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TABLE OF CONTENTS 3

ABSTRACT:

Wireless communication is a ubiquitous phenomenon in the leisure products market, to a lesser extent in the arena of business, and to the least extent in the health care environment. This pilot study successfully demonstrated the feasibility of wireless text and image data transmission from a Picture Archiving Communications System (PACS) to both Tablet PC's and Personal Data Assistant's (PDA's) in an Emergency Department environment. However, this concept of operation could not be implemented within the confines of the security architecture currently required of wireless communications within the Department of Defense (DOD). With appropriate modifications to the security infrastructure that would allow for the strength of the security suite to be maintained, wireless technology within the DOD could be realized.

BODY

Wireless communication is a ubiquitous phenomenon in the leisure products market, to a lesser extent in the arena of business and to the least extent in the health care environment. The ability to transmit information by means of text, static image or video loop is nearly universally available in the developed world. This accessibility is largely limited by the availability of infrastructure and the financial ability of the consumer. In the world of business wireless communications is nearly universally available in metropolitan areas and extensively used by the business community. The availability of wireless communications in the hospital or health care environment is technically feasible; it is limited by costs, concerns of patient confidentiality and privacy, and in the military health care environment the additional overlay of network security and the network integrity.

In the early 1990s, the Department of the Army embarked upon an ambitious analysis and eventual conversion of the film based radiology environment into a digitally based film-less radiology environment. This medical digital imaging system (MDIS) was first introduced at Madigan Army Medical Center and by the late 1990s was operational at a number of medical centers throughout the Department of Defense. By 1997, this program which relied on a single dedicated and isolated network for the distribution of digitally acquired radiographic images was undergoing a transformation. This transformation took place in conjunction with the development of industry standards for the acquisition, distribution, interpretation and storage of digital acquired imaging data. As a result, the Digital Information Communication in Medicine (DICOM) standard was developed.

By the year 2003 virtually all Department of Defense medical treatment facilities were operating in a film-less radiology environment using digitally required information and image distribution to designated high resolution work stations in the Department of Radiology and key clinical areas. Furthermore, this radiographic information was widely available to clinicians and other health care provider's desk top through web server capabilities available through all the major Picture Archiving Communication System (PACS) vendors. Despite the wide distribution of both imaging and reports there were still substantial limitations. Clinicians and other health care providers were still required to go to a work station or a desk top application, log in and query an index of studies to locate the study in question. Although desk top applications have extensively penetrated both the office environment the clinical space including exam rooms and operating rooms, stat reports to key functional areas such as the emergency department could not be delivered to the health care provider in an efficient and expeditious way. In November 2003 the Department of Radiology, Walter Reed Army Medical Center initiated a dialogue with IMCO Technologies to discuss the feasibility of wireless communication to emergency physicians. As described in the proposal the concept was to provide real time availability of both images and reports from the interpreting radiologists to the emergency department physician at the bedside or at any location in the emergency department. The concept of operation was to provide wireless communication using personal digital assistant's (PDA's) already widely available to the clinical staff as well as tablet PC's which would be made available to centrally located nursing or clinical staff. In essence, emergency examinations such as Computed Tomography (CT) and

plain film radiography (R) as well as Ultrasonography (US) would be made available to the ordering physician or health care provider as soon as this report was completed within the Department of Radiology. As described in the protocol a number of metrics were designed to demonstrate the hypothesis that the provision of health care could be streamlined with decreased waiting times, times to disposition, or final treatment of patients waiting in the emergency department. The emergency department was selected as the pilot site for this protocol for the obvious reasons of expediency, turn around time, disposition time and the well defined scope of clinical operation in a territory over which a wireless communication system could be installed. Prior to attempting installation a demonstration project was instituted. This demonstration project demonstrated successful connectivity between the existing AGFA PACS and the IMCO-Stat Wireless Server. The IMCO Wireless Server was able to successfully transmit physician notification, radiographic images, and text reports to both the PDA and the tablet PC. The technical features of this data transfer are described in the technical summary. Furthermore, wireless transmission points were established and demonstrated in the Department of Radiology and in the Emergency Department at Walter Reed. In accordance with DOD Directive 8100-2 Use of Commercial Devices and Technologies in the DOD Global Information Grid the demonstration project was required to adhere to the encryption and security policies described in this DOD directive. As interpreted all wireless communication devices and systems are required to operate in a defined security suite. This wireless security suite solution included five essential elements. The first was a Cranite wireless firewall software program, (2) Cisco (Airspace) Wireless Manager, (3) Cisco Access Points; (4) Access Points POE Injector Cables; (5) Credent Client Device Manager Software. During the time of system testing within the Department of Radiology the Optometry Clinic at Walter Reed Army Medical Center was also evaluating wireless communication technologies. As a result of proof of concept by the Optometry Clinic, it was demonstrated that the wireless network access point would rapidly lose connectivity with its controller when more than one person was signed on to the wireless network. After extensive analysis it was determined that this problem was traced to the security suite of wireless products. In particular, the Cisco Wireless Controller Network Processing Unit was not able to consistently validate Cranite traffic this problem was eventually ratified after several code upgrades assuring that Cranite traffic would be validated by the wireless controller. A second problem encountered was one of dual authentication. In essence, this required the health care provider to log into both the Credent security solution and then into the wireless network using the Cranite security solution. To eliminate the problem of dual authentication, the engineers in WRAMC's Division of Information Management (DOIM) were able to successfully relocate the Credent server behind the Cranite firewall thus allowing simultaneous authentication using Active Directory (AD) access. The Optometry Clinic pilot study was thus able to demonstrate wireless capabilities at Walter Reed.

When this application was applied to the Radiology Wireless Network it became apparent that it was relatively easily to distribute imaging and report information to the tablet PCs. However, it similarly became evident that it was impossible to transmit data to the PDA's. Despite multiple attempts over several months it became evident that both the Cranite and Credent software requirements were incompatible with the operating systems of the PDA's. Therefore, although it was possible to distribute information to

tablet PCs, this in no way met the requirements of the proposal to provide immediate stat data reporting to physicians and other health care providers. In effect, the tablet PC was provided no greater accessibility to imaging information than a laptop or desktop computer.

KEY ACCOMPLISHMENTS:

Despite the failure of the primary intent of this proposal, which was to provide immediate reporting of imaging and text data to emergency department staff via the PDA, several important successes and accomplishments were achieved.

In conjunction with the pilot study in the Optometry Clinic, WRAMC Radiology's *Wireless Communication of STAT Radiology Reporting Pilot Study* did clearly demonstrate that wireless communication capabilities could be instituted in an effective manner. This was demonstrated with our tablet PC solution, but not with our PDA solution. It was further demonstrated that the technical capabilities within the Department of Radiology and the Division of Information Management (DOIM) could be brought to bear to institute and to manage such a program. Our technical partners, IMCO technologies, developed an extremely robust, user friendly method for image distribution and measurements of outcome. A software program was developed to measure multiple parameters including verification of transmission, reception validation and user identification. Although these capabilities would be essential in a wireless communication environment, this pilot study clearly identified multiple obstacles to the development of a wireless information infrastructure and clearly identified the incapability of both Credent and Cranite software with PDA's. Subsequently, this requirement is being removed from the DOD requirements package. Once removed, the PDA solution could become a reality. As of this writing the DOIM is performing a comprehensive survey of Walter Reed Army Medical Center with an expressed intention of deploying wireless capabilities throughout this institution. Once installed, we would like to reassess the ability of the PDA solution to provide digital information to our clinical staff. Furthermore, with the distribution of wireless capabilities it would be possible to distribute stat imaging information, in this case radiology examinations and reports, to any health care provider in the institution in procession of a PDA registered to the network. In the third phase of deployment, it is conceivable that certain critical care specialists such as Neurosurgeons or cardiothoracic surgeons could be provided with external wireless communication capabilities allowing them to receive not only radiographic information and reports but other essential elements of clinical decision making in wide area of network concept within the National Capital Area (NCA). This could be an extremely important development as both Walter Reed Army Medical Center (WRAMC) and the National Naval Medical Center (NNMC) join to from the Walter Reed National Medical Center at Bethesda (WRNNMC). This reorganization and restructuring will further enhance the interoperability of these two locations and necessitate a more robust communication system for physicians and health care providers within this health care environment.

CONCLUSION:

This pilot study demonstrated some of the capabilities of wireless communication using tablet PC's and PDA's. It further demonstrated the incompatibility of the Cranite and Credent software solutions required in all wireless systems within the Department of Defense.