Telemedicine Imaging using OFDM/802.16/WiMAX-MAC Layer

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***Abstract*- The worldwide interperability for microwave access or WiMAX is a broad band wireless networking standard which focuses to address interperability across IEEE 802.16 standard based products as this feature provides a common platform to all operating systems in terms of compatability.Telemedicine is one of the necessity of the hour and has become interesting field of research since decades ago. Rapid development of telecommunication technologies have opened up opportunities for further exploring the use of wireless technology to attains the objectives of telemedicine.**

***Keywords*- WiMAX, OFDM, TELEMEDICINE IMAGING, QOS.**

I. INTRODUCTION

Telemedicine as explained in [1] is a provision of health care through a combination of telecommunication and multimedia technologies with medical expertise. In the process of making the medical data available instantly at any location, telecommunication holds an important role. The use of WiMAX MAC layer for the implementation of this provision is reflected in this paper.

II. OFDM CONCEPT

An OFDM signal transmits coded information in multiple carrier channels simultaneously. A pre-determined bandwidth partitioned into N subcarriers, each being a harmonic of the lowest frequency in the band. In this sense, all subcarriers are mutually orthogonal to each other . The orthogonality allows for close spreading of the data in frequency with ideally no and otherwise minimum interference between them, resulting in a more efficient use. Although the use of OFDM in communications is wide spread, there has been limited research in OFDM for medicinal imaging till date. Despite OFDM usability, linear frequency modulation (LFM) has been the waveform of preference for imaging due to its range compression and baseband sampling properties. Modern OFDM research can be found in recent literature. Falcone and Chetty has presented OFDM detection and tracking work respectively in their literature. Imaging concepts using ultra-wideband OFDM are proposed by Garmatyuk while Sturm has obtained range profile information using an OFDM waveform in both simulation and experimental setups . Gutierrez evaluated the bistatic ambiguity function properties of the WiMAX signal where favorable wide-angle bistatic characteristics have been observed . In this paper, investigatation is done about the telemedicine image processing required to recover the reflectivity function from OFDM WiMAX signals.

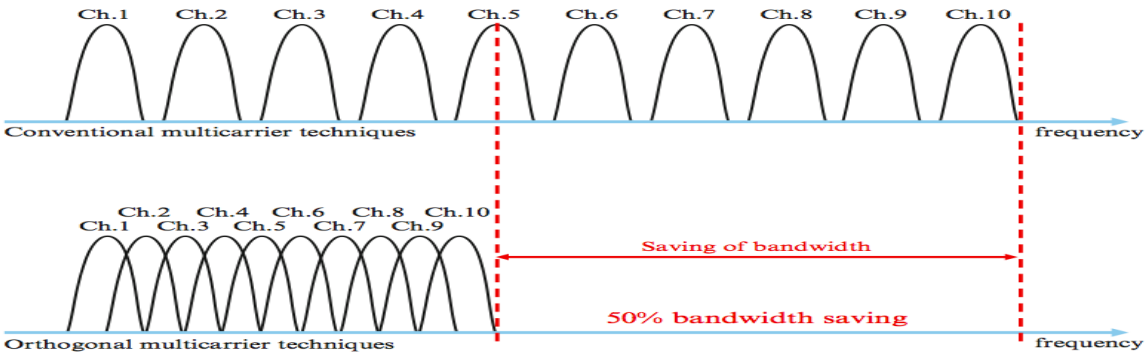

Figure 1. OFDM CONCEPT

Quality Of Service

Quality of Service (QoS) in WiMAX denotes some form of assurance that a service will perform at certain level. QoS in WiMAX can be classified into five levels, as follows. 1. Unsolicited Granted Access (UGS) This class of service provides a fixed periodic bandwidth and designed for Constant Bit Rate (CBR) real time traffic such as video conference and guarantees maximum sustained rate, maximum latency and tolerated jitter. 2. Real Time Pooling Service (rtPS) This class of service is intended to use

for Variable Bit Rate (VBR) application such as video streaming. 3. Extender Real Time Pooling Service (ertPS) This class of service is intended to use for Voice over Internet Protocol (Vo IP) which is different with original rtPS in the voice silence suppression mechanism. 4. Non Real Time Pooling Service (nrtPS) This class of service is for use with non real time VBR such as File Transfer Protocol application. 5. Best Effort (BE) Most application falls into this QoS category. This QoS guarantee neither throughput nor delay.

With QoS, we can flexibly assign type of session for every type of data in telemedicine application. That way, sessions which carry important or urgent information can be prioritized during resource allocation process.

III. MEDICAL IMAGING CONCEPT

This paper tries to compile any work related to telemedicine image transfer and summarize the requirements. From literature study, it is found that medical image transfer requirements are as follows; Quality of the image, total transmission time (network requirement) and type of session (real time/non-real time). Quality of the image transferred over mobile wireless network can be defined into three levels of i.e.; Mathematical Losslessness (ML), Diagnostic Losslessness (DL) and Best Effort (BE). Apart from above mentioned specifications we need to take into account the errors in the image that might be originated from bad channel quality which results in packet loss during transmission period. While image quality measurement such as MSE (mean square error) can be considered irrelevant in the MAC study, the MAC capability of preventing packet loss from happening is that of importance. For further information regarding image quality postulation see ref. [4]. To gain knowledge regarding image transfer performance in multiuser network, the work reported in [5] has evaluated that third generation (3G) network performance is best for telemedicine, especially image transfer for consultation. The authors used three different protocols namely TCP/IP, HTTP and FTP. In the report, Magnetic Resonance Image (MRI) sized 514 KB transferred using FTP in 3G Networks took 15 seconds of transmission time. Nevertheless, as image file size gets bigger which for example around 3 to around 8 MB for mammogram image in DICOM format (*.dcm), demand for higher throughput is inevitable. Image transfer application usually can be classified as nonreal time although there are cases where teleconsultation integrates image transfer to further enhance the quality of medical consultation. In these cases, as stated earlier, higher throughput is needed so that practicability of the transmission time of the image can be maintained. For instance, the range of bit rates for image transfer stream for consultation purposes is 7 Mbps. With that rate, typical X-ray image 2048 x 2048 pixels and 12 bit/pixel with each pixel stored in 2 bytes, the delay for one image transfer is 10 seconds all these being specified in refrence [1].

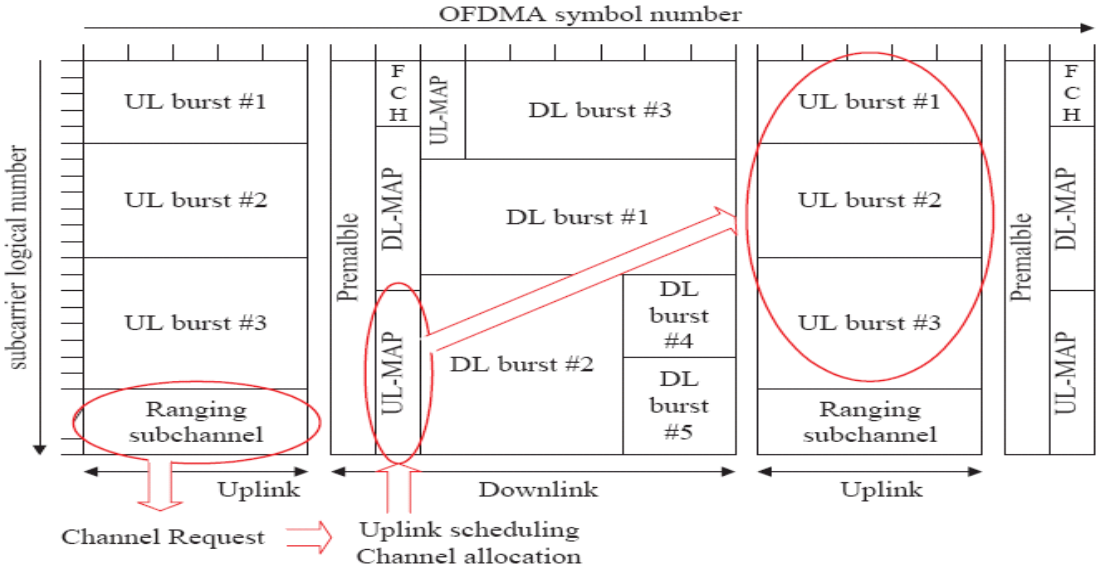

Figure 2. OFDMA/TDD FRAME STRUCTURE

Table no:1 SCHEDULING TYPES AND QoS

Scheduling type	Parameter
UGS	Max latency
RTPS	Max latency
NRTPS	Max info rate
BE	Max info rate
MSIR	Max info rate

The table is briefing about the various scheduling types being available for the transferring of image as telemedicinal data . The type is selected as per the requirement and specifications of the image that needs to be processed and transferred.. Scheduling selection procedure is mentioned above in QoS part of the paper.

IV. CONCLUSION

This paper depicts current trends in development in the MAC layer. It indicated that good MAC layer performance for the telemedicinal image transfer can be made if schedular and OFDMA resource mapping approaches can be jointly enhanced..

Further it also suggests that there is also the need to develop scheduling techniques which can answer telemedicine application under various development scenarios using WiMAX system.

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