

Building a Network-Based Office Environment

Masahiro Noguchi*1

Abstract:

At Nippon Steel Corporations' Computer Systems Laboratory, researchers are building and operating a computer system, aiming at an environment in which each member is assigned a workstation and uses the workstation as his or her main workplace. Part of the Electronics Research Laboratories, this office environment is designed to use electronic mail as a basic means of communication with a news service and the World Wide Web (WWW), enabling researchers to make the best use of the knowledge and information of other researchers. Many electronic services deemed necessary for improving work efficiency are also furnished to help the researchers carry out a variety of tasks at their desks.

1. Introduction

The Computer Systems Lab. of the Electronics Research Laboratories⁽¹⁾ undertakes computer software research and development. The laboratory has well over 100 staff including researchers under direct employment, staff working on joint research and trainees from other organizations, as well as subcontract workers. The researchers themselves are building and operating a network in which workstations are assigned to individual members and networked with other computers. This computer network is not only used as a research and development tool, but also has original systems built to serve as a foundation for smoothly carrying out various tasks.

Previous computer systems were built for the main purpose of partially supporting core jobs, and computers were used as

aids to core jobs. The laboratory aims at creating the environment where computers themselves can be utilized as the main workplace, so that users can carry out most of their tasks at their desks. The researchers are also encouraged to enjoy the benefits of participating in the same network by sharing and adding to the networked information.

This report introduces the computer system's main functions.

2. Configuration of Network

The laboratory is composed of 15 offices and several laboratories occupying the second to fourth floors of a building. The offices and laboratories are connected by a network. About 200 computers, including UNIX⁽²⁾ workstations assigned to individual users, and about 100 network devices are linked. The network is

*1 Electronics & Information Systems Division

*(1) Renamed the Systems Research & Development Center, Electronics & Information Systems Division, on June 29, 1995, as a result of the company's reorganization.

*(2) Registered trademark licensed by X/Open Company Limited in the United States and other countries.

operated as 15 subnetworks for balancing the load, localizing failures, and delineating the administrative boundaries. The network is also linked with other networks within the company and with the Internet through access control zones, called firewalls. It is built as the environment where users can easily converse and exchange information with others outside of the laboratory and the company.

The laboratory's system is accessible from outside via modems, so that staff can use it from their hotel while on business trips or from home.

3. Electronic Mail

3.1 Description of electronic mail system

Electronic mail (e-mail) is the most important means of communication in the laboratory. Since standard UNIX mail was adopted as the e-mail system, users can exchange e-mail with any address on the Internet. At present, about 5,000 e-mail messages are exchanged per day within the laboratory, and about 1,000 e-mail messages are exchanged with people outside the laboratory and the company every day.

There are several e-mail writing and reading programs to choose from. Most people use the freeware programs RMAIL and mh-e on the GNU Emacs editor⁽³⁾.

Usually, software to monitor the arrival of e-mail messages is run on the workstations, so that the e-mail service can be used when a quick response is required⁽⁴⁾.

An example of an open mh-e screen is shown in Fig. 1.

3.2 Usage patterns of electronic mail

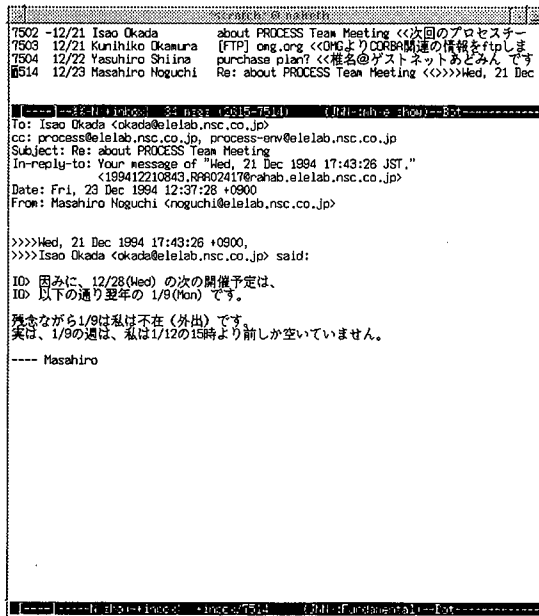


Fig. 1 Example of electronic mail system screen

⁽³⁾ GNU Emacs has multiple buffers and is designed to launch an e-mail system or news system from inside or to invoke a UNIX command. Since documents can be freely copied or edited between the buffers, part of the content written in a news article, for example, can be copied to an e-mail message and sent out again. Or the program contained in the e-mail message can be copied to another buffer, compiled and executed, and this can be again mailed. This editor is very convenient for this purpose.

Relatively many people believe e-mail is a substitute for the telephone. In reality, however, there are unexpectedly few situations in which we exchange e-mail messages on a one-to-one basis. E-mail messages are often multicast by using a mailing list and the carbon copy (cc) function.

The mailing list defines an address for a group of users and provides multicasting to the users registered at the address. At our site, for example, a message sent to the address "all" reaches all staff at the laboratory, and a message sent to the address "process" reaches all members of the group named "process control technology" among our research groups. The multicasting function allows a message or questionnaire to be sent to a group of users in the same way as a message is sent to a single user. Our department currently has about 130 mailing lists.

To send the same document to other addresses as well as to the original address, "cc: address" is written. If this function is used properly, a message sent to a particular user can be disclosed to a certain group of other users for the ongoing discussion to be undertaken from their point of view. This done, the users can enter the ongoing discussion or follow the course of the discussion undertaken while they were absent.

In Fig. 1, the e-mail message is also multicast to the users on the mailing list written on the cc line.

At the laboratory, e-mail is recognized as a powerful tool with functions surpassing those of the telephone and is extensively used for a wide variety of purposes, including requesting users in and out of the laboratory to perform tasks or giving them instructions, inquiring about something, replying to them, exchanging weekly reports, reviewing or discussing research results, coordinating schedules, and notifying about and applying for participation in events.

3.3 Applications of electronic mail

The electronic mail system can be applied to build a system for making job requests to computers and receiving the results of executed jobs from computers. When the message "send format/xxx" is sent to the computer system, a document template named "xxx" (for example, a purchase specification or book purchase request) can be sent back from the computer system. The template is a LaTeX⁽⁵⁾ documents. When the template is copied to another buffer in the editor, it has the necessary items already filled in and is processed by the LaTeX processing system. In this way fixed-format document can be easily prepared.

This framework is very helpful in reusing documents. The laboratory also provides an automatic registration service to a data base for a technical report subscription service and a directory service (see Chapter 6). Some mailing lists are linked directly with the news system to ensure rapid response and public access at the same time.

3.4 Advantages of e-mail

Many reports extolling the advantages of e-mail are available in the literature. At the risk of repeating previously reported com-

⁽⁴⁾ When the e-mail message "As I'm conducting an experiment, please reply as soon as you read this message" was sent without notice to 10 people sitting at their workstations, eight responded within 3 min, and the latest responded within 10 min.

⁽⁵⁾ A type of document processing system.

ments, advantages from the laboratory's standpoint are summarized below.

1) Information can be sent to other people in their absence.

Information can be sent to users who are often absent, are away on a business trips, or have already gone home. Conventional telephone messages are unreliable, and their urgency or intention is often lost.

2) Information can be received in one's absent.

Even when absent, we can follow what is happening at the office or how the discussion is evolving.

3) Meeting time reduced.

Using the previously-mentioned multicasting function, we can simultaneously communicate with a number of colleagues on the network. Since the discussions often deal with identification of problems and presentation of solutions, we can reduce the need for actually meeting together. If we actually meet, we have our prior discussions through e-mail as background information and only need to concentrate on the remaining points. Thus meeting time is shortened.

4) Meetings can be easily scheduled.

When trying to schedule a large meeting, we must often make many telephone calls to the intended participants. Important participants are often so busy that they cannot be contacted and their schedules are almost fully booked. The time required to schedule such meetings by telephone is enormous. Meetings can be scheduled with relative ease by multicasting an e-mail message to all prospective participants and then processing the replies.

5) Time spent sending documents is reduced.

When sending a document to several people by regular postal mail, we must copy it for the number of the recipients, enclose the copies in envelopes, write addresses on the envelopes, and post them. The tasks involved in sending a meeting notice to 20 persons, for example, are simple but time-consuming. With e-mail, the necessary work load does not differ much between sending an e-mail message to a single user or to 100 users, and it is smaller than sending a single document by regular mail.

6) Staff can work at their own pace without being interrupted by telephone calls.

We converse via e-mail with not only research members in our department but also with clerical staff members, and rarely receive telephone calls. We are seldomly disturbed by telephone calls; therefore we can work more efficiently.

7) Problems of "I have sent the message/I have not received the message" are reduced.

Unlike a telephone call, with e-mail we express our intention in a document so it is possible to make a more logically consistent argument. Since e-mail messages are also left as records, the problem of "I have sent the message/I have not received the message" is reduced.

8) Replies to difficult questions can be made after due consideration.

Sometimes we are forced to make quick replies to questions by telephone. In such a case, questions may be answered without due consideration. With e-mail, we can reduce this situation because time is available for adequate consideration.

4. News System

4.1 Description of news system

The news system distributes information of high publicity value to many users at a time. Individual users read the news at

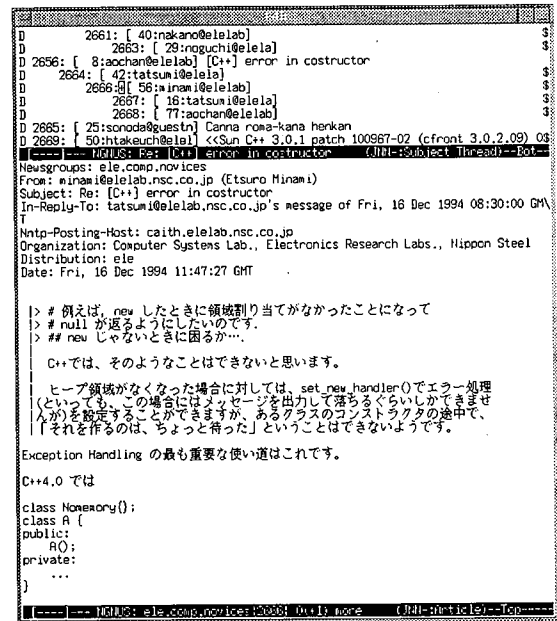


Fig. 2 Example of news system screen

different times, but are assumed to it at least once per day. The news distribution range is roughly set, such as for a laboratory, division, or company. That is, the news system is a tool for disseminating information of low immediacy to many unspecified users and plays a different role to that of the e-mail system.

At present, there are 19 laboratory-level news groups, four division-level news groups, and five Company-level⁽⁶⁾ news groups. The number of contributions varies among the news groups, with some news groups providing about 50 contributions per month.

Besides these intracompany news groups, we can also subscribe and contribute to news groups on the Internet, which are spread throughout the world, including Japanese news groups such as fj.

Most people at our laboratory use the freeware GNUS on the GNU Emacs editor as the software to read and write news articles. An example of GNUS' screen is shown in Fig. 2. This is an article in a news group established to accept general, simple computer-related questions.

4.2 Usage patterns and advantages of news

The main usage patterns and advantages of news at the laboratory are summarized below.

4.2.1 Clerical and job communications

Notices of meetings, seminars, and business formalities, for example, are circulated in the news system. These were formerly circulated on paper. With when they were circulation on paper, the documents were beautifully prepared, copied in to the necessary number, and circulated to the people concerned.

This circulation method involved the following problems:

- 1) Documents were written more beautifully than necessary (for example, with elaborate layout, shading, and ruling).

⁽⁶⁾ Although these are called Company-level news groups, because there are not many intracompany organizations that have news systems, they are actually news groups involving the exchange of news between several organizations.

- 2) Documents had to be copied for the number of recipients.
- 3) Documents had to be distributed by office mail. Much time was required for addressing envelopes, enclosing the copies in the envelopes, and sealing them.
- 4) Document circulation took time. Some documents did not reach their intended readers.

After creating an article in plain text and invoking the contribute command, the news system communicates the information to other users in a predetermined range quickly and reliably.

4.2.2 Reports

There are some items of information, such as a report about a meeting of an academic society, that should be shared by as many people as possible. Experimental reports also belong to this category. Formerly, it was difficult to send information to many unspecified people interested in a certain topic and to receive information from such people. The scope of information exchange was thus limited. Using the news system, we can now easily exchange information with like-minded people whom we personally do not know.

4.2.3 Questions

Other people often know the answers to questions that trouble us. We cannot identify people who may know answers to our questions nor can we go around asking everyone. The news system can be readily used to post questions to a large audience. If properly used, the news system will prove effective in training new employees.

4.2.4 Discussions and exchange of opinion

The news system provides us with opportunities for expressing our opinions in public, discussing a wide range of topics from technical to administrative ones, finding clues for problem solving, and obtaining ideas for improving present situations.

4.2.5 Information gathering

News on the Internet is an extremely important source of technical information where abundant information can be gathered quickly. We can follow the emergence of problems in society, their solutions, and other important trends by monitoring news over a long period of time. News articles on the Internet flow in such vast quantities that it is not possible to single-handedly read those articles that are related to one's own research. We also cannot expect other people to read the same articles as we read. When we find articles not directly related to our research but helpful to other researchers, we mail copies of such articles to them. The results of information gathering are put to effective use in this way.

5. System Using World Wide Web (WWW) and Mosaic

5.1 Description of WWW and Mosaic

Formerly, we shared documents, be they paper or electronic documents, by copying and filing them by ourselves or by filing them in a common place. Whichever method adopted, we had to expend considerable labor in filing documents in such a way that we could retrieve them on an as-required basis and were resigned to some overheads for retrieving necessary documents. Particularly when documents were stored electronically, it was necessary to memorize their locations on the computer and the commands corresponding to their format. It took time and retrieve the necessary documents.

The laboratory started using the World Wide Web (WWW) as a means of solving this problem to some degree. The WWW

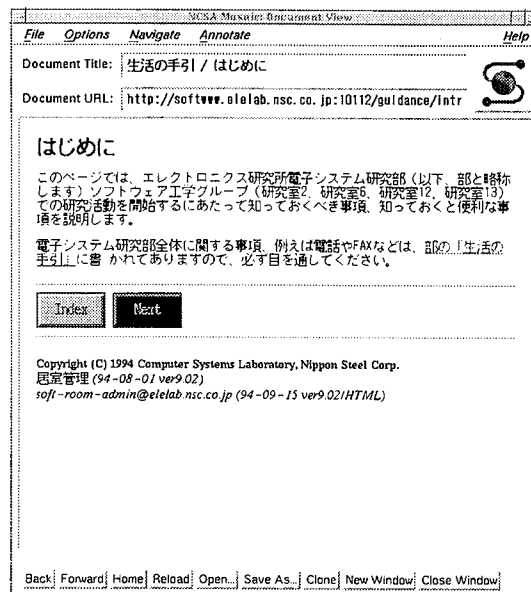


Fig. 3 Example of Mosaic screen

is a hyperlink of information stored throughout the world, and we can follow the hyperlink to retrieve associated information. The HyperText Markup Language (HTML) is the format for making WWW documents. HTML itself is expressed as the Document Type Definition (DTD) of the Standard Generalized Markup Language (SGML)⁽⁷⁾.

HTML attaches what is called an "anchor" to any word in a document to link the word with another document. When used with the client program called Mosaic, the anchored word is shown in a color different from that of the other words in the document. When this word is clicked on with a mouse, the document specified by the anchor appears on the screen.

Mosaic has been adapted for multimedia and can handle not only textual information but also still images, full-motion video, and audio in an integrated manner. The display tools for making specific document and image types are managed by Mosaic and are automatically launched without the users' knowledge. This greatly facilitates the convenience of Mosaic.

An example of a Mosaic screen is shown in Fig. 3. This screen is part of a document describing the work rules for the group to which the author belongs. Buttons are pasted to the document and used to go up and down the hierarchical structure of the document. The phrase "guide to work rules at the laboratory" is an anchor. Clicking on this phrase reveals the document⁽⁸⁾.

5.2 Examples of WWW uses

Examples of documents and information accessible on the WWW at the laboratory are described below.

- 1) External circulars (paper-based circulars entered via a scanner)
- 2) List of jobs and persons responsible for specific tasks at the laboratory
- 3) Documents on laboratory budget procedures

⁽⁷⁾ A language and international standard for defining structured documents.

⁽⁸⁾ "Guide to work rules at our laboratory" is written not in HTML but dvi format, so that it is shown when the tool called xdvi is automatically launched.

- 4) Documents on laboratory-level work rules and business formalities
- 5) Documents on laboratory get-togethers (such as list of organizers, rules, and accounting information)
- 6) Materials for training and educating new employees
- 7) Network service-related information

At the group level, servers provide access to guidebooks for work rules and business formalities, research and development policies, and technical information. At the research team level, information is furnished concerning research results. These items of information are increasing daily, and various information can be simply retrieved and displayed by using Mosaic. As some users are uploading their own information, the WWW-based system is rapidly growing. Of course, we can also search the WWW for information from outside the company.

6. Other Electronic Services

Besides those described previously, various other electronic services are furnished. We can use these services at our workstations; some of which follow.

6.1 Schedule information service

When we write our schedules in files of predetermined format, these are automatically collected and displayed as the schedules of individual members and as daily schedules of all laboratory staff.

6.2 Directory service

Information on the laboratory staff (such as room numbers, extension numbers, and e-mail addresses) can be searched, and staff photos are also included.

6.3 Dictionary search service

Five dictionaries, including a Japanese dictionary, an English-Japanese dictionary, and a Japanese-English dictionary, can be accessed from within the GNU Emacs editor. Some of the dictionaries undertake searches by partial matching of character strings or by carrying out associative searches from word contents.

6.4 File Transfer Protocol (FTP) service

This is the so-called file transfer service. It retrieve software and information made publicly available outside the Company such as freeware and papers created at universities and research institutes. At the laboratory, a computer in which such items of information are stored (<ftp://elelab.nsc.co.jp>) is set for external access. Some software programs and papers in great demand within the laboratory are mirrored, directly or indirectly, with originators, so that the latest versions are available after only a few days' delay.

6.5 Coffee availability monitoring service

The laboratory's offices are scattered over a wide area, so the researchers often complained that they wasted time walking to the coffeemaker only to find it empty. Accordingly a TV camera-equipped coffeemaker monitoring service that estimates from the processed TV camera images the residual amount of coffee in the coffeemaker was installed. Users can open a small window on the screen of their workstation to view the amount of coffee.

6.6 Railroad timetable service

Train timetables for the lab's nearest station to the stations close to the company-owned apartment buildings for the employees are also provided. By entering a command, several train departure times are displayed along with available train connection information.

7. Conclusions

Several factors have contributed to the successful implementation of our network-based office environment. For example, many staff were enthusiastic about enhancing their work efficiency by going on-line, and in view of the essential nature of our organization, we were blessed with many people with high systems development capabilities. Although these factors were important, the greatest driving force was the laboratory's top management who obliged us to use the electronic mail and news system services from the early stages of the endeavor. If top management had been unresponsive to these electronic communication means, then the present financial and personnel resources would not have been forthcoming, and most staff would have stuck to their old work methods without experiencing the benefits of the network-based office environment.

With this system, we can carry out most of our tasks, including data entry, while sitting in our booth. We can concentrate on our work in an office environment where the telephone rarely rings. Some future issues are described below.

- 1) At present, the information sources are unevenly distributed within the laboratory. To share the knowledge of all staff, it is desirable that more people should be creators of on-line information. We are, however still searching for the means to encourage more staff to do so.
- 2) The present network is isolated from the mainframe system that performs routine jobs, such as purchasing and personnel management, and there are separate terminals for the mainframe system. As a result, some work flow areas do not function smoothly. This situation will have to be improved.
- 3) As use of the WWW-based system is rapidly expanding, large volumes of information, including image information, are beginning to flow with in the network, requiring a new network of greater capacity.

Through this system, the laboratory has accumulated a considerable amount of know-how about the construction and operation of electronic office environments. Transfer of this expertise to other organizations is a major priority. We supported the laboratories' administrative staff in using electronic mail and news systems. As a result, these staff are able to use the system to reliably handle information and inquiries about technology planning, purchasing, accounting, and welfare. We are now helping other laboratories to launch WWW servers. In the near future, a system will be established for sharing laboratory-level documents (including images) by electronic means.

The author hopes that this report will be of some help to those interested in this field.