LEADERS FOR MANUFACTURING PROGRAM ELECTRONIC MAIL NETWORK

by

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ABSTRACT

The LFM Electronic Mail Network is an effort intended to improve communication and coordination within the MIT Leaders for Manufacturing Program via technology. This effort includes both hardware implementation and development of an e-mail culture within LFM.

The network is designed to provide a fast, inexpensive, and readily accessible alternative to complement the conventional method of communication for the LFM fellows, professors, staff, and sponsoring company personnels. It is implemented by horizontal integration of existing hardware and software within LFM to achieve a nation wide communication network linking MIT and the eleven sponsoring companies. A database is also developed to help manage all of the e-mail user information required to maintain a centralized distribution server at the Sloan School of Management. This server is responsible for forwarding both individual and group mails to appropriate receiving addresses. The training involved assisting the LFM staff and fellows to become proficient in utilizing e-mail as a daily communication tool. Detailed documentation is also made available to LFM to assist in their evolution of e-mail culture.

Armed with this new tool, the members of the Leaders for Manufacturing Program can communicate with each other with greater efficiency and effectiveness and therefore improve communication and coordination.

Thesis Supervisor: Prof. Stuart Madnick

Title: Professor of Management Science

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1. INTRODUCTION

1.1 Leaders for Manufacturing Program

The Leaders for Manufacturing Program (LFM or the Leaders Program) is a major collaborative educational and research effort between academia and the industry through the merging of disparate management and engineering disciplines. It is designed to train a new generation of manufacturing leaders who will be competent in both business and technology to rebuild America's manufacturing leadership in the world. It was officially launched in the spring of 1988. Since then the program has grown to a partnership between the Massachusetts Institute of Technology's Schools of Engineering and Management and eleven major American manufacturing firms. Five departments are involved within the School of Engineering: Aeronautics and Astronautics, Chemical Engineering, Electrical Engineering and Computer Science, Materials Science and Engineering, and Mechanical Engineering. The manufacturing firms include: The Aluminum Company of America, The Boeing Company, Chrysler Motors Corporation, Digital Equipment Corporation, Eastman Kodak Company, General Motors Company, Hewlett-Packard Company, Johnson & Johnson, Motorola Incorporated, Polaroid Corporation, and United Technologies Corporation.

The Leaders Program offers its fellows the opportunity to earn two masters degrees in two years, one in business management and the other in any one of the five participating engineering disciplines. In the course of study, each fellow will be given up to six month of work experience at one of the sponsoring company sites under close supervision of a liaison faculty. This is a rigorous two years and requires a great deal of communication and coordination among all participants of the program, the fellows, staff, faculty, and the company liaison from various industries.

The Leaders Program has an Operating Committee and nine internal working committees to design and implement the educational curriculum and research agenda based on the goal goal stated above. The nine internal working committees are: Working Group,

Admissions Committee, Communications Committee, Company Liaison Committee, Company Projects Committee, Curriculum Committee, Intellectual Property Rights and Property Data Committee, Pro-Seminar Committee, and Research Committee.

The Communications Committee felt that a main key to better the program is through better communications and coordination among all participants. On MIT campus, it may not be too hard for professors and students of the same department to track down each other. But LFM's communication scope reaches far beyond a single department located in a single building. It requires cross-departmental communication where the faculty and students are dispersed over a distance of over one mile. Furthermore, due to the multi-company involvement, tasks as simple as getting a memo from one professor to a liaison personnel in a manufacturing firm may prove to be difficult. Of course, one can always send memos via facsimile machine. But we feel that a better solution is electronic mail. With such a system, people can send memos and messages across a network with relative ease. The communication response time would then be reduced by many fold from days to just a matter of hours or minutes, depending the location of mail destination.

With the above vision in mind, an effort was initiated to examine the feasibility of an electronic mail network within the LFM context. If feasible, a network providing electronic communication among fellows, professors, staff, and the company sponsors will be implemented.

2. OBSERVATION

2.1 Means of Communication

The Leaders for Manufacturing Program utilizes four major means of communication to serve varying purposes: telephone, facsimile machine, MIT Interdepartmental mail, and various courier services.

The telephone is the most commonly used, general purpose form of communication. It is the most personal of the four alternatives listed above and allows immediate two-way feedback. Unfortunately, most of the participants in the program are overloaded with activities and therefore are not available for answering their phone most of the time. In such a case, a short message is left with a secretary, answering machine, or on a voice mail system where possible.

The facsimile machines is capable of duplicating paper documents, transmitting the copies electronically over a telephone line and output them in paper form. This makes it an excellent candidate for forwarding typed or written documents of limited length. It is especially useful for sending graphics, drawings, or sketches since facsimile machine does distinguish between text and graphics. It simply digitizes the paper image into electronic format. However, although all top executive offices of sponsoring companies have ready access to facsimile machines and are using them for both internal and external communication, there are very few facsimile machines installed on the MIT campus. Only the LFM Headquarters and a few professors have immediate access to such machines. Thus, this form of communication is used primarily only between the LFM Headquarters staff and the company executives. Another disadvantage is that documents sometime have to be re-sent due to transmission distortion.

The MIT Interdepartmental mail is used for on-campus communications. It serves as a channel for memos, announcements, and various documents distribution. Even though it does not carry any delivery cost, it is often too slow for time dependent messages such as meeting announcements or rescheduling. Many meeting reminders reach

professors' offices days after the event. Even then, this form of communication is excellent for sending documents or messages that does not require immediate attention.

Courier services includes the US mail and other express mail services. Its function is very similar to the MIT Interdepartmental mail except it is used for communication between the MIT campus and the sponsoring companies. Like the MIT mail, it is used for documents circulation. The cost depends on the delivery speed required and can potentially become too expensive to justify sending a three line memo via Federal Express.

In addition to the delivery time constraint on some of the document types, addressing for mass mailing can be very tedious especially for short memos. The task of placing address labels on a hundred copies of a simple memo every week is performed by the LFM staff and can become a document processing bottleneck. An automatic distribution system (at least for certain types of documents distribution) would relieve the administrative staff from doing such mundane work.

As a result of the above observations, the conclusion is that a new distribution system shall be developed to supplement the current one. Such system must meet the following requirements:

1. This system must have messaging capability to handle the possibility that the recipient may not be readily available.
2. This system must be able to automate the mass distribution process to relieve the administrators to perform more meaningful tasks than doing address labels.
3. This system must be fast and inexpensive to allow mass distribution of meeting reminders and other short memos.
4. This system must be readily accessible by all supported LFM participants. This scope of support may include the fellows, staff, active professors, and companies.

2.2 Existing Hardware

A system with the above suggested requirements can be met using an electronic mail system. E-mail is fast, cheap, and have group distribution capability. Intuitively, its implementation in the LFM context should be relative easy through integration of the existing technology available within the Leaders Program since computer hardwares are easily accessible to most of the LFM participants. So a survey was deviced to study the feasibility of such implementation. Its purpose is to study the existing computer technology available within the Leaders Program that can potentially support electronic mail. It is conducted in four areas, professor, LFM Headquarters, companies, and network feasibility.

2.2.1 Professor

Most of the professors at MIT have easy access to some computer system. In the School of Management, all professors have Professional Office System (PROFS) accounts on Sloan's IBM 4381 mainframe. PROFS, developed by IBM in the early eighties, is an office support information system designed to improve office productivity by simplifying the scheduling of meetings and facilitating communication among the members of the organization. It provides a common menu-driven front end for several VM/SP[1] applications including electronic mail, calendar management, information retrieval, and document processing. It is widely implemented in the corporate America. The Sloan professors either use an IBM personal computer or a Macintosh[2] in their office to link to the IBM mainframe to access their PROFS accounts. Such connection is established via ethernet[3]. However, some Sloan professors who are affiliated with engineering departments do prefer to use their non-PROFS accounts such as one in the MIT Artificial Intelligence Laboratory.

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1 Virtual Machine/System Product is an IBM mainframe operating system.

2 Macintosh is a product of Apple Computers.

3 Ethernet is the primary communications circuitry used in many mainframe, PC, and UNIX local-area networks. Originally developed at Xerox, it is becoming an international standard for high-speed telecommunications.

Most of the School of Engineering professors have access to mainframes or workstations in the research facility within their department. These systems typically run the UNIX operating system. The hardware platforms range from Symbolics Lisp Machine[4], VAX computers and MicroVAX workstation[5], to IBM RT workstations[6] and a few others. These system all have electronic mail and networking capability. Only a few engineering professors do not have access to any e-mail account. However, they all have easy access to stand alone personal computers from their offices. These machines are either IBM PC compatibles or Apple Macintoshes.

2.2.2 LFM Headquarters

The Leaders for Manufacturing Program Headquarters includes office for its two co-directors, program manager, administrative staff, and twenty fellows. Except for the fellows office there is a Macintosh II per user available in every office. One of the Macintosh II is even equipped with special hardware designated for desktop publishing purposes. In the fellows office, there are three Macintosh II's shared by all twenty fellows. All these Macintoshes are networked using PhonNet[7] at the physical connectivity level. The protocol used by this network is the Apple LocalTalk protocol.

2.2.3 Companies

With the exception of Chrysler Corporation, all Leaders sponsoring companies have well developed internal networks composed of multi-vendor platforms. The most commonly used office support systems for internal electronic mail and coordination purposes are PROFS and DEC's All-In-One. External gateways exist in the following

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4 Symbolics Lisp Machine is a product of Symbolics. It specializes in artificial intelligence applications.

5 VAX and MicroVax workstations are products of Digital Equipment Corporation.

6 The IBM RT workstation is a RISC architecture based machine developed by IBM.

7 PhoneNet is an inexpensive alternative to the AppleTalk hardware. It is designed to utilize conventional telephone wire instead of using the AppleTalk cable to support the Apple LocalTalk protocol. It is a product of Farralon Inc.

companies: Aluminum Company of America, Boeing Company, Digital Equipment Corporation, General Motors Company, Hewlett-Packard Company, Johnson & Johnson, Motorola Incorporated, and United Technologies Corporation. Even though these gateways are usually available through the engineering and research computers, linkages to the mainframe used by the management are commonly available or can be easily established.

2.2.4 Network Feasibility

Network feasibility will be discussed from two perspectives: within MIT campus and outside of MIT campus. There are two major networks on the MIT campus, the MIT Internet and the AT&T 5ESS ISDN network. The former provides a full networking environment for all computers on-campus. It includes the MITVMA gateway which provides the capability to communicate with the outside world. The latter at current time is used primarily as a mean for dial-in connection.

With the exception of stand alone personal computers, all of the mainframe, mini-computer, and workstations used by LFM MIT participants are interconnected via the MIT Internet. The Sloan IBM 4381, Wheaties at the Artificial Intelligence Lab, and Project Athena are all part of this network. MIT Internet is a campus wide ethernet network composed of coaxial and fiber optics cables designed to provide communication, including electronic messages, for all computer platforms on MIT campus. It can potentially transmit data at the rate of 10 million bits per second and therefore can support a large traffic flow.

The MIT Internet gateway, MITVMA provides access into many public external networks including the ARPANET and the BITNET. This gateway can be accessed from anywhere on the MIT Internet and therefore gives LFM participants the ability to communicate with the outside world directly. There is no need to connect to a special node in order to link to the sponsoring company networks and therefore greatly simplifies connectivity procedures. Many LFM sponsoring companies also support these two

network and can potentially make implementation of e-mail connection relatively easy. (See Appendix G for background information on BITNET and application procedures)

The AT&T 5ESS Integrated Services Data Network provides simultaneous voice and data communication through a sophisticated central switching computer and a network of local telephone data modules. The local data module is implemented in the AT&T digital phones which are used in every MIT offices. It contains a standard RS232C serial port to allow computer hardware connection. Potentially two users can have voice conversation and digital data exchange simultaneously on the same telephone line. This can allow users to dial into host computers using personal computers as dumb terminals from anywhere within the MIT campus.

The ISDN technology is first commercialized by AT&T in late 1987. Its circuit switch (or the network layer) runs on the AT&T proprietary Q.931 and Q.921 protocol. At the data communication layer, it supports two internal AT&T data modes, B2 and BA. It also support the X.25 Packet Switching standard[8] for general data communication purposes. The central switch software serves as a packet handler. It gathers the out-going data from all data modules on the network and distribute them to their appropriate destinations. The bandwidth of the digital telephone line is capable of supporting maximum transmission rate of 19,200 bits per second and limited video conferencing at about ten frames per minute. This is sufficient to support personal computers serving as data terminals.

2.2.5 Summary

The widely installed computer technology base within the Leaders for Manufacturing Program makes the implementation of an electronic mail system feasible. Most of the hardware and software pieces are already available. The key is to integrate them in a cost effective way to provide an easy-to-use electronic mail communication

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8 X.25 is an internal communication standard.

service. The diagram shown on the next page summarizes the network architecture base for building this LFM network.

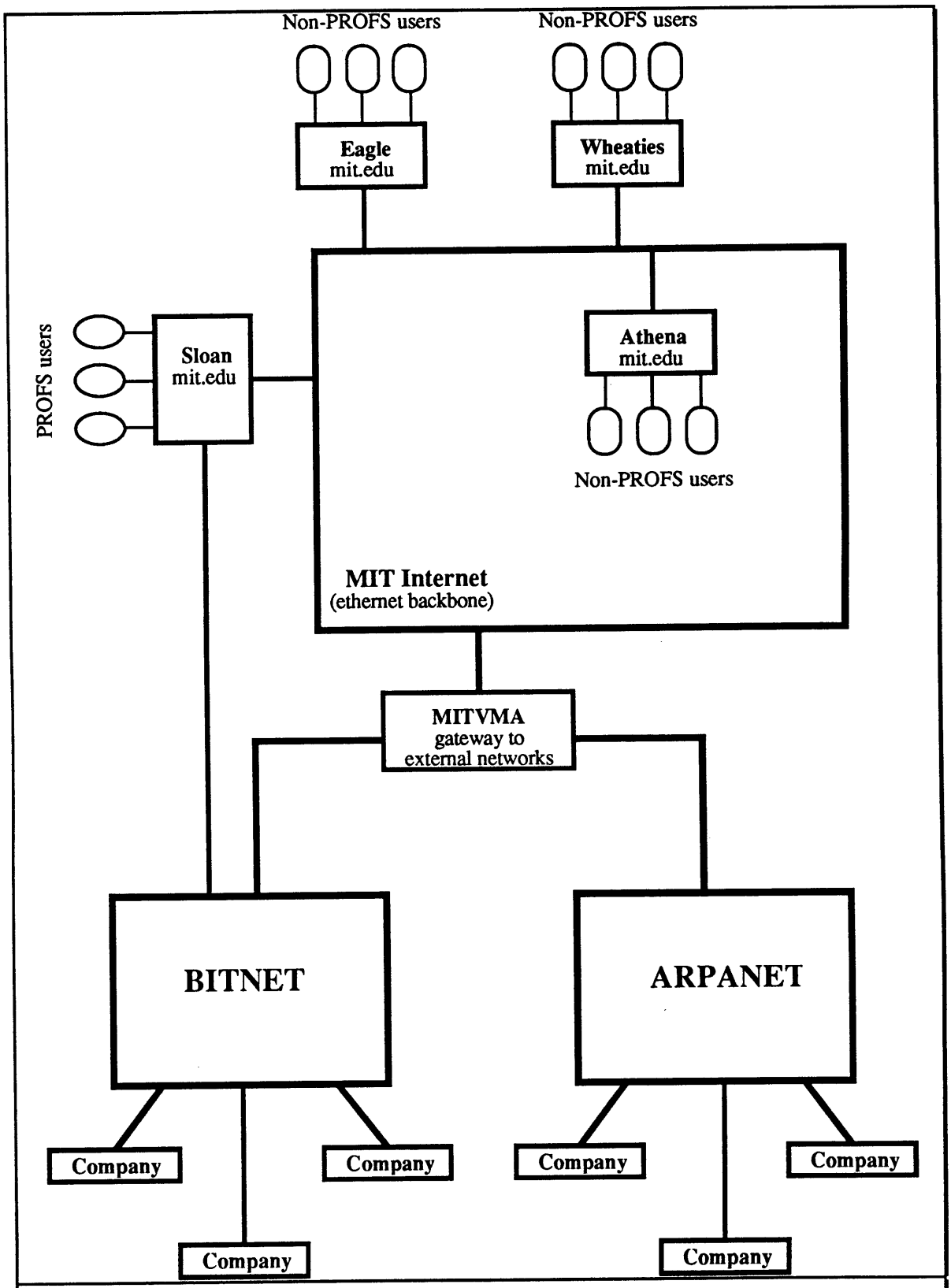

Figure 1. LFM E-mail Network Topology

3. IMPLEMENTATION CONSIDERATION

Two factors are continuously being considered through out the implementation process of the LFM Electronic Mail Network, cost justification and acceptability of the system. They eventually led to the formulation of the LFM network design organizational structure as well as the methodology for hardware implementation.

3.1 Cost

The cost of installation and maintenance of e-mail must be justified. Like most other information systems, justification is computed by weighing the short term and long term benefit of the new system and its cost. Some of the cost may not be justified by e-mail alone. However, if the future implication of the network is also considered, the benefit may be beyond what can be foreseen at this time. The ability to tap into the MIT Internet provides immediate access to the vast computational power and information resource available on the MIT campus. Especially the gateway to ARPANET and BITNET can open up a whole new world of international information sharing and exchange at the finger tip of the LFM fellows from their student office in Building 9. This potential benefit is tremendous when compared to other alternative means of communication such as MIT interdepartmental mail, US mail, express mail services, and facsimile machines. It is clear that a cost analysis is difficult to run at this time. So through out the implementation process, the cost issue translates into the general guideline: make minimum changes to the existing available hardware equipments and software applications. The 'surround' methodology for implementation is use. Instead of running a general cost analysis, it is handled on a case by case basis.

The installation costs include network implementation, purchase of computers and softwares. So by building the LFM network out of existing equipment can result in

tremendous saving. For example, by making use of the MIT Internet[9] or ISDN digital phone network[10] for on-campus communication can eliminate the need to setup a dedicated local area network serving LFM which can potentially save tens of thousands of dollars.

The maintenance cost include the monthly cost of PROFS accounts and MIT Internet address where applicable. Such costs are minimal and can be easily justified. The actual maintenance of the machines usually fall under other departments such as the Sloan Systems Administrator and therefore is not applicable to LFM's cost analysis.

3.2 Surround Methodology

The surround methodology make the LFM e-mail network implementation affordable by building it on top of the existing hardware/software equipments by horizontal integration of new and existing systems. To the existing e-mail users, the LFM e-mail network would appear to be an added service. New user are added to the existing network architecture to support a complete service.

This methodology raises the information system acceptability through minimum changes at the hardware/software level. This would then translate into minimum changes at the user level. The users who already have access to an e-mail account are most likely accustomed to the e-mail functionality on his system. In most cases such users are probably not willing to switch to a new system even if the new system is better. It is like using a word processor. Under normal circumstances, when one is used to a particular word processor, the likelihood of the user switching to a new one is very low. So it would be unwise to impose a new e-mail system on existing users. Such an act may result in resentment to the new system and therefore lowers the acceptability. Furthermore even if the user agrees to use the new system in conjunction with his old system, confusion of

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9 MIT Internet is an ethernet network composed of coaxial and fiber optics cables serving the MIT computer community.

10 MIT recently installed the AT&T 5ESS Integrated Services Data Network. It is capable of both voice and digital data transmission.

having multiple mail boxes will be resulted. In such case he will likely forget to open some of his mailboxes and miss important messages. To counter this problem, messages should be forwarded to his existing account.

3.3 Ease of Use

Ease of use is one of the most important factors involved in the determination of acceptability level of any information system. Often times an implementation team forgets that an information system is just a tool for enhancing human productivity. It has to be used by human in order to be useful. Therefore it must be designed in such a way that it can be easily learned and comfortably used. Especially in cases where a large user group is involved, the system must be easy and convenient or else it is bound to fail.

In the case of the Leaders for Manufacturing Program, many users are not computer-technically inclined. So it is even more imperative to make it as easy to use as possible. The issue is approached at two different levels, e-mail addressing and user interface. The goal at the e-mail addressing level is to create a simple addressing scheme so users will have no need to hunt for e-mail address pathnames every time a mail is to be sent. At the user interface level, both the actual e-mail interface and the PC connectivity interface must be considered.

3.4 E-mail Addressing

The following description of e-mail addressing methodology is intended to illustrate the issue of addressing complexity. An e-mail address must contain all information necessary to identify the recipient in the domain of a network. In the LFM e-mail network, there are three levels of domain scope, PROFS, MIT Internet, and ARPANET/BITNET. Within the PROFS scope, only the userid is required for addressing. At the MIT Internet level, the host machine node also need to be identified for communication between different MIT host machines. And depending on the host machine, the 'mit.edu' domain id may have to be included. So to be on the safe side, the following convention should be used all

the time to ensure proper identification: *'userid@hostnode.mit.edu'*. The next scope up deals with inter-corporate and MIT communication and therefore requires another level of sophistication; the company gateway to external networks must also be specified.

The following chart summarizes the three layers of scope. Sample addressing formats are also given for each layer.

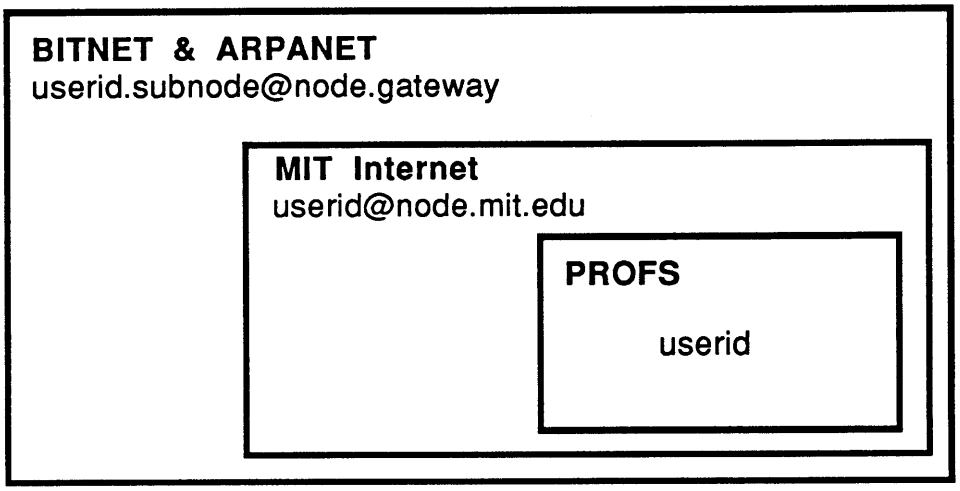

Figure 2. LFM E-mail Addressing Scope

The userid is only addressing requirement for PROFS users to communicate with other PROFS users. This is also true for other single host machine communication. Since all LFM fellows are on PROFS, the procedure involved for a LFM fellow to communicate with another LFM fellow is relatively simple. He only needs to specify the receiving fellow's userid in the addressing header section of the e-mail message. Unfortunately, although a large number of the LFM faculty also have PROFS account at the Sloan School of Management, many professors use e-mail accounts located on other host machines on the MIT Internet.

For communication within MIT, each user can be identified by his userid and the node id of his/her host machine on the MIT Internet. So the e-mail address will be composed of the userid, the node id of the host machine, and the MIT domain name. For

instance, the LFM Headquarters account can be reached from anywhere within MIT by the following address:[11]

LFMHQ@SLOAN.MIT.EDU

LFMHQ is the userid, SLOAN is the node id, and MIT.EDU is what identifies the MIT domain to the outside world. The @ sign is a standard convention used to separate the userid from the node name.

For the purpose of the Leaders Program, communication requires reaching out of the MIT domain to the sponsoring companies as well. It is accomplished by utilizing available MIT and company gateways to the ARPANET and the BITNET. ARPANET and BITNET are both international computer networks. The former is composed of mostly organizations which are involved with U.S. military researches. The latter is an educational network linking major universities and educational institutions worldwide. So due to the actual size of the network, the inter-campus communication addressing is very complicated.

Both ARPANET and BITNET support thousands of local networks each of which may support thousands of users. Therefore a valid e-mail address must identify the gateway of the company in addition to the node id's within the company. Furthermore, some company's e-mail message may require going through multiple nodes and gateways before reaching the company's external gateway. This process can make the addressing scheme long and confusing. For example, to send e-mail to someone in Motorola from MIT, the e-mail must go through ARPANET to an university gateway near Motorola, then the message is forwarded to the Motorola's gateway. An sample address for Motorola is shown in standard Internet addressing format:

USERID%SUBNODE1.NODE1.MOT.COM@UXC.CSO.UIUC.EDU

Such addressing scheme requires a great effort on the user's part for memorizing each individual pathnames. So if this e-mail system is to be widely accepted by LFM

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11 Shown in standard Internet addressing format.

participants, some simplified addressing must be developed to make the tedious node/gateway identification transparent.

3.5 Connectivity Interface

The user-interface issue are considered at two separate levels, local and remote. The local interface level involves connecting a terminal or a personal computer to a host machine and the remote interface level deals with the actual e-mail utility interface.

Very few users use a directly linkage to connect a dump terminal to its host machine. Most users use a personal computers or a workstation to connect to the system of choice. This can be done either by ethernet, direct linkage, or telephone dial-in. In any case an user-friendly communication software is needed to emulate a dumb terminal. The terminal mode emulated is usually VT100 or IBM 3270. After connection has been established between user's personal computer and the e-mail host machine, the personal computer becomes no different from a terminal. This is when the user-friendliness of the e-mail system comes into play. At this level a friendly user-interface would greatly lower the learning curve of the LFM e-mail system and therefore enhance the acceptance level. So, together with an easy-to-use connectivity interface, new users can start using LFM e-mail with ease.

4. NETWORK ORGANIZATIONAL STRUCTURE

The Leaders for Manufacturing Electronic Mail Network builds on top of existing available hardware equipment and software application through horizontal integration. Any LFM user has the capability to send electronic mail messages to any other LFM user on any host machine from his own user account. Furthermore, a centralized distribution center is chosen for simplifying the addressing of individual and group mail by eliminating the need to specify host machine and gateway node names.

The distribution center can be thought of as an electronic post office where a mail box is assigned to every LFM participant. So each user has the option to either deliver mail on his own by specifying the complete recipient's address pathname; or the mail can be sent to the recipient's mail box at the centralized distribution center, then the server will look up the appropriate pathname of the recipient and forward the message to that address.

In the case of group messages, the server will look up the every recipient's listed under the group id and forward a copy of the mail to all of them. The following diagram summarizes the e-mail distribution operation.

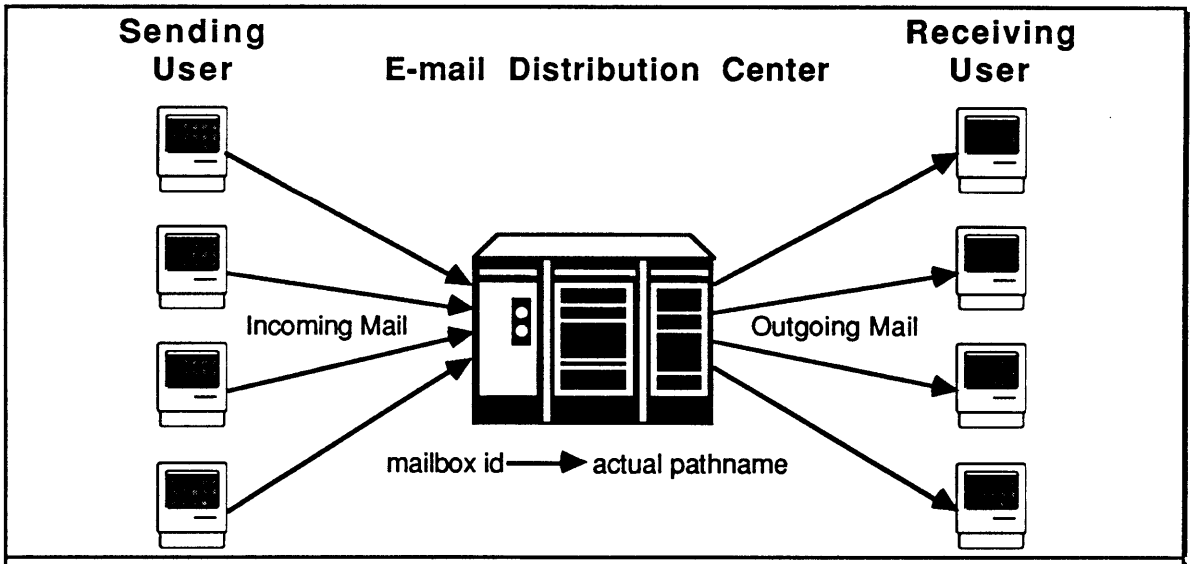

Figure 3. LFM E-mail Distribution Schematics

4.1 Centralized Server

The PROFS system running on the IBM 4381 mainframe in the Sloan School of Management is chosen to serve as the centralized e-mail distribution center for the following reasons:

1. Over 50 percent of the LFM participants on the MIT campus already has account on PROFS and therefore makes e-mail communication among them extremely easy.

2. PROFS has the capability to assign nicknames (fake userid's) in place of long e-mail addresses to make the complication of internet addressing transparent to the users.

3. PROFS has the capability to create distribution lists and therefore can allow user to send group messages with relative ease.

4. PROFS has direct connection to BITNET and indirect connection to ARPANET and other external networks via the MITVMA gateway[12] through the MIT Internet.

PROFS provides a relatively user-friendly electronic mail front-end interface for PROFS users (see the LFM Electronic Mail User's Guide in Appendix A). All functionalities ranging from invoking the e-mail system to sending mail is menu and function key driven. Once the e-mail system is invoked, a templet like the one shown in Figure 4 on the next page is displayed on screen for text entering. The user simply enters the userid of the recipient PROFS user in the "Send to:" field (see Figure 4), compose the message text, and the mail will be forwarded to the recipient's mail box with a simple touch of the "SEND" command key (Function Key 7). The userid specified in the "Send to:" field can be the userid of another PROFS user, the nickname for a non-PROFS recipient, distribution list name, or a list of userid's. Each userid must be no more than eight characters. It is composed of the first initial and the last name up to seven characters. This convention is chosen to standardize userid assignment, so the user can easily guess the recipient's userid. All possible commands for text manipulation are listed across the bottom of the screen.

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12 BITNET and ARPANET are international public networks. MITVMA is the gateway to external networks that serves all machines links to the MIT Internet.

The appropriate function key for activating each of the command is also include. On-line help is also available for unfamiliar users.

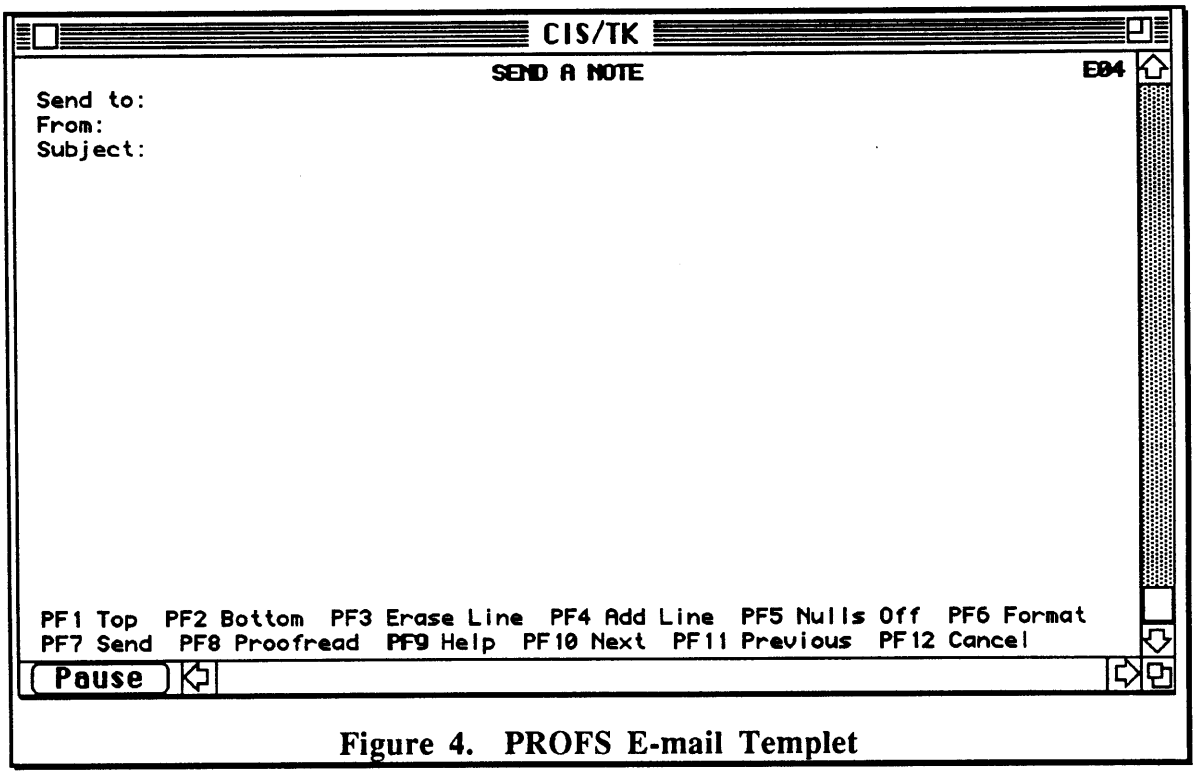

Figure 4. PROFS E-mail Templet

The nickname and distribution list has to be either globally or locally defined prior to its usage. The global definitions are implemented and made publically available by the Sloan System Administrators. Once defined, they are accessible to everyone on the LFM e-mail network including the non-PROFS users.

The LFM Electronic Mail Network provides a global nickname for every non-PROFS user on the network. Many global distribution lists are also defined based on the LFM message distribution pattern. The most commonly sent group messages are mailed to the liaison faculties, companies, fellows, and internal working committees. A distribution list is setup accordingly for each committee (see Appendix F for a full listing). Every PROFS user can also define their own nickname and distribution lists locally based on their

own needs by using the *longname*[13] facility on PROFS. Such definitions will only be accessible from the creator's own user account.

4.2 Non-PROFS Users

The PROFS central distributor does not interfere with normal non-PROFS user's e-mail operation. To send LFM e-mail from a non-PROFS environment, the user has two alternatives. First he can simply use the e-mail facility available on his machine and send e-mail the same way he/she always has by specifying the full pathname of the recipient's address. This method will allow e-mail messages to be sent directly to the recipient's account. Conventionally, most non-PROFS e-mail systems require specification of full recipients' address pathname. This addressing scheme must include all necessary gateway id's and node id's. It is tedious and creates room for error. The LFM central distributor offers a simpler addressing alternative. Instead of having to memorize the long pathnames, the non-PROFS users can send LFM mail to PROFS and let PROFS forward mail.This can be done by sending mail to *<userid>@sloan.mit.edu.* The node id section of the e-mail address becomes constant. The *userid* can be a PROFS userid, a nickname for company sponsors/non-PROFS recipients, or a distribution list. For example, if a non-PROFS user wishes to send mail to everyone in the LFM program, he can make use of the distribution list, LFMALL, by sending mail to LFMALL@sloan.mit.edu. When PROFS receives this mail, it will recognize LFMALL being a distribution list. Then it will decipher the address pathname information of each recipient and forward a copy of the message to everyone on LFMALL distribution list.

4.3 Electronic Bulletin Board

LFMHQ is a special account setup on PROFS for LFM serving as an electronic bulletin board for announcements and reminder record keeping. LFMHQ stands for

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13 The longname facility is actually an IBM VM/SP utility. It can be invoked from the PROFS environment by typing lname on the command line.

Leaders for Manufacturing Headquarters. This account is accessible for every LFM participant on the MIT campus via ethernet or the 5ESS ISDN digital telephone network. It can post memos by direct user input or mail by distribution. Whenever a group message is sent via a distribution list, a copy is also sent to this account. Through it, members from various committees can find out what's going on in other committees with relative ease and therefore enhances inter-committee coordination.

4.4 Inter-Campus Connection

The inter-campus connection employs the same implementation philosophy as the on-campus setup: build on top of the existing network and make as little changes to the present hardware/software as possible. Based on the observational study, ARPANET and BITNET are accessible by MIT and many companies. This makes them the obvious choice for supporting MIT-company communications. And since both networks can use the standard internet addressing, it can make 'nickname' implementation simpler on the PROFS system.

For companies which are not on either network, two alternatives are available. One is to use a personal computer with a modem to dial into the LFM network. Although this is not the most elegant form of solution, it will allow people at the company site to communicate with the rest of LFM. This method will be used by some fellows on their summer assignment at company sites. It will allow the students to communicate with their faculty advisor even if the affiliated company does not support inter-campus e-mail. The other alternative is to use facsimile machines. This is a somewhat limited form of communication since facsimile machines are not very common on MIT campus. For professors who has a facsimile machine, they will be able to communicate directly their affiliated company. Otherwise, the LFM Headquarters (where staff and fellows are located) will serve as an incoming fax-mail distribution center for professors who do not

have access to fax. Since most of the MIT-company communication is between the staff, fellows, and the companies, this is a feasible alternative.

5. IMPLEMENTATION

The implementation of this electronic network is divided into three separate stages, the e-mail centralized server, the MIT campus, and the inter-campus connections. The centralized server area includes the development of a database for storing all LFM user information, simplification of long e-mail pathnames, and the maintenance of distribution lists on the server itself. The work on the MIT campus includes the setting up of electronic mail boxes for users, the creation of new userid's for people who do not previously have e-mail, the establishment of the physical connection between local personal computers or workstations and host machines, and the installation of communication softwares on local machines. The inter-campus connections involves getting permission from the senior executive of the sponsoring company to make the connection, working with the technical staff to establish the physical connection, and the implementation of nicknames and distribution lists on the LFM centralized server.

5.1 Centralized Server

The effort to establish the LFM e-mail centralized server is a collaboration between the LFM Communications Committee and the Sloan System Administrators. The LFM Communications Committee maintains a database containing information of all LFM e-mail users. They include the fellows, staff, faculty, and sponsoring company personnels. The Sloan Administrators handle the actual implementation of the nicknames and distribution lists on the IBM PROFS system.

5.1.1 User Information Database

A customized database was developed on the Macintosh using HyperCard shell for the purpose of maintaining user information. Macintosh was chosen to be the hardware platform for the following reasons:

1. This database will be maintained by the communications staff at the Leaders for Manufacturing Headquarters.

2. Macintosh is the primary computer used at LFM Headquarters for office functions

3. The HyperCard application shell supports menu and button driven user-interface programming at the system level for creation of user-friendly front-end interfaces.

The database design assumes a very low level of technical familiarity with database and computers in order to accommodate a wide range of users with varying computer experiences. It is furnished with an extremely user-friendly front-end interface and is tailored for the LFM e-mail database management. This is very important in the long run for the following reasons. The operator who will be in charge of updating the database may vary from time to time. He may or may not be technically inclined enough to use complicated off-the-shelf Macintosh databases such as 4th Dimension[14] or dBase III[15]. So the LFM database utilizes Macintosh-consistent buttons, menus, and icons to simplify database operation down to a matter of point and click. As a result it raises the system acceptance level and reduces the learning curve.

HyperCard is an Apple Computers product that comes with every Macintosh purchased. It provides end-user with hypertext capability for text search and referencing. It can be programmed to perform specialized database management tasks using HyperTalk, the programming script language of HyperCard. HyperTalk is very similar to "Object-Oriented Programming". It has five types of objects: stacks, backgrounds, cards, buttons, and fields. Each type of object has its own characteristic. In our database application field is used for data storage and button is used to define commands. A card is programmed to hold records and background used to define a class of cards. A stack can be treated as a program. Communication between each object takes place in the form of message passing.

The following page shows the schematics of the database design.

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14 A relational database product by Acius Inc.

15 A database product by Ashton Tate Inc.

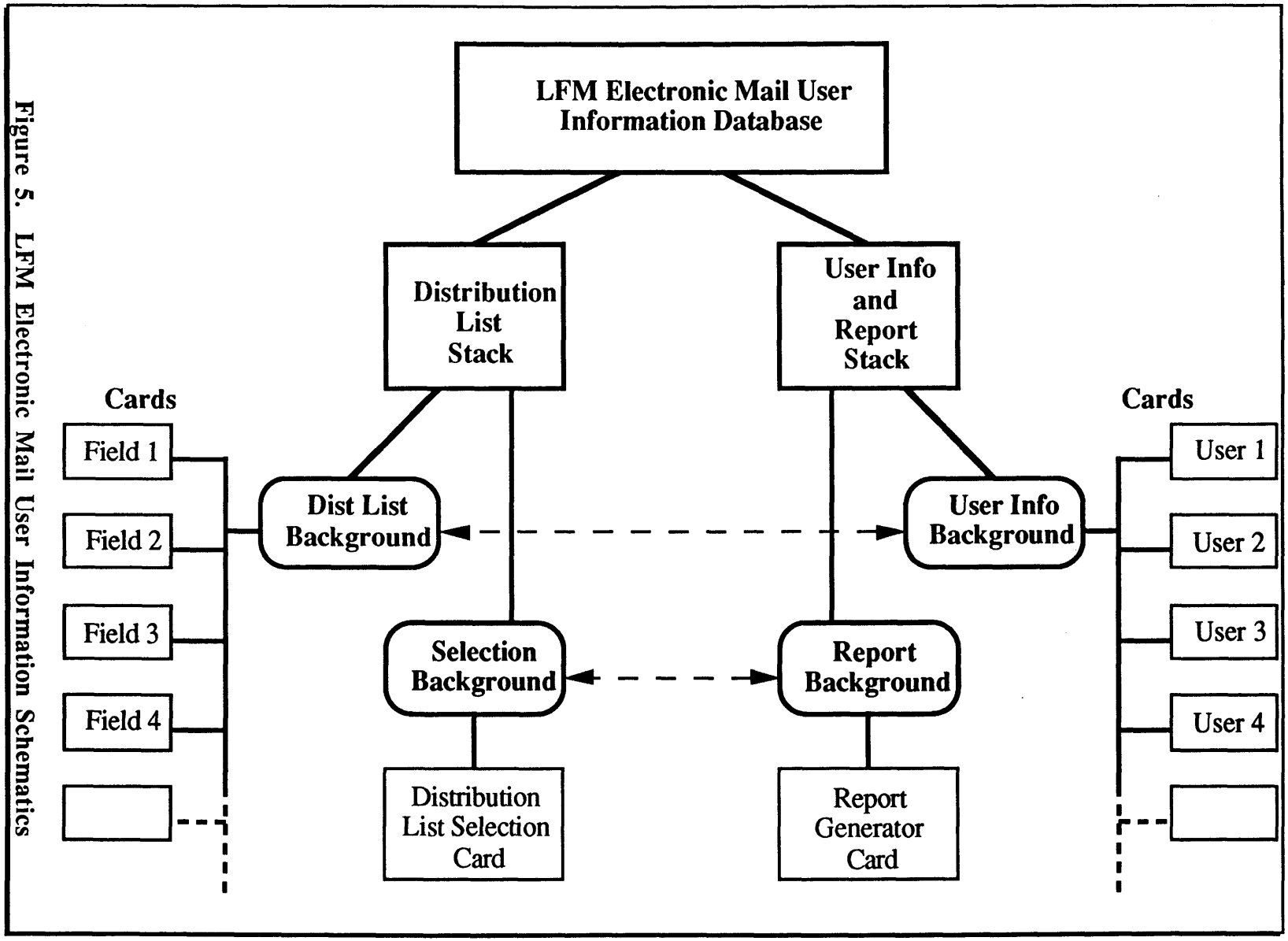


Figure 5. LFM Electronic Mail User Information Schematics

The LFM e-mail database contains two separate stacks, the User Information/Report stack and the Distribution List stack. The former contains two backgrounds, the User-Info and the Report background. They are accessed by the database operator directly. The latter contains the Distribution List and the Selection background. They are called by the User-Info and the Report background on demand for distribution list data input and access.

Shown below is a card from the User-Info background. This background provides a common templet for storing and manipulating information for all LFM users. The presentation is fairly self-explanatory. The data fields are labelled by bold-faced field names and all commands are in button forms displayed in either icon or text.

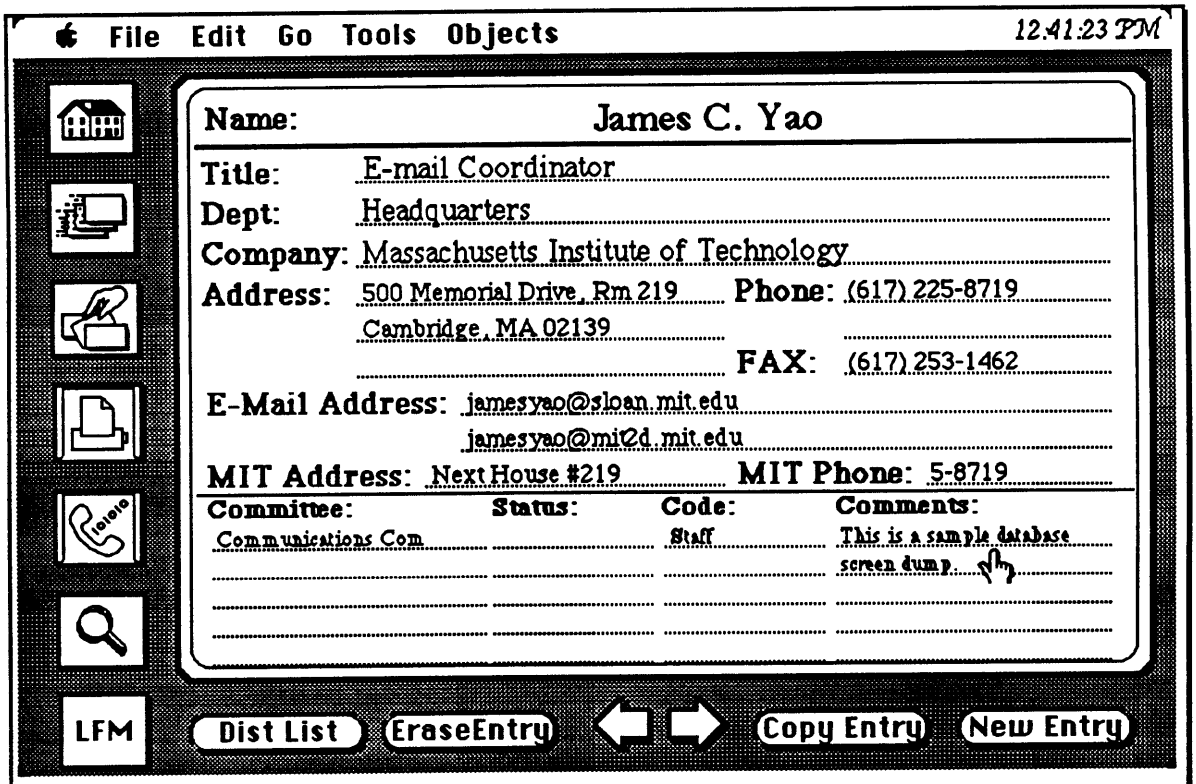


Figure 6. User Information Database Templet

The User-Info background contains 14 data fields for information storage and 27 command buttons for database manipulation. The 14 data fields are name, title,

department, company, address, phone, fax phone number, e-mail address, MIT interdepartmental address, MIT phone number, committee, status, code, and comments. The field names are very descriptive of the kind of information that it stores. For instance, the *title* field holds the user's title information. So the data that goes into this field can be any one of the following: Fellow, Professor, Assistant Professor, various staff and company titles. However, there are a few field that might seem ambiguous and therefore require some explanation. The *dept* field is intended to hold information pertain to the user's department. For fellows and professors, it is the MIT department they belong to such as the Department of Electrical Engineering and Computer Science, or Sloan School of Management, etc. For company personnels, the department within the company would be entered here. The *address* and *phone* field holds the respective company address for company personnels and home address for fellows, staff, and professors. The *MIT address* and *phone* field usually are not applicable to the company personnels.

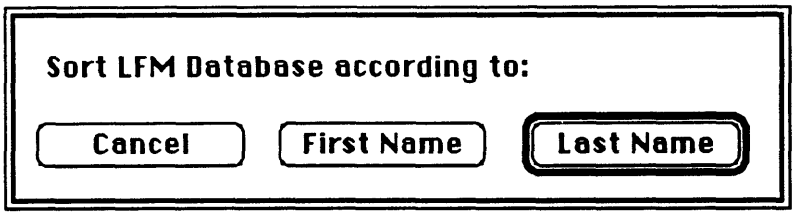
The four data fields across the bottom of the card and the company field contain identifiers for distribution list generation. The *committee* field stores the name of the committee each the user serves. The *status* field indicates whether a professor has leader or junior status. The *code* field indicates whether the user is a professor, staff, fellow, or company sponsor. The *comments* field is currently used for general comments only. But it can be used for distribution list generation as well in the future.

The record for each individual user is stored in the form of cards. Such cards all share the User-Info background which serves as the templet (see figure 6). That means all user share the same available data field and command options. The first card in this background is the only exception. It is used as the 'cover screen' for this database and is unique.

All commands used in this database software are displayed in forms of button and icon. This is intended for intuitive user interaction. It creates a very user-friendly environment and therefore greatly reduces the learning curve. It follows the conventional

Macintosh user-interface design methodology. So users who are familiar with the Macintosh interface can practically look at the screen and know what to do without referring to an instruction manual. He will never have to type in any commands. All command actions are activated with a simple point and click of the mouse.

Fourteen out of the 27 command buttons are for sorting purposes. They are transparent buttons located directly over the bold-faced field names. They serve as the mean to sort the database by any data field. When a sorting button is pressed, a dialogue box similar to the one shown below will open up notifying the user what action the database is about to take:



In this case the dialogue box opens in response to the click on the **Name:** sort button. It prompts for more specification for sorting. But in general it simply prompts for for user's approval in case of a button mis-click.

The rest of the buttons are immediate commands. The command action of these button is initiated at the click of the button without a notification dialogue box. It does not prompt for error checking either. With the exception of *Dist List, Erase Entry, Copy Entry, and New Entry* command, all immediate commands are in the form of icons. The icons are designed to resemble the functionality of the button it is associated with. So the user does not need to memorize the database commands. They simply need to learn to read the icons.

The command name and functionality of each button is summarized in the table shown on the next page.

Icon	Command	Description
	*Home*	- return to the HyperCard Home stack
	*Browse*	- quickly browse through the database
	*Sort*	- gives instruction on how to sort the database
	*Report*	- activate the report module
	*PROFS*	- connect to the PROFS system
	*Find*	- to find a specific entry in the database
	*LFM*	- return to the LFM cover card
	*Previous*	- go to the previous card
	*Next*	- go to the next card
	*New Entry*	- create a new card
	*Copy Entry*	- make a copy of the current entry
	*Erase Entry*	- remove the current entry from stack
	*Distribution List*	- go to the distribution list module

Figure 7. LFM Electronic Mail Database Commands

The *copy entry* command is extremely useful for entering data for company personnels. When the button is pressed a copy of the current card is created with the name field automatically selected for editing. This way the duplicate information does not need to be retyped and therefore reduces data entry time.

The *find* command will allow the user to locate any card based on the search information specified. When clicked, it will prompt for a search key string. Then it will go through the entire stack until a string pattern is matched in any of the data field of a card. The selected card will then be displayed on screen. This design allows the user to specify information in any of the data field for searching purposes and therefore gives the searching capability a great deal of flexibility.

The *report* command will activate the report generation module for print LFM e-mail directories, distribution list, summary reports, and address labels. The *Dist List* command will move to the distribution list module to distribution list creation and editing purposes.

The *PROFS* command will temporarily exit the LFM database, launch the communication software, and establish connection with the PROFS system. It requires that the proper hardware and communication software been properly installed on the host Macintosh. When the user exits PROFS, the Macintosh will disconnect from the IBM mainframe and return to the database automatically. This command can be configured to work with either ethernet or 5ESS ISDN digital network. (See Appendix B for more detail.)

The report background contains only one card (see Figure 8) and is invoked by the click of  , the *report* button. This card is physically located immediately after the 'cover screen' in the database stack. It is capable of generating the LFM E-mail Directory, address labels, distribution list, and address labels based on distribution list. Again it is all button driven. The user simply selects the report desired, then click the print button to generate the report. This background is shown in the following figure.

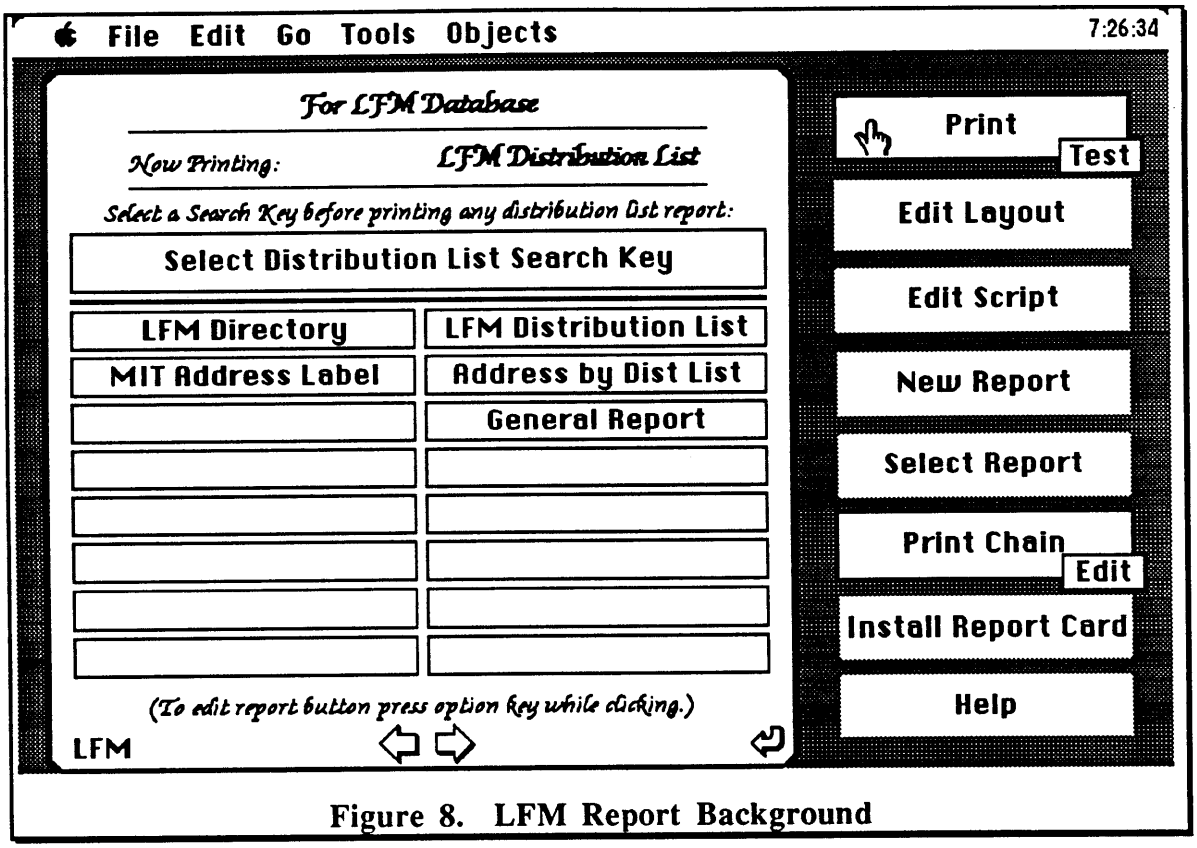


Figure 8. LFM Report Background

The report buttons include a general summary of the database, the LFM E-mail Directory, distribution lists, general address labels, and address labels based on distribution lists. Each button contains the necessary information for extracting data from the User-Info background. In the latter two cases, a specific distribution list must be selected prior to printing or else the report background would not know which distribution list to print. The report background will go to the Dist List background to obtain the search key and naming information for reporting.

The last capability listed is very helpful in the beginning of the execution cycle of the e-mail network since both e-mail and paper mailing are sent in parallel. It allows the database operator to print out a distribution list and an address label sheet containing the address of the list of users as appears on the distribution list. (See Appendix B for more technical detail and full instruction on the use of the report background).

The Dist List background is organized by the data field of the database. This design is consistent with the distribution list generation philosophy since the committee, company, status, and code fields represent the categories of distribution lists. Each field has its own card. The distribution card for the committee category is shown in Figure 9.

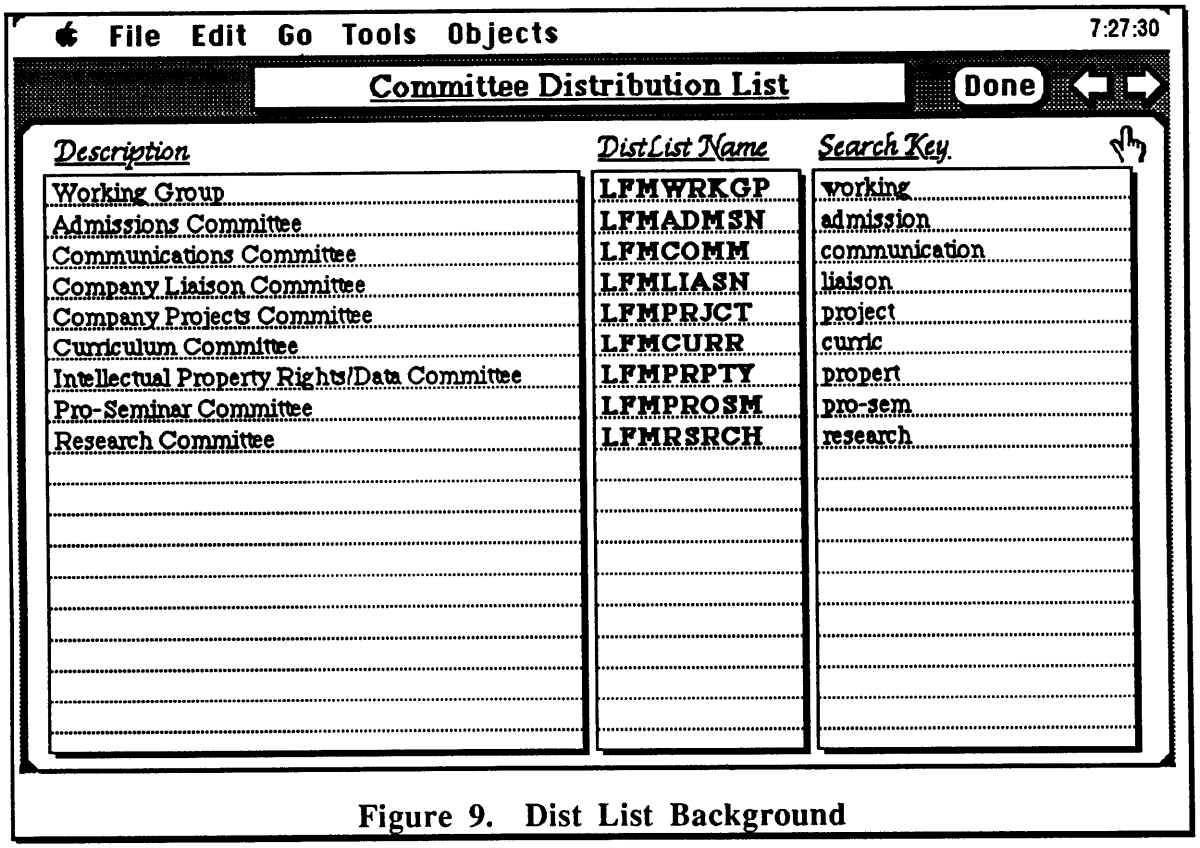


Figure 9. Dist List Background

Each distribution card contains three information fields. They are distribution list name, distribution list description, and search key. The distribution list name is the 'nickname' for the group of user represented. It becomes the userid that e-mail user specifies in the 'Send to:' field when sending group messages. The distribution description is the full name for the distribution list. This name is stored in the PROFS global distribution list database along with the distribution name. After the e-mail has been sent out, the PROFS system will replace all 'nicknames' with the full description for the recipients so the header section of the incoming mail will be more informative. The search

key is used for selecting users when generating distribution lists. It may or may not be the same as the distribution list description field since abbreviations are generally used for data entry due to the physical size of the field. It must contain enough string information to uniquely identify the label used in the database for accurate list generation. For example the Communications Committee is abbreviated as *'Communications Com'* in the database. So the search key only need the key, *'communication'* for identification.

The Selection background (see figure 10) allows the database operator to specify the distribution list to be printed in either distribution list or address label format. When invoked the background will be displayed on screen with an empty description field. The instruction is located above the command buttons for beginning users.

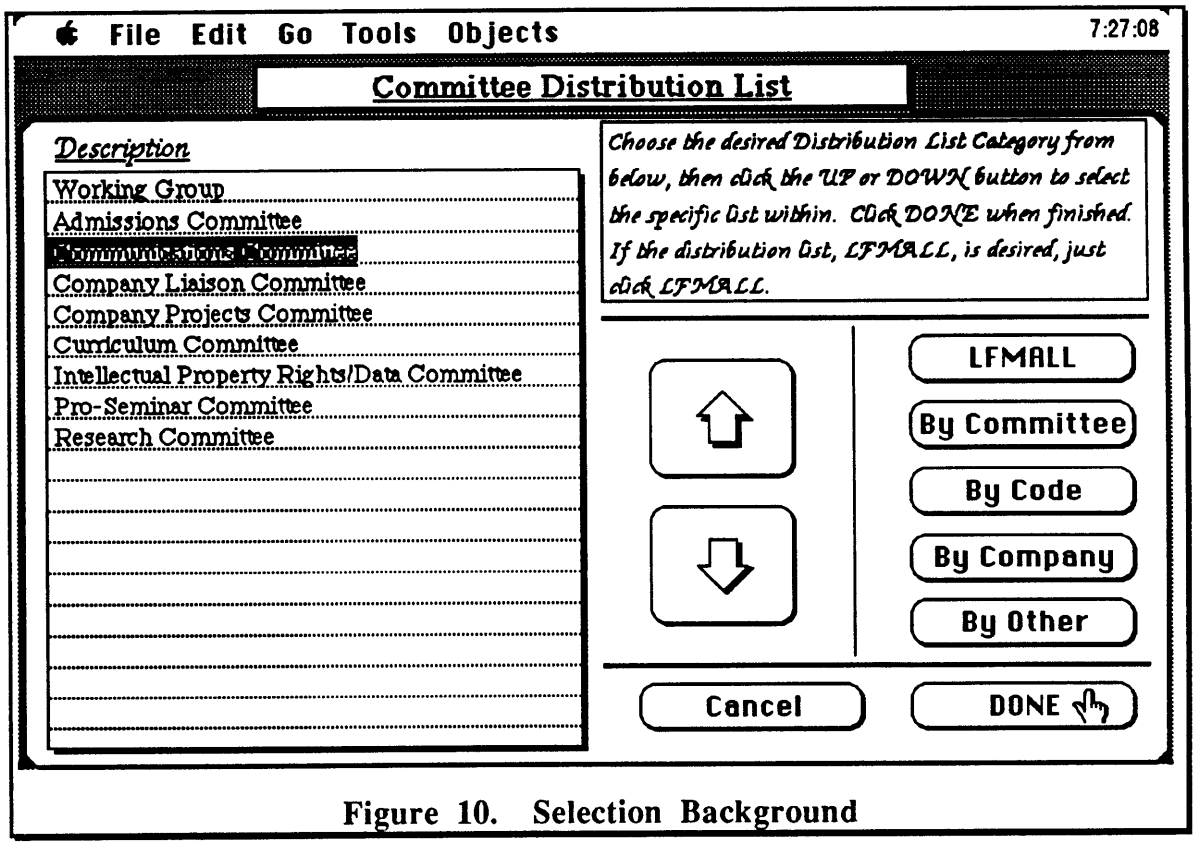


Figure 10. Selection Background

There are several options available for users. The operator can either select the entire database by clicking the button, [LFMALL]. Or he can also select distribution

list from the three most commonly generated categories which are pre-defined, Committee, Code, and Company by clicking the respective buttons: By Committee, By Code, and By Company. Or the operator can choose from user-defined categories by clicking the By Other button. See Appendix B for defining new categories.

When a category is properly selected, the distribution lists included in that category is displayed on the left side of the screen with the first entry highlighted as the default selection. The ⇧ and ⇩ buttons can be used to move the highlight bar up and down to select the desired list. When the selection is done, the proper information will be sent to the Report background for printing. Again all command and information requisition are menu driven or done through dialogue boxes.

5.1.2 PROFS

The purpose of the centralized server is to provide a gateway for forwarding mail to all users and for sending group messages on the LFM electronic mail network. In order to accomplish this, the e-mail address of all users and distribution group information must be kept on the system. The distribution list generated by the LFM Electronic Mail User Into Database contains all necessary information such as distribution name, description, user's name, and userid (both PROFS and non-PROFS) and can be forwarded directly to the Sloan System Administrators via MIT interdepartmental mail for installation on the IBM 4381 PROFS system.

The creation of nickname for non-PROFS address involved two steps. First the 'nickname' and the e-mail pathname of the non-PROFS user is entered into the system via the *longname* facility. Then a fake userid is create. This userid would be the same as the 'nickname'. Thereafter the fake PROFS userid can be treated as any other PROFS userid by the PROFS e-mail system. The creation of distribution also involves two steps. First the distribution name must be defined. Then the userid (including the nicknamed id's) of the user belonging to the distribution group is entered.

The creation for both nickname and distribution list is implemented by the Sloan System Administrators. Some automation utilities are available to automate the creation process

5.2 MIT Campus Installation

The MIT campus installation includes the creation of new users accounts and the implementation of physical connection to link personal computers to PROFS at the Sloan School of Management.

5.2.1 Creation of New Accounts

New e-mail accounts are created for the users who previously do not have e-mail. The LFM participants who already have accounts on PROFS are the fellows and the Sloan professors. They comprise of over 50 percent of the total LFM e-mail users on MIT campus. Therefore in trying to keep this e-mail system as simple as possible, it is logical to issue new e-mail accounts on PROFS instead of any other host machine on the MIT campus. Again, LFM Communications Committee requests for the creation and the Sloan Systems Administrator implements the the new accounts. However, one more layer of administrative detail in involved. Each new account requisition must be approved by the Leaders for Manufacturing Program Director, Thomas Magnanti. This procedure is required by Sloan for charging purposes.

5.2.2 Physical Connectivity

The physical connectivity problem at MIT turned out to be less complicated than originally anticipated. The MIT Internet, a sophisticated ethernet network composed of twisted pair wires, coaxial cables, and a fiber optics backbone, has already interconnected most workstations and mainframes on-campus. Ethernet is the primary communications circuitry used in many mainframe, PC, and UNIX local area networks. It was originally developed at Xerox and has become an international standard for high-speed

telecommunications.[16] This network is capable of data transmission at up to 10 million bits per second (bps). And since the MIT internet is already there, it virtually eliminated the connection work involving setting up the linkages between all LFM affiliated host machines. The only connectivity problem left is to connect the personal computers to PROFS system at Sloan.

There are two alternative solutions to the PC to PROFS connection problem. One is via the MIT Internet and the other is via MIT's ISDN telephone network[17]. They each have advantages and disadvantages. In general ethernet offers faster data transmission and better availability at a higher cost while ISDN offers slower data transmission and less availability at a substantially lower cost.

The establishment of ethernet capability on a personal computer has several hardware requirements. First there must be an ethernet drop present along with an IP address[18] assign by the MIT Telecommunications. If no ethernet drop is available, MIT Telecommunications can perform the installation for $100 to several thousand dollars depending on the location of installation and the proximity of the nearest ethernet branch. An ethernet drop is a coaxial cable which links to the MIT Internet. Then the personal computer must be equipped with ethernet circuitry. This usually requires an add on ethernet card with a price ranging from $500 to $800.[19] An ethernet gateway, FastPath 4 from the Kinetics Inc. Division of Excelan Inc., in the price range of $3,000 is available to link a Macintosh local area network to an ethernet network. The hardware installation cost is high. The installation and the maintenance is complicated and time consuming due to the bureaucracy of having to go through MIT Telecommunications.

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16 "Making a Small Network" by John Rizzo, MacUser May 1989, pg 151.

17 MIT uses the 5ESS ISDN telephone network developed by AT&T. It was installed and operationalized in September 1988.

18 Internet Protocol address. Usually in the format 00.00.00.00.

19 "Making a Small Network" by John Rizzo, MacUser May 1989, pg 151.

The true advantage of using ethernet is that the Sloan's IBM mainframe supports many ethernet ports and therefore can ensure a near 100 percent connection success rate. The data transmission very fast. At about 50,000 bits per second on the average[20], there is virtually no communication delay as far as the user is concerned.

The ISDN alternative is very inexpensive and easy to install. All MIT offices are equipped with AT&T digital telephones with asynchronous data module. This makes hardware installation as simple as connecting the PC to the digital phone by using a standard RS232C serial cable. Such cable only costs between $15 and $50.[21]

The AT&T digital telephone is an asynchronous data module which links the personal computer to the MIT AT&T 5ESS Integrated Services Data Network. The following figure illustrated the basic P-ISDN-mainframe topology.

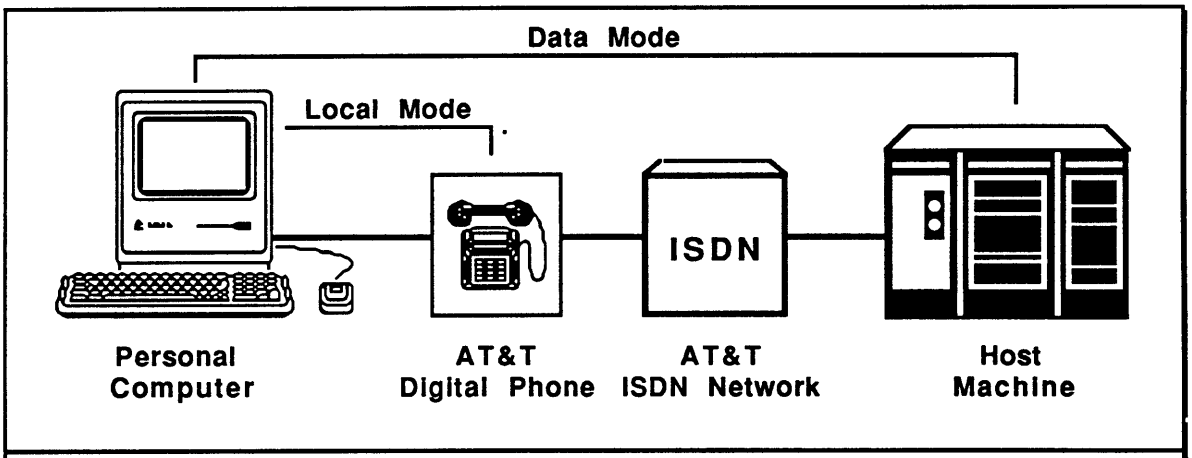

Figure 11. PC-mainframe Connection via ISDN Schematics

There are two layers of communication involved, the local mode and the data mode. Local mode is invoked as soon as the personal computer's communication software is activated.

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20 The theoretical limit on transmission over thick ethernet cable is 10 million bits for second. However this is seldom achieved, due in part to the fact that the medium is shared by many nodes and also to the fact that nodes do not have hardware that can receive data that fast. The usual transmission performance is observed to be about 50,000 bits per second according to Sloan System Administors.

21 Computer Peripheral Price List, MIT MicroComputer Center.

It allows the personal computer to interact with the digital phone to initiate phone calls to request connection to other digital phones on the MIT campus. When connection is established with another digital phone, both phones will enter the data mode which enables data transmission on the network. The IBM PROFS system is equipped with four such digital telephone lines and therefore allows dial-in access from any digital phone on MIT campus.

The personal computer to digital telephone connection is done by using a serial cable. The serial port on the digital phone is a standard RS232C port which looks like this:  . The IBM PC also contains a standard RS232C port. So only a standard serial cable is required for the connection. The Macintosh serial port uses a 9-pin din connection,  . So a standard Mac-to-modem cable is used. Such cable converts the Macintosh serial port,  , to  , the standard 25-pin RS232C connection. There is virtually no maintenance.

The major drawback of using ISDN is digital line availability. The Sloan PROFS system only offers four digital lines for dial in. So the total number of digital line dial-in users allowed at any given time is limited to maximum of four. The probability of failing to connect would be much higher than using ethernet. The slower transmission rate is not really a problem. The ISDN network can support data transmission rate at up to 19,200 bits per second. The actual rate is confined to 9600 bps by the hardware limitation of the IBM mainframe modem. The delay caused by this transmission rate is not significant and is acceptable to most users.

The communication software for ethernet connection is telnet. Both the IBM and Macintosh version can be obtained from the System Administrators at Sloan. They must be configured to the IP address assigned in order to sign the local machine onto MIT Internet properly. The Macintosh version is a public domain software developed at Brown University. For personal computers linked to the ISDN network, a modem communication software is required for terminal emulation. For IBM users, PROCOMM utility is selected

as the mean for communication. Unfortunately, like most of the other IBM softwares, it uses the standard IBM PC interface which can be difficult to learn for some users. For Macintosh users, MicroPhone II developed by Software Ventures is used. It provides a very user-friendly interface composed of menus and dialogue boxes. Its macros scripting capability adds flexibility for the users. When properly configured and programmed, it can hunt for an open phone line and allows the user to dial into his system with a simple click of a button. (see Appendix C for detail)

The Leaders for Manufacturing Headquarters in building 9 is equipped with both ethernet and ISDN capability for communicating with PROFS. It has a local area network composed of eight Macintosh II's and three laser printers running the AppleTalk protocol. This LAN contains a Kinetics FastPath 4 which serves as the gateway into MIT Internet. This gateway hardware is chosen with future expansion in mind because it can support up to 60 local machine at once. It is assign a base IP address and three dynamic internet IP addresses. The base IP address identifies this gateway to the MIT Internet. Internally, the dynamic IP addressing allows the three IP addresses to be shared by all Macintoshes in the complex. So any of the fellows or staff can access PROFS from any Macintosh via one of the three IP addresses. The LFM Headquarters network configuration is shown in Figure 12 at the end of this section.

Four out of five staff-use Macintosh II's and one of the Macintosh II in the student office cluster are equipped with ISDN connection. Unlike ethernet which provides PROFS access from all Macintoshes, these are the only machines that can dial into PROFS via ISDN from LFM Headquarters. Together with the three IP addresses, the current setup can provide PROFS access to seven out of the eight Macintoshes simultaneously. If more Macintoshes are purchases in the future, the PROFS access can be easily expanded through either ethernet or ISDN. For ethernet expansion, up to sixty dynamic IP addresses can be from MIT Telecommunications for this gateway.

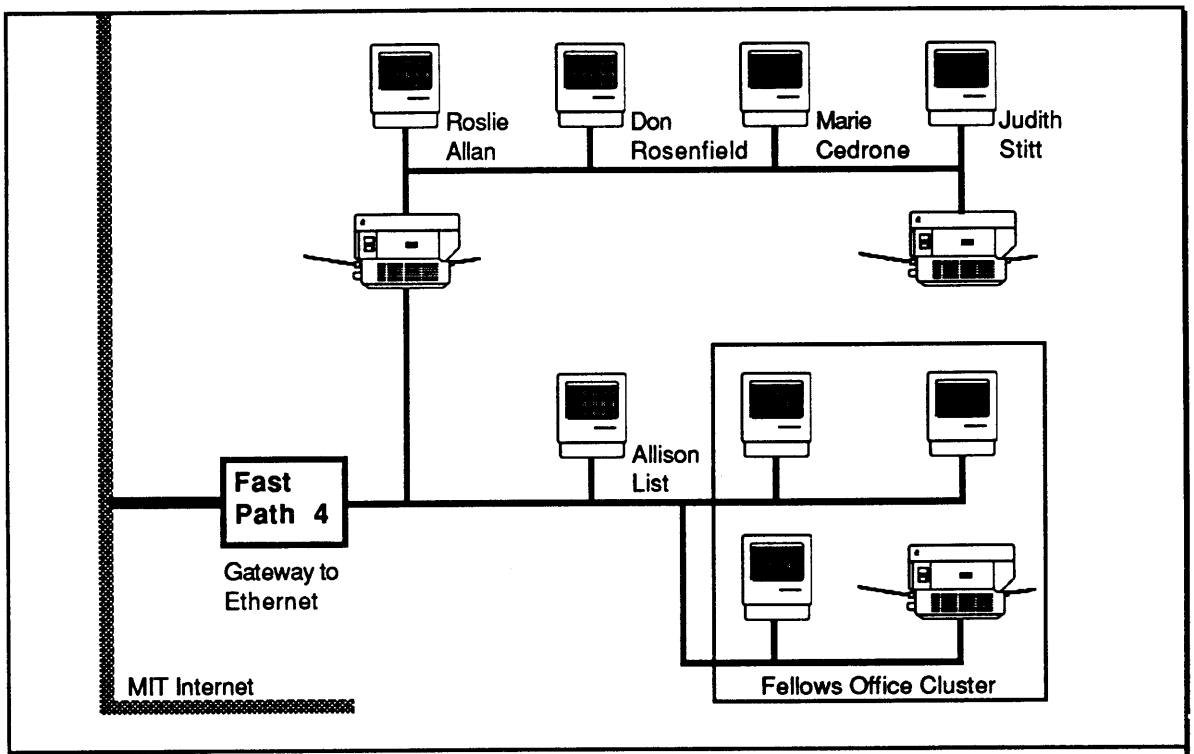

Figure 12. LFM Headquarters Network Architecture

5.3 Companies

The company connectivity issue is a complicated one. It involves physical connectivity, upper management approval, and security issues. In general the companies are very cooperative with the Leaders for Manufacturing Program in establishing network connections. Though every company have their own procedure of running their business, there are some common grounds to this the e-mail implementation.

In general it is best to approach the senior executive first. They usually can either setup a special task force to handle such connection or can give reference to the appropriate division within the company. If cost or security becomes an issue, the senior executive can usually make a decision promptly. Furthermore, carrying the 'mandate' from the senior executive of a company makes it easier for deal with the technical staff who perform the

actual connection on the company end. The fact that most of the LFM company liaisons are in the senior management level makes it easy for this initial contact.

After the senior executive gives the 'GO', the technical staff is usually the one that implements the connection. Such person can offer information such as the name of the company gateway to BITNET, or ARPANET and the necessary node information for mail forwarding. A test message is always sent before the full connection is made. If successful, due to the large network structure and the varying e-mail systems within the company, it requires the technical staff to set up some physical connection for either node identification or mail forwarding to the appropriate internal computer. In the case where the company liaisons connection to the company gateway is previously established, the full node and userid information is given to MIT for mail forwarding. Otherwise the mail that originates from the MIT end will be sent to the company gateway, then the gateway is configured to forward that message to the appropriate locations. If the technical does not know the gateway id or does not know if his company is on any external network, a test message to *LFMALL@sloan.mit.edu* is sent from the company site. If it is received at Sloan then the company is on either BITNET or ARPANET. Afterward the address path information can deciphered from the header information[22] of the received mail. Sometime a company gateway may not recognize the node, *sloan* at domain *mit.edu*. So in the case where no mail is received at Sloan, another test message is forwarded to the address, *JCYAO@athena.mit.edu* in the hope that *athena* can be recognized. If this attempt still fails or the company does not have any external gateway, alternative forms of e-mail such as modem dial-in is implemented.

The e-mail connection status of each company is summarized as follows:

Aluminum Company of America

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22 The header information contains id information on all redirection and transfer performed at each node in the process of forwarding the message from the originator to the receiver.

Alcoa is fully connected through ARPANET. The internal e-mail system used is All-In-One. The fellows will be given internal e-mail account while on summer assignment. The technical staff responsible for making the connection is Mr. John Gartley at *gartley@aldnef.alcoa.com*

Boeing Company

Boeing is on ARPANET and IBM Information Network. The internal e-mail system is PROFS. Technical staff is currently working on internal connections.

Chrysler Motors Corporation

Chrysler has All-In-One for internal e-mail communication purposes although it is only used in a very small part of the company. It does not have gateways to the outside world. The Executive Engineer in Technical Assessment, Al Bosley however suggested the following four communication alternatives in the order of preference: telephone, US mail, Federal Express, and then facsimile machine. Students will be given a personal computer with modem dial out capability to access their PROFS account at Sloan while at Chrysler.

Digital Equipment Corporation

DEC is fully connected with MIT via ARPANET. All internal host machines are mapped to the DEC external gateway, *decwrl.dec.com.* The e-mail culture within the company is well developed; the e-mail address was given by a senior manager himself. Summer fellows will be given internal e-mail accounts.

Eastman Kodak

Eastman Kodak is on the IBM Information Network. Might be on ARPANET. Still researching.

General Motors

GM is fully connected through ARPANET. The internal e-mail system used is PROFS. The fellows will be given internal e-mail account while on summer assignment. The technical staff responsible for making the connection is Mr. John

Muenz at *muenzj%aesv01%hac2gm@engvax.scg.hac.com.* All incoming mail to GM is sent to the *aesv01* node and will be forwarded to appropriate internal locations.

Hewlett-Packard

HP is fully connected through ARPANET. There are two different internal e-mail systems in use. One is the standard UNIX mailx facility used by the engineering staff. The management and executive staff uses DESK, an in-house e-mail system. The fellows will be given UNIX accounts during the summer and the mail sent to the executive management should be sent to Mr. Tom Menzies at the following address: *tomm%hpmwtd@hplabs.hp.com.* indicating that this is an LFM e-mail. Mr. Menzies will forward the e-mail manually from his workstation until automatic forwarding is setup.

Johnson and Johnson

Johnson and Johnson is connected via its external gateway ALLOY provided by Rutger University on BITNET. Mr. Ken Hahn, the J&J internal information systems consultant is working on forwarding messages to appropriate locations within J&J from this gateway. fellows will be given internal accounts for the summer.

Motorola

Motorola is fully connected via ARPANET. Currently all mail are sent to Mr. Bob Tykal at *rwt%cassun.srd.mot.com@uxc.cso.uiuc.edu* and he will perform the forwarding from his workstation to the appropriate personnel. Eventually automatic forwarding will be setup. Fellows will be given e-mail accounts during the summer.

Polaroid

Polaroid currently does not have external gateway support although the e-mail culture is well developed internally. This is not very crucial for the summer fellows

since Polaroid is physically near MIT. However, an external gateway might become available sometimes during the summer of 1989 according to Herbert W. Ahrens, the director of Manufacturing Strategy.

United Technologies Corporation

UTC is supported by ARPANET. However, due to internal policy and security concerns it refuses to establish e-mail connection. Fellows will be given a stand alone personal computer and a modem to dial into their PROFS account.

The following two tables summerizes company connection statuses and company technical staff contacts.

Table 1. Company E-mail Connection Status

Company	*Internal System*	*External Network*	*Connection Status*
Aluminum Company of America	All-in-One	ARPANET	fully connected
Boeing Company	PROFS	IIN* ARPANET	still trying
Chrysler Motors Corporation	All-In-One	none	modem
Digital Equipment Corporation	All-in-One	ARPANET	fully connected
Eastman Kodak	PROFS	IIN*	still trying
General Motors	PROFS	ARPANET	fully connected
Hewlett-Packard	HP Desk	ARPANET	fully connected
Johnson and Johnson	internal**	BITNET	working on internal forwarding
Motorola	Unix Mail	ARPANET	connected; waiting for auto-forward
Polaroid	internal**	none	ext. gateway will be available 8/89
United Technologies Corporation	internal**	ARPANET	modem

* IIN stands for the IBM Information Network

** These companies did not want to disclose their internal e-mail system information for security reasons.

Table 2. Company E-mail Contact Person

Company Name / *Personnel's Name*	*E-mail*	*Phone*
Aluminum Company of America		
John Gartley	gartley@aldnef.alcoa.com	(412) 337-2698
Boeing Company		
Susan Vandervarrt	n/a	(206) 237-7081
Henry Schomber	n/a	(206) 234-6585
Chrysler Motors Corporation		
Al Bosley	n/a	(313) 956-1127
Digital Equipment Corporation		
Douglas Braithwaite	braithwaite%asabet.dec@decwrl.dec.com	(508) 493-6939
Eastman Kodak		
(716) 724-2174	Lu Anderson	n/a
General Motors		
John Muenz	muenzj%aesv01%hac2gm@engvax.scg.hac.com	(313) 947-1336
Hewlett-Packard		
Tom Menzies	tomm%hpmwtd@hplabs.hp.com	(707) 577-2275
Johnson and Johnson		
Ken Hahn	n/a	(201) 524-3480
Motorola		
Bob Tykal	rwt%cadsun.srd.mot.com@uxc.cso.uiuc.edu	(312) 576-5094
Polaroid		
Herbert W. Ahrens	n/a	(617) 577-2407

6. EXECUTION

The goal of the execution stage of the Leaders for Manufacturing Electronic Mail Network is to develop an e-mail culture within the program. Unlike the emergence of computer word processors where technology increased productivity on an individual basis, the true power of electronic mail depends on the usage proficiency of the entire user organization. A single e-mail user can not benefit from the system if he is the only person using the network. The organization as a whole must have a common vision that electronic mail will improve productivity. After all it is a coordination and communication tool.

The execution stage of the overall implementation raises many managerial and human issues. This is very different from the network implementation stage where technology is the primary concern. Now the system must become accepted by the LFM community or else it is meaningless in spite of its technological elegance. Several questions are of concern. How can the LFM participants be persuaded to use such information technology? On the technical support level, how can they be trained to become proficient with the system? After the initial 'kick off' of the network, how can the usage momentum be sustained?

6.1 Persuasion

The execution of any information system is likely to encounter large resistance from the receiving end of technology, in part, due to the natural human tendency to be skeptical about changes to existing system. Likewise, the problem of people's unwillingness to change was anticipated in the LFM e-mail network. To counter such inertia, a top-down approach was use by gaining upper administration support first.

The conceptualization of utilizing electronic mail network for improving communication and coordination within the Leaders for Manufacturing Program originated in the Communications Committee. Before any implementation work was started, one of the co-director of LFM, Thomas Magnanti was approached. Professor Magnanti himself is

an avid user of e-mail and was very supportive of the idea. Then the program manager, Donald Rosenfield, and the administrative officers, Marie Cedrone and Rosalie Allen, were contacted to discuss the e-mail project. They were briefed on the potential benefits of electronic mail and became strong supporters of the project as well.

Armed with the support from the top management of the Leaders for Manufacturing Program, a survey was conducted among the fellows and professors mainly by telephone. There are three main purposes served by the survey:

1. To inform the LFM participants that a electronic mail system has been planned for and the possible administrative changes that might come along with it.
2. To get feedback from the future users on their feelings concerning the use of e-mail.
3. To collect information on existing hardware/software equipment for implementation purposes.

The general response was very supportive. Many of the previous non-e-mail users indicated great interest to learn how to use it. Only few indicated negative sentiment about e-mail.

6.2 Initiation

As soon as the electronic mail network became operational, a memorandum (both paper copy and electronic copy) was sent out to all participants supported by the network. This memorandum was endorsed by the Communications Committee as well as the LFM Headquarters. It informed the LFM participants of the future administrative changes incurred by the e-mail system. Soon after, copies of the LFM E-mail Directory, LFM Distribution Lists, and instruction on how to use the distribution lists was sent out to users.

The upper administration and fellows were trained to use the e-mail system in detail. This training included the installation procedure to access the 5ESS ISDN network capability from their Macintoshes, the use of the communication software responsible for

establishing data communication between Macintosh and PROFS, and the e-mail processing procedure on PROFS. All procedures are documented in detail in the "LFM Electronic Mail User's Guide". (See Appendix A) It is available at the LFM Headquarters for future training as well as trouble shooting purposes.

6.3 Building the Momentum

An information system if not properly maintained at the user level, can lose its initial attraction and eventually fail. The LFM electronic mail is no exception. The users must be trained to use the system and become comfortable with the system so e-mail can become a habitual form of communication. Once this is accomplished, no more pushing and shoving by the administration is necessary. The momentum will carry itself on its own. A good analogy is the introduction of telephone system. After people grew accustomed to it, it became a daily tool for communication purposes. No one needs to be forced to use the telephone.

To accomplish this the 'parallel methodology' was used for implementation. In the early stage of electronic mail use, both paper and electronic versions of the same memo are distributed to the recipients. So instead of forcing e-mail upon users, this procedure is designed to help people ease into using e-mail. Then as people grew accustomed to the idea of using electronic mail, paper mailing is gradually phased out. This is done based on the assumption that people do not like abrupt changes. They usually prefer evolution rather than revolution. Daily announcements were also sent to get people used to opening their electronic mail boxes. Such announcements cover a wide range of topic including meeting reminder, memos, reschedule notices, and e-mail usage tips. This way the announcements will not be treated as junk mails. Instead they will motivate the users to use their new communication tool.

The fellows are trained to utilize e-mail to communicate with their advisors during the summer while on working at company site. This is a very good time for them to fully

explore and appreciate the power of e-mail since they will be away from MIT. E-mail will serve as an excellent alternative communication method for sending memos, notices, and documents. Then, once the fellows and staff are used to the idea of e-mail, they will be able to help propagate the e-mail culture within the Leaders Program.

7. ANALYSIS

7.1 Usage

During the early stage of the execution, a controlled experiment was carried out to study the learning curve of this information system. This was made possible by taking advantage of a special feature available in PROFS electronic mail. This feature allows the sender to request for an acknowledgement from the recipient when the mail is read. It is automatically generated when the recipient opens the mail. So if this special feature is applied properly, e-mail traffic can be monitored.

In the early execution stage of the LFM e-mail network, group e-mail messages are sent out to every user supported by the LFM network from the LFMHQ account on daily basis. These messages all include the *".ak"* command to request for automatic recipient acknowledgement generation. When the recipient reads the mail, an electronic message will be sent back to LFMHQ as a standard note. Then it can be read using the *View the Note* module on PROFS. A sample acknowledgement is taken direct from the *View the Note* menu:

```
                          VIEW THE NOTE                          E01

From: JLAWTON --SLOAN              Date and time    05/08/89 10:04:59
This is to acknowledge that your note of 05/02/89 09:11:10 has been
opened.

                          E N D  O F  N O T E
```

The message includes the recipient's userid (in this case is JLAWTON), the date and time of when the message was originated at LFMHQ, and the date and time of when the message was read.

There are some limitations to this automatic acknowledgement monitoring scheme due to the nature of the network setup:

1. The acknowledgement will only be generated from PROFS recipients' accounts. Non-PROFS host machines are not capable of generating such automatic acknowledgement message.
2. This scheme can only monitor e-mail messages that are sent from the LFMHQ account. So monitoring of the overall traffic is not possible.

Nevertheless the data still serves as a good indication as how often users are using their electronic mail system. Furthermore, partial data on Non-PROFS users' usage is obtained from their messages sent to LFMHQ and telephone interviews.

The data is compiled to show the total number of users actively using the network as a function of days after the network became operational. Here's the result:

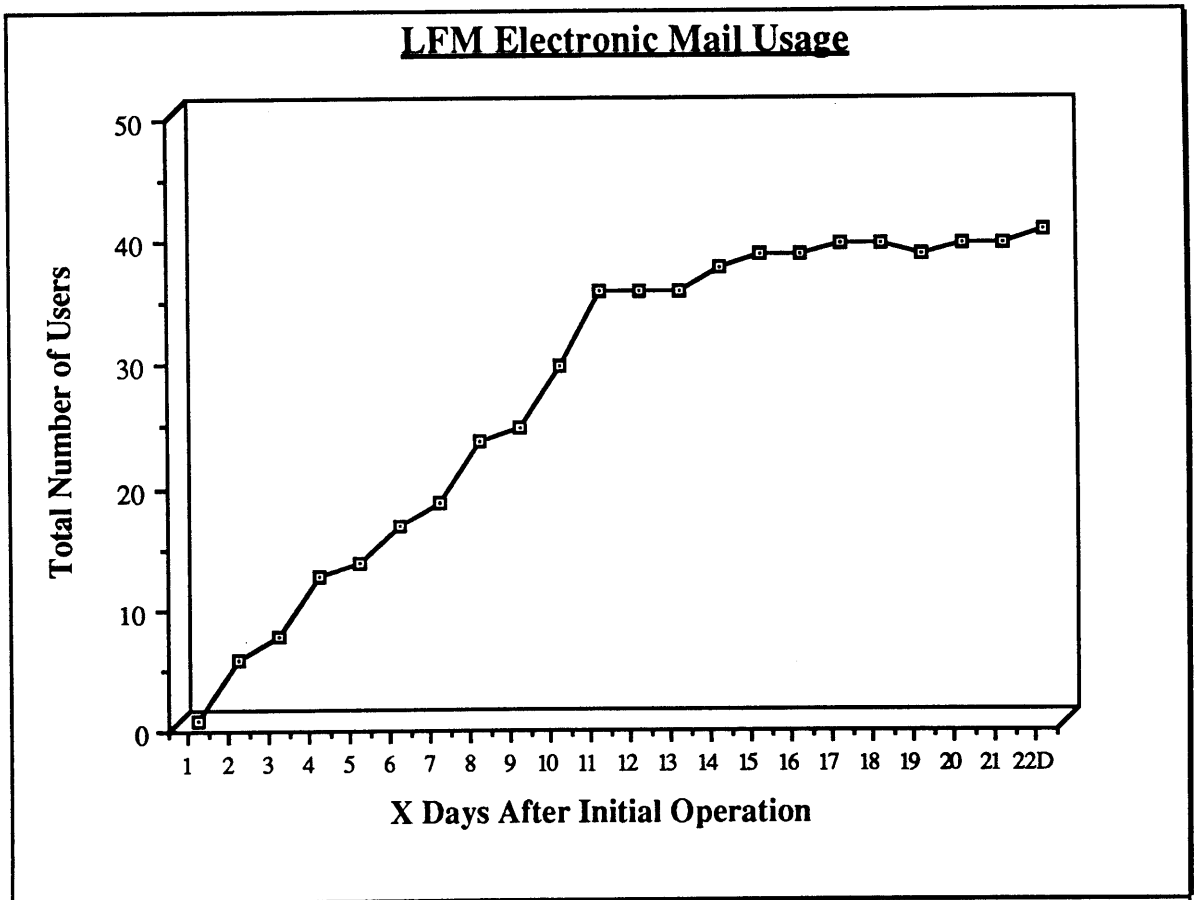

Figure 13. LFM E-mail Usage

The time delay from sending the message to when it is actually opened is also taken into consideration. If the lag time is greater than seven days, then the user becomes a non-active users. Only one users had a lag time of greater than seven days since they started using e-mail. This is what accounted for the drop between day 18 and day 20.

Between day 1 and day 10, the number of users drastically increased from 0 to 30. Then the increase became a steady minimal increase. The total number of users reached 40 on day 17 and eventually reached 41 on day 22. The leveling off of the curve is an indication that the rate of active user increase is slowing down. However most users remain active after they started using e-mail. So as long as there is a steady increase, the network will serve its function.

7.2 User Feedback

About a month after the LFM electronic mail became operational, a survey was sent out electronically to get user feedback. Here are some samples of the response from users. Again they are directly compiled from PROFS's *View the Note* module.

```
From: RHENDERS--SLOAN                Date and time    05/01/89 17:27:31
To: LFMHQ    --SLOAN

*** Reply to note of 04/26/89 08:24
From: Rebecca Henderson
Subject: LFM E-mail Usage

James:
     with respect to your query as to the usefulness of E-mail, the
date of my reply may be your best indication. Although it is easy to
access and I appreciate the reduction in paper, I am still not using it
freqently - my e-mail correspondence has yet to reach critical mass, so
I do not access it every day. No easy answer to this one, but I expect
that it will change with time.
```

E N D O F N O T E

```
From: TLOUCKS --SLOAN                Date and time    05/01/89 17:12:25
To: LFMHQ    --SLOAN

*** Reply to note of 04/26/89 08:24
From: Tim Loucks
Subject: LFM E-mail Usage
```

1.The E-Mail has been very useful. It will be even more useful in the future if it is connected to my office in Lafayette, IN. 2. The memos have been fairly useful, especially now that I am reading my E-mail regularly. 3. My only suggestion is to ensure that the mail is availble to all students during the internship.

E N D O F N O T E

From: SGRAVES --SLOAN Date and time 04/27/89 07:27:20
To: LFMHQ --SLOAN

*** Reply to note of 04/26/89 08:24
From: Stephen Graves
Subject: LFM E-mail Usage
1. I have fairly easy access.
2. Yes it has kept me better informed about LFM events.
3. Yes, but don't overdue it with the memos...

E N D O F N O T E

In general the user response is very positive. They have easy access to the e-mail system. They feel that it is easy to use and are better informed about the program. So the overall conclusion from the user's stand point is that the e-mail system can actually enhance communication with the Leaders Program.

7.3 Problem/Suggestion

There are some general concerns on the user's part:

1. The possibility of accumulation of junk mail.
2. The momentum has not yet reached a point where the e-mail culture will evolve by itself.

The first concern can be solved by the overall discretion on the user's part. Now the LFM participants have a easy mean to mass distribute group messages and memos. So they must be careful not to abuse such convenience and end up jeopardizing the e-mail operation.

The second concern will require more effort on the LFM administration's part to encourage e-mail usage and keep it properly maintained. The administration must take the initiative to continue using e-mail. The Communications Office, Judith Stitt will play a

major role. She will be in charge of maintaining the LFM E-mail User Information Database and updating the distribution lists. The students will probably become the major driving force in this e-mail culture propagation. They are very enthusiastic about the network and will depend on it heavily during their summer assignment. The Policy and Procedures Guide shown in Appendix D outlines the e-mail maintenance process in detail.

With the current network size, the maintenance work can be done as suggested in the Policy and Procedures Guide. But if it continues to grow, a third person might have to be hired to dedicate to the task of maintaining the e-mail system. See Appendix D for the list of maintenance and procedures.

8. FUTURE EXPANSION

The current implementation of electronic mail system for LFM can be expanded or improved in the following two areas: scope of support and distribution list automation.

8.1 Scope of Support

Currently the LFM electronic mail support is not available to the professors who expressed interest in the program but do not actively participate. This limitation is imposed by the cost justification of issuing computer accounts on PROFS. So if the cost of electronic mailbox can be lowered or eliminated, the LFM electronic mail service can be extended to those above.

One possible solution is to participate in the Eagle project initiated by the MIT Information Services. It can be thought of as an electronic post office support service designed to serve all members of the MIT community at no cost. Such mailbox is capable of sending as well as receiving mail both inside and outside of the MIT campus. The hardware required for access include a personal computer running the post office front end interface and telecommunication capability. Telecommunication capability can be accomplished via ethernet, ISDN, or modem. The user does not need to have a computer user's account anywhere on the MIT campus. So far the Macintosh ethernet front end is available for beta testing. In fact, Professor Stephen Eppinger, one of the LFM professors, is an active beta tester for this system. When this system is fully implemented, instead of giving new users e-mail accounts on PROFS, mailbox can be given through this post office system for free. Furthermore, for users who are not satisfied with the PROFS user interface, they can also switch over to the Eagle project. According to Mark Curby at the MIT Information Services, the Eagle project should be in full operation by summer 1990.

Another possibility is for the Leaders Program to purchase a dedicated file server of its own. So instead of using PROFS as the central server to keep track of all e-mail addresses and distribution lists, LFM can use its own server to perform such task. This

way LFM can have immediate control over the server instead of having to go through the Sloan Systems Administration. With such implementation e-mail accounts can be issued from the LFM internal server directly to new users at no added cost.

8.2 Distribution List Automation

The process of maintaining the LFM distribution database is a combined effort between the LFM Communications Committee and the Sloan Systems Administration. The LFM Communications Committee would determine whatever system server changes are needed and forward it to Sloan. Such changes include all modification or creation of distribution lists. Currently the LFM E-mail User Database does not have the capability to directly download the distribution list information to PROFS. So instead of forwarding hard copies of the computer generated distribution list to Sloan for processing, it would be nice to be able to download the distribution list directly from the LFM User Info Database to the IBM 4381 for implementation directly. This effort will involve a change in Sloan's system maintenance policy as well as close collaboration between Sloan and LFM to facilitate such automation. At the LFM end, user and distribution list information can be uploaded onto Sloan using Kermit[23], ftp[24], or other file transfer facility. But a software has to be written to on PROFS to process the information received and implement the changes.

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23 Kermit is a text file transfer utility available on most computers.

24 ftp is a general ethernet file transfer utility.

9. CONCLUSION

The Leaders for Manufacturing Electronic Mail effort is an initial success. As a result, a cross-continental network spanning from Boston to San Francisco is established. Speedy, flexible, and easy-to-use electronic mail communication is now possible among the LFM fellows, professors, staff, as well as the sponsoring company personnels. In addition to the four previously established means of communication, a new communication channel is now open.

What has been accomplished is actually more than just an electronic mail network. It now gives all Leaders for Manufacturing participants the ability to access the power of a sophisticated communication network. It opens the door to the vast computing power available over the network especially in the area of remote data exchange and resource sharing. Electronic mail is just the first step for exploring the different possible applications in using a networking environment. There are still vast amount of power yet to be discovered in networking. The potential can be enormous.

This network becomes a very important support tool to a revolutionary educational program designed bring back the American manufacturing competitive edge.. When the fellows graduate, they will take this electronic mail (or networking) culture with them and propagate the application of this information technology in the American manufacturing industry.

APPENDIX A: LFM ELECTRONIC MAIL USER'S GUIDE

INTRODUCTION

As the Communications Committee, we feel that a main key to improve the Leaders Program is through better communications and coordination among all participants. On the MIT campus, it may not be too hard for professors and students to track down each other. However, due to the actual physical distance, tasks as simple as getting a memo from one professor to a key player in a manufacturing firm may prove to be difficult. Of course one can always send memos via Federal Express. But we feel that a better solution is electronic mail. With such system, people can send memos and messages across the network with relative ease. The communication response time would be reduced by many folds from days to just a matter of hours or minutes depending the location of mail destination.

The Leaders for Manufacturing Electronic Mail (LFM E-Mail) is designed and built around existing hardware and software with cost efficiency and simplicity of use in mind. Recognizing the fact that every participant in the program have easy access to either a stand alone personal computer and/or some type of company/university network, it would not be difficult to network all these systems together to provide electronic mail support. The key is to make use of as much of the existing equipments as possible.

The PROFS system is chosen to be the primary server of this e-mail system since many professors and all LFM fellows already have accounts on it and distribution lists can be setup at ease for multi-user access. Therefore all the new e-mail users are also given accounts on PROFS. For the users who already have a regular e-mail address, all mail are forwarded to that address to eliminate the confusion of multiple mail boxes.

This documentation describes the use of the LFM e-mail via PROFS in detail. For other system e-mail users please refer to your system documentations.

USING PERSONAL COMPUTERS TO LOG ON

If you have a Macintosh and chose to have the automated logon option, then skip the Non-Automated Logon On section and go on to the Automated Log On.

Non-Automated Log On

Set the parameters on your communication software as follows and use it to dial into the IBM PROFS system at the Sloan School of Management:

Baud Rate:	*9600*
Bits per Character:	*7*
Stop Bits:	*1*
Parity:	*even*
Terminal Type:	*VT100* or *VT102*
Mode:	*ANSI*
Phone Number:	*258-6275*[25]

As soon as you receive the "Connect" message, press <return>. The screen will scroll and prompt for the terminal type. Enter "vt100" then the computer will display the login screen as shown after the Automated Log On section.

Automated Log On (Macintosh Only)

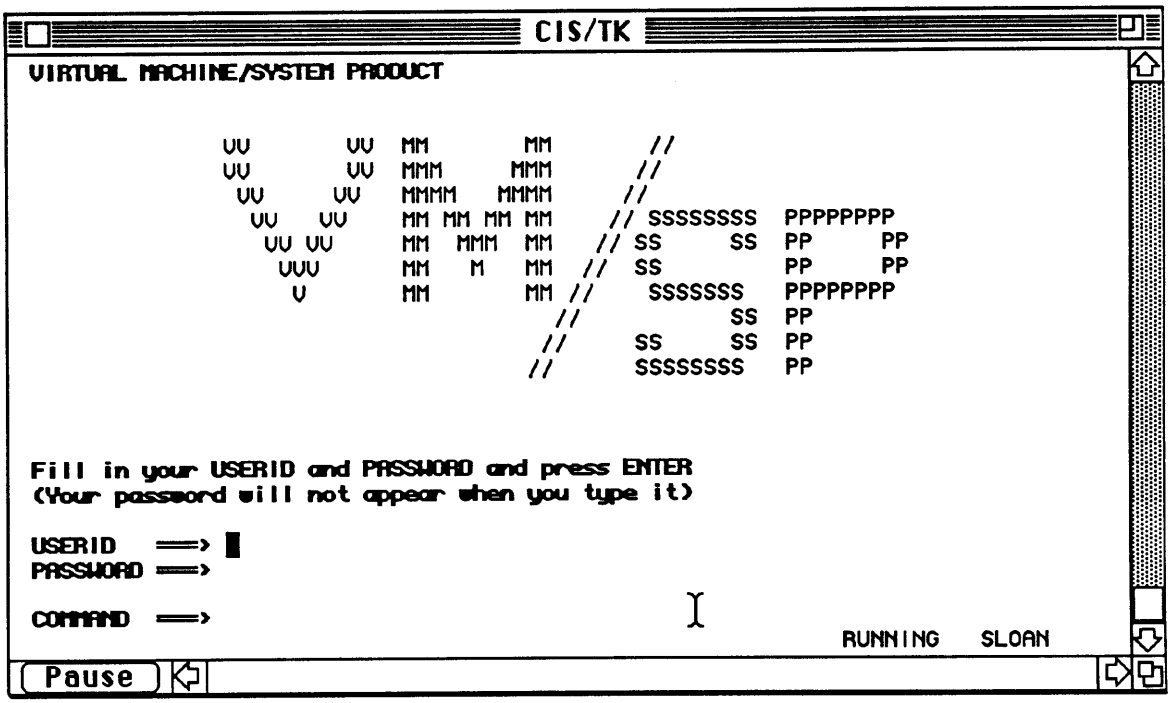
If you have Automated Log On installed, the computer will be capable of dialing up PROFS, set parameters and terminal type for you. The required equipments include a Macintosh, The Microphone II by Software Ventures, and a script file supplied by LFM Communications Committee called LFM-Email. Microphone II by Software Ventures was chosen for its ease of use and macros capability. To start, double click on the script file icon marked LFM-Email on the desktop of your Macintosh.

25 There are actually four digital dial in lines for PROFS. They are setup in a hunt group so the user only has to dial 258-6275. PROFS will hunt for a free line automatically.

In a few seconds, the Macintosh will automatically dial up the IBM 4381, select the terminal type and display the following screen for login. If there are no available lines, the computer will stop and ask you to try again later.

Ethernet

If you are equipped with ethernet, refer to the TN3720 documentation for log in.



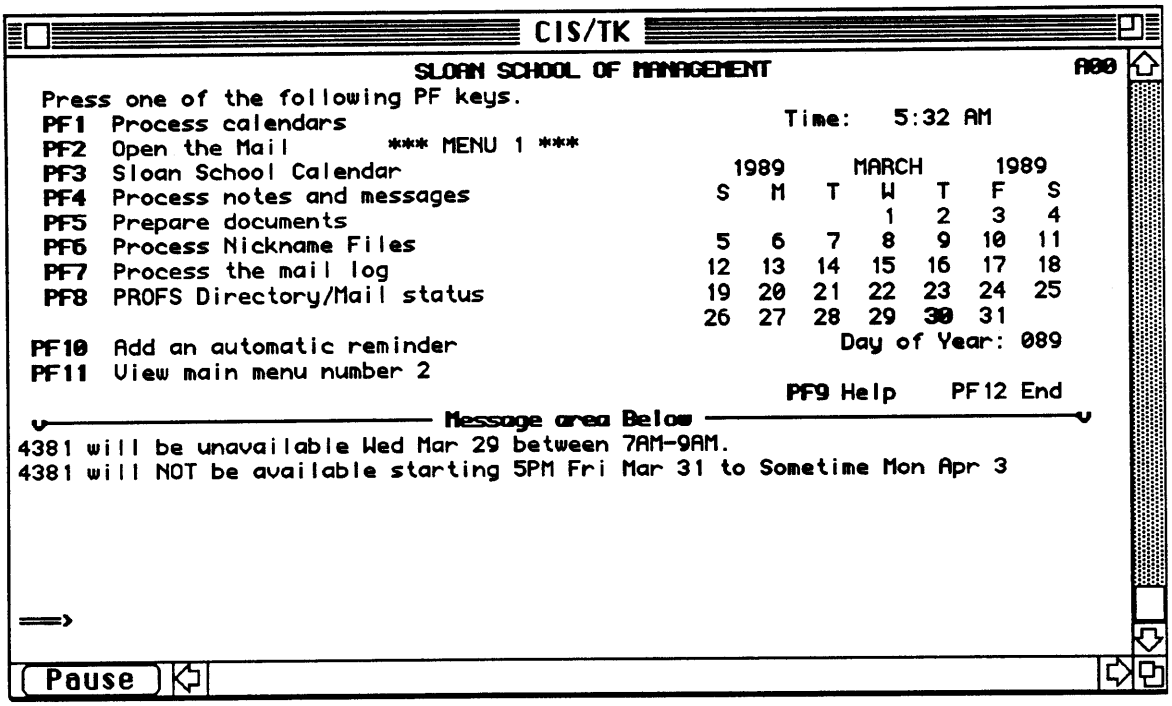
The users can customize their LFM-Email script to enter their userid and password automatically too. However, this is not recommended on a PC/Macintosh that is shared by more than one person.

Enter your user id (up to eight characters long). If your userid is exactly eight characters long, then the cursor will automatically position itself for password entering without <TAB>. If your user id is less than eight characters, then press <TAB> to move the cursor to the password prompt.

Enter your password and press <RETURN> or <ENTER>. At this point, the screen will clear and a few system status messages will appear as the computer startup your account. Then the Main Menu will appear as the login procedure successfully completes.

INTRODUCTION TO PROFS

The purpose of this section is to familiarize user with the IBM PROFS system and keystroke sequences. So for those who already know how to use PROFS should skip ahead to the next section. Shown below is the PROFS main menu which will be shown when successfully logged in.



PROFS stands for Professional Office System. It contains many different modules to serve various office automatic functions. Some are listed in the sample Main Menu screen shown above. For the purpose of LFM-Email, two primary modules will be used: "Open the Mail" module for retrieving mail and "Process Notes and Messages" module for sending mail.

PROFS is a menu driven system. You almost never have to type a command when using PROFS. At all times the screen will display a list of possible actions and the corresponding function keys (denoted by PF) for activation. Depending on the current module you are using, the list is either displayed in the upper portion of the screen or

across the bottom of the screen or both. For example, at the Main Menu level, by pressing PF4 will activate the "Process Notes and Messages" module and PF2 will activate the "Open the Mail" module.

There are two forms of mail in PROFS: notes and messages. You can use either one to communicate with others on the network. However, for the purpose of LFM, notes should be used most of the time for the following reasons: A note is more lasting than a message. When you send a note, the note goes into the other person's incoming mailbox. It will stay there until the person opens the mail. You can keep a copy of the notes you send in a note log. On the other hand, when you send a message, it appears directly on the other person's screen. It does not go into the incoming mail, and PROFS does not keep a copy of it. Therefore, your message will only be received if the other person is currently logon to the network.

The PROFS system has on-line help. Please feel free to explore other functionalities other than the e-mail related options. Please direct questions concerning the electronic mail network to James Yao at 225-8719 or JAMESYAO@SLOAN.MIT.EDU.

SPECIAL KEY SEQUENCES

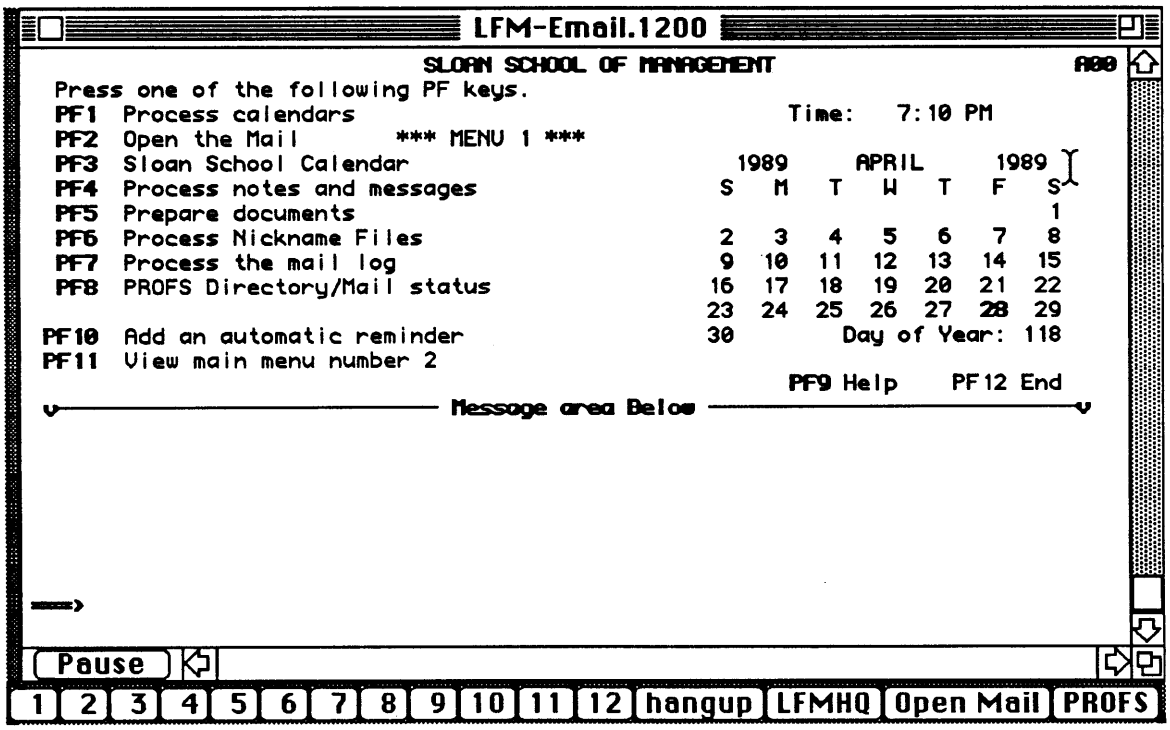
When entering text in PROFS, use <TAB> to move to the next line.

Whenever the PROFS system displays a message such as "Hold", "Waiting", or "More" on the bottom-right-hand corner of the screen and your screen freezes, press <ENTER> to proceed. This will typically happen when you enter in and out of modules or right after you have sent mail. If you are using an IBM PC, press <ESC> <ESC> instead of <ENTER>. <ENTER> only works on the Macintosh.

When a communication error occurs between PROFS and your Mac, press <ctrl-g> to refresh and screen and remap the keyboard.

If your keyboard does not have an INSERT mode toggle key, use <.> on the numeric keypad. If you do not have a numeric keypad, you can not activate the INSERT mode.

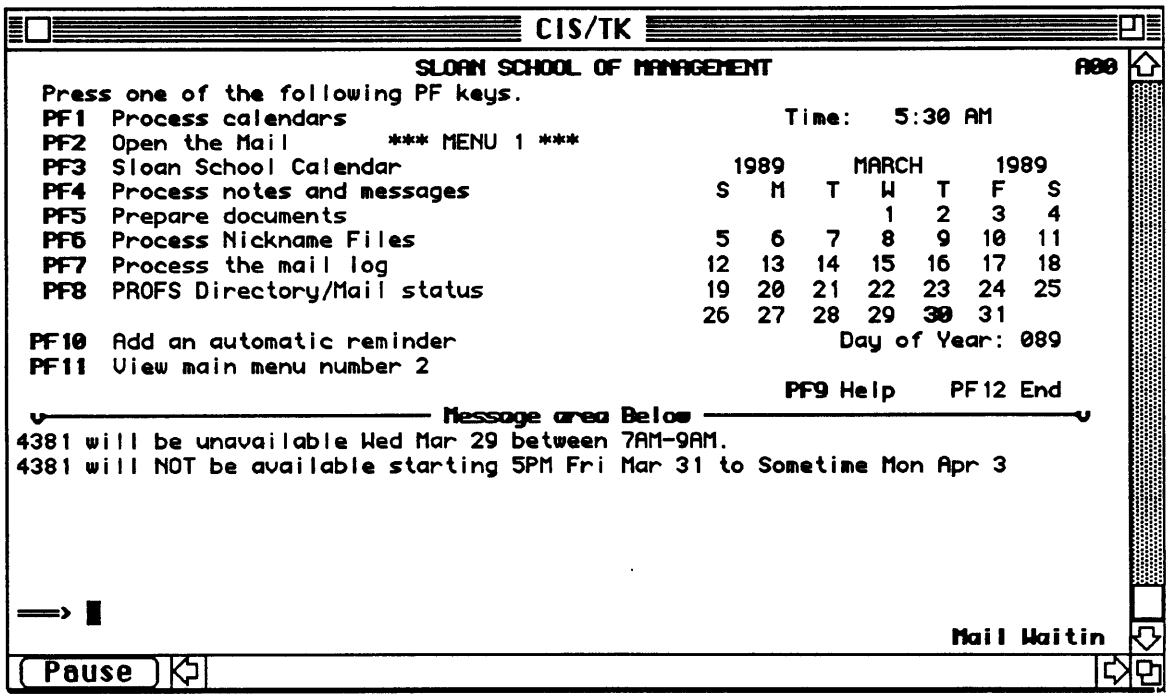
If your keyboard does not support function keys, use the screen defined function buttons at the bottom of your screen as shown below (Macintosh only) or alternate keystrokes listed at the end of the user's guide.



TO OPEN AND SEND MAIL

Open PROFS mail

Whenever you have new mail or unread mail, the "**Mail Waiting**" message will be displayed on the bottom-right-hand corner as shown below.



Use PF2 to activate the Open Mail Module. The computer will display a list of mail containing information on who the mail is from, its type, date, and the subject it is concerned with in the order it is received. The most recently received mail is listed on top. The corresponding function key for activating the mail is to the left of the screen.

The bold-face or highlighted entries are the new incoming mail. They can be opened by pressing the function key listed to the left of the entry. If only the function key number is highlighted in an entry, it is an old mail which has not yet been opened. The plain text entries are the ones that have already been read.

On the bottom-right-hand corner of the screen shows the length of the list. If it is longer than one screen, it will read "Screen 1 of 2" and so forth.

After you have finished reading the mail. You have the option to reply, forward, or erase the mail. PROFS will keep a copy of all incoming mails for future references unless you command otherwise.

Use PF12 to return to Main Menu. You may have to use PF12 more than once depending on your current position within the module.

If you see a message on the bottom-right-hand corner of the screen showing "Hold", "More", or "Waiting", press <ENTER> to continue.

Open Non-PROFS mail

If you also have received messages from a non-PROFS users or from a company personnel, PROFS will prompt you by asking whether you would like to process non-PROFS messages before exit back to the main menu. Answer yes and PROFS will activate another mail processing utility to process such mail. Instruction on opening these messages are listed across the bottom of the screen.

Again you have the option to store or erase each message. However, PROFS does not have reply capability for non-PROFS mail. You will have to reply by sending a new note. The non-PROFS mail will be stored in a file named NOTEBOOK.ALL. It can be access by using the *flist* command. Refer to on-line help for more detail.

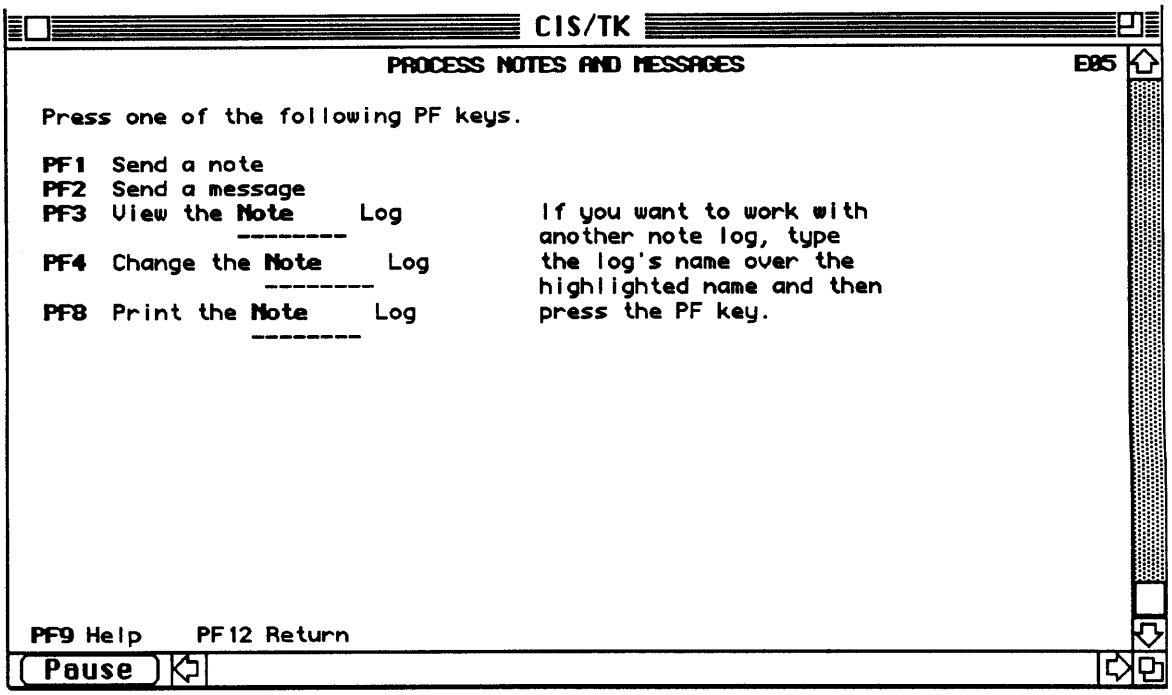
The lastest version of PROFS offers the option to merge both PROFS and non-PROFS mail and is now available on the Sloan's IBM mainframe. It can be selected by reconfiguring the PROFILE of your account. If you would like to use this option, send an e-mail message stating your userid and purpose to Mr. John Maglio, a Sloan System Administrator at JM@sloan.mit.edu or call him at 253-1491 between 8am and 4pm on weekdays. He will either implement the changes for you or give you detailed step-by-step instruction on how to do so.

TO SEND MAIL

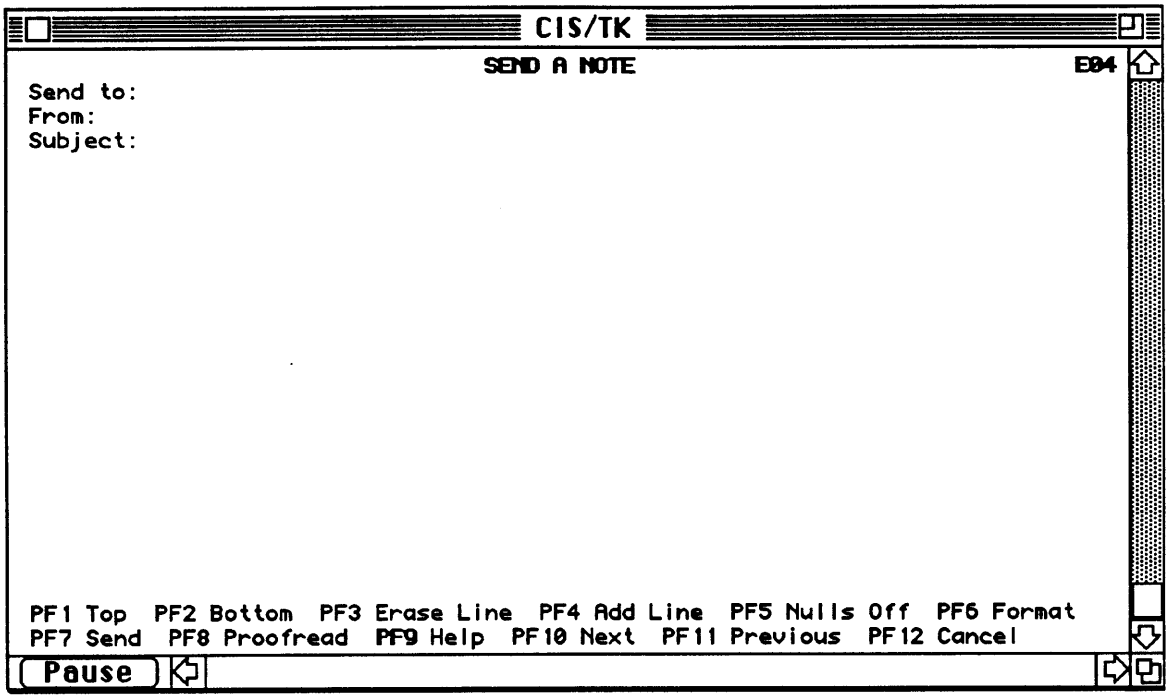
From the Main Menu level, press PF4 to enter the "Process notes and messages" module. The screen shown on the following page will appear listing the possible note

processing capabilities. You can either send a note or message, view or change a note log, or make a hard copy of all the note you have kept a record of. This printout can be sent to either the IBM 3812 laser printer or a line printer.

For the purpose of this user's guide, only the "Send a note" option will be described. If you want to find out more about the other command options, please refer to the guide, "Using the Professional Office System". It is available at the Sloan Systems Administration. Or you can access the on-line help by pressing PF9.



Press PF1 to activate the "Send a note" module (see below). The first three lines serve specific purposes. The "Send to:" line is used for holding recipient's e-mail address. The "From:" line uses your USERID by default (default is when this line if left blank) unless you specify otherwise. The "Subject:" line is used to indicate the subject of this mail. It is usually the title of the message or a one line summary.



The USERID used in the "Send to:" field can be a userid of a PROFS e-mail recipient, the PROFS nickname of a non-PROFS recipient, or a distribution list name. A distribution list name is used to send mail to a pre-defined group of people. You can also send mail to a group of people by listing all of their userid. The PROFS userid and nickname are usually composed of the first initial and the last name up to total of eight characters. For example, the e-mail address for Don Rosenfield is DROSENFI. When in doubt, check your LFM E-mail directory. Refer to Appendix F for a list of global distribution list available to LFM users.

PROFS will position the cursor behind "Send to:" initially. Enter the recipient's userid, or userid's, or distribution list name then press <tab> to move to the "From:" line. Fill in "From:" line and "Subject:" line. Again, to move to the next line, press <tab>. Text can start at the line immediately follows the "Subject:" line.

While entering text in this module, do not press <RETURN> or <ENTER> as you do on typewriters at end of line. Press <TAB> to move the cursor to the next line whenever end of line is reached.

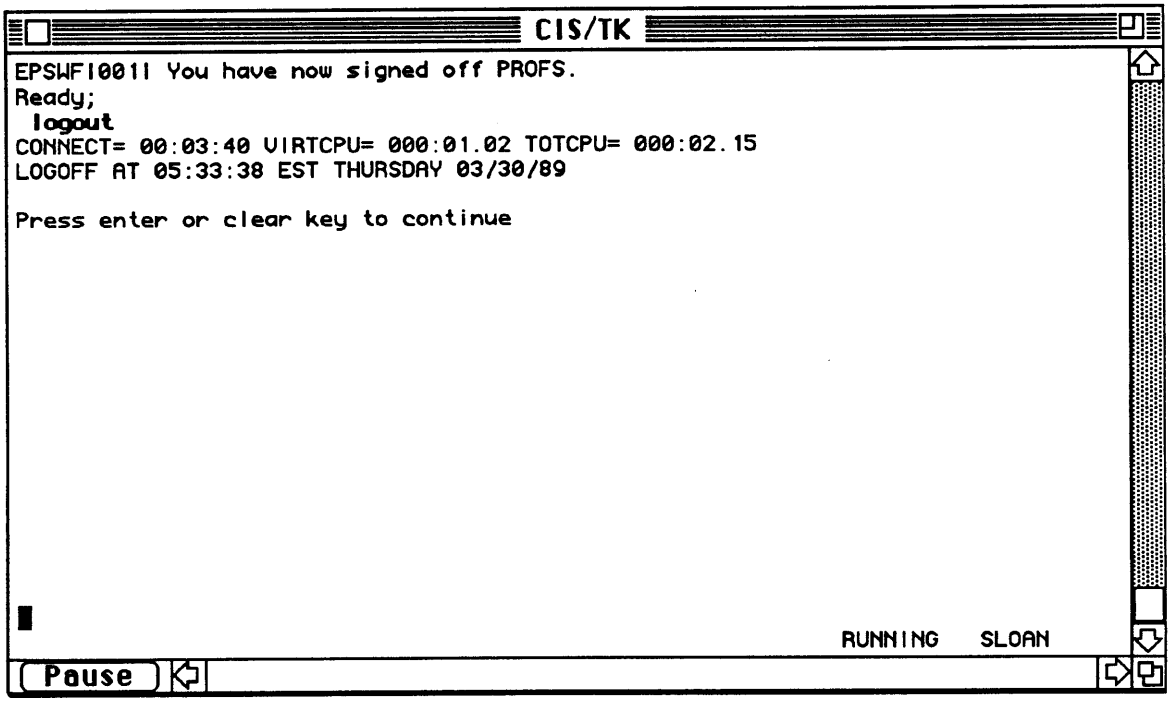
Before you send your message, you can use the Proofread option (PF8) to check for spelling error and comprehension level. The spelling checker works fine but I do not recommend the comprehension level.

When done, press PF7 to send the note. PROFS will give you messages indicating that the mail has been sent. At this time there will be a "Hold" or "More" message at the bottom-right-hand corner. Press <ENTER> to continue.

Use PF12 to return to Main Menu. You may have to use PF12 more than once depending on your current position within the module.

TO LOG OUT

At the end of your session please remember to logoff especially if the PC you are using is a shared resource. To log out, go to the Main Menu from wherever you are. Press PF12 to exit PROFS. Then enter "logout"<enter> or "logout"<return> to close your account. Or you can enter "logout"<enter> or "logout"<return> at the PROFS main menu level. When successfully logged out, the following messages will be displayed



At this time, if you want to leave your PC connected to the IBM PROFS, press <ENTER> to go back to the log on screen.

If you would like to quit at this time, please DO NOT forget to hang up so you don't tie up the line for other users. For Macintosh LFM-Email script users, you can hangup by simply clicking the "Hangup" button at the bottom of your screen.

ALTERNATE KEY STOKES FOR KEYBOARD WITHOUT FUNCTION KEYS

For Alternate 1, press the <ESC> key then <NUMBER> in sequence. For Alternate 2, press ⌘ and <NUMBER> together.

Function Key	Alternate 1	Alternate 2 (Macintosh SE, II only)
PF1	ESC 1	⌘1
PF2	ESC 2	⌘2
PF3	ESC 3	⌘3
PF4	ESC 4	⌘4
PF5	ESC 5	⌘5
PF6	ESC 6	⌘6
PF7	ESC 7	⌘7
PF8	ESC 8	⌘8
PF9	ESC 9	⌘9
PF10	ESC 0	⌘0
PF11	ESC -	⌘-
PF12	ESC =	⌘=

APPENDIX B: LFM DATABASE DOCUMENTATION

Introduction

The LFM Electronic Mail Database is built to store user information of LFM participants on the LFM Electronic Mail Network with relative ease. It helps the LFM e-mail administrator to keep track of all necessary information to generate e-mail directory, distribution lists, and address labels. It is also capable of browsing, searching, sorting, as well as launching e-mail application with simple clicks of buttons shown on screen.

This database is designed with ease-of-use being the top priority. It is built using the HyperCard utility on the Macintosh and follows the general menu and dialogue box design methodology of the Macintosh to create an extremely user-friendly environment. It takes advantage of the HyperText and scripting capability of HyperCard to create an user-friendly database interface.

Command Language

The command language are all button and menu driven. It is very intuitive. The functionality of the command buttons are as follows:

Home - return to the HyperCard Home stack

Browse - quickly browse through the database

Sort - gives instruction on how to sort the database

Report - activate the report module

PROFS - connect to the PROFS system

Find - to find a specific entry in the database

LFM - return to the LFM cover card

Previous - go to the previous card

Next - go to the next card

New Entry - create a new card

Copy Entry - make a copy of the current entry

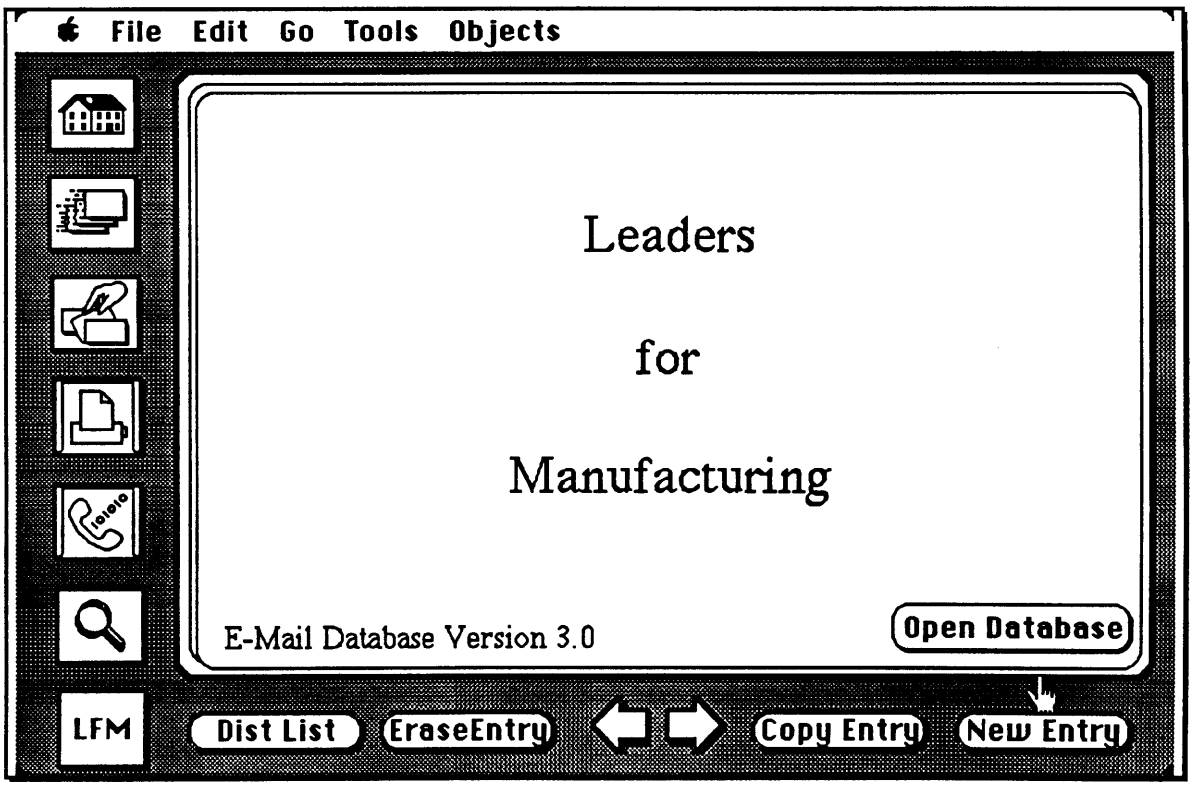
Erase Entry - remove the current entry from stack

Distribution List - go to the distribution list module

Activating the Database

When the LFM Electronic Mail Database is activated, a greeting card (shown below) will appear. Click on the 

button to enter the database.



Cursor Movement

The user can move between data fields via one of the following two methods:

1. The <tab> key will allow the user to move to the next field sequentially. When end of card is reached, it will wrap around to the first field in the card.
2. The user can use the mouse to point and click on field for random access.

The left and right key has the same function as the  and  command button: to move the the previous or next card.

Add a new entry

A new entry can be inserted anywhere in the database by clicking the (New Entry) button. A new card will be created with empty data fields having the cursor placed in the **Name** field for immediate data entry. Use the <tab> key to move the cursor to the next field.

Copy an entry

The (Copy Entry) command makes a copy of the current card with the text string "Copy of" inserted in front of the **Name** field to indicate to the user that it is a copy. The text in the **Name** field is highlighted so the user can enter the new name immediately. This feature is especially useful for entering multiple entries with similar field information such as personnels from the same company.

Remove an entry

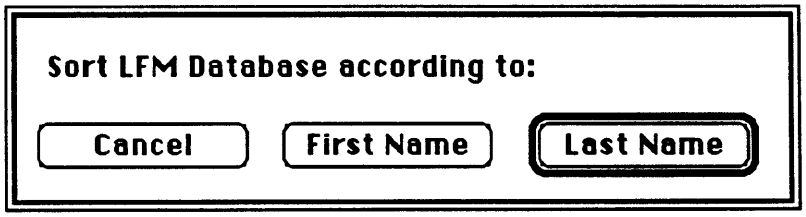
The (EraseEntry) command is used for removing the current entry. When clicked, the user will be prompted to confirm such move.

Search

This database allows the user to locate a person by issuing a search key for any data field. This can be done by clicking the  , find button. When pressed, the database will open a dialogue box to prompt for the search key.

Sort

This database allows the user to sort by any data field by clicking on the bold-faced data field identifier. For example, to sort the last name, the user simply click on **Name:** and the database will respond by the following dialogue box for more information:



In most cases, the database just prompts for user's confirmation.

Define distribution lists

Distribution lists are defined through the distribution list stack. It can be activated by clicking the Dist List button. In this stack, distribution lists are defined within each applicable LFM User Database data field. For instance all distribution list generated using labels in the *Committee* field would be defined in the same card. Likewise *Company*, *Status*, and *Code* all have a card containing their own distribution list definition.

The cursor movement in the distribution list stack is similar to the ones described in the LFM User Database. When finished, the Done button will return to the LFM User Database.

The Report Module

The report module is activated by clicking the report,  button. One can select from a list of pre-defined reports to generate the LFM E-mail Directory, address labels, distribution list, and a general report. Then by click the PRINT button the database will start the search engine and print the appropriate reports. In the case of printing distribution list or address label by distribution list, a specific list must be selected prior to the printing. This is done by clicking the following button:

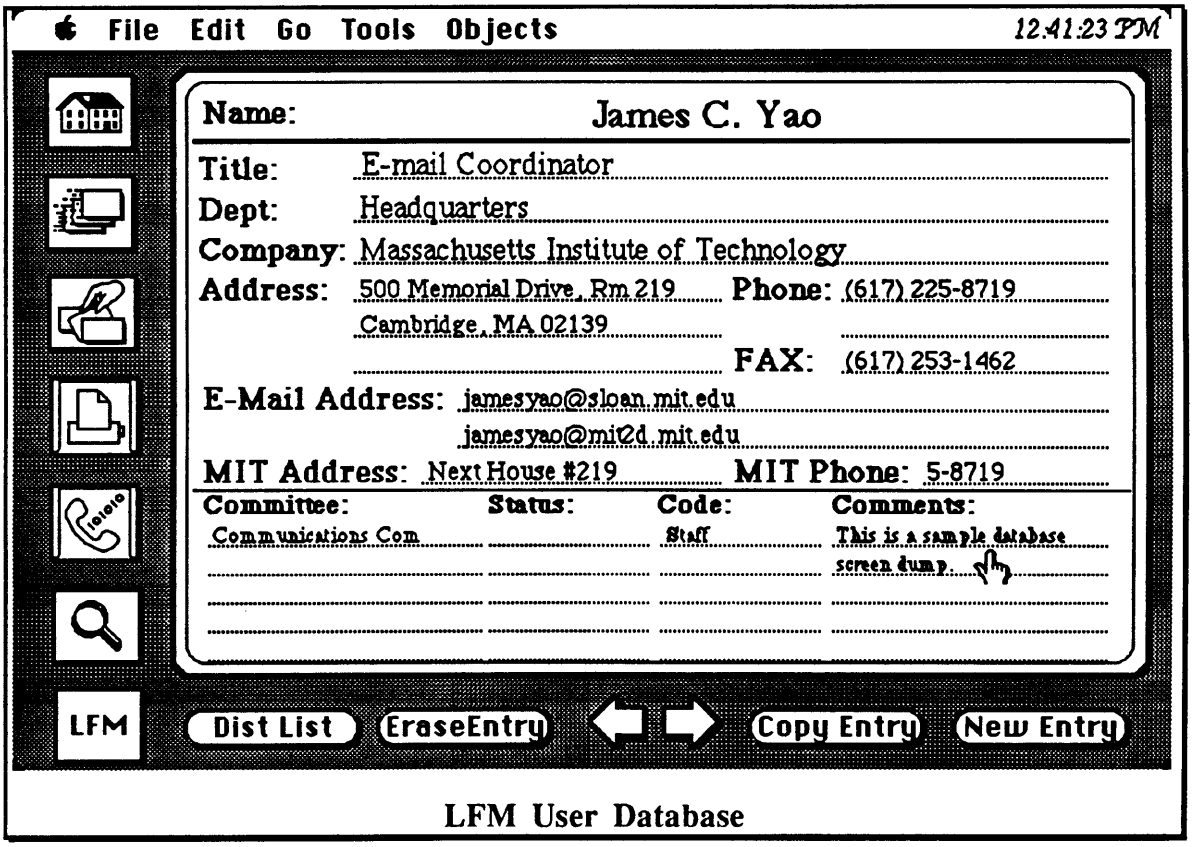
This button will activate the *select* card of the Distribution List stack. From it a specific distribution list can be selected from any of the category listed. The LFMALL button is for selecting all entries in the database. Again all commands are button driven and is intuitive.

Access LFM-Email

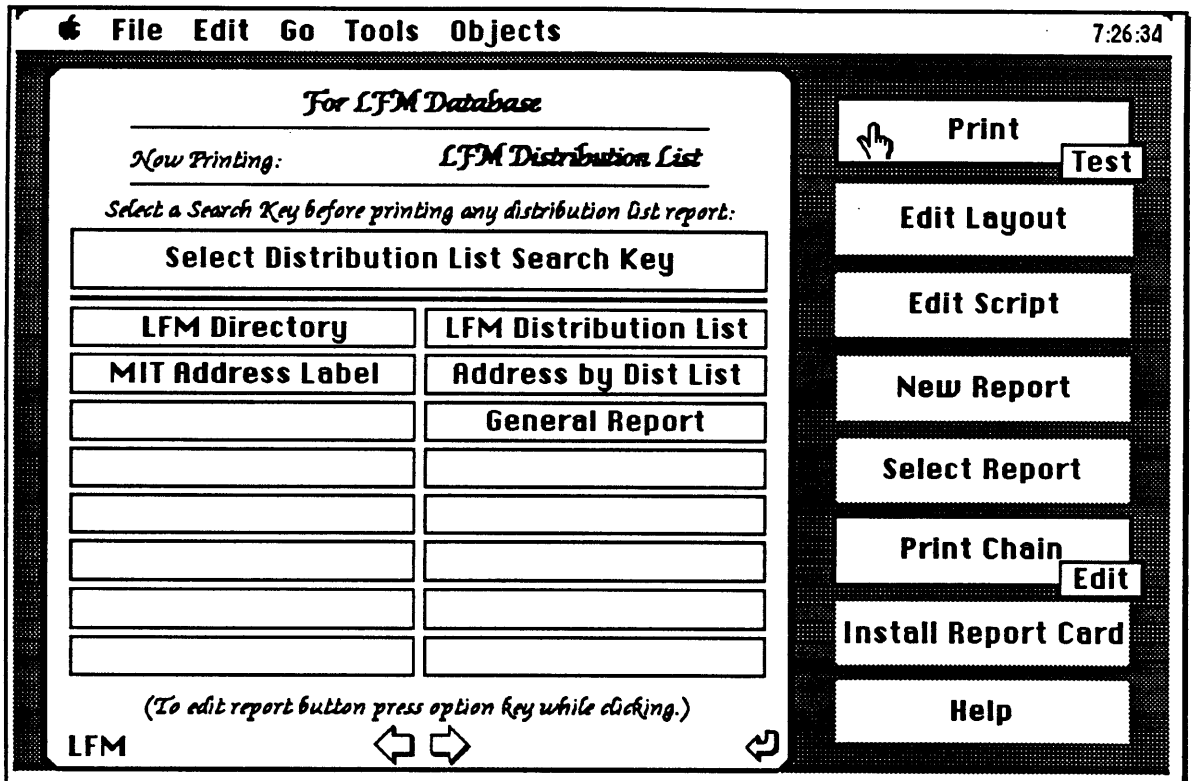
This database also provides the capability to directly launch LFM-Email for accessing PROFS without quitting HyperCard. When the PROFS ends, the computer will return to the LFM User Database. This function is activated by the button.

Sample Screens

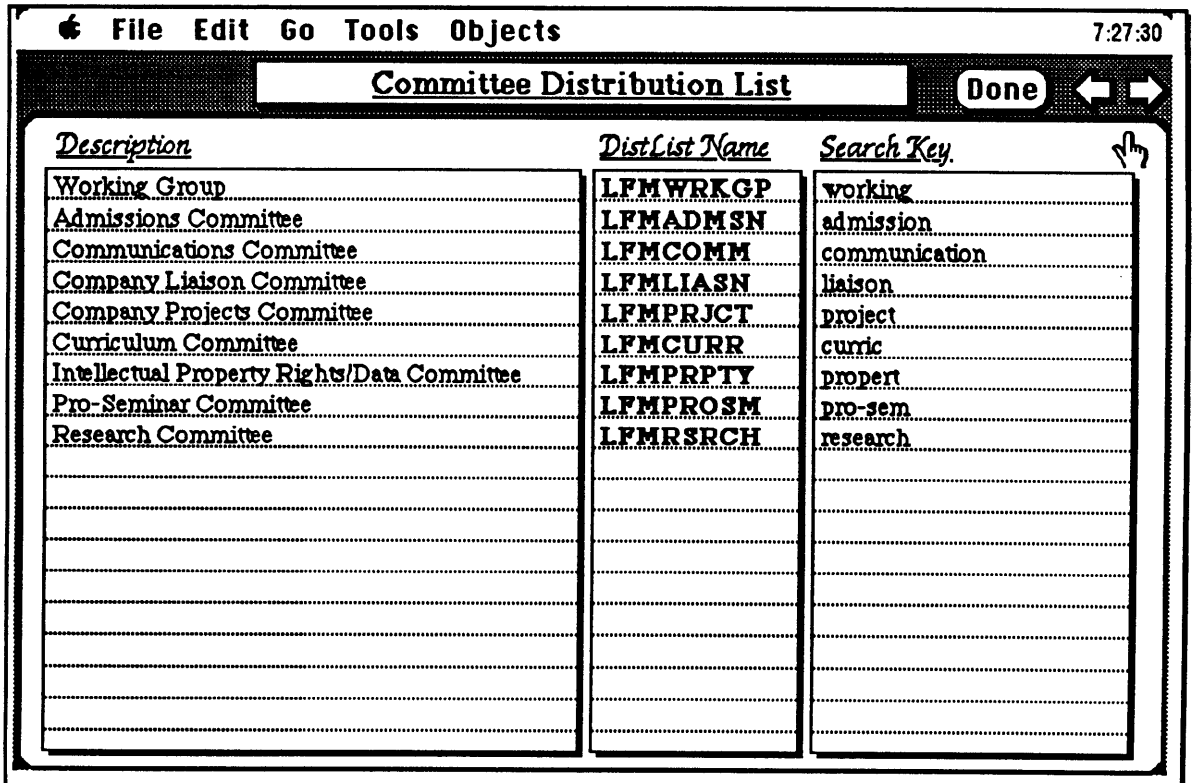
The following two pages display sample cards from LFM User Database, report module, distribution list stack, distribution list *select* card.



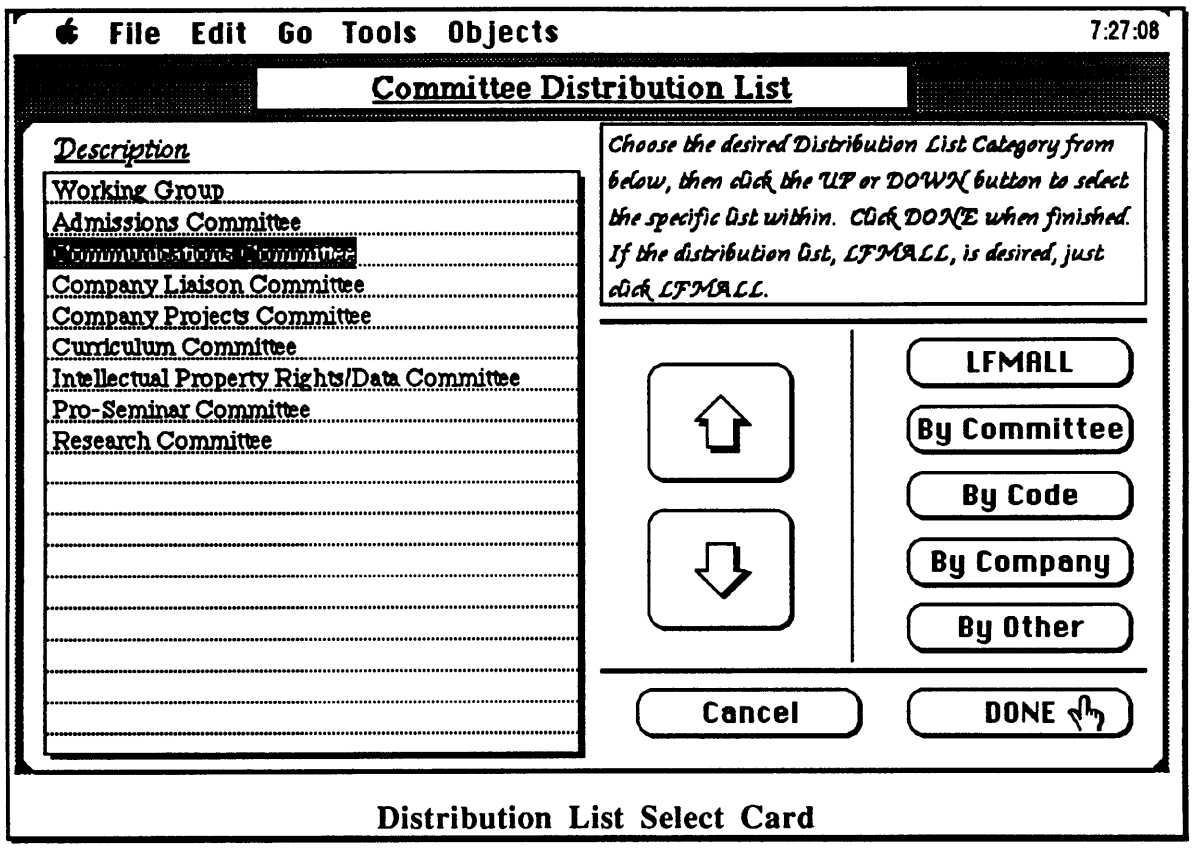
LFM User Database



Report Module



Distribution List Stack



Distribution List Select Card

APPENDIX C: LFM-EMAIL SCRIPT DOCUMENTATION

There are two versions of LFM-Email built using the MicroPhone II™ communication software by Software Ventures. One supports the MIT AT&T 5ESS digital phone transmitting at 9600 baud. The other supports conventional analog modem transmitting at 1200 baud. When activated it will set all applicable parameters and connect the Macintosh to the PROFS system.

There are currently four scripts included in the LFM-Email script file: PROFS, LFMHQ, OpenMail, and hangup. They can be activated via button or menu. There are also twelve function key alternate buttons. These buttons are displayed across the bottom of the screen (see attached diagram) and their functionalities are described as follows:

PROFS This script sets the proper parameter for transmission, dial into the PROFS mainframe system at Sloan School of Management, connect, set terminal type to VT100, and displays the login screen of PROFS when finish. If all lines are busy this script will end and inform the user to try again later. This is also the startup script that LFM-Email calls when clicked.

LFMHQ This script will log onto the LFMHQ account from the PROFS login screen level.

OpenMail This script will open the PROFS mailbox and display the list of mails from the Main Menu level.

hangup This script will properly hangup the telephone after the user has logged off the PROFS system.

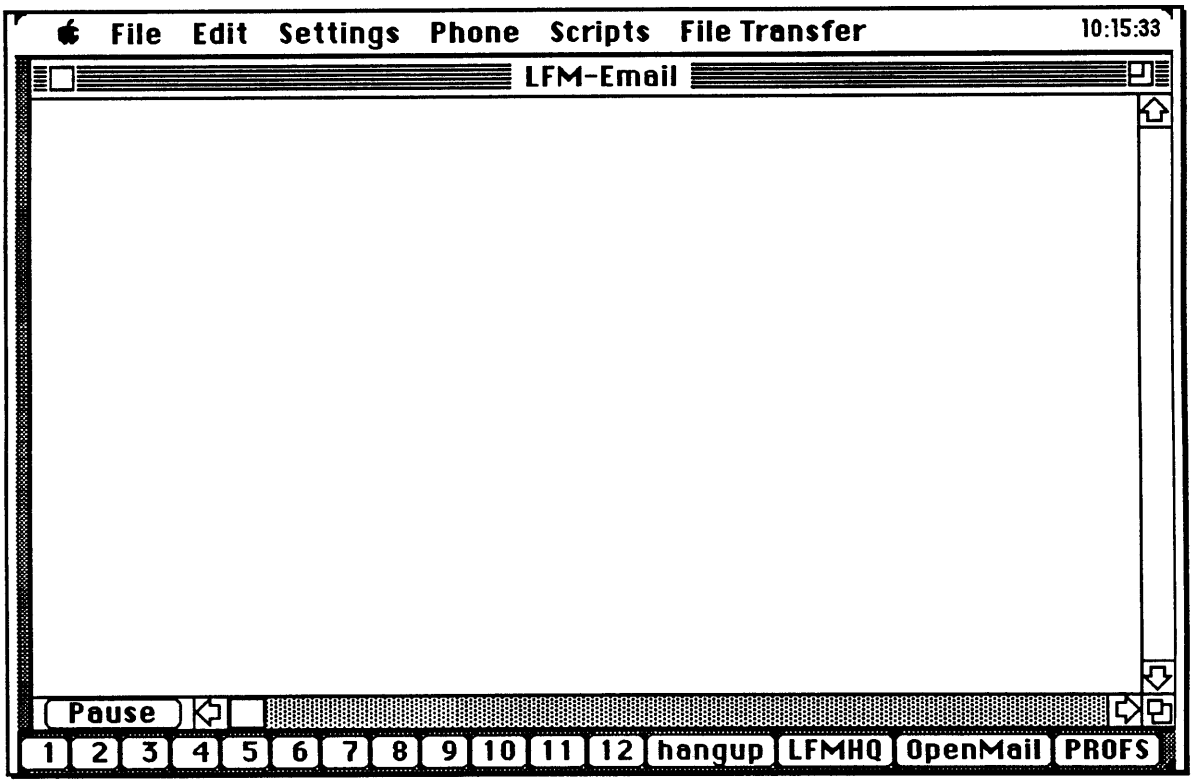
1 **2** **3** **4** **5** **6** **7** **8** **9** **10** **11** **12**

These buttons are used as function keys for Macintoshes that uses the standard Apple Keyboard which does not contain function keys. Only the Apple Extended Keyboard contains functions.

This script can be customized to enter the userid and password automatically. So when the user double clicks on the LFM-Email icon, it will return input control to the user after it has successfully logged into the user's account and display the PROFS Main Menu on the screen.

This software also support Kermit and XCMD file transfer capability between the Macintosh and the host machine.

A sample screen of the LFM-Email prior to PROFS connection is shown below:



APPENDIX D: POLICY AND PROCEDURES

WHO IS ON THIS NETWORK?

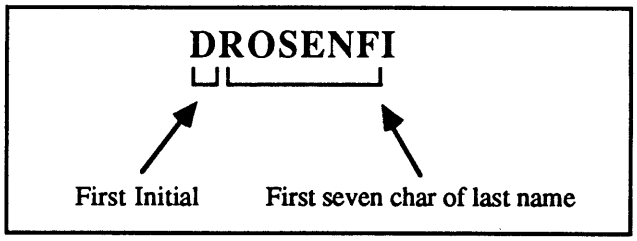
As of May 1989, the Leaders for Manufacturing electronic mail network includes the administrative staff, all LFM fellows, sponsoring company representatives, professors who serve on the working group and various internal function committees.

ELECTRONIC BULLETIN - LFMHQ

LFMHQ@SLOAN.MIT.EDU is serving as the electronic bulletin board for Leaders for Manufacturing Program. This account will retain a copy of all memos sent to any distribution lists. So if anyone lost a memo for a meeting, he can go to LFMHQ to look up the relevant information.

CONVENTION FOR USERID ASSIGNMENT

The userid and nickname for non-PROFS users shall be composed of the first initial and the last name up to the first seven characters of the last name. So the name will be maximum of eight characters. For example, the account name for Don Rosenfield is:



In the case of userid duplication, use the first two characters of the first name plus the the first six characters of the last name.

The distribution list name shall be maximum of eight characters. This name must start with the first three characters being LFM. Then the rest of the five characters can be anything that will uniquely represent such list.

ADDITION OF NEW USERS

The following procedure is recommended for such occurrence:

1. If PROFS user, update user information to the LFM Electronic Mail Database. If non-PROFS user or company personnel, obtain the complete e-mail addressing information, assign nickname and update user information.
2. Update distribution list where applicable.
3. Send all update information to Virginia Gifford or John Maglio at the Sloan Systems administration for physical update on PROFS.

E-MAIL DIRECTORY DATABASE MAINTENANCE

Judith Stitt, the editor for printed communication (JSTITT@sloan.mit.edu, 9-313, 253-1462) is responsible for maintaining the e-mail directory database and the distribution list. Her contact information is as follows:

E-mail:	JSTITT@SLOAN.MIT.EDU
Telephone:	(617) 253-0812
FAX:	(617) 253-1462
Interdepartmental Address:	9-313

One major update shall be done at the beginning of each semester. It includes addition of new students, faculty, and sponsoring company representatives information and deletion of all outdated information.

The committee and other distribution list information shall be updated as soon as a member is added or removed. A new distribution list shall be generated whenever such a change occurs. New lists shall be forwarded to Virginia Gifford or John Maglio for implementation.

DISTRIBUTION LIST

The Communications Committee and the administrative staff shall determine the need of creation or deletion all global distribution lists. If a participant feels a need to create a global distribution list, he should file a request via electronic memo to Judith Stitt at JSTITT@SLOAN.MIT.EDU. Judith will update the database and send a memo to John Maglio at JM@SLOAN.MIT.EDU to implement the new list.

HARDWARE INSTALLATION REQUIREMENT

5ESS ISDN

Hardware requirement include: a personal computer (either personal computer or Macintosh, an AT&T digital phone (can be either model AT&T ISDN 7505, 7506, or 7507), a standard modem cable, and a communication software. The modem cable can be purchases at the MIT MicroComputer Center. The modem communications software can be obtained from the Sloan Systems Administration. A copy of the automatic dial-in script for the Macintosh is available the the LFM Headquarters through Judith Stitt.

Ethernet

The hardware requirements include a ethernet drop, a personal computer equipped with ethernet circuitry or a local area network with a gateway into the MIT Internet, Telnet software, and an IP Address assigned by MIT Telecommunications. All installation ranging from the ethernet drop to configuring the Telnet software and gateway is handled by MIT Telecommunications. All requests forward to:

Ron Hoffmann
Assistant Network Manager
MIT Telecommunications
253-4101
E40-311A
HOFFMANN@BITSY.MIT.EDU

WHO PAYS FOR THE NETWORK

All existing accounts are paid for by its respective department. For the new PROFS accounts that had to be set up are currently paid by Sloan School of Management. The LFM program will eventually assume the financial responsibility of the e-mail network.

APPENDIX E: LFM ELECTRONIC MAIL DIRECTORY

Name	Title	E-mail Address
David C. Allan	Student	dallan@sloan.mit.edu
Rosalie M. Allen	Staff	rallen@sloan.mit.edu
Anant Balakrishnan	Professor	balakri@sloan.mit.edu
William Beckenbaugh	Company	wbeckenb@sloan.mit.edu rwt@cadsun.srd.mot.com
Sara L. Beckman	Company	sbeckman@sloan.mit.edu tomm%hpmwtd@hplabs.hp.com
Dimitri Bertsimas	Professor	dbertsim@sloan.mit.edu
Gabriel R. Bitran	Professor	gbitran@sloan.mit.edu
Thomas A. Black	Student	tblack@sloan.mit.edu
Kent Bowen	Professor	kbowen@sloan.mit.edu
Douglas Braithwaite	Company	dbraithw@sloan.mit.edu braithwaite%asabet.dec@decwrl.dec.com
William Branan	Company	wbranan@sloan.mit.edu rwt@cadsun.srd.mot.com
Robert Brown	Professor	rab@jack.mit.edu
Stuart B. Brown	Professor	sbrown@sloan.mit.edu
Marie C. Cedrone	Staff	mcedrone@sloan.mit.edu
Michael A. Cusumano	Professor	mcusuman@sloan.mit.edu
Alvin W. Drake	Professor	drake@athena.mit.edu
Thomas W. Eagar	Professor	teagar@sloan.mit.edu
Harold E. Edmondson	Company	hedmonds@sloan.mit.edu tomm%hpmwtd@hplabs.hp.com
Scott Elliot	Company	selliot@sloan.mit.edu scotte%hpmwtd@hplabs.hp.com
Gerald L. Elson	Company	gelson@sloan.mit.edu elsong%aesv01%hac2gm@engvax.scg.hac.com
Steven D. Eppinger	Professor	eppinger@wheaties.ai.mit.edu seppinge@sloan.mit.edu
C. Fred Fetterolf	Company	fetterol@sloan.mit.edu brownne@aldncf.alcoa.com
Charles H. Fine	Professor	cfine@sloan.mit.edu
Wayne S. Firsty	Student	wfirsty@sloan.mit.edu
Charles P. Fletcher	Company	cfletche@sloan.mit.edu fletchercp@aldncf.alcoa.com
Kevin D. Freund	Student	kfreund@sloan.mit.edu
Mark E. Friedberg	Student	mfriedbe@sloan.mit.edu
Corinna S. Fu	Student	cfu@sloan.mit.edu
John Gartley	Company	jgartley@sloan.mit.edu gartley@aldncf.alcoa.com
Michael J. Graves	Professor	mgraves@sloan.mit.edu
Stephen C. Graves	Professor	sgraves@sloan.mit.edu
Timothy G. Gutowski	Professor	tgutowsk@sloan.mit.edu
William C. Hanson	Company	whanson@sloan.mit.edu henson%cormts.dec@decwrl.dec.com
David E. Hardt	Professor	hardt@lmpvax.mit.edu
Brian R. Harris	Student	bharris@sloan.mit.edu

Rebecca Henderson	Professor	rhenders@sloan.mit.edu
Ronald R. Hoffman	Company	rhoffman@sloan.mit.edu
		brownne@aldncf.alcoa.com
Brian M. Kanter	Student	bkanter@sloan.mit.edu
Thomas A. Kochan	Professor	tkochan@sloan.mit.edu
Richard A. Krueger	Student	rkrueger@sloan.mit.edu
Paul A. Lagace	Professor	plagace@sloan.mit.edu
James W. Lawton	Student	jlawton@sloan.mit.edu
Thomas Lee	Professor	thlee@sloan.mit.edu
Allison List	Staff	alist@sloan.mit.edu
Timothy P. Loucks	Student	tloucks@sloan.mit.edu
Bernard Loyd	Student	bloyd@sloan.mit.edu
Stuart E. Madnick	Professor	smadnick@sloan.mit.edu
Virginia L. Maggs	Student	vmaggs@sloan.mit.edu
Thomas L. Magnanti	Professor	tmagnant@sloan.mit.edu
Andrew P. McAfee	Student	amcafee@sloan.mit.edu
Frank McCabe	Company	fmccabe@sloan.mit.edu
		mccabe%memit.dec@decwrl.dec.com
Tom Menzies	Company	tmenzies@sloan.mit.edu
		tomm%hpmwtd@hplabs.hp.com
Peter W. Moran	Student	pmora@sloan.mit.edu
John Muenz	Company	jmuenz@sloan.mit.edu
		muenzj%aesv01%hac2gm@engvax.scg.hac.com
Rebecca J. Munroe	Student	rmunroe@sloan.mit.edu
Richard C. Rawe	Company	rrawe@sloan.mit.edu
		rawerc@aldncf.alcoa.com
Donald Rosenfield	Professor	drosenfi@sloan.mit.edu
Donald Runkle	Company	drunkle@sloan.mit.edu
		sherwoop%aesv01%hac2gm@engvax.scg.hac.com
Emanuel M. Sachs	Professor	sachs@caf.mit.edu
Benjamin R. Samuels	Student	bsamuels@sloan.mit.edu
Martin Schlecht	Professor	schlecht@caf.mit.edu
Julia S. Schneider	Student	jschneid@sloan.mit.edu
Warren P. Seering	Professor	wps@wheaties.aimit.edu
Jeremy F. Shapiro	Professor	jshapiro@sloan.mit.edu
Christine T. Shipp	Student	cshipp@sloan.mit.edu
Alexander Slocum	Professor	aslocum@sloan.mit.edu
David H. Staelin	Professor	dstaelin@sloan.mit.edu
John Sterman	Professor	jsterman@sloan.mit.edu
Judith V. Stitt	Staff	jstitt@sloan.mit.edu
Julian Szekely	Professor	jszekely@sloan.mit.edu
Robert J. Thomas	Professor	rthomas@sloan.mit.edu
Bob Tykal	Company	btykal@sloan.mit.edu
		rwt@cadsun.srd.mot.com
Marcie J. Tyre	Professor	mtyre@sloan.mit.edu
Karl T. Ulrich	Professor	ulrich@wheaties.ai.mit.edu
James M. Utterback	Professor	jutterba@sloan.mit.edu
Dean A. Vlasak	Student	dvlasak@sloan.mit.edu
Mauro J. Walker	Company	mwalker@sloan.mit.edu
		rwt@cadsun.srd.mot.com
Donald E. Walker	Company	dwalker@sloan.mit.edu
		rwt@cadsun.srd.mot.com
David A. Weber	Staff	dweber@sloan.mit.edu
Lawrence M. Wein	Professor	lwein@sloan.mit.edu

Roy E. Welsch	Professor	rwelsch@sloan.mit.edu
Bob White	Company	bwhite@sloan.mit.edu tomm%hpmwtd@hplabs.hp.com
Ron Whitney	Company	rwhitney@sloan.mit.edu rohw%hpmwtd@hplabs.hp.com
Neil Wylie	Company	nwylie@sloan.mit.edu tomm%hpmwtd@hplabs.hp.com
James C. Yao	Staff	jamesyao@sloan.mit.edu jamesyao@mit2d.mit.edu

APPENDIX F: LFM DISTRIBUTION LISTS

The current distribution lists include:

LFMADMSN	Admissions Committee
LFMALCOA	Aluminum Company of America
LFMALL	All participants included in the LFM e-mail directory.
LFMBOENG	Boeing Company
LFMCOMM	Communications Committee
LFMCURR	Curriculum Committee
LFMDEC	Digital Equipment Corporation
LFMFELLW	All LFM fellows
LFMGM	General Motors
LFMHP	Hewlett-Packard
LFMJJ	Johnson & Johnson
LFMKODAK	Eastman Kodak
LFMLIASN	Company Liaison Committee
LFMMOTOR	Motorola Inc
LFMPRJCT	Company Projects Committee
LFMPROSM	Pro-Seminar Committee
LFMPRPTY	Intellectual Property Rights and Property Data Committee
LFMRESCH	Research Committee
LFMWKGRP	Working Group

APPENDIX G: BITNET INFORMATION

BITNET is an inter-university network. Each BITNET member is an educational computer center which has an operating system compatible with the network and supports at least one leased line to another member. Users at member universities may utilize the facilities BITNET offers. At present these include electronic mail, the transfer of programs and documents, and access to the BITNET server machine, BITSERVE.

BITNET was developed at CUNY/UCC to perform a number of services for general use to the BITNET community. BITSERVE provides, by special-message and file-transfer facilities, access to two kinds of files: its own CMS files, and files designed for BITSERVE in a VSAM database. For the purpose of the Leaders for Manufacturing Program, it primarily serves as a communication mean for sending electronic mail messages to foreign servers.

In order for a company to apply for BITNET membership, it must find a Class A or B member (such as MIT) willing to provide a connection port and sponsor the organization. The company must also have substantial research collaborations with an institution of higher education. The application will be reviewed by the BITNET Board of Trustees Membership Committee for approval. If approved, there will be a $8,000 annual fee. In addition, the leased line will cost about $1,400 per month. So the annual operation fee for a company to access BITNET will be about $25,000 per year.

An application packet can be requested from BITNET by sending an electronic mail message to SELLERS@BITNET. Other general information can be obtained by forwarding requests to INFO@BITNET.

Information on how to use BITNET and a list of all BITNET members can be found on Sloan's IBM 4381 mainframe by typing *"help BITNET"* at the VM command level.