Improving Quality of Video Streaming over Mobile Networks to Leverage Healthcare Services

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Abstract: ***Advancements in mobile technologies paved way for transmission of multimedia over such networks. Wireless devices and wearable devices are widely used in healthcare infrastructure. Due to errors in wireless channel video streaming quality over wireless devices is deteriorated. In a healthcare unit physicians need to know vital signs of patients in real time. Physician can diagnose the problem of patient before patient reaches hospital with the innovative technologies that seamlessly integrate mobile devices and healthcare network in hospital. All stakeholders of healthcare unit are connected with the network. The problem to be addressed here is to ensure that video pertaining to patient's ultrasound or any such useful thing is transferred healthcare server with acceptable quality. Thus doctors can have diagnosis and provide real time response to the needs of patients who are in need of emergency health services. In this paper Ifocus on using error concealment technique to improve quality of video streaming based on the region of interest specified by doctor. Thus better communication to physicians is made possible and the utility of the healthcare infrastructure is appreciated. To achieve this cross-layer design is made and implemented using NS2 simulations. The experimental results revealed that the proposed solution is useful to improve quality of services in healthcare unit.***

Keywords: Healthcare, Error Concealment, Region of Interest, E-Health, M-Health, Video Streaming, and Cross-layer Design CLD

1. Introduction

Wireless networks are growing rapidly due to innovations in technologies and telecommunications. In tune with this, there is increased usage of mobiles in the real world. In this context, the usage of mobiles is increased for useful applications as well. Healthcare is an important domain which is associated with the health of people across the globe. People are increasingly depending on healthcare services as their quality of living is based on health. Quality healthcare services are to be given paramount importance. In this context, it is understood that patients can use technologies and wearable devices in order to connect with healthcare infrastructure in hospitals. Thus patients can send their vital signs to physicians automatically and real time. It can help them to have better and timely treatment. Iconsidered the following as motivating scenario.

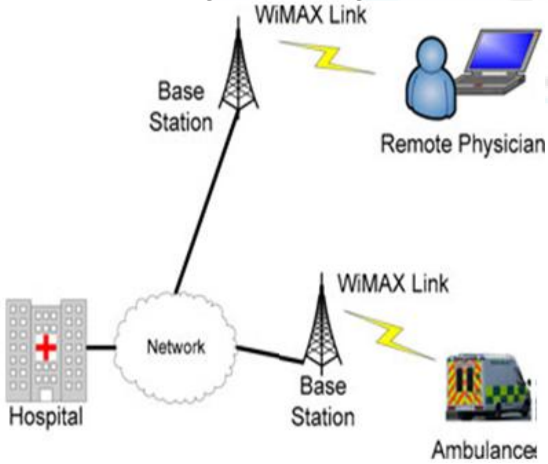

Figure 1: Motivating scenario

As shown in Figure 1, it is evident that ambulance is linked to healthcare infrastructure. At the same time the patient when having wearable devices, can produce conditions and transfer to the healthcare network. A remote physician needs to view, for example, ultrasound video of patient; it is possible with this kind of network. When physician is able to view such video, he can give treatment without delay. He can pass on instructions to the concerned people and real time treatment starts thus improving quality of services in healthcare domain.

Now the problem with this kind of network is that it depends on the wireless channels that may not be consistent and may cause problems. To overcome these problems, a cross layer design approach is needed in order to optimize performance of network with respect to multimedia content dissemination. This is the problem considered in this paper. The remainder of the paper is structured as follows. Section II provides review of literature. Section III presents the proposed system in detail. Section IV shows experimental results while section V concludes the paper.

2. Related Works

Many researchers contributed towards improving quality of services over wireless network with respect to multimedia transmission. Stockhammer *et al*. [1] explored tools used for improving quality of wireless networks. Panayides *et al*. [2] focused on educating improvements needed in medical video transmission systems. Pynayides *et al*. [3] focused on video coding for robust and efficient ultrasound transmission over noisy wireless channels. Wu and Rao [4] used the notion of perceptual coding for improving digital video image quality. Zhang *et al*. [5] explored cross layer design approaches for multi-hop wireless networks in order to improve Quality of Services (QoS).

Wang *et al*. [6] threw light into error concealment that is used to improve quality of video transmissions over warless networks. Agrafiotis *et al*. [7] on the other hand focused on optimized temporal error concealment for improving QoS in video transmission. Martini [8] made a review of broadband multimedia services in healthcare domain. Andersen *et al*. [9]

focused on models pertaining to propagation measurements for performance improvement. Rajkumar and Latte [10] studied the need for Region of Interest (ROI) in video transmission for better rendering of video. Aegean *et al.* [11] focused on advanced coding for ROI. Chen and Chen [12] also focused on error concealment techniques. Khosla et la. [13] studied the need for having intelligent systems to support automatic body ROI for improved transmission of data. Panayides *et al.* [14] investigated the usage of 3G technology and recent developments in medical video transmission.

Other techniques came into existence of late include low complexity error concealment [15], error concealment of motion vectors that are lost [16], Macroblock ordering [17], WiMAX [18], and CLD for wireless sensor networks [19]. In this paper our focus is on optimization of MAC and physical layers as part of CLD in order to improve the quality of services in medical video transmission.

3. Proposed CLD Approach

Iproposed an approach that makes use of MAC and physical layers in order to improve the quality of video transmission in wireless networks. This approach is used to know application layer needs and then optimize MAC and physical layers independently and then have combined optimization in order to have better quality of medical video transmission.

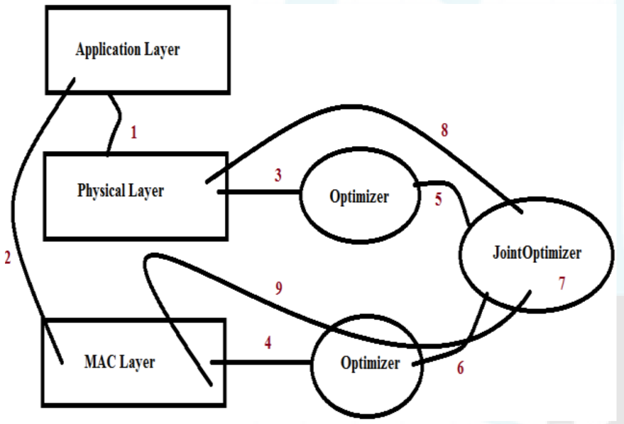

Figure 2: Proposed joint optimization of in CLD

As shown in Figure 2, it is evident that the PHY and MAC layers take QoS needs from application layers (1, 2). Then the corresponding optimizations are made for these two layers (3, 4). Afterwards joint optimizations takes place (5, 6, and 7). After performing joint optimization, the result of the optimizations is sent to both the layers (8, 9). The actual improvement are made in the joint optimizer include modulation, duplex mode, channel bandwidth, Tx power and CTS/RTS dynamics.

4. Experimental Results

This section provides experimental results. The results of CLD proposed in this paper are observed in terms of delay, energy efficiency, packet delivery ratio and throughput. The environment used for experiments is as shown below.

Table 1: Shows NS2 environment used for experiments

S.No	Parameter Type	Parameter Value
1	Channel Type	Wireless Channel
2	Radio-Propagation	Propagation/TwoRayGround
3	Network Interface	WirelessPhy
4	Interface Queue Type	DropTail
5	Antenna Model	OmniAntenna
6	Interface Queue Length	50
7	Routing Protocol	DSR/AODV
8	CTSThreshold	2000
9	RTSThreshold	5000
10	basicRate	1MB
11	dataRate	5MB

Table 2: Delay performance comparison

Simulation Time	Existing	Proposed
0	0	0
5	0	0
10	0	0
15	0	0
20	0.055723446	0.052757646
25	0.035017435	0.031017402
30	0.029097512	0.026097544
35	0.025965571	0.021965571
40	0.023530958	0.020530958
45	0.021938428	0.019938428
50	0.020812441	0.018812441
55	0.019977	0.016977
60	0.019329289	0.016159289
65	0.018814347	0.015814347
70	0.018411068	0.015201068
75	0.018046976	0.015016976
80	0.017752636	0.014752636
85	0.017502694	0.014252694
90	0.017284326	0.014144326
95	0.017095083	0.014035083

As shown in Table 2, it is evident that the delay performance of the proposed and existing systems is compared. The results revealed that the performance of proposed system is better than that of existing system.

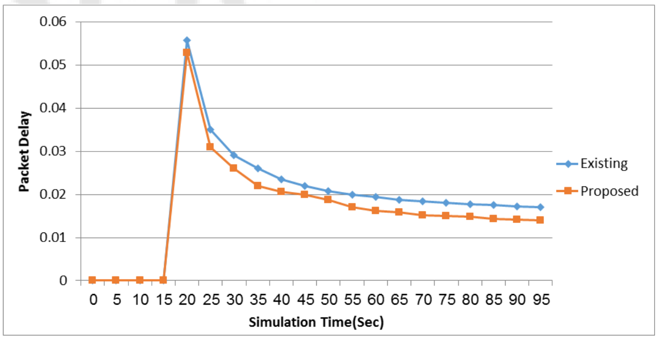

Figure 3: Delay performance comparison

As shown in Figure 3, it is evident that the proposed system shows less delay in delivering packets and thus performance is improved. Two trends are visible in the results. The first one is that delay is more initially and reduced as simulation time is increased. The second one is that proposed system shows better performance over existing system.

Table 3: Energy consumption comparison

Simulation Time	Proposed	Existing
0	90	80
5	75.2	71.5
10	73.3	69.3
15	70.4	67.4
20	66.42	60.24
25	57.51	51.12
30	45.53	39.59
35	40.51	37.18
40	35.55	30.58
45	35.5	30.25
50	35.42	30.18
55	35.41	30.16
60	26.4	21.24
65	22.42	18.22
70	21.41	17.24
75	20.42	16.32
80	20.48	13.21
85	20.38	16.15
90	20.32	16.13
95	20.21	16.11

As shown in Table 3, it is evident that the energy consumption is observed for both existing and proposed systems.

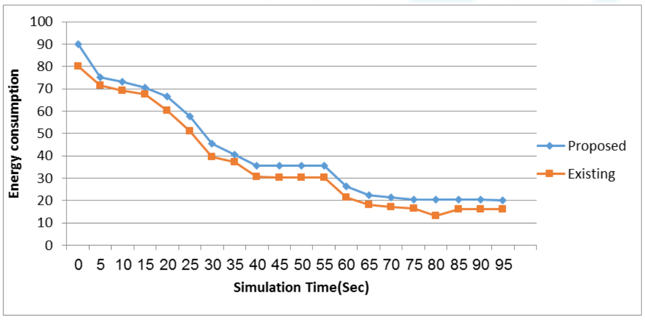

Figure 4: Energy consumption performance comparison

As shown in Figure 4, it is clear that the energy consumption is increased as simulation time is increased. At the same time, the energy consumption of proposed system is less when compared with that of existing system in terms of residual energy.

Table 4: PDR performance comparison

Simulation Time	Proposed	Existing
0	0	0
5	0	0
10	0	0
15	0	0
20	2	1
25	5	3
30	7	5
35	9	7
40	12	9
45	14	12
50	17	14
55	19	17
60	22	19
65	24	22
70	27	24
75	29	27
80	32	29
85	34	32
90	37	34
95	39	37

As shown in Table 4, it is evident that performance of the existing and proposed systems is compared in terms of packet delivery ratio (PDR). The PDR of the proposed system is better than that of existing system.

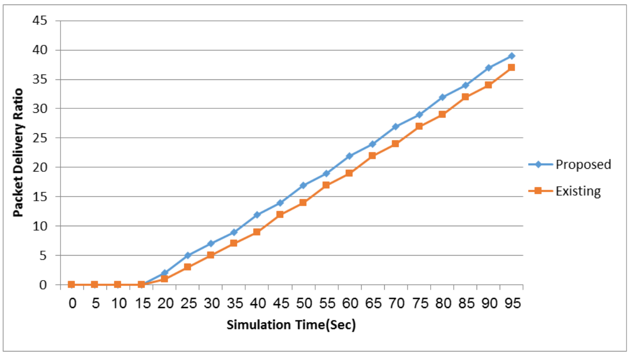

Figure 5: Comparison of PDR

As shown in Figure 5, the simulation time and PDR are presented in horizontal and vertical axes respectively. The results revealed that the performance of the proposed system is better with respect to PDR. This trend is clear for all simulation timings presented.

Table 5: Throughput performance comparison

Simulation Time	Proposed	Existing
0	0	0
5	0	0
10	0	0
15	0	0
20	42560	39605
25	42560	39605
30	38304	36403
35	38304	36403
40	42560	39605
45	42560	39605
50	42560	39605
55	42560	39605
60	42560	39605
65	42560	39605
70	42560	39605
75	42560	39605
80	42560	39605
85	42560	39605
90	42560	39605
95	42560	39605

As shown in Table 5, the results presented reveal that the throughput is presented in terms of number of bytes transferred. As simulation time is increased, the throughput value is increased. Another observation is that the throughput performance of the proposed system is better than that of existing system.

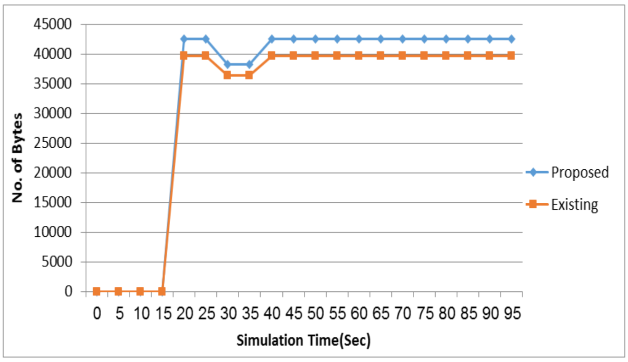

Figure 6: Throughput comparison between existing and proposed systems

As can be seen in Figure 6, it is evident that the throughput is increased as simulation is increased initially. Apart from this, the throughput performance of proposed system is better than that of existing system due to the cross layer design in wireless network.

5. Conclusions

In this paper Iinvestigated cross layer design for improving multimedia transmissions over wireless networks. The wireless channels are error prone and there might be other issues like signal strength. Ihave taken healthcare domain case study where patients need real time services. Iproposed a cross layer design that can help improve quality of rendering multimedia objects through wireless networks. The rationale behind this is that healthcare domain has infrastructure that is linked with mobile devices and wearable devices of patients. When any patient gets health problem, the wearable devices can capture vital signs of patients and send a video to physician. Especially in case of ultrasound kind of things, doctor needs to view it with good quality. Then doctor can provide suggestions to have real time healthcare service. Iimplemented by considering the combination of physical layer and MAC layer. Iimplemented the solution and demonstrated it in the form of NS2 simulations. The results revealed that the proposed solution has improved performance over existing one.

6. Future Work

In future Iwould like to investigate joint optimization of wireless networks with other layers of OSI reference model.

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