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The Potential for Electronic Mail Networks To Extend Farming Systems Research

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INTRODUCTION

Farming systems research projects usually suffer from a multitude of time constraints that limit the extent of analyses and publications produced. While in the field the time required to solve logistical and administrative problems, train and supervise data collectors, verify and organize data in an exploitable form, and transfer professional skills to local counterparts severely limits the time left for data analysis and reporting results. Analyses also suffer due to the relatively narrow range of analytical expertise available in small, isolated teams and limited access to adequate reference collections and computer resources. At the end of a project members of an interdisciplinary team often scatter to different locations and the demands of their new duties constrain their collaboration on analyses of project data. As a result, many farming systems research data sets are only superficially exploited and many relevant observations never appear in publications.

An electronic mail network, CGNET, has been used by former members of the Niger Farming Systems Research Project to continue collaborative analyses of data collected in Niger. The network allowed researchers to quickly exchange data and documents with their colleagues in several states. The ability to quickly circulate draft manuscripts among co-authors proved especially valuable. CGNET also allowed immediate communication with researchers at the ICRISAT Sahelian Center in Niger who provided additional current data. The authors believe that electronic mail holds much promise for improving the productivity of on-going farming system research projects, as well as facilitating post-project collaborations.

What is electronic mail?

Electronic mail (often abbreviated e-mail) is the transmission of messages and data from one terminal or personal computer to another via a host computer. The intended recipient does not have to be present at time of delivery since the host computer stores the recipient's messages on his account or "mailbox" until he logs on to his host computer account and checks for messages.

Features common to most e-mail systems include facilities to compose and edit messages, commands to send mail to one or more users, to read mail messages received, to reply to messages and forward them to other users, to quickly scan or list the senders and topics of mail received or sent, and to file mail messages by category for future reference.

Why Use E-mail?

Used appropriately, e-mail can provide a fast, accurate, convenient, and inexpensive alternative to conventional mail Telex, telephone, and courier services. Specifically, e-mail can

- Reduce costs. A typical message can cost less than the equivalent letter or Telex.

- Facilitate collaboration on multi-author documents. Exchange of word processing files permits a co-author to make editorial changes directly on a document before sending it to the next author.

- Encourage teamwork and contribute to group morale by bringing together remote locations thus allowing quick, easy involvement in projects by all interested parties.

- Provide a permanent record of communication.

- Reduce time wasted playing "telephone tag", and eliminate the difficulties associated with communicating across several time zones.

- Make messages available anywhere there is access to a terminal, 24 hours a day.

TYPES OF E-MAIL SYSTEMS

E-mail systems fall into two major categories: local, private systems used for communication within a university or firm, and open, public systems which can link users from around the county or world (however, gateways often exist which permit users of private systems to exchange mail through public networks). This paper focuses on the use of public systems, both commercial and research/educational.

Research - Educational Networks

Bitnet, first established in May 1981 to link CUNY and Yale University, now connects over 2,300 university computers worldwide via 9,600 bits-per-second (bps) leased phone lines. A cooperative effort, Bitnet provides free file exchange and e-mail between mainframe computer users at member institutions. Internet is a network of networks, tying 15,000 defense and research related subnets, including CSNet, ARPANet, NSFNet, NASAnet, and Milnet. Gateways provided by a number of computers which are on both Bitnet and Internet permit most users of the two networks to exchange mail.

Commercial

Commercial e-mail services don't require that users have a mainframe computer account. For the most part, subscribers access a central system via phone lines. In addition to the message exchange and file transfers provided by the educational and research networks,

commercial e-mail systems offer users a plethora of other services. These include access to databases, new services, airline reservations schedules, Telex, telegram, bulletin boards, and home shopping systems . . . at a price. Commercial e-mail vendors vary widely in the variety and sophistication of their offerings, number of subscribers, principal users (hobbyists to Fortune 1000 companies), and international reach. Major vendors include MCI Mail, Quik-Comm, EasyLink, Dialcom, CompuServe, The Source, and GEnie. British Telecom's Dialcom, General Electric's Quik-Comm System, McDonnell Douglas' OnTyme, RCA Mail, and GTE Telenet's Telemail are among the principal competitors in the international e-mail market. These services target the needs of large corporate customers and often have stiff minimum charges. However, GTE Telenet recently introduced pricing alternatives that permit individual subscriptions. Also, companies exist which essentially serve as electronic information and communications brokers, providing specialized services such as access to a number of different commercial networks or to networks normally inaccessible to small users because of high service initiation costs or high minimum use requirements. CGNET, for example, provides an international communication network interconnecting agricultural research organizations via electronic mail and data communication facilities. These companies make a profit by adding surcharges to rates they pay for accessing other networks, databases and communications services, so direct access to these services may be more cost-effective in some cases.

GETTING ON-LINE

Research/Educational Networks

The basic requirements for use of Bitnet or Internet are an account on a mainframe computer tied to the network and a terminal (or a microcomputer and modem). At some universities the local, interdepartmental e-mail system and Bitnet are linked in such a way that users have immediate and virtually transparent access to users at other universities which host the service. At other institutions an application must be made to receive Bitnet access. If all project participants have ready access to one of the mainframe computers on Bitnet or Internet the low cost, easy integration into daily work habits, and ready availability of local expertise in the form of university support personnel provide compelling reasons to rely on these networks.

Considering Commercial E-mail Services

The educational/research networks don't go everywhere that commercial services do, so recourse to commercial systems may prove necessary to bring some colleagues on-line. Before making the decision to commit the money and resources necessary to subscribe to a commercial system and use it effectively, project leaders should interview potential users in an attempt to determine their needs and their degree of receptiveness to the use of e-mail. They should be asked what services might be useful to them in their work, how often they might use these services, and whether they are they interested in learning about and using e-mail. This assessment of needs should

determine whether participants are enthusiastic enough to warrant further investigation of e-mail and, if so, the features of particular interest in considering alternative communications services.

In evaluating systems seek out evaluations from current users. Their experience can be especially useful in estimating costs of using a commercial e-mail system, which can prove surprisingly expensive. When estimating costs, request a detailed and up-to-date schedule of charges from each service under consideration. Pricing schemes used by commercial services vary widely, some relying on measures of usage, others on fixed fees, and most using a mixture of the two. Typical costs include account establishment charges, fixed monthly charges or minimums, monthly fees for additional mailboxes, fees for storage of mail or files left on an account, dial-up network charges (e.g. Telenet), connect time charges, traffic charges (i.e. number of characters transmitted), surcharges for international mail or mail sent to other systems, purchases of documentation, and fees for "value-added services", which may include file transfer programs, databases, specialized billing (e.g. paper bills). Appendix C details the calculation of the cost of an e-mail message for a hypothetical commercial service.

If group members plan to exchange executable programs, spreadsheet files, or non-ASCII word processing files note that some networks require specialized software to send and receive binary files. The use of services which bridge dissimilar systems or networks also complicates binary transfers. Other useful features in an e-mail service include the capacity to send copies of messages via Telex, fax, courier, telegram, or regular mail; the ability to include the text of messages received in replies, or to forward them to other users; automatic prompts for incoming mail; and passwords and user names which are easy to remember.

Commercial systems are usually reached via packet switching networks (PDN), also called public data networks, such as Tymnet (McDonnell Douglas) and Telenet (GTE). These companies provide access to dial-up computer installations around the country with a local phone call to a network node or to an 800 WATS number, typically at much lower rates than comparable long-distance telephone calls. In the U.S. no prior arrangements with these services are necessary. Once a user has established an account with the e-mail service, all he needs to know is the phone number of the nearest data network service node and the data network "address" of the mainframe host of the electronic mail service. E-mail users rarely do business directly with the data carrier other than to enter the id number of the service they wish to access. The data carrier bills the e-mail service for use of its network and the e-mail service passes these charges on to the user.

Outside the U.S. users must follow procedures established by the local postal and telephone authority (often called PTT or P&T), which are generally monopoly providers of data communications within their national boundaries. To access the local data network users must request a Network User Identification (NUI) code. The NUI is an account identifier which allows the subscriber to make a local phone

call and use the international networks to connect to an e-mail system's computer by signing on and entering the Network User Address (NUA) of the host computer. Subscribers pay the data network authority directly for use of its facilities. Typically this includes a fee for installation, and a monthly subscription fee, as well as variable charges for traffic and connect time. Modem rental may also be required. Application for an NUI should be submitted as early as possible since approval often takes a long time (i.e. several months). If there isn't a local data carrier, or dial-up access proves impractical, users may be forced to make a international telephone call to the U.S., after which the procedure for logging on will be essentially the same as in the U.S.

GETTING THE MOST OUT OF E-MAIL

E-mail demands more of its users than most other means of communications. Its effective use depends upon the adequacy of training, support, supervision, and encouragement of red users. Project leaders should select a supervisor who will oversee the assignment of accounts and mailboxes, check users' equipment needs, control costs, coordinate the provision of training and documentation, and encourage users to check the contents of their mailboxes on a timely basis. In controlling costs supervisors must impress upon users the need for security (i.e. the importance of preserving the secrecy of passwords, minimizing number of people who have access to passwords, and changing passwords at regular intervals. In particular, users should be discouraged from posting passwords or user names publicly, however convenient this may seem. Password thieves can very quickly run up service charges--and may not be immediately detected if the e-mail service doesn't produce detailed billings.

Simplify operations as much as possible. For example, on most systems mailing lists can be created to streamline distribution of copies of messages to groups of users with common interests or responsibilities. Dialing directories provided in all full-featured communications programs can be configured to set mundane but critical details such as modem speed and line parameters to those required by each service, e.g. baud rate, number of data bits, stop bits, parity. If users plan to exchange word processing or spreadsheet files will be exchanged try to standardize on a single word processing or spreadsheet program to minimize translation problems. At some sites it may be advisable to chose someone to retrieve and distribute e-mail, and to act as a local resource person. Generally this person should be the individual who is most enthusiastic about e-mail and learning to use it. Local supervisors need to recognize the additional demands on this individual's time and adjust their workload correspondingly.

People who actually send and receive e-mail will require training in use of the word processing software, the selected communications package, the e-mail service's procedures, and security. For the e-mail service this should include the: logging on and logging off; checking for mail; sending and reading mail; uploading and downloading ASCII and binary files; system commands used to list files, rename files, delete files, change passwords, suspend or cancel execution of a

command, access help features; file naming conventions; names of system files which should not be erased; and how to use batch mail facilities. For communications software the most salient topics would be using dialing directories, setting communications parameters, using the program's text editor, writing and using command files to automate procedures, logging sessions to file and/or printer, and sending and receiving files.

CONCLUDING COMMENTS

In conclusion it should be recognized that e-mail may not be an effective or economical communications tool for some groups. When large volumes of data need to be transmitted at a time, courier services may be a better solution. Startup costs for equipment, software, and training may be prohibitive if the frequency of communications is insufficient to amortise these costs. Project sites may not have access to phone lines of adequate quality to permit efficient data transmission. Finally, projects may encounter significant resistance to e-mail, especially when its use necessitates a significant departure from established work habits. No one should be forced to use e-mail; it should succeed or fail on the strength or weaknesses of its merits.

Alternative or complementary communications media include courier services, Telex, and facsimile transmission (fax). Telex, the exchange of printed messages by teleprinters, has been around for nearly half a century. Though E-mail and facsimile transmission devices have eaten into Telex's market share in the U.S., international business has continued to grow, especially in third world countries, where Telex messaging has often been the only reliable means of international communications. Fax machines transmit exact images of documents to other fax over phone lines, preserving signatures, letterheads, and graphics. An estimated 1 millon fax machines are now in use in the U.S. and analysts expect that number to grow to 2.5 million by 1990, with the fax machine eventually becoming as ubiquitous as the office copier. Falling machine prices and improvements in technology sparked the explosion in fax use--desktop or "personal" fax machines now selling for under $1000 can transmit an 8.5" x 11" page in 30 seconds over ordinary phone lines.

Appendix A.

TIPS FOR CUTTING COSTS ON COMMERCIAL E-MAIL SYSTEMS

- Encourage cost-consciousness. For example, ALL users should know the approximate costs of transmitting messages, on-line composition, and charges for value-added services. Encourage use of Bitnet or Internet whenever possible (they're free).

- Compose message files "off-line", using your microcomputer's word processing software or editor, and then upload (send it from your microcomputer to the large computer used by your e-mail service) the resulting file rather than composing your messages "on-line". In addition to saving money on connection fees, you avoid the time and ennui of learning to use the e-mail service's text editor.

  Some services provide batch mail utilities which allow users to combine all their outgoing mail into a single file containing both message texts and the addresses of intended recipients, then upload and send these messages in a single operation using the their communication program's ASCII transfer option. For example, Dialcom's PCMAIL utility accepts files of the form illustrated below.

```
mail r.deuson su Credit data
Robert,
   I need to know as soon as possible which variables
in the credit data set interest you.
Regards,
Roger
.s
mail s.swinton r.deuson su Database manual
Scott,
   Thanks for your editorial suggestions.  We'll
incorporate them as soon as possible.
Regards,
Roger
.s
.end
```

  Each message starts with line indicating the note's recipient(s) and its subject (after 'su'). A '.S' marks the end of each message's text, and '.END' follows the last message.

  Users create these files with a text editor, or a word processor which can create ASCII files; files which contain no special characters or control codes. In WordStar this can be done by opening a file in "non-document" mode. In WordPerfect the ASCII file save option accomplishes the same end (Press Ctrl-F5, then select option "1" when you've finished composing your message).

- Send messages after hours or on weekends to take advantage of reduced rates, if offered.

- Save mail messages to disk or dump them to your printer and wait until you're off-line to read them carefully. A 'quick and dirty' way of

doing this is to use your communication program's capacity to copy everything which appears on your microcomputer's screen to a file or to a printer (called logging), while quickly scrolling through your messages. Larger messages should be saved to a file then downloaded from the mainframe to your microcomputer using a file transfer utility.

- Regularly erase files which are no longer needed, since many services charge for storage. Administrators may be able to specify a limit on the amount of time a file can remain in storage without being viewed or modified.

- Always sign off properly. If you simply hang up the phone, turn off your modem, or exit your communications program, most e-mail service computers presume that you have been accidentally disconnected and will not terminate your session until a predetermined period of time passes without any activity on your account. Your account is then billed for the extra connect time. If you really have been accidentally disconnected, this feature permits you to reestablish contact with your service's and resume your session.

- Use a file-archiving package (e.g. PKARC) to compress large files before uploading them, if your e-mail service offers binary file transfer. These programs squeeze one or more files into a single archive file, using a variety of algorithms to economize on the use of space. Database and spreadsheet files typically shrink 50 percent and text files as much 90 percent thus cutting transmission times considerably. The recipient of an archived file then uses a companion program to de-archive the file(s), restoring them to their original size and format.

- Avoid unnecessary proliferation of mailboxes by assigning mailboxes to groups or locations rather than individuals. In deciding how to distribute mailboxes, weigh the need for privacy of communications and accountability against the costs of additional mailboxes. These costs include any fees per mailbox that the service may charge and the additional access charges incurred by adding another account which must be checked daily for mail.

- Change passwords regularly. If you're using an a script or command file to automate logon to your service, remember to update your password in this file using an ASCII editor, or a word processor in non-document mode.

Appendix B. Names and Addresses of Selected Product Vendors

Product	Vendor
CGNET	CGNET Services 400 Webster Street Palo Alto, CA 94301 (415) 325-3061
Mail	Dialcom, Inc. 6120 Executive Blvd. Rockville, MD 20852 (301 881-9020
OnTyme	McDonnell Douglas Information Systems Group 20705 Valley Green Dr. Cupertino, CA 95014 (800) 435-8880
Quik-Comm	General Electric Information Services Co. 401 N. Washington St. Rockville, MD 20850 (301) 340-4000
Telemail	GTE Telenet Communications Corp. 12490 Sunrise Valley Dr. Reston, VA 22096 (800) 835-3638
*Procomm 2.4.2 communications software	Datastorm Technologies, Inc. P.O. Box 1471 Columbia, MO 65205
MultiTech 224EHI modem	MultiTech Systems International 511 11th Avenue South Minneapolis, MN 55415 (612) 375-9824
*PKARC.EXE PKXARC.EXE archiving software	Pkware, Inc. 7032 North Ardara Avenue Glendale, WI 53209 (414) 352-3670

* Procomm 2.4.2, PKXARC and PKARC are <u>shareware</u> programs, widely available through PC users groups and electronic bulletin boards. Potential users can legally make copies of these programs and use them on a trial basis. Those who decide to continue to use the packages are required to pay a registration fee for this right.

Appendix C. Calculating E-Mail Message Costs

In the example below costs are calculated for sending a file containing a one-page message via a hypothetical e-mail service. The service charges $14 per hour or $0.23 per minute: $9 per hour for connect time plus $5 per hour for access via the public data network (e.g. Telenet). The service also charges a traffic fee of $0.05 per 1000 characters transmitted. To calculate the cost of sending a message, first estimate the number of characters to be sent (for a file, this is simply the size of the file in bytes):

```
     1 page
x   65 characters per line (spaces count!)
x   60 lines per page
= 3900 characters or bytes
```

Next you will need to know the speed at which your modem operates and thus how long it will take to transmit the message file. Assume that a 1200 bit-per-second (bps) modem is being used. Generally it takes 10 bits to transmit a character, thus 1200 bps translates to 120 characters per second or 7200 characters per minute:

```
  3900 characters to be sent
  7200 characters per minute
= 0.54 minutes to transmit the message
```

<u>Transmission costs</u>

```
    $0.23 charge per minute on-line
x    0.54 minutes to transmit the message
=   $0.124
                    plus

+   $0.05 charge per thousand characters
x    3.90 thousand characters
=   $0.195

=   $0.319
```

<u>Total cost</u>

```
    $0.319 cost to send the message
+   $0.319 cost to receive the message
    $0.638 total cost to exchange message
```

In practice the cost will probably be higher, since many services round up to the nearest minute when calculating access charges. The analysis assumes the sender composed the message off-line using his personal computer's word processing software and that the recipient saved the message to his personal computer rather than pausing to read it on-line. As a rule of thumb, e-mail messages will cost between $0.50 and $1.00 per page. Other significant costs of using e-mail may

include charges for service initiation, fixed monthly charges or minimums, and charges for "special" services such as changing passwords, sending messages to other networks or international destinations, requesting detailed billings or paper copies of charges. ALL group members should be aware of these costs and their magnitude.

Total variable costs of communications for a given period can be estimated by multiplying the expected volume of e-mail by cost per message. A break-even point for use of alternative services can also be calculated. For example, given the cost structure detailed above, a courier service which charges $14 for overnight delivery becomes cost competitive if the size of the file or document to be exchanged exceeds 85,000 characters, about 21 single-spaced pages.

Appendix D. Equipment and Software Requirements

Personal computer users will need communications software and a modem to tie into e-mail services. A modem--short for MOdulator/DEModulator--translates the digital signals from a microcomputer or terminal into analog signals suitable for transmission over phone lines to the host computer and also receives signals from the host's modem which are translated back into digital signals comprehensible to the PC. The most important characteristics to be considered when purchasing a modem are speed, compatibility, and the presence or absence of error-checking and data-compression protocols.

Modem speeds are measured in bits-per-second (bps). Common transmission rates are 300 bps, 1200 bps, and 2400 bps. Currently 1200 bps is the most common speed, but 2400 bps equipment is becoming increasingly popular. Preferably a modem should be capable of automatically falling back to a lower of speed if necessitated by poor phone line quality. If your e-mail service and local data carrier offer 2400 bps service, and bill for access time, a 2400 bps will eventually pay for itself through by speeding up data transfers.

Compatibility Bell 103, Bell 212A, CCITT V.22, CCITT V.22 bis, and CCITT V.29. are modem standards; sets of technical specifications which have been established to ensure that modems produced by different manufacturers can communicate with each other. Unfortunately, the U.S. and Canada use the Bell modem standards for 300 bps and 1200 bps communications, while most of the rest of the world uses CCITT standards. Modems which may be used to communicate in either environment must support both sets of standards, e.g. if direct access to the U.S. is planned as a fall back communication method for a site will normally logs on via a european public data network. Communications software use command sets, special sequences of characters which the modem recognizes as instructions and intercepts, to initialize the modem, direct it to dial a phone number, hang up the line, and perform other functions. Hayes Microcomputer Products has dominated the modem market to the extent that industry has effectively standardized around the Hayes command set. Many communications packages come pre-configured for Hayes-compatible modems, so choosing a Hayes-compatible modem can simplify software installation and use.

Error checking and data compression protocols MNP (Microcom Networking Protocol) is group of data compression and error-checking protocols built into some modems, which can increase both the speed and reliability of communications. Some data carriers, e.g. Telenet provide MNP (Microcom Networking Protocol) service for users who have MNP capable modems or MNP software, as well as using MNP technology for transmission on their own lines. Currently six levels exist, which provide increasing levels of functionality. Classes 1 through 4 are in public domain, and class 3 is becoming very common in new modems in the U.S. Class 4 modems have improved capacities to adjust to bad or noisy telephone lines. Class 5 introduces data compression. The MNP classes are compatible downward; two modems with MNP capability will negotiate to the highest mutually compatible level, so class 5 modems can communicate with class 4 and class 3 modems, as well as non-MNP modems.

MNP is transparent to other protocols such as Kermit and Xmodem. An example of a highly-rated, versatile modem in widespread use for international data communications is the MultiTech 224EHI. This modem supports both Bell and CCITT modem standards at 300 bps, 1200 bps, and 2400 bps, supplies class 5 MNP data compression and error protection, and can be purchased wired for 220v. It lists for about $700 but can be had at substantial discounts.

Other Hardware needs: For external modems a serial communications card must be installed in your PC. This card provides a RS-232 serial port to which the modem will be connected via a serial communications cable ("modem cable"). Care must be taken to purchase a cable with the correct connectors. No single cable will work for all equipment since the connectors can have 9, 15, or 25 pins. Finally, a modular telephone cable and jack will be needed to connect the modem to the phone network. For internal modems only a modular telephone cable and jack are required.

Communications software

Communications software allows a microcomputer to act like a terminal, in fact these packages are sometimes referred to as terminal emulation software. Procomm and Crosstalk XVI are two of the most popular general purpose communications programs available. A good software package can save money, time, and frustration. For example, Procomm permits users to redisplay and search through text which has scrolled off screen, log (capture) a communication session to printer or file, define keyboard macros, and create a dialing directory which stores phone number and line parameters for frequently called systems. Procomm "scripts" or command files may be written to automate tedious and frequently performed tasks, such as logging on. The program supports all the most common data transfer protocols, including ASCII for text files and Compuserve B, Kermit, Xmodem, and Ymodem for transfers of binary files (e.g. spreadsheet, program, or word processing document files). Procomm provides emulation of VT52, VT100, IBM3101 and Televideo terminals.