Optimized Routing Framework for High End Video Data Transmission in Wireless Networks

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***Abstract*— Protocols required to find the best path to reach destination in wireless networks are specificfor each application. Superior quality videos are in great demand in the present scenario. In this paper, the main aim is to minimize distortion of high-end traffic occurring over wireless networks. We propose a new routing technique named Minimum Distortion Routing (MDR), in which it concentrates to delineate a routing framework for minimizing distortion from source to destination effectively. The proposed work is to minimize the distortion experienced by the user and enhancing the video quality by catering the application needs. Traditional link based routing policies like ETXproduce a large video distortion as they neglect the correlation among the links in a path. Therefore the complete communication path becomes congested, leading to high distortion. An analytical framework is the only solution for minimizing video distortion. Here an optimized protocol for routing is built based on the framework's policy. The efficiency of the protocol is verified using NS2 simulator, which results in increased bandwidth utilization and reduced distortion within a short time intervalwhen compared with the existing routing protocols. We have also improvedthe efficiency of the network through increased throughput and decreased data loss when delivering packets from source to destination.**

***Keywords*—distortion in wireless networks, Traffic congestion,ETX, analytical model, video distortion minimization, wireless networks.**

1. INTRODUCTION

In recent days, usages of wireless systems are more widespread than earlier days [2]. Communications in cellular and wireless networks are unavoidable for humans in their daily routines. Data Transmissions are detected and controlled by central base stations [1]. In multipath communication systems, there are many nodes involved between the source and destination. These nodes communicate among themselves along the entire path from the source tothedestination. They are mainly used to route the data packets and identify the best route in the wireless networks. Multi path networks are dynamic in nature and existon its own without any base station. These networks are capable of transferring high end data like video traffic over it. Network phenomenons like Internet Protocol Television (IPTV) and Voice Over Internet Protocol (VOIP) deliver a high quality video by increasing bandwidth time to time. Broadband plays a very important role in the above type of transmissions [1].Effective usage of broadband services is not possible in tough terrains and rural areas because of lack of technological facilities and their cost. This is the main reason why broadband services are not a hit in Rural India. One path VLANs, mainly 3G and WiMAX are expensive and also require licensed access. So, it is expected thatthe multipath network can eliminate this issue and also provides high quality ofservice [1].

It is necessary that we have to look on to those VLANs offering multimedia services, as these are the biggest upcoming traffic sources. With advent of smart phones, this traffic has gone to a further shoot up. Transmission of important and necessary information such as voice data, video data from vulnerable areas which are in immediate need forhelp are badly disrupted due to increasing network traffic. Usually quality of service during video transmission is affected by the variety of compression mechanisms used at one end and also due todisruptions in wireless channel. The losses that occur in the transit can be minimized by adopting video encoding standards, for example: I-type frames are a certain group of frame types as established by video encoding standards. Our main consideration is I-type frames where data encoding happens independently. The end level performance of video transmission can be detected using GOP (Group of Pictures). GOP determines performance by taking into account the frame losses as a distortionmetric.

The most important functionality for video transmission is often looked upon which in turn leads to deduction in the quality of videos. The losses that happen along the path from source to destination are related to each other and are also specific to each application. In most cases, only few links suffer high traffic resulting in distortion whereas other few are free and not utilized. The main error so far was concentrating on the network parameters rather than application in routing traffic.

2. RELATED WORK – *EXISTING SYSTEMS AND THEIR LIMITATIONS*

Many different techniques from standardized organizations governing video encoding for the transmission of videos are available. The entire video data can be split up into numerous chunks and sent across different paths in the same network. Multiple Description Coding is the name given to the above technique [20], [21]. The process of reassembling the original video can be made successful by accounting the description in a network and also the quality of service (QoS) can be increased based on the sub streams used. There are other techniques such as layered technique for increasing the QoS. Different layers are added to the base layer for improving the performance but the main work takes place in the base layer. The layered encoding technique [5], [6] establishes video standards like MPEG-4 [7] and H.264/AVC [8] that provide the necessary orientation for the video transmission in a network [9], [10]. The splitting up of video clips into different frames facilitates better quality. All the frames area GOP.I-frame is the one, which carries information, and B and P-frames are used as sources. The video clip is split into different chunks. Temporary errors occur in the video streams due to compression and quantization [11]. An algorithm is proposed to estimate the difference between inter and intra codings. Peak Signal to Noise ratio becomes high because of the addition of the algorithm.The distortion minimization is taken as the base for determining the coding parameters [4]. Recurring frame loss rate is considered in simulation for observing the transmission on a network. Effects of wireless channel fading [13] and distortion are studied over a single hop already. Similarly other studies have been performed on single links to study the effects [14]. Based on the length of errors among the frames, experimentations are done and Markov chain system is established over multi-hop networks. A recursion model is used to show the distortion in a 2D scenarioand works have been carriedout based on that. Although all these experimentations and studies have been carried out earlier none have considered routing metrics as an important functionality, though impact of routing plays a crucialrole [4].

In today's scenario 4G networks are also used for determining the performance of the transmissions. H.264/SVC encoding is examined over mobile WiMAX [17]. The studies have concluded that the different encoding standards used on protocols have direct impact on the performance. But none of these studies claims any report on the impact of routing protocols on video distortion. Researches have been conducted upon various adhoc and mesh networks [1], [2], [3], [18] regarding QoS and optimization among cross layers. Different evaluation metrics based on the network layers define QoS in several ways. Only throughput and delay constraints have been considered as performance metric so far rather than application specific metrics [19]. One more study based on QoS is done where disjoint paths from source to destination are used for transmission. Minimization of distortion is claimed to be achieved by selecting routes properly, but this selection of routes itself is complicated and is therefore considered heuristic.

3. PROPOSED SYSTEM

The main aim of this paper is to minimize the distortion experienced by the user and to enhance the video quality by catering to the application needs. A video clip can handle only a few packet losses using different schemes. The clip cannot be decoded if there are large number of packets lost in a frame. The distortion is calculated by taking into account the unrecoverable video frames that are lost from source to destination. The approach used here is a multilayer design model. Rather than concentrating on one network quality metric, the aim here is to analyze the frame losses as an analytical model to delineate the dynamic behavior. The loss is calculated by associating the frame loss probability mapping it with packet loss probability. It can thus be identified that routing is the optimized solution to reduce the source to destination distortion by finding the optimum path between them [22], [23].

In the routing protocol designed, the links are treatedindependently. The loss that happens during the transmission process can be found out using a programming approach, which is dynamic [25]. This becomes the base of the routing protocol that we have built. I-type frames are the frames that carry the most important information and therefore if they are sent on a congested path it affects the distortion metric considerably [24]. So if we find a path that is least congested it will lead to minimization of the distortionrate.

4. SCOPE

The scope of this work is to eliminate the existing technical glitches in routing and to improve the performance metrics like Quality of Service, Packet delivery ratio, Throughput, Bandwidth utilization etc.

5. ADVATANGES OF THE PROPOSED SYSTEM

5.1) ***Usage of a systematic layered approach***:

This is one of the important contributions of the system as theminimization in the distortion rate is achieved by findingthe optimal route using a systematic approach. Also thefunctionalities of physical and MAC layers areconsidered correlatively and put into best use.

5.2) ***The practicality of the routing framework***:

The source keeps track of the routing information and theprimary video is sent based on the practical optimalpath.

5.3) ***Severe experimentations and testing***:

The minimization of the distortion rate is proven by carrying out various experimentations and testing and also by analyzing the different parameters that are considered to be important performance metrics. The factual figures prove the above. Peak Signal to Noise Ratio (PSNR) rate is increased by 20%. The QoS is verified by considering different performance metrics and is proven to be at a higher rate than the existing protocols.

5.4) ***Application requirements rather than networkrequirements***:

Taking into account that application specific requirements rather than network requirements alone have given an edge over the traditional routing policies.

6. SYSTEM AND PROTOCOL DESIGN

In the flowchart, initially the multi-hop setting is created using different nodes in a network. The client and the server are set up, and the client forwards the request to the server. Whenever the server is ready to process the request, it takes the request from the client and processes it. In this process, the video frames are split into numerous packet chunks and the optimal path from the source to the destination is found out using the optimal path finding algorithm. Then the I-frames or the chunks are forwarded across this optimal least congested path. The video frame is thus sent successfully with minimal distortion.

The protocol design of MDR requires the full knowledge of the network, and hence we have used ETX to determine the information about the network. The number of links and the nodes in the network as well as the neighbors of the nodes are updated in the routing table. This is taken as the estimate for processing the requests. After collecting the route table estimates, request is sent and if the request reaches the appropriate node, reply is obtained else the same procedure is repeated [4].

7. ALGORITHM

Procedure: NeighboringNode Discovery Input: Source node ‘S’, Destination node ‘D’ Output: Distortion Resistant Path.

Step 1: Begin

Step 2: Send Route request.

Step 3: For all nodes

If

request message is for a particular node D

send Route reply to source S

Else

forward request message to nextnodes.

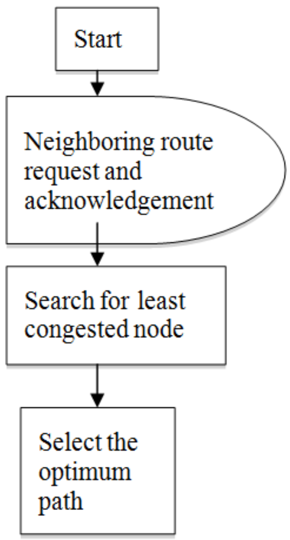
Add the nearest node to the path.

End if

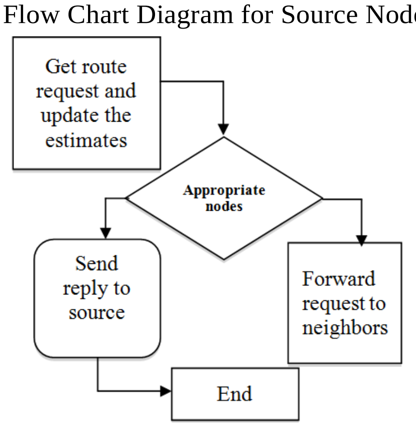
End for

Step 4: return the path to source.

Step 5: End.



Flow Chart Diagram for Source Node



Flow Chart Diagram for Intermediate and Destination Node

8. PSUEDOCODE

1: For the discovery of the neighboring node from the network

// Neighboring node discovery Algorithm / / Input: source node s , destination node d
Input: frame size F
Output: route R from to s to d

```
Send route request
ReceiveACK(estimates,node-id's,messages) n←←s
  c←←F R←←[] y←←(n,c)
 update y to R
repeat
p* ←←Next Optimum Node
   C1 ←←M[Cnew|Ccur=c]
     n←←p*
     c←←C1
     y←←(n,c)
     update y to R
     Until y is last node
```

2: To find the optimal path between the source and destination

//Optimal Path Algorithm //

Input: Initial State y , last node l Input : set of free nodes [Fn] Input: frame size F
Output: next node p* in path

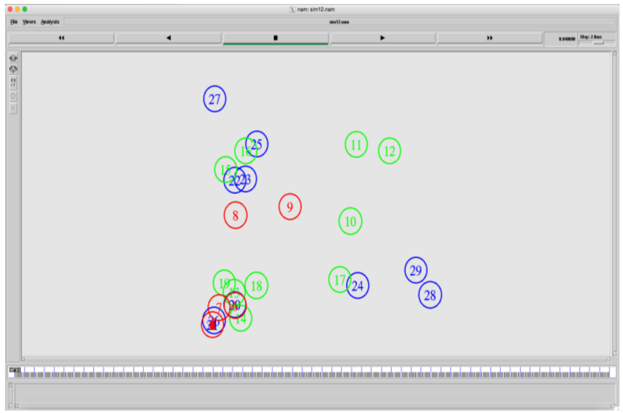
```
A←←n*c
I←←||A||
/*Optimal Calculation */

for j=I to 1 do
  if j=I then
    for all y belongs to A do Jj(y)←←k(y)
        end for
else
for all y=(n,c) belongs to A do
U(n)←←{n' |n,n' 1 –hop neighbours }
Ji(y,u)<-{g(y,u)+p(c,c'|u)J(y')
J(y)←←min(j(y,u))
P(y)←←arg min(j(y,u))
end for
end if
end for

     n*←←P(y)
     return n*
```

9. IMPLEMENTATION

The methodology, which we have used, comprises of the following four phases:

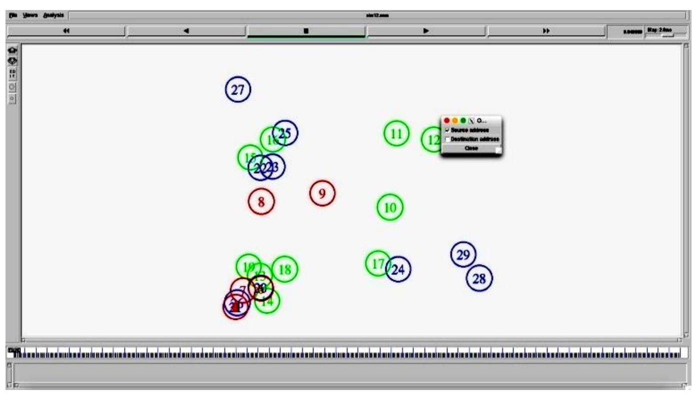
MODULE 1: MULTIHOP ROUTING NETWORK

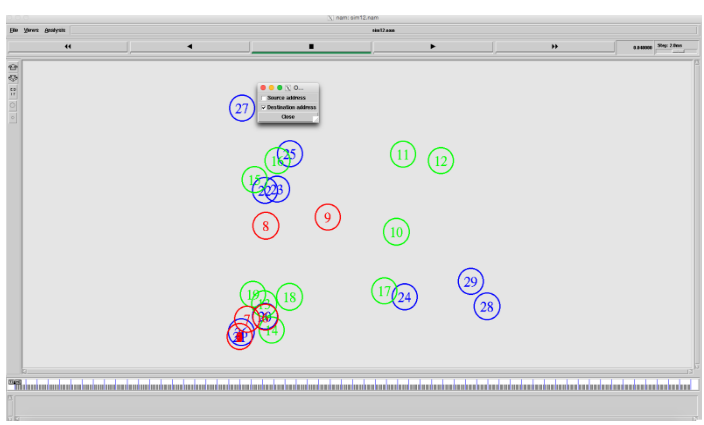
The earlier protocols used did not account for a multi hop setting, so in our protocol design we have optimized our routing to work in a multi hop environment. In this module the basic multi hop set up is established along with the appropriate number of nodes in the network (50 nodes in the network). The source and destination nodes are defined. The interlinking connections between all the nodes along the source and the destination are created. The node and server design are concentrated to give a complete view of the network.



MODULE 2: VIDEO ANALYTICAL MODEL

In the next phase, we send a request from the source to the server. This is done by constructing an analytical model. This model waits for the acknowledgment from the nodes after request is being sent by the source. The server gives an acknowledgement whenever it is ready to process the request. The ETX estimates of the neighboring nodes in the network are then obtained and updated in the routing table. This analytical model facilitates request and information about the nodes in the network simultaneously.





MODULE 3: VIDEO DISTORTION MINIMIZATION

The main aim of this protocol is to minimize the distortion rate. So in this module, we concentrate on this methodology to implement an effective solution for distortion minimization. Our solution includes finding an optimum path. Optimum path is the path which is leastcongestedfortheI-framestoreto reachthedestination without much distortion. Here we calculate the nearest neighboring node or the next available hop for the delivery of frames using the neighboring node discovery algorithm. After finding all the intermediate nodes from the source to destination, an optimal least congested and shortest path is determined.

MODULE 4: VIDEO DISTORTION DYNAMICS

The ultimate result of the protocol design is shown in this module. Here we compare the performance metrics of the existing protocols with the new protocol. This is done using charts and graphs. The efficiency of the new protocol is proven using simulation results. From the simulation results, we can see that the improvement in the performance metrics have considerably increased the efficiency of the network compared to the already existing protocols' metrics.

10. SIMULATION RESULTS AND DISCUSSIONS

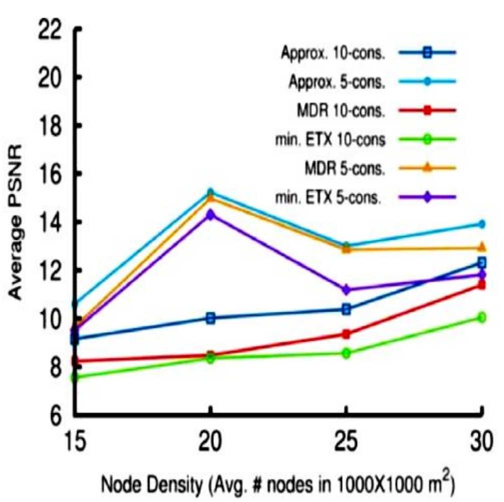


Figure. 1 Node density Vs PSNR

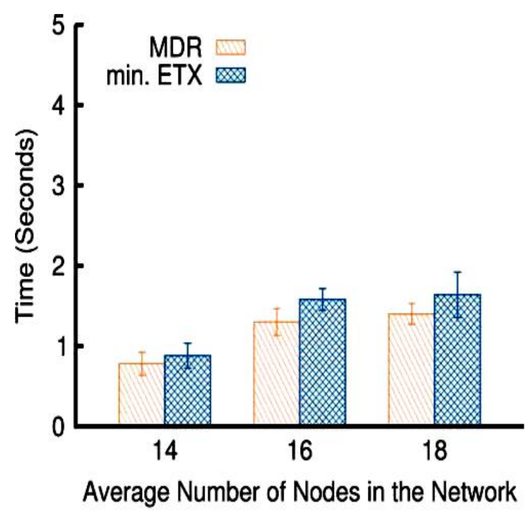


Figure. 2 Time Vs average number of nodes

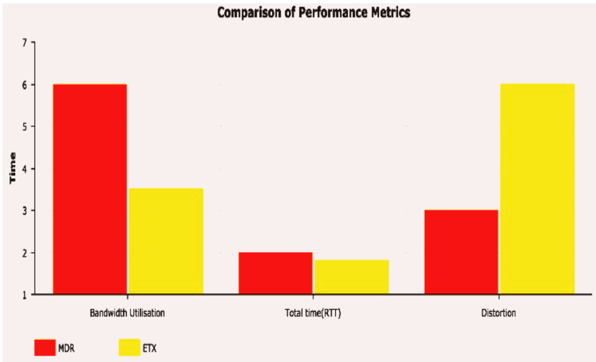


Figure. 3. Comparison of Performance metrics

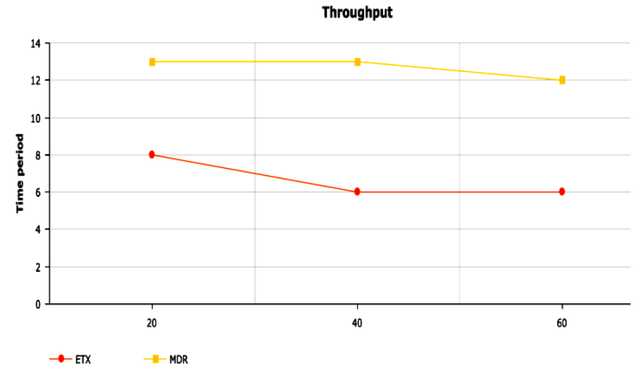


Figure. 4. Comparison of throughput

In Figure 1, the node density is plotted against average PSNR for ETX and MDR which eventually proves MDR's efficiency. In Figure 2, the average number of nodes in the network is plotted against time and the result shows that in MDR, more number of nodes is covered in less time. In Figure 3, the Bandwidth utilization, Round Trip Time (RTT) and Distortion are plotted against time and the improved efficiency of the MDR is highlighted. In Figure 4, the throughputs of ETX and MDR are compared to highlight MDR's efficiency over ETX.

11. CONCLUSION

We have found that the existing wireless network systems are not efficient in terms of bandwidth utilization, RTT and distortion. We have proposed a new routing protocol framework which helps in effectively minimizing the total distortionduring the video data transfer in the wireless network.The analytical framework designed with the help of a new MDR protocol sends the frames in the least congested path to achieve minimum distortion.Using NS2 simulator, the performances of the proposed protocol were evaluated and the results show increased bandwidth utilization and reduced distortion within a short time interval as compared to the performances of the existing routing protocols.We have also proved that the network's throughput has increased and data loss decreased when delivering packets from source to destination. So, our proposed routing protocol is proven to give much better results for video data transmission in wireless networks.

12. FUTURE WORKS

In the present we have aimed at reducing the distortion for high-end data traffic in mobile wireless networks. In the future work, it is possible to implement a protocol for low-end data in homogeneous and heterogeneous Wireless Sensor Networks.

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