Wireless Telemedicine as Heart of E – Medicine

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Abstract- *Wireless telemedicine is rather a new emerging area.. The new wireless broadband technologies enabled creation of telemedicine services previously only possible via cable connections. Advanced medical services can be provided to rural areas or areas stricken with disasters otherwise unreachable by cable connections, very quickly and with fraction of the previous cost. Wireless telemedicine is especially suitable for areas lacking proper cable connections or places where installing cable links is difficult, economically unavailable or simply impossible. For instance, in cases of natural disasters such as earthquakes, hurricanes, tsunami, installing WiMAX wireless links is the only possible way to establish communication and provide medical service. This technology consists of implementing several wireless telemedicine components of an integrated system for e-medicine. WiMAX (IEEE 802.16) and Wi-Fi (IEEE 802.11) plays a predominant role.*

Keywords- BreezeMAX, Protocol, Telemedicine, Transmitted records and WiMAX

I. INTRODUCTION

Telemedicine is one of the forms of development in technology which concentrates more on the development of medical and health care for the people. It eliminates the possible transmission of infectious diseases or parasites between patients and medical staff. This is particularly an issue where MRSA is a concern. Additionally, some patients who feel uncomfortable in a doctor's office may do better remotely. For example, white coat syndrome may be avoided. Patients who are home-bound would require an ambulance to move them to a clinic are also a consideration. This issue can be rectified through telemedicine. Treatment can be done in distance as treated in hospitals.

Telemedicine is the use of telecommunication and information technology to provide clinical health care from a distance. It helps eliminate distance barriers and can improve access to medical services that would often not be consistently available in distant rural communities. Early forms of telemedicine achieved with telephone and radio have been supplemented with video telephony, advanced diagnostic methods supported by distributed client/server applications, and additionally with telemedical devices to support in-home care.

Telemedicine and related healthcare technologies aim to provide efficient healthcare remotely. It ought to improve the well-being of patients and bring medical expertise at a lower cost to people in need at the right time. Telemedicine has various potential uses such as clinical, educational and administrative. Telemedicine can bring high quality medical service to under-served areas.

II. GRADES OF TELEMEDICINE

Telemedicine can be drawn into three main categories:

- store-and-forward
- remote patient monitoring and
- (real-time) interactive

Store and forward

Store-and-forward telemedicine involves acquiring medical data (like medical images, biosignals etc.) and then transmitting this data to a doctor or medical specialist at a convenient time for assessment offline. It does not require the presence of both parties at the same time. Dermatology (cf: tele dermatology), radiology, and pathology are common specialties that are conducive to asynchronous telemedicine. A properly structured medical record preferably in electronic form should be a component of this transfer. A key difference between traditional in-person patient meetings and telemedicine encounters is the omission of an actual physical examination and history. The 'store-and-forward' process requires the clinician to rely on a history report and audio/video information instead of a physical examination.

Remote monitoring

Remote monitoring, a tele health Blood Pressure Monitor, also known as self-monitoring or testing, enables medical professionals to monitor a patient remotely uses various technological devices. This method is primarily used for managing chronic diseases or specific conditions, such as heart disease, diabetes mellitus, or asthma. This service provides comparable health outcomes to traditional in-person patient encounters, supply greater satisfaction to patients, and is cost-effective. Examples include home-based nocturnal dialysis and improved joint management.

Real-time interactive

Electronic consultations are possible through interactive telemedicine services which provide real-time interactions between patient and provider. Many activities such as history review, physical examination, psychiatric evaluations and ophthalmology assessments can be conducted comparably to those done in traditional face-to-face visits. In addition, "clinician-interactive" telemedicine services may be less costly than in-person clinical visit.

III. WIMAX TECHNOLOGY

WiMAX network is used as basis for telemedicine services. WiMAX is a popular name for a wireless digital communications system. WiMAX is a telecommunications technology aimed at providing broadband wireless data connectivity over long distances. It is based on the IEEE 802.16 standard. The high bandwidth and increased reach of WiMAX make it suitable for providing a wireless alternative to cable and DSL for last mile broadband access. WiMAX can provide broadband wireless access (BWA) up to 30 miles (50 km) for fixed stations, and 3 – 10 miles (5 – 15 km) for mobile stations. In contrast, the Wi-Fi /802.11 wireless local area network standard is limited in most cases to only 100 – 300 feet (30 – 100m). With WiMAX, Wi-Fi-like data rates are easily supported, but the issue of interference is lessened.

WiMAX operates on both licensed and non-licensed frequencies, providing a regulated environment and viable economic model for wireless carriers. WiMAX can be used for wireless networking in much the same way as the more common Wi-Fi protocol. WiMAX is a second-generation protocol that allows for more efficient bandwidth use, interference avoidance, and is intended to allow higher data rates over longer distances. The IEEE 802.16 standard covers spectrum ranges up to about 66 GHz inclusively.

IV. BREEZEMAX

The infrastructure of the provider that we used in the experiments consists of BreezeMAX antennas and client devices, manufactured by the company Alvarion. BreezeMAX TDD (BreezeMAX) is Alvarion'sWiMAX compatible platform operating in Time Division Duplex (TDD) mode. The BreezeMAX equipment is based on the IEEE 802.16/ETSI HIPERMAN standards. It is designed to meet the requirements of the wireless Metropolitan Area Network (MAN) environment and to deliver broadband access services to a wide range of customers, including residential, SOHO, SME and multi-tenant customers. Its Media Access Control (MAC) protocol is designed for point-to-multipoint broadband wireless access applications, providing efficient use of the wireless spectrum. The access and bandwidth allocation mechanisms accommodate hundreds of subscriber units per channel, with subscriber units that may support different services to multiple end users. The system uses OFDM radio technology, which is robust in adverse channel conditions and enables operation in non line of sight links. This allows easy installation and improves coverage, while maintaining a high level of spectral efficiency. BreezeMAX supports a wide range of network services, including Internet access (via IP or PPPoE tunneling), VPNs and Voice over IP. Service recognition and multiple classifiers that can be used for generating various service profiles enable operators to offer differentiated SLAs with committed QoS for each service profile. The system also supports IP CS Switching Mode that is compatible with the infrastructure of next generation WiMAX systems or DSL systems. IP CS Switching Mode provides smooth upgrade to systems that fully support the IEEE 802.16e standard, with the same “Look and Feel” of service provisioning.

V. WIRELESS INFRASTRUCTURE

The telecommunication market in Macedonia is growing quickly and de-monopolizing. Currently there are several statewide backbone networks operated by various data communication providers. In order to implement our telemedicine system we used the backbone network of a fast growing privately owned data communication provider. The backbone network consists of some fiber optic connections in the city limits of Skopje and mostly 802.16 (WiMAX) base stations throughout the country. The optic fiber connections are used for provision of fast bandwidth services. The WiMAX antennas are used for connecting hospitals where the optic fiber has not reached yet and 802.11 hotspots are used for wireless devices. Other providers operate fiber optical backbone networks throughout the country, but due to lower costs of WiMAX based systems and other advantages, the network is used. Due to the sufficient bandwidth of WiMAX, it is used to cover most of the needs of our telemedicine system. The high bandwidth and increased reach of WiMAX make it suitable for providing a wireless alternative to cable and DSL for last mile broadband access.

The performance of both fixed outdoor and fixed indoor WiMAX antennas are tested and the results are very promising, since both provide robust connections. Within the city limits of the capital Skopje there is a functional fiber optic Metro Ethernet network. Hospitals in the city are (or will be) connected to the network. The fiber optical connection enables fast and robust connectivity for provision of advanced telemedicine services like high quality video streaming of surgical procedures, medical visualization etc. Even when the

fiber optical lines are used for communication, the WiMAX wireless lines could be used for backup in case of interrupted cable communication. While cables are physically cut, the WiMAX connections are stable even in severe weather conditions. A wireless backbone network is established throughout the country, and hospitals in different cities are (or will be) connected to the network. Antennas are placed on hills overseeing cities, and coverage with the radio signal is good and robust.

VI. SOFTWARE MODULES

While researchers in developed countries have different goals, our objectives have to be scalable, ranging from establishment of basic telemedicine services up to advanced up to date functionalities.

The main concepts of the integrated system include:

- Creation of necessary basic Medical Information Systems (MISs) for hospitals
- Creating a framework and interfaces where various multiplatform MISs could interconnect inan integrated MIS
- Using modern telecommunication technologies for connecting parts of the integrated MIS andprovision of advanced medical services at remote locations.
- Using the integrated MIS for various telemedicine applications (sharing knowledge, experience and expertise among physicians in different hospitals, consultations, video streaming, enabling better remote patient-doctor communication, and better access to medical information).

Querying data in the web based MIS is possible using multiple criteria. Data can be searchedfrom other patients with similar symptoms in order to learn from other previous experiences. Entire patient history is accessible online, with strong regard to privacy issues. While patient identity details are available to the physician in charge of the particular case, for other medical personnel with lower access privileges, only medical information is available, without disclosing the identity of the particular patient. A vital part of a telemedicine system is the sharing of knowledge, experience and expertise. The initial MIS includes a forum and a virtual chat room where physicians can consult each other. Since the children's hospital and the university hospital are connected to the same system, consultations are possible among physicians from both hospitals.

The system has an Internet interface toward the outside world where advices can be gathered or given from and to physicians anywhere in the world. The developed system includes software components specialized for use by PDA devices. Both patients and staff can wirelessly access different software modules. Physicians can access patient's data, results from laboratory analyses, forums and chats, web sites with medical scientific papers. Patients can access their results from different analyses, make appointments, and check the availability of certain physicians.Due to the resolution and dimension limitations, significant effort was made to maximize the utilization of the given space on the small screens and to enable easy navigation through the user interface. We adopted a policy of gradual increase of details presented on demand, since scrolling and navigating large texts is unpleasant on a PDA device. Initially telemedicine was defined as provision of medical services at remote locations without direct physical contact between the physician and the patient. Our system incorporates modules that enable laboratory results and other analyses to be submitted for review to the specialists. Physicians working in smaller towns could access the system using their accounts and could submit questions alongwith supporting materials electronically. Special web application software modules are developed for submitting images (MRI, X-Ray, CAT scan) from remote hospitals in the country to the specialist working in the capital. Also results from blood analysis are filled in online forms. Specialists review the results and can post their reply to the sender. This system enables reduction of transport costs, response times are drastically smaller and patients do not have to suffer through long trips to the specialist. Video Streaming also plays an important role in completing the job successful.

VII. CONCLUSION

The mobility and quick deployment offered by wireless communications will help change our former views of the medical treatment in general, enabling high quality health service remotely and inexpensively. It has been estimated that a tele dermatology consultation can take up to thirty minutes, whereas fifteen minutes is typical for a traditional consultation. Additionally, 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. Wireless telemedicine would certainly be a milestone for the recovery of the sick as early as possible without any risk and expenditure.

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