CHIME-Net, The Connecticut Health Information Network: A Pilot Study

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ABSTRACT

CHIME-Net is a state-wide community health information network project which uses a frame-relay approach to interfacility and internet connectivity. This is a collaborative effort among competitive institutions, which embraces technologies new to the health care industry. The experiences of implementation of the CHIME-Net pilot project are presented as a first milestone for the state-wide effort.

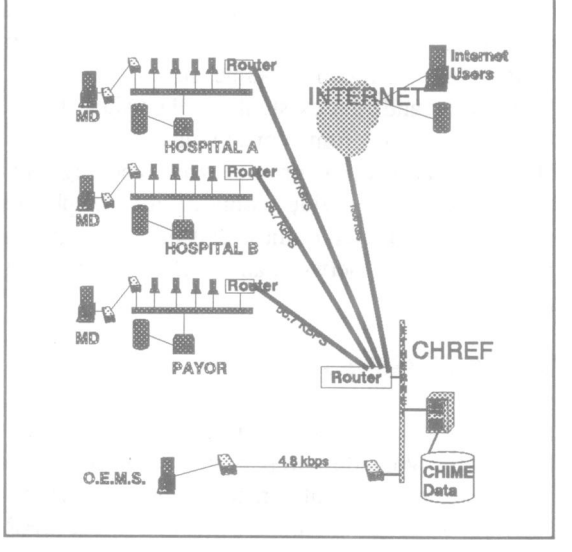
INTRODUCTION

In December of 1993, the Information Systems Conference of the Connecticut Healthcare Research and Education Foundation (CHREF) began to explore alternatives for creating a wide-area network infrastructure which would be capable of providing the health care institutions in the state with a much needed means of both state-wide and world-wide communications. With the growing need in the health care industry to both reduce the costs of operation and to improve access to the latest technology in quality health care, this infrastructure would need to be flexible, expandable, and affordable. Based upon these requirements, a frame-relay network was proposed. Six acute care hospital agreed to work with the CHREF to pilot the implementation if this network structure.

The design of the network infrastructure shown in figure 1 is such that each participant obtains a link into the Southern New England Telephone (SNET) frame relay cloud at a minimum of DS0 (64kilo-bits per second(kbps)). Each link is provisioned with a Permanent Virtual Circuit (PVC) to the CHREF central site where pass-through traffic is allowed. The CHREF is then provisioned with a DS1 link (1500kbps) to an internet provider. This allows for communication between any two providers on the network, and between each of these sites and any node on the internet[1].

A pilot implementation of this network was implemented as a cooperative effort. Stamford Hospital, Middlesex Hospital, Rockville Hospital, Greenwich Hospital, Danbury Hospital, and the Lawrence and Memorial Hospital each obtained a frame-relay connection to the SNET frame-relay network each securing a PVC to the CHREF. The CHREF, in turn, has obtained an additional DS1 line to the frame relay cloud containing a single PVC to the internet provider, Netcom.

Figure 1



ENVIRONMENT

High speed wide-area networks, particularly frame-relay services, are relatively new concepts in health care information systems, yet these technologies are fundamental to the future direction of health care. This is new territory for most facilities outside of academic institutions, and there is an associated learning curve. However, one of the strengths behind a cooperative effort is that learning curve may be accelerated by capturing and sharing the learning experience. As we sought participants, we found that many facilities were already investing resources into interfacility connectivity and internet connectivity. Under these circumstances, working as a group has many advantages. Not only is duplication of effort reduced, but the multiple viewpoints and various abilities of the members result in a more thorough analysis of each option. In order to facilitate a central support structure, 'preferred vendor' arrangements were sought. By standardizing on a single product, we help insure interoperability, establish standard implementation guidelines, and use

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the purchasing power of the group to negotiate a reasonable discount. Participants in later installation phases will benefit from the groundwork laid by this pilot group.

The current environment at Connecticut hospitals is mixed. Many sites are strengthening local networking resources and applications. Strong network backbones are being laid, and personal computers are proliferating in both administrative and patient care areas. Enterprise-wide electronic mail systems are common at some sites, in progress at some sites, and non-existent at other sites. Network support ranges from consultant arrangements to Network teams. Some providers are reaching into the community to provide connectivity to physician offices and affiliated clinics. Our pilot hospitals each have a local area network and LAN-based interoffice mail.

ROUTING ISSUES

As is the case in many industries, one of the first tasks involved in preparing to connect a network to the internet is to obtain legal addresses from the Internic. In order to simplify this effort, the CHREF obtained a single class B address which is sub-netted and issued to each participant by the central network administrator. Depending upon the penetration of TCP/IP based products, each facility which has used a bogus addressing scheme must make a significant effort to re-address each sub-network which has a node requiring wide-area network access. In order to postpone the re-addressing task, some institutions have chosen to provide only a single segment of the network access to the WAN. This technique can also serve as an added security measure.

Because of the common use of illegal addresses, the routers can not be set up with protocols that allow for address learning. Many routers can be configured to build their own routing tables by learning the sources and destinations of the routed traffic. CHIME-Net is currently set up using static routes until such time as a site utilizes exclusively legal addresses. Major performance degradation can occur if a router learns the same address from multiple sources. Since most of the traffic will pass through the central router, the maintenance of this scheme is primarily done by a single entry on the central router for each participant. The remote sites are simply set up with the 'next hop' of the central router, where the remainder of the route is resolved. Addresses not local to the CHIME-Net are sent to Netcom for resolution.

For institutions not currently connected to the Internet, domain name service (DNS) is another learning point. It is not necessary for each of the remote facilities to maintain a DNS. This service is better maintained by a shared service. CHIME-Net uses the DNS services provided by Netcom, although the CHREF would have been a viable alternative for service maintenance. Maintenance of the CHIME-Net domain names is coordinated through the central network administrator which serves to both expedite the process, and to prevent duplication.

SECURITY

One of the greatest concerns of a facility connecting to the internet is the potential security risk. Security measures must not be limited to the internet connection, but should be examined from all means of access. Poor security measures on dial-up access, leaving default passwords installed on hardware and software products, and lack of user security training can all lead to unwanted security breach. Although the central site could have provided some degree of security to each facility, it is not feasible to insure that each entry point to each facility be identified to the central site for securing. Each facility, therefore, must accept responsibility for securing its own site. The prototype sites examined several security packages, many of which were rather costly. The central site will support two firewall packages in order to accommodate the variable budgets.

The most popular solution was a public domain proxy server installed on a dedicated PC. This was intended as a temporary solution for those awaiting a new budget cycle. The second option is a commercial product with a graphical user interface and robust audit and logging functions. The firewall primarily addresses access issues at the network traffic level. Further security measures such as encryption and authentication will primarily be addressed at the application level. Due to the sensitivity of this issue, the central site will provide consultation to participants with some generic guidelines and multi-layer security options.

ELECTRONIC MAIL

The electronic mail communication standard which has been established is Simple Mail Transfer Protocol (SMTP). Translation modules for this standard are available for the major interoffice mail systems. Once again, however, communications with systems outside of the acute care hospital is new territory for non-university affiliated hospitals. Most

of the pilot sites currently have stable inter-office mail systems, with varying penetration throughout the institution, and three of the sites including the CHREF were able to make the transition from interoffice mail to internet-capable mail without incident. The remaining sites are all using the same product, which unfortunately has a more complex implementation process. This is a prime example of the benefits of the cooperative effort. Despite its complexity, the office product in question is the most popular one currently installed in the acute care hospitals in Connecticut. The central network specialist was trained in the installation process, and this knowledge has been shared in subsequent installations. Rather than each institution investing in the learning curve for the SMTP gateway, the time was invested once, and the information was shared among the participants.

Because one of the easiest and immediately beneficial internet feature is world-wide communication capabilities through electronic mail, an institution which does not have an inter-office mail system will not obtain as much benefit from the connection. It is therefore important that such future participants select and install an electronic mail system before embarking on the wide area connectivity, or that such efforts at least happen concurrently. Assistance will be provided to such subsequent sites by the central network specialist if the preferred vendor product is selected. Should an alternate vendor be selected, generic documentation will be provided along with telephone support.

INSTALLATION PROCESS

Most of the pilot sites have participated in this project since its inception, and have therefore been well educated in requirements. Risks and other pitfalls have been an expected part of the learning process for this group. The challenge is to capture the learning experience so as to maximize the installation efficiency for subsequent participants. We identify here an installation process which is intended to address these issues. This process will be tested with the next group of participants and modified accordingly based upon feedback and further learning.

One of the major contributing factors to delay of CHIME-Net use was in the planning and execution of appropriate modifications to the remote site networks to accommodate the connectivity. The tasks to be completed at the remote site depend upon four issues. These issues are internal access requirements, TCP/IP addressing, security, and electronic mail.

These issues were identified as stumbling blocks in establishing connectivity and electronic mail access at the pilot sites. Although basic connectivity was achieved with little effort, this was primarily accomplished through the use of a dirty segment, which did not properly accommodate access to users. One site was delayed several weeks in order to completely readdress the local area network with legal IP addresses. Another site which had planned a phased approach to various network segments found an anxious librarian connected to a segment intended for a later implementation phase. Based upon such experiences, the following process has been identified in order to expedite connectivity for subsequent locations:

1) The facility must first define which users within the facility will require immediate access to the network. If access is provided to only one segment of the institution network, some users may need to be moved to that segment.

2) The site must also consider the ramifications of legal TCP/IP addressing. Those facilities not currently running TCP/IP, will simply need to purchase the product and install it on the segment which requires CHIME-Net. However, depending upon the size of the network, this could result in a significant task. Those sites currently running TCP/IP applications using bogus addresses will similarly need to readdress every machine on the segment which requires access. Furthermore, if there is another segment which will remain with bogus addresses, while not recommended, the internal routers and bridges must be configured such that these bogus addresses are not broadcast over CHIME-Net. As part of the pre-installation process, the specific addressing requirements of the institution will be examined in order to provide support and insure proper routing and addressing through CHIME-Net.

3) Another issue which should be resolved before the final installation is that of security. The pilot sites have shared security guidelines and sample policies and procedures. These have been supplemented with new information gathered by the group during the pilot study. This information encompasses internal practice guidelines as well as firewall information. Since the users can be one of the weakest security points, we recommend that each facility examine the materials, and establish internal guidelines. New policies should be supplemented with internal educational programs and information dissemination

in order to educate the users prior to exposure to the internet. The site should select a firewall product such that its installation can be planned as an integral part of the implementation process.

4) Although many facilities already have enterprise-wide electronic mail systems already in place, there are several sites which either do not yet have an office mail product, or which have mail for only a limited portion of the network. Facilities should plan to make mail available to all users of the system. If no product currently exists within an institution, central support will be provided should the site select the preferred vendor. Alternate selections will be supported with more general guidelines. Since mail is the easiest and most immediately beneficial offering of internet connectivity, a facility should have a solid electronic mail implementation plan as a part of the pre-installation phase. It is best if the installation of the local mail system is tested prior to the wide-area installation. CHIME-Net has selected Simple Mail Transfer Protocol (SMTP) as the translation standard for electronic mail. Therefore, the in-house mail system should be equipped with an SMTP gateway module. The hardware and software requirements for this module varies from product to product, making it difficult to provide specific instructions. However, many installations will require a dedicated PC, which will serve to both translate the message, and to identify the IP address of the recipient. In order to identify the recipient address, the software must be configured to point to the Domain Name Server (DNS) for CHIME-Net. In addition to supporting the preferred vendor product, the central site will maintain a list of successful implementation sites for alternate selections in order to assist with information sharing.

5) The central site will coordinate the wide-area installation services. This will include ordering of the router, CSU/DSU, and frame-relay lines. There is approximately five to six weeks between service order and service installation. During this time, the central site will work closely with the new facility in order to insure that the addresses are assigned, TCP/IP is installed, firewall products are selected and configured, and electronic mail implementation is planned. The priorities and requirements of each facility are unique, and the central support personnel will work within these boundaries to assess any necessary alternatives.

6) The central network specialist will configure the router. Once the frame-relay lines are installed and active, the central network specialist will deliver the router to the site, and assist in the installation of the router, and firewall. Testing of the TCP stack will be performed both within CHIME-Net, as well as out to other internet locations. The firewall will be tested to determine whether the settings behave according to expectations. If the site has selected the preferred electronic mail vendor, the central network specialist will assist in product configuration and test send and receipt of electronic mail both within CHIME-Net and to other internet locations. Once the installation is complete and tested, the site should advise CHIME-Net application users to contact the appropriate product support personnel for application deployment.

APPLICATIONS

One of the first features to be available to a new site is internet access. This resource is valuable even prior to resolution of electronic mail issues. CHIME-Net encourages the use of a graphical user interface web browser to facilitate access to the end-user. The standard selected was Netscape. A group has been established consisting of health care librarians and information systems professionals in order to more thoroughly investigate user support requirements. This group has also been tasked with identifying and documenting health care resources accessible over the internet as well as with training concepts for CHIME-Net.

In addition to internet access, several applications are under investigation and development for access over CHIME-Net. These applications include a bulletin board service which will provide a forum for up-to-date health care administrative and legal issues, electronic data interchange negotiations, and access to shared patient care information through the CHIME database. This database contains over 15 years of shared inpatient data, and is being expanded into other points of health care delivery such as the emergency room, and rehabilitation data. Development is currently under way to make limited portions of this information available to health care providers over CHIME-Net in a client-server environment.

CONCLUSION

Despite the learning curve associated with wide area connectivity in the health care arena, the potential benefits of this endeavor will provide participating facilities the ability to position themselves for an ever-changing health care delivery environment. Access to the latest information in

patient care and regulation will allow for more rapid adoption of new policies and clinical practice guidelines, thereby improving the ability to improve quality and efficiency of health care. The outcome of this effort is intended to be a strong infrastructure over which the advancement of health care technology may proceed. By sharing in the learning experience and establishing a single direction for the local community, we can both save time and cost as the facilities delve into uncharted territory.

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