Electronic document delivery using the Internet*

By Valerie M. Bennett, A.M.L.S., AHIP
Manager, Document Delivery Services

Scott Memorial Library
Thomas Jefferson University Medical Center
Philadelphia, Pennsylvania 19107

Eileen M. Palmer, M.S.L.S.†
Assistant Director
Health Sciences Libraries Consortium

University City Science Center
3600 Market Street, Suite 550
Philadelphia, Pennsylvania 19104-2646

The Health Sciences Libraries Consortium (HSLC) was established in 1985 by thirteen founding member institutions in Pennsylvania and Delaware. In 1989, the Interlibrary Loan, Document Delivery, and Union List Task Force, appointed by the HSLC Board of Directors, successfully demonstrated the feasibility of supplying 94% of all interlibrary loan (ILL) photocopy requests in forty-eight hours or less by a network application of group 3-level memory telefacsimiles. However, the expenses associated with the telefacsimile operation and the limitations associated with network polling protocols challenged participants to seek new alternatives for ILL. In 1990, the HSLC introduced HSLC HealthNET™, an online wide-area network linking eleven of the thirteen institutions and their resources while providing access to the Internet. The HSLC HealthNET additionally supports a centralized shared library system, several locally mounted databases, and consortiumwide electronic mail. In 1991, a project was initiated to evaluate Ariel™ software, pioneered by the Research Libraries Group (RLG), compared to the existing network application of group 3-level telefacsimiles. Factors identified as critical to Ariel’s potential to replace the telefacsimile network were the proprietary software specifications for Internet access, the use of HSLC’s existing wide-area network (WAN), and a hardware platform that was optimal for an ILL environment. This article describes the Ariel project history, the transition to Ariel from the telefacsimile network, evaluation of equipment features for processing efficiency, and operational issues affecting ILL policy.

INTRODUCTION

The Health Sciences Libraries Consortium (HSLC) was established in 1985 by a grant from the Pew Charitable Trusts to develop mutually beneficial co-

† Now electronic networking and communications specialist, Library of Michigan, 717 West Allegan Street, Lansing, Michigan 48909.

operative resource-sharing programs. Thirteen institutions in Pennsylvania and Delaware are HSLC founding members. These include all Pennsylvania medical schools, as well as the Philadelphia College of Pharmacy and Science, the College of Physicians of Philadelphia, Pennsylvania Hospital, Fox Chase Cancer Center, and the Delaware Academy of Medicine. The Board of Directors, composed of library directors at founding member institutions, governs HSLC. Assisting the board are a series of committees and task forces, which focus on each of the consor-
tium’s service areas. The initial grant project included the appointment of an Interlibrary Loan, Document Delivery, and Union List Task Force to address expansion of interlibrary loan (ILL) services.

In 1990, the consortium introduced HSLC HealthNet™, an online wide-area network linking eleven of the founding members and their resources while providing access to the Internet. Seven HSLC libraries are directly connected to the Internet through the HSLC HealthNet. Leased telephone lines (56K) extend from each institution to the HSLC computer center in West Philadelphia; a T1 leased line extends from there to the Pennsylvania Research and Educational Partnership Network (PrepNET™) in downtown Philadelphia. PrepNET is the Pennsylvania backbone network connecting to the Internet. The four remaining institutions are connected to the Internet directly via PrepNET or another regional Internet backbone network. The HSLC HealthNet also supports a centralized shared library system, several locally mounted databases, and consortiumwide electronic mail.

Since 1990, HSLC membership has grown to 250 libraries covering six states. The ILL and Union List task force members recognized the spiraling demand for ILL services coupled with the growing availability of the Internet. As a result, the task force charge of investigating cost-effective alternatives to the existing telefacsimile (fax) network became a priority. This paper highlights the project history of the task force and introduces its present work using Ariel™ software.

PROJECT HISTORY

The HSLC is evaluating the use of the Internet for document delivery as compared to a network application of group 3-level memory telefacsimiles for enhanced ILL. Group 3-level telefacsimile technology, evaluated by Bennett in an earlier study, was used to test unattended HSLC telefacsimile transmission of documents for ILL [1]. The eleven member institutions participating in this study evaluated the reliability and speed of the equipment relative to document delivery costs.

In 1991, filled requests for photocopies totalled 21,883, a 37% increase over the 13,784 filled using the telefacsimile network in 1989. The network application of group 3-level memory telefacsimiles for ILL evaluated by Bennett in a second project demonstrated the feasibility of supplying 94% of all ILL photocopy requests in forty-eight hours or less [2].

Although the existing technology represents a breakthrough in overcoming the physical barrier to delivery of materials, there is room for improvement. The expenses associated with the initial purchase of a single brand of equipment, equipment operation, and phone line costs posed a challenge because participants had to budget significant library resources to support ongoing costs in an uncertain financial future [3]. As a result, Internet technology was key to enhancing ILL capabilities.

Task force members considered and rejected a number of digital technologies. The Ariel document transmission workstation demonstrated the greatest potential, primarily due to its use of the Internet and nondedicated equipment. Ariel was acknowledged in the library literature for its high speed, reliability, and superior image quality [4]. And, although Ariel would not employ existing HSLC telefacsimiles, its standard PC platform would be useful for any library service.

Ariel’s use of Internet high-speed data lines offers a twofold advantage over the use of telefacsimile voice-grade lines. First, by using HSLC’s existing wide-area network (WAN), transmission speed and document quality is improved from voice grade (9,600-baud transmission rate) to digital grade (1.5 megabytes per second). The use of a high-resolution laser printer (400 by 400 dots per inch) at the receiving site further improves document quality and virtually eliminates the need for resends due to line noise. In addition, costs associated with long-distance phone calls are eliminated.

Ariel’s ability to send and receive transmissions simultaneously frees participants from adhering to polling protocols. Bit-mapped images are compressed in preparation for Internet transmission to write files to available hard disk storage more economically than telefacsimile. In effect, one page of health sciences literature consumes approximately .7 megabytes of hard-disk storage using Ariel.

ARIEL INSTALLATION AND TRAINING

Ariel was pioneered by the Research Libraries Group (RLG). RLG is a consortium of research institutions whose mission is to identify and solve problems of information creation, collection, and access that require cooperative solutions beyond institutional capabilities [5]. In 1981, the partnership established its Shared Resources Program. One of the goals of this program is to achieve timely transfer of print materials among RLG members.

Similarly, the HSLC task force aimed to improve transmission speeds without compromising image quality or customer service. The University of Pennsylvania, an HSLC member, was one of six institutions selected to participate in the original RLG beta test. The first Ariel document was transmitted by beta-test participants in October 1990, before most librarians had begun to discover the potential of the Internet. The following summer, the University of Pennsylvania Biomedical Library ILL staff invited fel-
low task force members to attend an Ariel software demonstration. Based on this demonstration, HSLC staff purchased two beta-test copies of Ariel and began testing its performance over the HSLC network beginning in October 1991.

Over the course of eight weeks, beginning in February 1992, the HSLC staff installed eleven workstations and provided training for ILL staff in the use of Ariel software. Installation presented few problems, although difficulties were encountered with sites not directly connected to the HSLC WAN. Technical problems at these sites usually required assistance from campus systems personnel and took longer to resolve than those discovered on the HSLC WAN.

Of obvious concern to librarians is the amount of time that must be dedicated to software training once installation is complete. Task force members were particularly concerned that sufficient initiation to the software be provided so as not to raise doubts about the telefacsimile network. That is, it was important that the decision to migrate to Ariel not imply that the telefacsimile network project was unsuccessful. The key challenge for instructors was to address various levels of microcomputer skills and teach technicians to use the software as well. Beyond that issue, Ariel software is menu driven, so the learning curve is minimal.

Instructors emphasized basic workstation components and maintenance issues such as toner cartridge replacement, paper jams, and the use of printer control panels. Instructors realized early the need to avoid intimidating staff members who had limited knowledge of the Internet and were unfamiliar with the software. Therefore, training sessions were conducted informally as roundtable discussions. Instructors avoided technical jargon, instead presenting a conceptual framework of the Internet and HSLC WAN. The goal was to introduce the Internet, discuss the expected benefits, and provide an opportunity for hands-on software training.

SOFTWARE CONSIDERATIONS

The Internet is composed of a multitude of U.S. and international networks. Transmission Control Protocol/Internet Protocol, commonly known as TCP/IP, is the standard that was developed to allow many individual networks to be joined by gateways and appear as a single network to users. Factors identified as critical to Ariel's potential to replace the existing telefacsimile network were the proprietary software specifications for Internet access, the physical Internet connection, and the hardware platform that was optimal for an ILL environment [6]. Ariel's proprietary software specifications use the TCP/IP. While efficient, this limits use of the application to workstations directly connected to a TCP/IP network.

Workstation components appropriate for Ariel use include a microcomputer with a network interface card, a compatible packet driver to handle communication between the Network Interface Card and Ariel application software, and associated hardware for scanning and printing documents. Once connected to the network, an Ariel workstation transmits a document to the address of another Ariel workstation using both RLG's proprietary data-compression methods and the network's TCP/IP.

If, for any reason, Ariel becomes inappropriate for dedicated ILL, then the PC may be transferred elsewhere in the library to earn back the initial investment. However, Ariel was developed under DOS, a single-tasking environment, rather than a multitasking platform. Therefore, Ariel must run continually in the foreground to send or receive documents. In effect, for high-volume ILL, the workstation must be dedicated to the Ariel application and, in this respect, is not superior to any other dedicated document delivery system.

Minimally, the task force's goal was to improve the average telefacsimile flatbed scan time of eight seconds per page. Ariel is designed to support moderate-speed scanners. This design feature was intended by the vendor to attract a high market share of libraries. Few libraries would be able to afford an extra $5,000.00 to achieve a faster scan speed. Adequate scan speed is, however, essential for high-volume lenders.

Although less than 2% of all document transmissions need to be repeated, network problems, incorrect network addresses, or a PC that is turned off or not actively running Ariel usually guarantee failed transmissions. The sending Ariel station attempts to transmit the document to the inaccessible station approximately twenty-eight times over a twenty-four-hour period. At present, it is not possible to alter the cycle time of sending attempts or the number of retries.

If the Ariel application is left running overnight, the transmission is usually successful. In the case of unsuccessful transmissions, however, Ariel does not alert the sender. Therefore, technicians need to routinely view each of the documents in the "send and retain" queue.

IMPACT ON ILL PROCEDURES

The task force drafted procedural guidelines with regard for the expectation of increased efficiency and multipurpose use offered by the workstation. HSLC is offering this procedures document as a model to libraries interested in participating in an expanded academic health science library Ariel network. In as many cases as possible, telefacsimile network procedures are applied to Ariel to minimize frustration for staff and expedite ILL.
Ariel’s “send and retain” feature requires more maintenance than that of telefacsimile. Queue entry files must be deleted first from the Ariel hold queue and next from the DOS directory. Deleting DOS queue entries without first deleting corresponding queue entries from Ariel causes the software to crash.

With the telefacsimile network, participants logged polling activity from transmission confirmation reports each morning. To compensate for Ariel’s lack of transmission confirmations, network members standardized the information recorded on the Ariel header page. The header page, which precedes each printed document, lists the document ID, patron, text of note field, text of notice field, number of pages, name of sender, and date/time stamp.

Memory telefacsimiles as well as Ariel challenge technicians to familiarize themselves with unidentified error message strings. In Ariel, two types of error messages occur: screen messages that usually indicate hardware problems and messages in the ARIEL.LOG log file that indicate problems with the receiving system causing transmission failures. Unfortunately, the ERRMSG.S.TXT file is not possible to decrypt, and it is impossible to view the ARIEL.LOG log file without exiting the application.

Ariel does not allow users to select queued items for later transmission as does the delayed-send feature available with telefacsimile. Such a feature would ensure a mechanism to batch process selected items so that ILL documents designated “rush” could be sent first.

One-touch, group dial codes available with telefacsimile also are not possible using Ariel. Each Internet destination must be entered by the operator prior to scanning. To minimize keystrokes, technicians use three-letter alias codes rather than physical addresses.

Basic activity staging was recommended to help maintain unimpeded workflow. During the work day, the staff scan documents for transmission to actively running Ariel workstations. Printing is disabled at most sites so that incoming transmissions are automatically received and stored to hard disk until an operator initiates the print command. Disabled printing allows high-volume lenders to scan documents continuously during library open hours, while simultaneously receiving ILL transmissions. Printing is possible at any time; however, the staff discovered early that scanning speed degenerates during active printing.

**IMPLICATIONS FOR ILL POLICY**

Ariel presents a unique situation for both national advisors and ILL managers. The program offers libraries unlimited potential for reciprocity with virtually no geographic barriers. The HSLC members have begun to add routinely their IP addresses in the DOCLINE® “comments” field to encourage cooperative agreements and resource sharing on an international level. But elimination of geographic barriers does not eliminate the need for a local network, because Internet access does not guarantee the possibility of connection to an Ariel workstation. Ariel requires both the sender and the recipient to be physical Internet nodes. Only libraries with the resources to pay for a direct Internet connection are able to afford the software.

Participants in the Greater Northeast Regional Medical Library Program with dial access to the Internet are unable to use Ariel. Unless Basic Unit libraries join the Internet or RLG enhances Ariel to proliferate its use by remote log-on, resource sharing will be driven toward agreements that involve peers with comparable collections rather than neighborhood proximity.

National advisors, such as the Association of Academic Health Sciences Library Directors, may fundamentally change the economics of regional agreements by incorporating the use of Ariel into DOCLINE routing channels. Because phone-line costs are no longer an issue, the costs of physical delivery no longer need to be factored into loan fees. The use of Ariel by a growing number of libraries nationwide may influence regional guidelines for loan fees, institutional agreements, and even patron fees.

**THE FUTURE**

Consortium participants support the underlying concepts of Ariel product development. The HSLC participants are actively seeking increased ILL traffic via Ariel but are also realistic about its present capabilities. Ariel supports scanning a document to disk, compresses and encrypts the file, and sends it over TCP/IP to a physical Internet address. It also responds to incoming ethernet packets, decompresses and decrypts the files, and spools the files to a printer. It does so by using DOS, the most inexpensive, widely available operating system for which there is the widest available support. That does not mean, however, that HSLC members are completely satisfied.

Throughout 1992, HSLC staff reviewed daily logs of Ariel transmissions conducted by HSLC participants. It was discovered that a ten-page document is scanned and received in an average thirty-six minutes or less. For regular ILL transactions, turnaround time using Ariel is more than adequate, considering that a telefacsimile network document is polled overnight and stored in the receiver’s memory until an operator initiates the print command, usually on the next working day. Turnaround time is inadequate, however, for clinical rush documents on which patient care depends. HSLC participants continue to use tele-
facsimile for clinical documents where speed supersedes image quality.

HSLC offers the following strategies for prototype enhancement. First, Ariel should operate on a multitasking platform such as Windows™ or UNIX™. A multitasking platform would support delivery of a background document via fax modem to the majority of non-Ariel library affiliates. Second, the Internet ARIEL.ADDRESS file and the ARIEL.LOG log file should be accessible to the operator while the software is active. Third, the scanner should have a more elegant interface with the Ariel application. A user prompt to preselect the number of pages to be scanned would avoid the need to “stack” enter commands with the use of a sheet feeder. Fourth, a wider choice of scanners, along with support for transferring digitized image formats, dial-up connections, and international paper sizes, is also highly desirable.

RLG needs to list identified problems with the application in priority order, announce the level of technical effort involved in product development, and establish its identity with the library community as a product vendor oriented toward customer service. To this end, RLG has announced that Ariel product development will focus on high-speed scanners, store and forward capabilities, conversion of foreign TIFF files, screen displays of scanned images, and a possible Windows version.

CONCLUSION

HSLC participants agree that Ariel software supersedes the capabilities of the telefacsimile network and offers even greater potential for resource sharing due to its growing number of users and ongoing product development. HSLC members understand that Ariel is an immature product. Despite its present shortcomings, it will become the cornerstone of HSLC cooperative development efforts.

The short-term challenge for HSLC librarians is to strike a balance between accommodating each library’s need for multifunctionality while increasing overall ILL productivity. The long-term goal for HSLC members is to fully automate the ILL process from request transmission to full-text document delivery without even the library’s involvement in the ILL process.

REFERENCES

3. Ibid., 270.
6. Ibid., 187.

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