

Implementation considerations in electronic mail

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WHAT IS ELECTRONIC MAIL?

Electronic Mail is the transmission of text or a document by electronic means. Examples of Electronic Mail Systems (EMS) include traditional teletype services, facsimile, and computer message systems (CMS).

All such systems must be able to accept input, transmit the message, and output the information. In addition, a number of other facilities might be provided in areas like message preparation, filing and retrieval, addressing and distribution, accounting and control, coordination and content processing, and others.¹ See the companion paper in this proceeding for more information on Electronic Mail features.²

DESIGN CONSIDERATIONS

The selection of transmission media, data base methodology, hardware, and other design criteria are subordinate to meeting the end user requirements. It is necessary to define these objectives first, and then select the right combination of technologies to implement the EMS.

Basic objective

Certainly an EMS must accomplish its mission—the timely delivery of the message to one or more recipients. During research in the general business marketplace the following objectives were identified as general requirements.³

1. Low cost—due to the decision process, the justification of such system requires tangible benefits and transmission economies.
2. Reliability—the system must be available when needed, and must deliver the message accurately and dependably.
3. Ease of use—the system must be human engineered with its operator and user in mind, and be responsive in real time to operator action.
4. Control—there must be a provision to monitor and control usage.
5. Terminal independence—compatibility with as broad a range of user interface devices is desirable.

6. Security—privacy and security measures must protect the physical facilities and guard against unauthorized entry or access of the system through communication channels.

Some important characteristics should be also considered during the design phase. The potential for rapid growth in both message volumes and geographic dispersion must be planned for. Furthermore, the system must be flexible enough to change with the dynamic business requirements and growing sophistication of the users.

Organizational issues

In many organizations the impetus for Electronic Mail will originate with the communication's manager. In that case, the system is likely to be a TWX/Telex replacement; it will be designed to minimize common carrier costs. In others, the office services function will assume the responsibility; the goal is likely to be reducing clerical costs and improving secretarial productivity.

In other cases, the management information system function will start the ball rolling. EMS is an entirely different discipline than data processing and needs to be approached with different technologies and orientation. At the same time, a progressive management information systems department that has fully mastered data communications and understands the business needs of the company can leverage on these abilities quite successfully.

The companies with the greatest chance of success have merged these various responsibilities together. Information (computer and office) is a precious asset and communications (data and non-data) is the key to its effective use. Computer and communication techniques of all types are no longer distinct; but are converging. This is a fortunate phenomena offering real benefits, and alert organizations will change to take advantage of it.

In implementing Electronic Mail, it is necessary to analyze the real needs of the organization and its people. Senior management must also be involved.⁴ However, I think it is all too easy to get into "the managers must have a terminal" syndrome. That is an extremely complex psychological and motivational area that very few companies are equipped to

tackle now. Good, useful systems can be put together without going that far. The right terminal will sit on the boss's desk soon enough; but take modest steps to get there.

Communications media

The choice of transmission media include hardwiring for local terminals, the dial-up telephone network, leased lines, Dataphone Digital Services (DDS), specialized common carriers and value-added networks (VANs), and shared high bandwidth networks. Except for hardwiring, these alternatives will require either modems or data service units at the CMS and at (or within) the terminal equipment.

Direct Distance Dialing (DDD) provides access everywhere, but is expensive for calls placed during business hours. Wide Area Telephone Service (WATS) can reduce DDD toll charges at certain volume levels. Foreign Exchange and leased lines provide economies between sites that exchange a steady stream of traffic. Compatibility features, code conversion, and error checking must be performed by the CMS and the terminal equipment. The specialized common carriers can provide added transmission economies and some specialized services between certain cities, and some of these are ideal for facsimile users.⁵

Value-added networks, like TELENET and TYMNET, offer a number of useful services. They provide for compatibility for a large number of different terminals. That means, the network will handle the code, transmission speed, and terminal characteristics (for example, ASCII, 300 baud asynchronous, 200 millisecond carriage return delay, full duplex terminal) of a variety of devices and present the data stream in a uniform way to the CMS. They provide error checking within the network (from the node of access to the node of delivery). Perhaps most importantly, VANs provide for the sharing (multiplexing) of higher speed transmission facilities, providing significant economies.

TYMNET, described as a "terminal oriented" network by the inventor,⁶ has 450 nodes and is a local telephone call away from 175 cities in the United States,⁷ and services 30 foreign locations. TELENET, initially based on ARPANET technology, presently services over 90 cities. Based on the culmination of the GTE merger, TELENET plans to expand to 138 cities, and will implement SDLC in selected locations.⁸

AT&T's Advanced Communication Service (ACS) promised to offer the most extensive range of VAN services if it ever gets off the ground—and there is no technical reason why it should not. While AT&T has recently withdrawn this petition, I believe it will eventually develop and offer a similar service.

In a few years, high bandwidth transmission paths will become available at low costs. Companies with high volume requirements will use these "pipelines" for most communications. One network will carry voice, data, message, and perhaps some form of video communications. In these cases, Electronic Mail should be designed to fit right in.

Data structure

A CMS data base has special properties. One message may be sent to many recipients. The data structure should minimize the number of copies of a message. Pointers to the message contents become associated with senders and recipients to minimize storage and maintenance overhead. The same is true for user names and other data. As functionality increases, each element of data is associated in interlocking ways.

List processing can get pretty complicated even in a simple situation. Let's assume that the system lists, for the sender, mail that has not been read by its recipient(s) in an "out basket," and has an "in basket" so that a recipient can check his incoming mail and choose when to read it. When a user "sends" a message, the sender is linked to the message, and the message is linked to the recipients. All users are linked to their in baskets and out baskets. The message is likewise linked. When a recipient reads the message, for example, the sender is identified. Furthermore, the recipient's in basket and (by following the links) the sender's out basket is updated to reflect the message is read.

Users are sending and receiving messages all the time. There are sure to be conflicts in updating these linked lists. The system must have methods for resolving these conflicts and contention.

Because of the reliability issue, it is essential that all messages are backed up. In a system with moderate functionality, furthermore, the linked lists must be able to be rebuilt. In high volume systems that cannot be taken out of service, the development of a back-up and recovery procedure will compound the complexity of the data base.

Let's add one final, very real consideration that would be of utmost importance in developing a large scale intercompany public service. Because of volume or response or other reasons, it is necessary to distribute the processors and the data base. The question of distributed data base requires a conference of its own. There is a lot of good research being done, but I do not believe that this problem has been satisfactorily resolved, much less applied to a functionally rich CMS.

Data base sophistication compounds exponentially with functionality. For even a moderate system, the data base structure requires extensive list processing, multiple access protection, and sophisticated back-up and recovery methods. Before some systems are fully successful, the distributed data base problems must be solved.

Hardware

Minicomputers should be carefully considered as the delivery vehicle for a store and forward Computer Message System. A CMS is a special purpose system supporting multiple simultaneous users with uneven data rates, experiencing frequent interrupts, and requiring specialized list structures and string manipulation. It has been my experience

that general purpose operating systems and timesharing systems are not well suited for CMS development.

Minicomputer performance makes it practical to develop powerful message systems today. Minicomputer prices justify devoting the computer(s) to that application. Microprocessors, as part of intelligent terminals, make it possible to prepare the text locally; communication line charges can be saved by batching completed messages and transmitting them as a group. Microprocessors will become increasingly important for unloading the minicomputer of specialized communications functions. Ultimately, most functions will be performed by discrete microprocessors organized as modules of a Multi-Processor System.

In the case of facsimile, the basic tradeoffs are hardware cost versus transmission speed. Selected properly, a more expensive unit will reduce communication line charges per page and increase operator productivity.

Other issues

There are a number of other problems unique to the CMS environment.

1. Names—The recipient addresses should be easy to remember and appealing to human users. If possible, the users should be able to get the right address without having to search for it. In a large company, try developing a friendly scheme that prevents a message from going to the wrong Dave Smith. And what about the directory problem for Stuart instead of Stewart?¹⁰
2. Undelivered Messages—Provision must be made for messages that are sent to an addressee, but the addressee chooses not to read the message. What happens when a message is sent, but the recipient's user name is deleted before the recipient reads the message?
3. Interrupted Transmission—When a recipient chooses to "read" a message or group of messages, the CMS will put all the characters in an output buffer and flag the message as having been delivered. When the transmission is through a VAN, the network itself will accept and buffer characters. However, the recipient may be just seeing the first characters at 30 cps. If the transmission is interrupted (line failure, accidental disconnect) the characters that are on the way will be lost.
4. Custom Tailoring—For a large system, some users will need specialized services. Examples might be a special screen format, or a different protocol, or more detailed billing, or customized identification. Certain kinds of "execution files" and user programmed "partitions" might be considered. ACS plans to provide these kinds of options.
5. Legal and Regulatory—There is an extensive body of national and international regulation on the electronic switching of messages. Domestic EMS operated by a company on its own hardware for its own use is unregulated. Otherwise, it is best to check both existing and pending legislation.

IMPLEMENTATION

Depending on the scope of your EMS, implementing Electronic Mail can be a big job. Careful analysis and planning are an essential prerequisite. A number of specialized technical, organizational, management, and business skills will be brought into play. Good project management and trouble shooting skills are a must. The panelists at this session will offer their own experiences in implementing Electronic Mail.

Computer Decisions magazine has editorial offices in Rochelle Park, New Jersey; Sunnyvale, California; Bethesda, Maryland; and Lockport, Illinois. They are experimenting with a well-known vendor supplied computer message service. They are a small organization, and their experience and those of other users is recounted.

Chrysler Corporation has had its share of problems, and has cut expenses in a number of ways. However, a progressive project in Electronic Mail and communications continues to be funded because of important benefits. The status and progress of this project is reported.

Texas Instruments is a company known for technological innovation. Using their own hardware, TI has been aggressively developing and implementing an internal Electronic Mail system. The evolution of this system and its benefits worldwide are discussed.

The airlines have been pioneering users of communication technologies for years—the early work in reservation systems is a well-known example. Texas International Airlines has been increasing its Electronic Mail usage including facsimile, computer message systems, and a post office interface. Their thrust, current status, and future expectations are described.

Electronic Mail is alive and well in the real world. Companies are implementing this technology and achieving the benefits of decreased cost, increased responsiveness, and better utilization of resources. EMS is one of the challenges of the '80s. It greatly enhances the value of the information assets and improves the timeliness of effective decision-making. That is a real competitive advantage, and translates surprisingly soon into improved margins, larger market share, and greater profitability.

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