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QOS METRICS IN TELEMEDICINE -MODERN APPROACHES IN TRADITIONAL MEDICINE

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ABSTRACT

Quality of Services (QoS) support was challenging in wireless communication networks compared with the wired networks due to bandwidth scarcity, latency and high bit error rate and the characteristics of the wireless channel differ based on the time and space. In the field of telemedicine, it was difficult to transfer the audio and video images due to lot of disturbances caused by different sources of noise in the transmission. This also resulted in the degradation of the *QoS* in the field of telemedicine. Therefore, we go in for a new approach by optimizing the physical, data link, and the application layers of the OSI protocol stack by modifying specific parameters which results in improving the *QoS* metrics in telemedicine.

KEYWORDS: Telemedicine, Cross-Layer design, Quality of service, WLAN (Wireless Local Area Network).

INTRODUCTION

Telemedicine is generally an approach combining both the telecommunications and computer technologies together with medical expertise to facilitate remote healthcare. A patient from a remote place or village can able to consult with doctor based on the medical reports. Here the reports are sent electronically to the remote areas where the doctor will give the remedial report or the suggested medicine to the patient. Mainly this can be done for the person who seeks for the help during disaster situations. This can be used when there is an emergency need or it can be a diagnostic centre kept at villages where people are financially dull to meet their medical expenses. Using scanning device and blood test reports taken at the diagnostic centre and the generated report has tp be send to the doctor electronically via network.

There are two different types of WLANS being focused. They are a conventional WLAN and the proposed WLAN. The conventional IEEE 802.11 WLAN technology, even though it fulfills the necessity for a scalable and low cost network, it still does not provide a reliable form of data transmission to deliver the patient's information [23]. It does not support Quality of Services (QoS) and thus, will not provide guaranteed bandwidth for the telemedicine applications. As a result of this unreliability, the telemedicine applications will experience major problems like QoS degradation or even it might fail to acquire the needed bandwidth during the time of transmission [1]. The reason behind such kinds of difficulties in transmission is why because the wireless local area networks have peculiar characteristics such as bandwidth, delay, jitter, packet loss which have major influence on the transmission and degrades the quality level of the telemedicine applications.

Using the proposed WLAN technology, we are using a cross layer design to optimize the protocol stack to obtain the guaranteed bandwidth to transmit the data in a telemedicine system [25].

LITERATURE SURVEY

The main problem behind this is that, even though the Internet and its infrastructures are playing a vital role giving success to the field of telemedicine, it is not safe to execute some of the critical applications like audio and video with high quality involved in telemedicine applications without proper Quality of Service (QoS) [7].

The key information components in telemedicine are voice, video, and data. The things that are to be taken care of are, precise communication, no cracking of voice and the most important of them all is, the audio and video traffic must be taken care of. The IETF (Internet Engineering Task Force) has standardized DVOIP (Digital Video over IP) to convert digital video streams into packets and adding headers and timestamps into each IP packet. The Quality of the video stream should be high and the response time taken should be less. The traffic being a bursty kind, a maximum and minimum and an average bandwidth would be needed to be specified. Different data streams have different characteristics and the traffic of each of the different data streams should be treated differently.

There are certain Quality of Service requirements needed to be fulfilled for the telemedicine applications like the Connection Admission Control – to guarantee traffic streams by not allowing the data packets to travel through congested routes, Traffic Differentiation, Real-Time Traffic Management and Congestion Control [20]. The bandwidth in a real time video depends on whether raw data streams are sent or some form of compression is used.

At present, the telemedicine applications focuses mainly on six key issues namely, reliability, efficiency, portability, functionality, usability, and, maintainability [8]. The telemedicine system is being used in fields like Tele-Radiology, Tele-Pathology, Tele-Cardiology, Tele-Oncology, Tele-Home Care, Tele-Surgery and Tele-Psychiatry.

Advancement in communication technologies have paved way for large medical centers to provide medical services to small and medium-sized medical facilities in small towns and rural areas. The communications tools like wireless systems, Low Earth Orbit satellite systems, and internet have reshaped the response communication from primarily “within” an organization to a more “between” an organization approach and from an individual use to a more common networked decision making group approach [25]. All the telemedicine applications are multimedia in nature like text, data, audio, and video. So they may be forced to require a feasible and expensive telecommunications infrastructure. Luckily, only a small number of solutions require only a basic infrastructure to provide health-care services of good quality to remote areas.

The bandwidth transmission required for telemedicine applications are categorized into low bandwidth transmission, medium or high bandwidth transmission. Various transmission media are used to deploy the telecommunication technologies. Even though standard telephone lines support several telemedicine applications, higher bandwidth technologies are required for many telemedicine applications.

The telecommunications links used are based on the type of services to be used which may require narrow or broadband, standard or high-speed telecommunications. Disaster management makes it more significant to arrange alternative strategies to maintain communication even when the local infrastructure is damaged.

The telecommunication methods used are:

1) Single channel Non-Trunked: It is a radio frequency connection in a half or full duplex communication that uses only one channel at a time. Based on the type of data transmission the frequency is divided into analog (mainly use for voice communication) and digital.

2) Trunked Multiple Channel Systems: a radio frequency which dynamically allocates traffic channel and control channel based on their availability. Radio trunking has got its properties like clarity, security, possible world-wide coverage, customization for special requirements, and, call identification.

3) Microwave Transmission: High frequency transmission is highly directional and is the apt solution for point-to-point communication. Height decides the distance between antennas.

4) LANs Connectivity under Wireless: They are used to confirm the access between a wired communication and a wireless communication.

5) Satellite: This method of transmission is more convenient since it offers large bandwidth [18].

6) GSM (Global System for Mobile Communications): It is more advantageous in aspects like mobility, small cell-size and security [18].

Table 1:Types of Traffic Streams

Traffic types	Packet Loss	Delay	Jitter
High quality voice	10^{-6}	100 ms	±50 ms
Digital video	10^{-10}	200ms	±50 ms
FTP, E-MAIL	10^{-10},10^{-12}	Not critical	Not critical
Patient Statistics	10^{-10},10^{-12}	≈100 ms	≈ ±25ms

In the above table, the different types of traffic streams has been tabulated with its corresponding parameters High quality voice, Digital video, FTP,E-MAIL, and Patient Statistics. Based on the identity of what type of traffic stream is being taken over, the data's are separated, for it is necessary to group them according to QoS metrics. A critical data stream like a patient's pulse rate should not be treated in the same way as e-mail traffic though they both are of the same type of traffic (CBR type of traffic). The e-mail traffic may arrive with a delay of minutes, but a minute of delay for ECG readings could result in major disaster in the treatment of a patient and thus, resulting a great disaster in the patient's life [6].

The ATM (Asynchronous Transfer Mode) and MPLS (Multi-Path label Switching) networks, even though they support QoS and are stable for the delivery of data on using a wired network, they lack in mobility and scalability. A 3G UMTS network, in the other hand, supports mobility, but it fails to provide QoS for the transmission.

FIG: A COMPLETE STRUCTURE OF AN OPTIMIZED APPROACH FOR OUR SYSTEM

Therefore, IEEE 802.11 WLAN technology has been developed to provide the required scalable, reliable, mobile and low cost network.

Previously, the wireless standards IEEE802.11a and IEEE802.11b were used, where the end-users became confused without knowing which standard was to be used. The IEEE802.11a and IEEE802.11b are both, non-compatible standards. Thus, IEEE 802.11g was a brain-child of the IEEE (Institute of Electrical and Electronics Engineers) Association for making the wireless medium of communication possible [23]. The IEEE802.11g standard of wireless networks, have overcome the difficulties or the critical situations against higher data rates, extended range and compatibility with already installed Wi-Fi devices.

The IEEE802.11g is used in the data link layer as well as in the physical layer. It is somewhat similar to IEEE802.11b standard for its 2.4GHz ISM band. MPEG-4 technology is used at the application layer for the transmission of video images without any breakage during the transfer.

The simulation is done using NS-2. The video sent as data is broken into frames using a convertor which is in-built. Those frames are transferred via the network are again got back at the destination.

Our System Design

The design of the system contains a medical expert station and the patient station. The medical expert station is connected to an access point of IEEE802.11g technology. The patient from the rural area accesses the medical expert station on the counterpart to be treated by the medical expert. The medical expert treats the patient in the rural area on seeing the medical reports given by the technicians present in the patient station. [19] Services provided by the doctors are being taken up by the technician who is aware of the patient's history of disease and prescriptions. The technician, thereby, acts as a mediator. He also gives treatment according to the doctors' instruction.

The cross layer optimizer that optimizes the physical layer, data link layer and the application layer is given the data which optimizes it and hands it over to medical expert and the medical expert sees through the report of the patient and starts treating the patient [26].

The parameters that are to be changed during the optimization of the OSI layer during the transmission of data are tabulated.

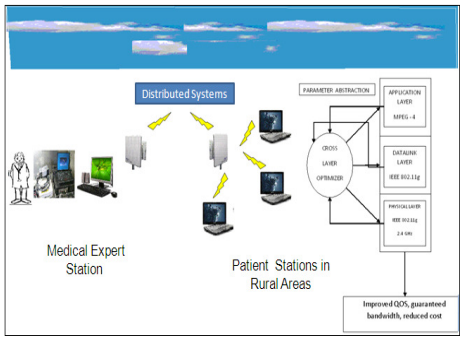


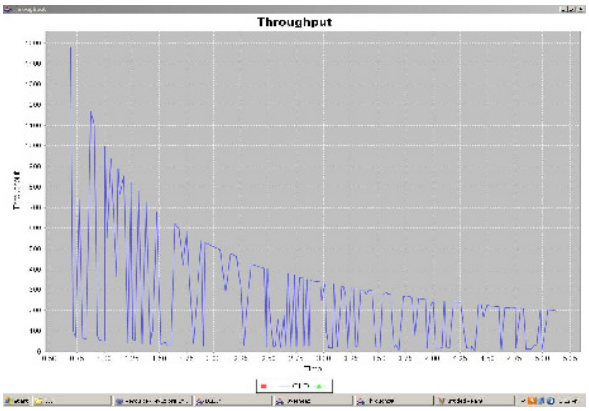
Table 2

DSSS Parameters	Values
CWMin	15
CWMax	1023
Slot Time	0.000009
CCA Time	0.000003

DSSS Parameters	Values
RxTxTurnaroundTime	0.000002
SIFS Time	0.000016
Preamble Length	96
PLCPHeaderLength	40
PLCPDataRate	$6.0e^{6}$
MaxPropagationDelay	0.0000005

The throughput is calculated by the formula

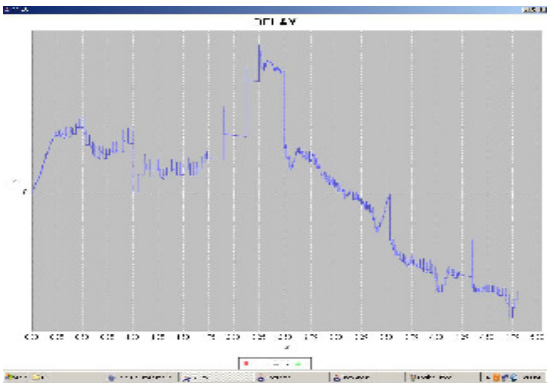
Throughput= packet size / time



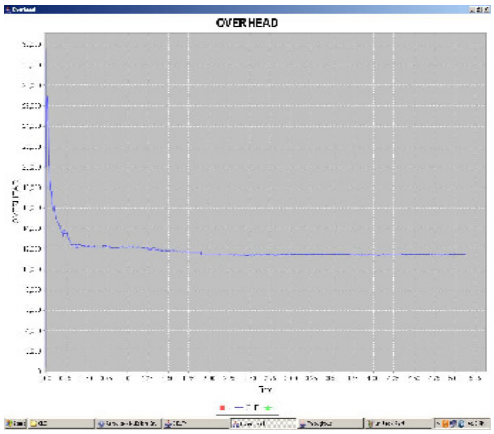
The above graph shows the ratio between the size of the packet and the time taken.

The delay is calculated using the formula,

Delay = send time- receiving time.



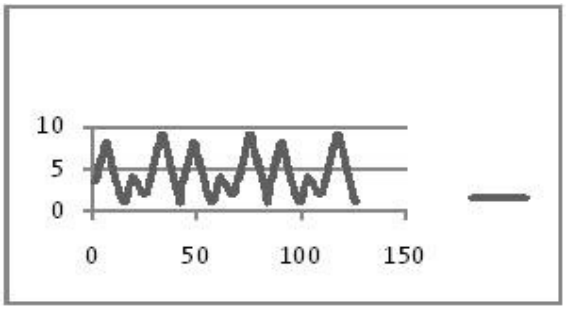
The above graph shows the difference between the time taken to send a packet and the time taken to receive the packet. The overhead is calculated using the formula, Overhead= number of times the packet was sent / total time taken.



The above graph shows the ratio of the number of times the packet was sent to the total time taken.

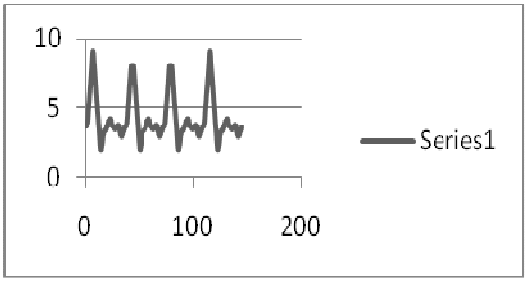
OBSERVATIONS

Some observations have made according to our traditional Indian medicine. It has been practiced in Tamilnadu. Eventhough it has a close affinity to Ayurveda , it maintains an identity of its own. Siddhars achieved supreme



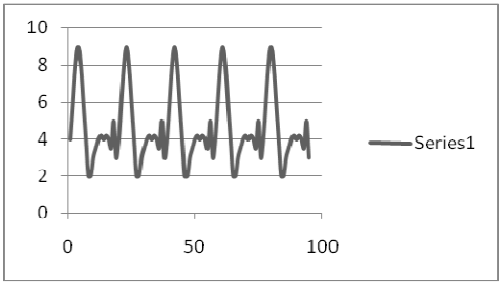
knowledge in this field. The term A normal pulse wave form obtained for has been given above. Based on the disorders, the variations in the pulse will obtain.

This will be examined in a remote centers and it will be analysed by a doctor connected to a network will provide suggestions regarding the symptoms.



According to siddha two dominant entities are energy and matter which have a great influence in shaping the nature of universe. Evergy and matter are inseparable.siddha system of medicine focuses on five proto- elements and it is made up of such elements and its combinations. This five proto-elements.

are three doshas and it is similar in Ayurvedic concepts.



The examination found was fever or cold or any disorder, based on the pulse signal variation, physicians can easily identify the disease. This will be used by siddha physicians sothat they can generalize the cncept. In siddha system of medicine diagnosis is carried out by examining nadi (pulse), neer (urine), kan (eyes), mala (faeces), na (tongue), sparisam (touch), swara (voice) and varna (color). In this system, the emphasis is on three branches namely Nayana Vidhi (ophthalmology), Bala vahatam (pediatrics) , Nanjunool (toxicology). But in Ayurveda it has been extended further. For diagnosis, eight items are needed, 1. tongue- the color of the tongue is black in vatha,,white in kapha and red in pitha.2.Varna – colour is dark in vatha, pale in kapha and yellow or red in pitha. 3. Svara or voice – normal in vatha, low-pitched in kapha and high-pitched in pitha. 4. eyes- muddy conjunctive in vatha,pale in kapha and red or yellow in pitha. 5. touch- dryin vatha, chill ot sweating in different parts of the body in kapha and warm in pitha. 6. Stool – black stools indicate vatha,dark red in ulcer nad shiny in terminal illness and yellow in pitha. 7.urine –normally it will be examined in early morning, straw color indicates indigestion, saffron color in jaundice, rose in blood pressure and reddish yellow in excessive heat. 8. Pulse- it has to be analyzed in the radial artery. This system generally identifies the causes of diseases. It is due to food, doings (seyal), climate and environment (kaalam) and by birth (kanmam).

CONCLUSIONS

Thus, the cross layer to optimize the physical, data link and application layer to deliver the data through telemedicine is designed. The results show that the improved qualities of services are being achieved. This can otherwise be implemented in wiMax.

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