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ADMIT – A simple Adaptive Data Rate Model for Medical Image Transmission over Wireless Network

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Abstract- **Choosing an optimal congestion flow control mechanism is the most fundamental decision that to be made before transmitting large amount of data through online or offline network. Image resolution and data rate are two things which plays a major role while finding an optimal data rate that overwhelms congestion but doesn't waste network bandwidth. In this paper we propose a new congestion control mechanism ADMIT to overcome existing disadvantages and make its performance become much more efficient. ADMIT is an optimal solution for congestion free Medical Image transmission over a wireless networks and also enables error free visualization of medical images of numerous modalities such as PET, MRI, CT, or microscopy. ADMIT implements, a simple mapping of categorized medical image data to the receiver side instead of transmitting entire content at a time, and provides a standard user- interface and visualization tools, which a consultant or any person at remote sites (via the internet or intranet) can share enough details about the patient or any type of medical image data for analyses, thereby enhancing their ability to diagnose, monitor, and treat medical disorders. The ADMIT provides a basis for selection of the processing content and method in different clinical settings.**

Keywords: **ADR (Adaptive Data rate), Image streaming, Medical Image**

I. INTRODUCTION

The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities. These technologies permit communications between patient and medical staff with both convenience and trustworthiness, as well as the transmission of medical, Imaging and health informatics data from one site to another.

Telemedicine applications are mostly implemented in the regions where infrastructure is a great question; for the most part they are used to link them with specialists, health-care providers, etc. Telemedicine applications are classified into two basic types, according to the timing of the information transmitted and the interaction between the individuals involved—be it health professional-to-health professional or health professional-to-patient. 1) Real time or synchronous 2) Store-and-forward, or asynchronous, telemedicine involves the exchange of pre-recorded data between two or more individuals at different times. In both synchronous and asynchronous, relevant information are be transmitted in a variety of media, such as text, audio, video, or still images (i.e. Medical Imaging).

Medical imaging is the technique and process used to create images of the human body (or parts) for clinical purposes (medical procedures seeking to reveal, diagnose, or examine disease) or medical science. These images are produced through various imaging modalities like Radiography, Magnetic Resonance Imaging (MRI), Nuclear medicine, Ultrasound, Elastography, Tactile Imaging, Photo acoustic imaging, Thermography, Tomography, Echocardiography, and also others such as Electroencephalography (EEG), Magneto Encephalography (MEG), Electro Cardio Graphy (ECG), that produce graph images which contain measurement locations of certain parameters. Since these images are large in size requires a large amount of storage space or high bandwidth for communication in its original form. The downsides of telemedicine include the cost of telecommunication (i.e. network bandwidth for image transmission) and data management. In today's computer world rapidly growing need for Internet and intranets make network management increasingly important. Organizations depend on Internet for everything like video, images, data, etc for corporate training and webcasting, are more complex to stream content such as live televised sports events. Organizations and institutions uses internet to transfer all type of data's. Numerous studies have shown that visual data is the most effective means of communicating for impact and retention. This has been proven in the real world by thousands of customers who are using online data to enhance their enterprise communications.

Investments in video conferencing infrastructure can be leveraged to stream and record content from video conferencing systems located in classrooms, medical facilities, meeting rooms and offices. Video conference and streaming functionality also can be integrated into an organization's Unified Communications strategy, thus creating a truly integrated communications platform.

The amount of content shared and accessed by the worlds is constantly increasing. Since the network is not perfect, a

small percentage of packets are lost due to congestion. However, it is important to note that visual data is very different from other data types. There are many challenges to ensuring that a high quality visual data (Image, Video) is always accessible without disrupting the network and other mission critical applications.

Causes of Medical image transmission over internet

There are three key differences between Medical image and other image data types:

1. Storage
   a. Medical image files are typically much larger than those of other data types.
   b. They contains sensitive images requires a lossless transmission
2. Simultaneous Access
   a. The biggest difference is that multiple people want to access the image at the same time, especially for consultation with more than one health care provider.
   b. This can create bandwidth issues if the streaming system is not properly planned and deployed.
3. Bandwidth
   a. Video (especially live video) requires a consistent amount of bandwidth to deliver a positive user experience.
   b. Video consumes much more bandwidth than other data types

II. RELATED WORK

Existing systems focuses on adapting congestion window based on content size, network bandwidth which doesn't cares about the delay or the quality of the data transmitted. Importantly they care about windows updating policies based on the recent congestion criteria of their own network[1]. And these decisions are made in order to provide a good quality of transmissions. How they a have care over the transmission rate of all the receiver, for that they adjusting their window size which is best suited for the receiver located in congested area. There is a problem situation that congestion free zone receiver's also receive data at modified window size. In another related work, high priority traffic attempts to use the time slot of the low priority traffic by deferring or even destroying its transmission. Previous adaptive transmission methods caresabout the fullness or the buffer variation, and use an adaptive play out control, delay in between frames for the sake of reducing the likelihood of buffer underflow events[6].So we are in the need to construct a platform that provides a possible way for ease transmission, a method of transmission that preserves our network bandwidth and available all the time for new receivers. The main objective of our work is to propose an adaptive data rate framework model, for congestion free Medical Image Transmission over wireless networks, that maps segmented data over the network without any loss of data. It also aims to list out the possible input parameters (based on that, the collected images are organized) which are used to design the transmission policy structure for mapping process. Also aims to categorize, patient treatment history and their corresponding image data. These categorized data are the only things that are mapped among the network to reduce the complexity of large data transmission over a network. The another objective is to extract information among various sources of data, (i.e.) participating resources, and grouping these data based on listed categories. It is assumed that the receiver is provided with the mapping structure designed earlier.

III. ADMIT SYSTEM

Our proposed solution focuses on data rate adaptation based on estimated the bandwidth strength and how ADMIT system can help for the implementation of congestion free streaming system that's easy to deploy and how to use it without any serious constrain on the network. Since bandwidth is measured via direct feedback (i.e.) Acknowledgement from the receiver, or by RTT based on packet delivery success/failures. To measure RTT in less moving network nodes are easier, in the case of fast moving nodes it is possible, expensive, and worse accurate, since by the time the transmitter uses the RTT, the channel might have changed. Available bandwidth measurement based on packet delivery success can be highly inaccurate, since packet delivery is a very coarse measure of available bandwidth strength, and can be distorted by factors such as collisions, etc. ADMIT avoids all these complications since it requires neither Transmitting channel-state status nor transmitting channels data rate (i.e.) Bandwidth.

ADMIT constructs an Adaptive model which enables effective utilization of available bandwidth access and a priority transmission method to catch the dedicated transmission bandwidth of the low priority traffic paths in its own cluster/group. ADMIT also aims to find an optimal transmission rate in terms of high quality of experience (QoE) such as reconstruction interruption, average reconstructed image quality and playback smoothness beyond user-perceived quality.

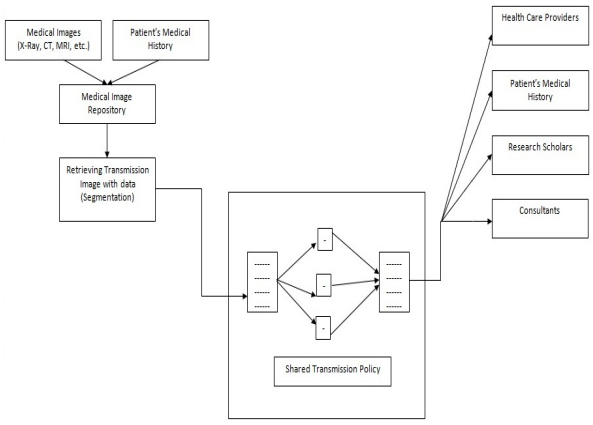

Fig 1: System Architecture of ADMIT

We hereby propose mechanisms that allow a mapping among them to be implemented by their cluster gateway (device which connected to the outer network) itself. It first determines the achievable bit-rates of the target node to be reached by each stream and then constraining the cluster

members to stay within their standard bandwidth as possible as. So the senders have to adapt transmissions rates according to nature of the transmitting medium and receiver's state, because of the threshold range, i.e. they transmit data only at or above a particular data rate threshold depending on the data rate of transmitting channel and receiver's buffer status.

In proposed scheme, data bags/data packets are coded with target node address, size and the construction of data packets, as well as the method for their delivery to receivers via their helping nodes to reduce the probability of fake routing, delivery failure possibility, also to add protection against noise. Coded bits are then transmitted to the respective channel medium.

Efficiency improvements include:

- Optimal data rate that matches the network bandwidth and the decoded medical image quality matches the receiver(s).
- Possibly shortest route to deliver sufficient quality, often through multiple/multipath routes that match the number of sub division from the image encoder.
- Allowing prioritization at the cluster/group, and redirect the request within them.
- ADMIT enables the delivery of optimal quality of image to the maximum as users perceived.
- Retransmission at cluster level, (i.e.) transmitting lost data from the same level itself.

In addition, potentially poor quality of transmitted records, such as images or patient progress reports, and decreased access to relevant clinical information are quality assurance risks that can compromise the quality and continuity of patient care for the reporting doctor. Since the digital medical images like X-Ray, MRI, Ultrasound, CT are extensively used in diagnosis. Due to the large volume of images, image compression is required to establish fast and efficient transmission and reduction in storage space of medical images. Medical image contains more sensitive data that to be transmitted with no data loss. So that it requires a selected set of data which comprise, non redundant data and needful data? Lossless Compression techniques are used while compressing digital medical images

Lossless compression techniques compress with no data loss but have low compression rate and lossy compression techniques can compress at high compression ratio but with a slight loss of data. Using lossless techniques in medical image does not give enough advantage in transmission and storage and lossy techniques may lose crucial data required for diagnosis. Our proposedframework address these problems, which uses reduced data for transmission without using any lossy compression, which is using multiple compression techniques based on Region of Interest (ROI). The ROI area is compressed using lossless compression (without any loss in the originality of ROI) and the other areas of the image are compressed using lossy compression techniques.

IV. IMAGE TRANSMISSION WITHIN CLUSTERS

A. Mapping

Since data transmission policy is determined by the content of data that to be transmitted over that time. Assuming that all the network participants are well known about their transmission content, since its medical image which may be later used for diagnosis, patient guidance etc,. Those images always contain sensitive data and require an error free transmission. To achieve these we propose a model which segregates image into ROI and Non ROI parts further they are subdivided into many based on the input requirement list of receiver. And these sub division are transmitted along their corresponding Tag information over the network. Since the transmission network doesn't aware of the data and also about the information carried, that is being transmitted.

Tags are information hints basically they are all in names of input parameters, attached along with every subdivision of image data helps the receiver to reassemble them in proper location. ROI and non ROI images are transmitted separately along with their container Tags over same network path also. So that it is not needed that sender and receiver should be synchronized, hence our proposed model is stateless model. Our proposed framework performs a preparatory work (i.e.) forming a transmission policy. It confirms the list of input parameters (i.e. by data can be identified) and retrieves data from the provider's database and packs the corresponding data into packets. These data bags will be mapped according to the receiver's request. Based on the input parameters information only ROI of image is identified.

B. Routing

ADMIT implements a simple transmission scheme for image transmission to utilize participants bandwidth rate to decide the transmission path based on the path diversities. To achieve high security without any key distribution and management, and thus the key management related problems do not exist. This scheme does not only allow each source to transmit medical image and related data through appropriate transmission paths in an Bandwidth-efficient way, but also provides equal protection to Region of interest images by path selections and adaptive bit rate requirement. It is possible to find minimal route for source to destination and also find another routes between them. By replicating a given part of image over several paths whose delivery rates are independent, it will be possible to achieve any reliability requirement. Since this transmission is possible for all services simultaneously i.e. to enforce an effective utilization of network resources, all the constraints and demands will be satisfied.

C. Framing Adaptive Data rate model

Achieving optimal bandwidth utilization also results a highly efficient system. Thus our proposed method measures RTT of individual receiptant and then adjusts it to required rate of the target system with the bandwidth assigned to the system where resources are under-utilized. Since these measurements are calculated by resource utilization logs at every system.

By using delivery performance measurements, we identify the response time and the over-utilized time for different resources as performance metrics. Then, on the basis of the real-time measurements, we select the intermediate network helper with the worst performance and its highly utilized bandwidth resource, because resource over-utilization is a dominant factor that leads to degradation of successful transmission. Finally, if there are under-utilized network resources in a network, we re-allocate them to the other system in order to improve its performance. Both preparing data packets and fulfilling the requirements are hard problems on their own. In order to resolve these anomalies our system focuses mainly on reliability issues. Why because is the data that we handling, in order to keep the data available whenever we need is further dividing them into small slices and also Tag information, then redistributing it among sufficiently many paths. This method of framing an image data solves the requirement constraints optimally.

V. CONCLUSION

Our proposed work provides an efficient data rate adaptive model that ensures user perceived quality of delivery as possible as over a highly congested network. ADMIT also delivers maximum throughput by utilising available network resources. ADMIT ensures less redundant content of image during transmission through its mapping process.

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