss event. To make the route reconstruction more efficient , SNR measurements are used along the entire path. Although SNR being used but the threshold is defined only at the sender and SNR of each node is transmitted to the sender to compare it with the threshold defined at the sender.The selection of SNR threshold affects the efficiency of the routing reconstruction. If a low threshold is chosen then it may result in very late reconstruction, else a high threshold is chosen then it may result to very frequent route discovery processes that will add routing overhead to the network. This causes the loss of packets and this is the challenge to be addressed.

3. Proposed Work

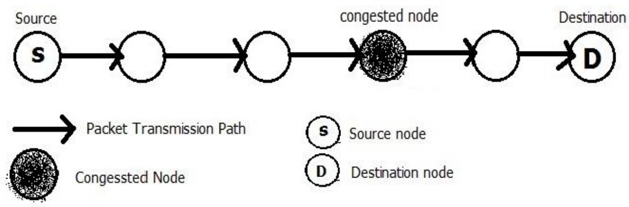
3.1. **Description**:

Here we focus on making video streaming an efficient application in Mobile ad hoc networks (MANETs). We use Signal To Noise Ratio (SNR)[1] for achieving this. Here we use AODV[4]. AODV routing table maintains record of any route that is recently used, so whenever a destination address is given, the source's routing table contains pre visited paths to the given destination. Hence using the information of pre visited paths , we define the SNR Threshold at nodes in the pre visited paths from source to destination, this Threshold is compared with SNR value at nodes, SNR value at the nodes is obtained by exploiting information from the MAC layer. SNR is calculated as follows [1].

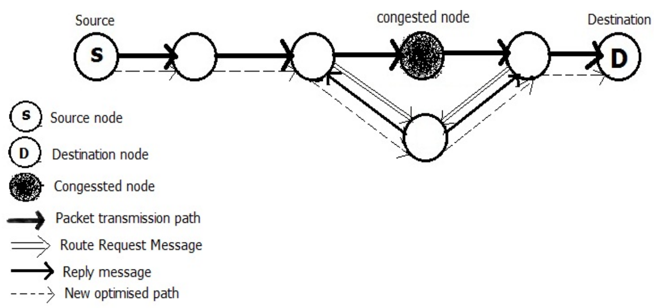
$$PSNR(n)_{dB} = 20\log_{10}\left[\frac{V_{peak}}{\sqrt{\frac{1}{N_{col}N_{row}}\sum_{i=0}^{N_{col}}\sum_{j=0}^{N_{row}}[Y_S(n,i,j)-Y_D(n,i,j)]^2}}\right]$$

Where $V_{peak} = 2^k - 1$, k = number of bits per pixel (luminance component)

Here the concept is to dynamically detect the level of congestion at the nodes in pre visited paths from source to destination and construct an optimal route dynamically while the video packets get transmitted from source to destination and this decreases the traffic in the network which improves the performance by reducing the loss of packets and fastening the transmission of video packets to the receiver. For this purpose we have a predefined SNR threshold at nodes as mentioned before and this threshold is compared with the SNR value of the node, if the SNR value of a node is less than the threshold then it is considered as congested and if the SNR value of a node is more than or equal to the threshold then the node is considered as free of congestion, so, while the packets are being transmitted the nodes in the path, if they find themselves congested, transmit feedback messages to their neighbors on either sides that they are congested , the feedback message is nothing but the SNR value of a node which directly indicates that it is congested. so while the packets are being transmitted if any node in the path finds its neighbor congested as it would already have got the feedback message , so when a node while transmitting video packets finds its neighbor congested, skips the congested neighbor and selects another neighbor which is free of congestion, hence dynamically congestion is detected and a bypass node is selected and packet transmission is continued instead of starting from the beginning i.e. from the source .Hence the path is dynamically constructed which reduces the overhead of unnecessary feedbacks from all nodes to source as their might be some congested nodes and some might be not , but we are concerned about the nodes which are congested so as to skip them dynamically and continue the passage of video packets , so our proposed work focuses on the congested node and only the congested nodes transmits the feedback to its neighbor which decreases the overhead and packet loss will be reduced and the delay in transmitting the delay sensitive video packets is also reduced .



(a)



(b)

Figure: **Finding an alternative neighbor node and continuing the passage of video packets**

As shown in the above figure whenever a congested node is found in the path, that node is skipped and request is sent to an alternate node from the current node to know whether the alternate node is congested or not and getting reply from that node that it is not congested, packets are transmitted via that node and the transmission is continued, the same process is repeated up to all packets completely get transmitted to the receiver.

3.2. A**lgorithm**

For describing the above given work we have defined an algorithm at nodes in all previously visited paths from source to destination and it is as follows

Algorithm: Optimized Feedback Algorithm

Feedback Phase

01Initialize Peak Signal to Noise Ratio ***psnr***

Initialize threshold ***t***
Initialize adjacent node 1 ***n1***
Initialize adjacent node 2 ***n2***
Initialize feedback message ***fmsg***
Periodic update of ***psnr***
IF psnr < ***t*** THEN
  fmsg = ***psnr***
  Send ***fmsg*** to ***n1***
  Send ***fmsg*** to ***n2***
END IF

Alternative Path Phase

Initialize broadcast message ***bmsg***
Initialize neighbour vector ***NV***
Initialize good neighbours ***GN***
Find out neighbour nodes ***N***
For each ***n*** in ***N***
  Add ***n*** to ***NV***
End For
For each ***nv*** in ***NV***
  IF psnr of ***nv*** >= ***t*** THEN
    Add ***nv*** to ***GN***
  END IF
End For
Choose one of the nodes in GN for alternative path

The above algorithm has two phases

a. Feedback phase

In the feedback phase we initialize peak signal to noise ratio (psnr),threshold(t) ,adjacent nodes n1,n2 and periodically update psnr value at each node as the number of packets competing to transmit through a node may change periodically .Then we define a conditional statement where in psnr value is compared with Threshold, if psnr at a particular node is less than threshold then the node's psnr value will be assigned to the feedback message and the message is transmitted to both the neighbors(n1 , n2) on either side of the node else the feedback is not assigned with psnr and transmitted to neighbors as the node is not congested.

b. Alternative path phase

In this phase we initialize the broadcast message(bmsg), neighbor vector(NV),good neighbor(GN),neighbor nodes(N),firstly we write a For loop for adding all the nodes to the neighbor vector(NV), then we write another For loop inside which we write an If condition where we compare the psnr of each node in the neighbor vector with the Threshold(t) and those nodes whose psnr is greater than or equal to the threshold(t) are added to the good neighbors (GN) , from the good neighbors we can select one of the nodes for the transmission of the video packets.

4. Experimental results and Analysis

The performance of the system is evaluated under three different scenarios. In the first scenario we have used IEEE 802.11e[2] protocol for traffic classification , in the second scenario we have introduced SNR mechanism[1] along with IEEE 802.11e so as to improve the performance, in the third scenario in addition to the above two scenarios we have used SNR mechanism at each and every node in previously visited paths from source to destination for further enhancement in the performance of the system . We have performed analysis on average throughput and packet delivery ratio and the results are as follows.

Figure (a) shows the average throughput in the three different scenarios and we have driven a conclusion that an ideal throughput is obtained in the third scenario i.e. utilizing the SNR mechanism at each and every node.

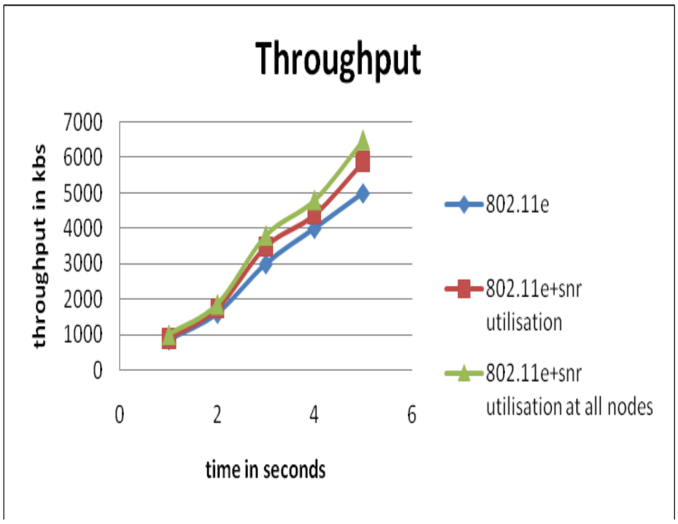


Figure (a) Average Throughput

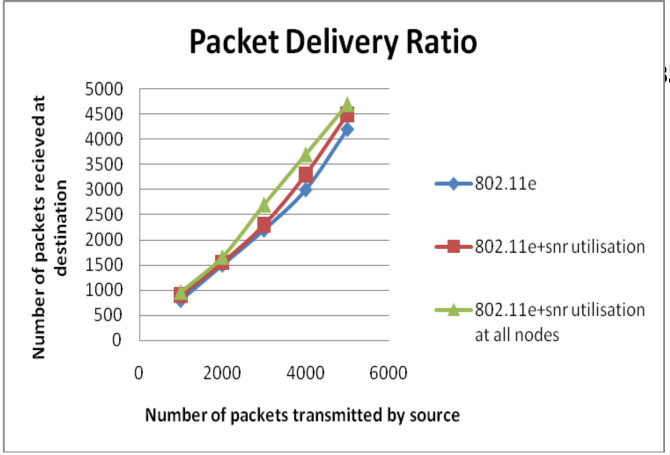
figure (b) shows the Packet Delivery Ratio, here we have evaluated Packet Delivery Ratio in the above mentioned three scenarios and we have obtained higher Packet Delivery Ratio in the third scenario when compared to the other two scenarios. Hence utilizing SNR mechanism at each and every node has provided higher Packet Delivery Ratio , means more number of packets are being delivered to the destination in the third scenario than the other two

Figure (b) Packet Delivery Ratio

From the experimental analysis we derive that the proposed work provides better throughput and packet delivery ratio in case of transmission of video packets by reducing the overhead in the network as there are no feedback messages throughout the network and the delay in the delivery of the video packets is also reduced because the reduction in the overhead of the network has directly influenced the packet loss i.e. the loss of video packets due to disturbance in the Mobile ad hoc networks (MANETs) is reduced which has also improved , thus analysis show that the proposed work makes video streaming a promising application in Mobile ad hoc networks (MANETs).

5. Conclusion and Future enhancement

In this work we have presented an optimized technique which utilizes SNR value of each node in the pre visited paths for the purpose of knowing the level of congestion at the nodes by



comparing it with a predefined threshold which is an ideal limit for the transmission of video packets, by this we construct an optimized path dynamically while the video packets are being transmitted this reduces the overhead in the network and because of this packet loss is controlled and the performance of delay sensitive video steaming is improved in Mobile ad hoc networks (MANETs). For future work we may focus on using the proposed work in different node populations and mobile scenarios and what is also left for the future work is to find the causes of certain Router failures and the solution for them while transmitting the video packets which may also cause the loss of packets.

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