EDI AND X.400

INPUT

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Electronic Data Interchange Program (EDIP)

EDI and X.400

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Abstract

X.400 was adopted by the International Telephone and Telegraph Consultative Committee (CCITT) in 1984 to allow different electronic mail systems to exchange messages. While the present X.400 standard does not specifically address EDI, its architecture is sufficiently open so that EDI documents can, and will, be incorporated. A movement is growing within both electronic mail and EDI circles to make the requisite changes to X.400 so that it will incorporate EDI.

The purpose of this report is to explore the X.400 standard so that service providers and end users will understand how X.400 can be used to exchange EDI documents, how long it will take before the required changes will be made, and what the likely impact will be on the EDI and electronic messaging industries.

The report contains 78 pages and 31 exhibits.

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Introduction

I

Introduction

A Background

Electronic Data Interchange (EDI) provides companies with highly significant, operational cost savings in accounting, shipping, and inventory management. As a result, value-added service and timesharing providers are flocking to the market in order to provide valuable EDI services to their customers.

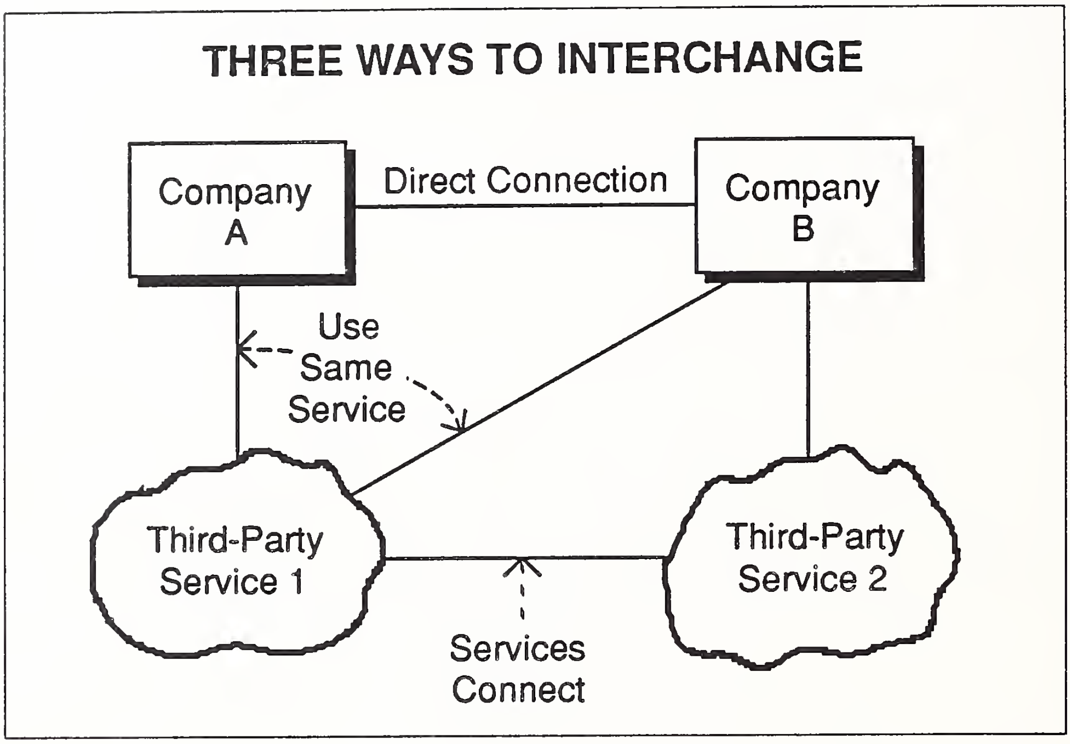
Even though the market is still in its nascent stages, there are more than 30 companies providing EDI services, with more likely to enter the market during the next several years. The entry of multiple service providers poses one major problem for users and providers: How do companies who use one service provider interchange trade documents with companies who use other service providers?

There are three ways for companies to exchange EDI documents:

- First, the companies can exchange documents directly between their computers.
- Second, the companies can subscribe to the same EDI service provider, which gives each subscriber a mailbox.
- Third, the service providers themselves can interconnect their services, passing EDI documents from companies subscribing to their respective services.

Each of these solutions illustrated in Exhibit I-1 is already being used in the market, although all have their problems. Direct connection between computers seems to be the most ideal method of interconnection. The myriad protocols in use on different computers, however, often make direct EDI interconnection impossible. Even if the protocol problem were solved, however, many companies cannot afford the staff, development, and communications costs required to be ready to receive EDI documents from multiple trading partners.

EXHIBIT I-1



Holding mailbox subscriptions on each EDI service is also a potentially effective solution. Unfortunately, with the growing number of service providers in the market, it is becoming unwieldy to have a mailbox subscription on each service.

Service provider interconnection also sounds like an excellent solution. Instead of a company having multiple mailboxes, each company needs only one—with the service providers handling the delivery among their systems. Unfortunately, service provider interconnection is fraught with problems, including keeping a single directory of users, keeping an audit trail of delivery across multiple providers, and developing a settlements process among the various service providers so that EDI tariffs can evolve with regularity.

B The X.400 Solution

The problems now associated with EDI interconnection will not go away soon. There is hope, however, that a long-term solution can be developed based on the X.400 interconnection standard. The X.400 solution was adopted by the International Telephone & Telegraph Consultative Committee (CCITT) in 1984 to allow different electronic mail systems to exchange messages. Although the present X.400 standard does not specifically address EDI, its architecture is sufficiently open so that EDI documents can be incorporated.

Although X.400 will not solve every problem associated with EDI interconnection, it can go a long way toward providing the security and regularity that EDI users require from any interconnected networks. As a result, a movement is growing within both electronic mail and EDI circles to make the requisite changes to X.400 so that it will incorporate EDI.

The purpose of this report is to explore the X.400 standard and its potential impact on EDI interconnection so that service providers and end users will understand:

- How X.400 can be used to exchange EDI documents
- How long it will take before the required changes will be made
- What the likely impact will be on the EDI and electronic messaging industries

Even though user organizations and service providers have made the assumption that X.400 will solve a number of problems associated with EDI interconnection, an important purpose of this report is to point out that the X.400 standard itself is only one piece of several important elements that must all fall into place before today's problems can be solved. As a result, service providers and user organizations should not raise their hopes that X.400 will provide a short-term solution to interconnection.

C
Scope

The study addresses the following topics:

- The X.400 standard and how it can be used technically by the EDI industry

- How long it will take to change X.400 so that it can be used for EDI

- What role tariffs and interconnection agreements play in EDI interconnection

- How X.400 will impact today's relationship between service providers and user organizations

- How service providers view X.400's impact on EDI

- How user organizations view X.400's impact on EDI

- The likely market impact of X.400 on the EDI industry

D Methodology

The research for this report consisted of:

- Corporate Interviews
  - Telephone interviews were conducted with 20 major user organizations, trade associations, and industry experts to understand their present position on EDI interconnection and their view of X.400.
- Vendor Interviews
  - Telephone interviews were conducted with 15 vendor organizations to discuss their present interconnection activities and their position on X.400.
- X.400 Expert Interviews
  - Telephone interviews were conducted with several known experts in the X.400 standards community to understand their position on X.400 and EDI, along with the steps that are being taken within major standards organizations to incorporate EDI into X.400.
- Product and Service Analysis
  - INPUT collected information on X.400 itself to understand from a technical viewpoint how EDI can be incorporated into X.400. INPUT also analyzed how the market is likely to react to X.400 when it becomes suitable for EDI.
- Custom Research Projects
  - INPUT has been involved in several custom research projects in EDI and Electronic Mail. Although no proprietary information is used from these reports, generic information and general industry knowledge gained from these studies is applicable to this report.

E Related Studies from INPUT

This study is one of a continuing series focused on EDI. Other reports published or planned for the series include:

- *EDI Software Products: Issues, Trends, and Markets*
- *EDI Implementation Case Studies*
- *North American EDI Service Market Analysis, 1988-1993*

- *North American EDI Service Provider Profiles*
- *Vertical Industry EDI Directions and Potentials*
- *EDI and Professional Services*
- *Network Services in Western Europe*
- *North American EDI Software Provider Profiles*
- *International EDI Services*
- *Federal Government EDI Initiatives*
- *Advanced EDI Services (1989)*

II

Executive Overview

II

Executive Overview

A
X.400 and Open Systems Integration

Electronic Data Interchange (EDI) is the electronic transfer of structured business data between computer applications in different organizations. It is process-to-process communication in machine-readable formats and overcomes organizational differences in computers, protocols, and data formats.

Over the past decade, the EDI industry has developed, adopted, and implemented a series of standards, called X12, that governs how EDI documents are exchanged. At present, communication of EDI documents takes place using a variety of low-level communication protocols, including the Universal Communications Standard (UCS), IBM's binary synchronous standard, and asynchronous communication protocols like Kermit.

Many EDI users have opted to use public EDI services, rather than exchange messages directly, for three reasons:

- There is no single protocol accepted by all users in the industry.
- The cost of operating direct communication networks under any of these protocols is high.
- Many companies are worried about connecting their sensitive host processors directly to communication networks.

When using a public service, the end user establishes a single session with the service provider and sends EDI interchanges for multiple trading partners and then retrieves all interchanges sent by its trading partners. The service provider acts like a post office by sorting the interchanges and placing them into the mailboxes for specific trading partners. In this way, an EDI user has to call the public service only once or twice daily to perform all EDI functions.

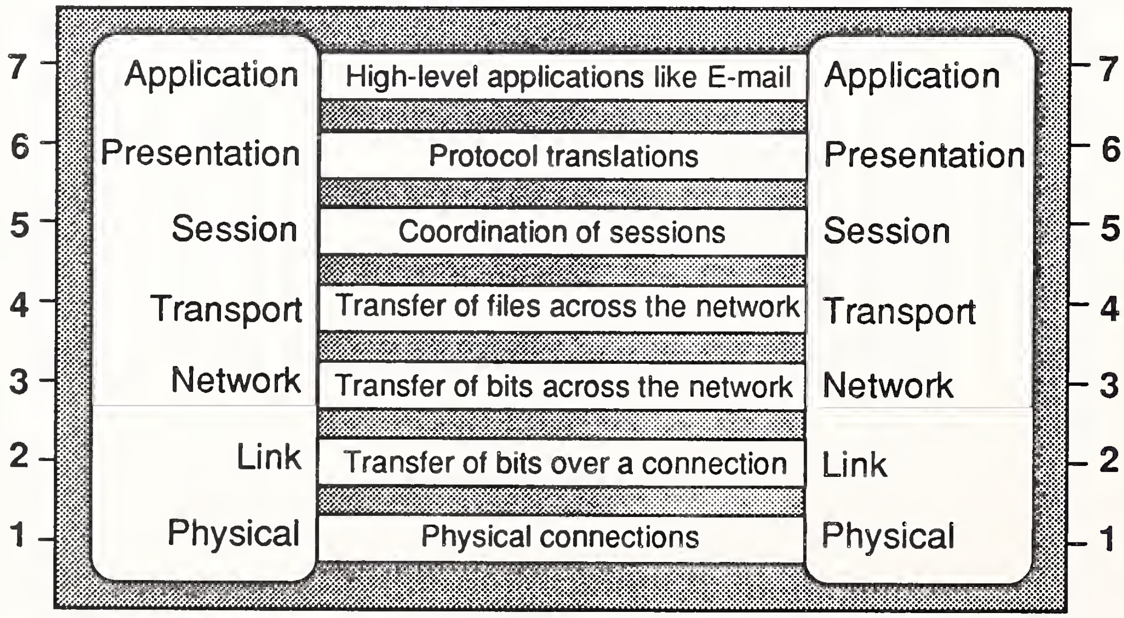
To provide even better service, the EDI service providers have interconnected their services using an open-mailbox concept. Basically, the service providers keep mailboxes on each others' services, so that an interchange can be placed in the mailbox of another service provider. The interchange is retrieved from the mailbox and then delivered to the recipient trading partner's mailbox. In this way, the service providers have eliminated the need for EDI users to keep mailboxes on multiple services.

In 1984, the X.400 Message Handling Standard was approved by the International Telephone & Telegraph Consultative Committee (CCITT) as a standard that would allow incompatible electronic mail systems to exchange messages.

X.400 is a high-level communications protocol that specifies how messages are exchanged between two computers and is part of the growing trend toward Open Systems Integration. Exhibit II-1 shows the OSI Reference Model, which identifies the seven levels of communications and computing systems. X.400 functions at the seventh level of the model, whereas the low-level protocols operated by most EDI users function at the second level.

EXHIBIT II-1

OSI SEVEN-LAYER REFERENCE MODEL



B

X.400 Benefits E-Mail and EDI

X.400 will add two very important capabilities to electronic messaging networks:

- X.400 will provide reliable transport of messages between different message systems, complete with an electronic audit trail.
  - At present, today's electronic mail gateways are all proprietary, meaning that a company that wishes to link several different mail systems must have several different gateways.
  - To make matters worse, the various gateways often have different levels of sophistication, which makes it almost impossible for a large company to develop a consistent grade of service among its different mail systems.
- X.400 will also allow a worldwide directory of electronic mail users to evolve via its companion X.500 directory standard.
  - X.500 will allow many different mail systems to keep track of their users in a standard format and will allow users on one system to find out information about users on another system.
  - The CCITT has already set up the idea of Administrative Domains (public services) that will interlink Private Domains (private mail systems) into a worldwide network. The Administrative Domains will keep track of the many different Private Domains worldwide and allow them to allow function inside a worldwide network.

At present, X.400 has been implemented by most leading computer and telecommunication companies worldwide, although end users are just now beginning to install X.400 gateways for their electronic mail.

Because X.400 will substantially increase the intelligence of communication among different electronic mail services (while also providing a consistent level of service), there has been much speculation that X.400's benefits can be extended to EDI. In September 1988, the CCITT formed a committee to create a modification to X.400 that will allow it to handle EDI documents. The committee plans to have a working version ready by the end of 1989.

X.400 is a powerful communications protocol that will be used by today's public service providers to replace Open Mailbox interconnections. Even though the Open Mailbox scheme works well, X.400 will improve reliability through audit trails and will also facilitate international EDI.

The benefits of X.400 are summarized in Exhibit II-2.

EXHIBIT II-2

X.400 BENEFITS E-MAIL AND EDI

- Reliable Intersystem Transport
- Electronic Audit Trail
- Electronic Directories

C
X.400 Front-End Processors for EDI

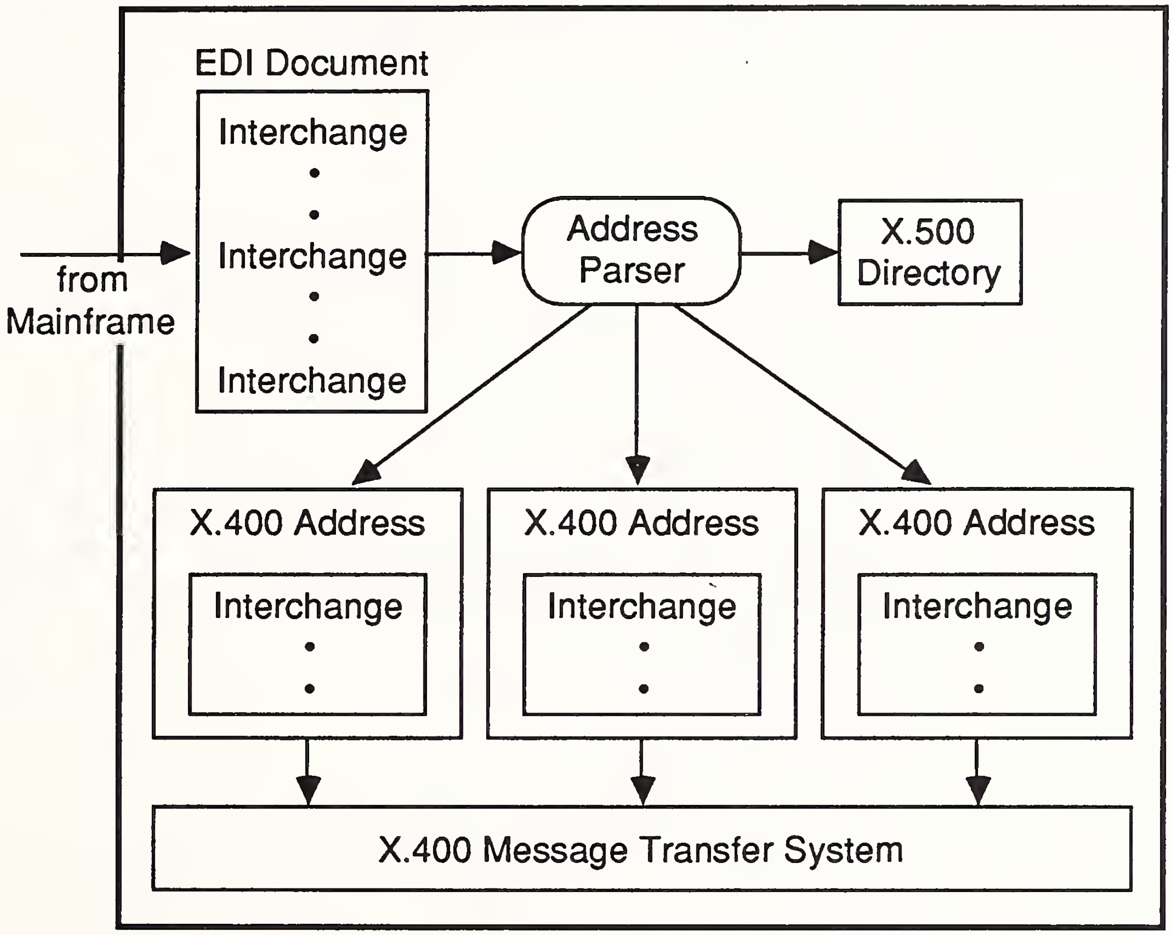
X.400 will also open the door to the development of special front-end processors for EDI application computers. These X.400 front-end processors will perform many of the postal functions that are now performed by EDI services, particularly routing messages between trading partners.

The X.400 front-end processor will receive a stream of EDI interchanges from the back-end application processor, just as public EDI services do today. The X.400 front-end processor will then sort the interchanges, wrap them in X.400 envelopes for each trading partner, and send the envelopes to the Message Handling System (MHS), which will deliver the envelopes either directly to the trading partners' X.400 systems, if possible, or to the trading partners' public services.

Exhibit II-3 shows how an X.400 front-end processor will function.

EXHIBIT II-3

X.400 FRONT-END PROCESSOR FOR EDI



Readers should note that the X.400 front-end processor that INPUT envisions will not be a "pure" X.400 system. Instead, it will consist of several modules that perform both EDI and X.400 functions.

- One module will break EDI batch documents into separate interchanges.
- Another will map EDI interchange addresses to communication network addresses.
- Others will perform communication functions associated with X.400.

Thus, the X.400 front-end processor will be a hybrid system that is a true integration of two separate disciplines, E-mail and EDI, rather than a simple wrapping of an X.400 envelope around an EDI document.

D

X.400 Will Impact the EDI Service Industry

X.400 will change today's EDI industry dramatically by shifting the technological balance away from using public service providers and toward connecting EDI systems directly.

Technology always exists in a balance between doing it yourself or paying someone else to do it. In the 1960s and 1970s, for example, the high cost and complexity of computers led to the rise of the timesharing industry.

In the 1980s, the high cost and complexity of network communications led to the rise of public EDI services. In the 1990s, X.400 will allow this balance to shift back toward trading partners communicating directly, in much the same way that the personal computer caused many timesharing users to perform their applications directly.

X.400, however, will evolve slowly in the market. The CCITT will not finish its work until the end of 1989 at the earliest. It will be 1990 before the first prototype systems are available. These prototypes, furthermore, will be only one of several subsystems that must be integrated to form a functional X.400 front-end processor. For this reason, INPUT expects that X.400's impact on EDI will not be felt until 1992.

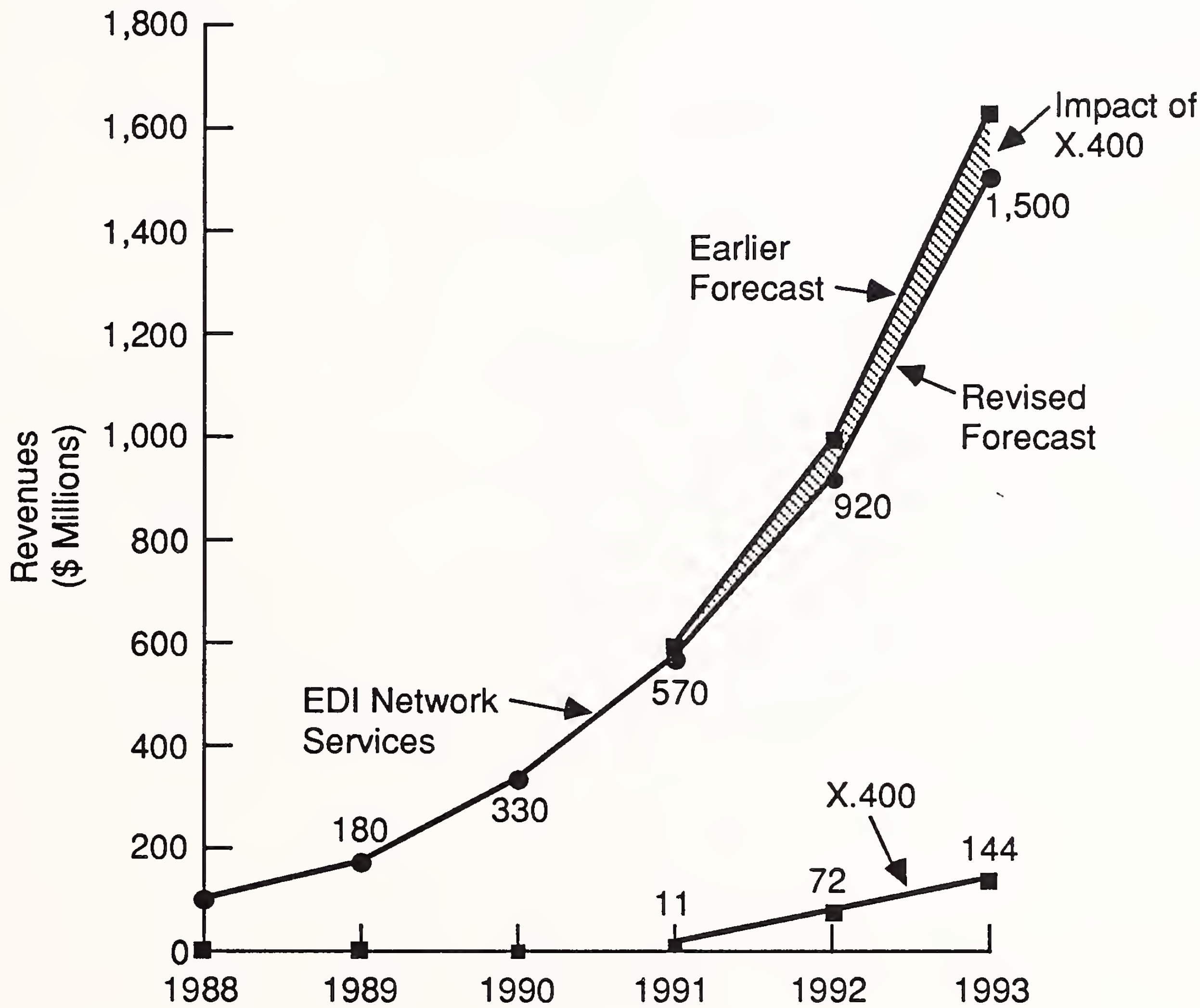
Exhibit II-4 projects the market impact of X.400 on the EDI network service industry.

Out of an industry that is expected to grow from $178 million in 1989 to $1.5 billion in 1993, X.400 is expected to account for only $144 million in revenues in 1993. The impact of X.400, however, will be much greater than meets the eye. Direct connections will transfer revenues from high-priced EDI services to low-priced packet-switching services and regular dial-up telephone calls. Direct X.400 connections will lower revenues to EDI service providers by a factor of five.

As a result of the anticipated impact of X.400 on EDI, INPUT is revising its EDI network service forecast downwards by $120 million in 1993—from $1.62 billion to $1.5 billion. This is a highly significant amount, especially since X.400 will just be reaching its stride in the market. By the 1995-1998 period, X.400 front-end processors will likely cause decline in the overall EDI network services market, even though traffic will continue to grow substantially.

EXHIBIT II-4

X.400 WILL IMPACT THE EDI SERVICE INDUSTRY



E
X.400 Affects the Market

Today's EDI service providers will not all be hurt by X.400. The value-added networks (VANs)—such as Telenet, Tymnet, Western Union, AT&T, and CompuServe—provide lower-level X.25 packet-switching services as well as higher-level EDI services. Although these companies might lose potential EDI service revenues, they will gain substantial packet-switching revenues. Thus, they will benefit under any scenario.

Remote computer services (RCSs), on the other hand, are particularly threatened because they do not operate their own lower-level communication networks. These firms—such as Control Data, Kleinschmidt, and Sterling Software—will have to adjust their strategies to maintain their position in the industry. Fortunately (because the impact is several years away), they have the time and specific strategies (described in this report) that will allow them to prosper.

Although network services will be hurt by X.400, the X.400 front-end processor will open up a new market for software and computer equipment. In the 1989-1993 period, the market will be small, growing from an estimated $2 million in 1990 to $39 million in 1993. By the late 1990s, however, this market will explode and could easily reach $200+ million if virtually every EDI user purchases an X.400 front-end system.

The companies who dominate this market niche will likely do so via either joint ventures or acquisitions. X.400 front-end processors will require multidisciplinary development teams that understand both EDI and X.400. At present, there are few companies that have such expertise and even fewer that have it under the same roof. As a result, INPUT expects that small EDI software firms, X.400 software companies, and computer equipment companies will have to join forces either by joint ventures or acquisitions.

The market effects of X.400 are summarized in Exhibit II-5.

EXHIBIT II-5

X.400 AFFECTS THE MARKET

Market Segment	Impact
VANs	EDI Revenues Decrease VAN Revenues Increase
RCS Firms	Need New Strategies
Software and Equipment	X.400 Front-End Opportunity

III

The X.400 Standard and EDI

III

The X.400 Standard and EDI

A Introduction

Electronic Data Interchange (EDI) is the electronic transfer of structured business data between computer applications in different organizations. It is process-to-process communication in machine-readable formats and overcomes organizational differences in computers, protocols, and data formats (see Exhibit III-1).

EXHIBIT III-1

ELECTRONIC DATA INTERCHANGE

The Application-to-Application Exchange of Intercompany Business Data in Standard Formats

Although typically used for the transfer of electronic purchase orders, invoices, bills of lading, and other trade documents, EDI exchanges are also used for electronic health care insurance claims, in property/casualty insurance, and in other industries.

EDI is being developed and used for one simple reason: it saves organizations enormous amounts of time and money because information can be exchanged in machine-readable format, rather than transmitted by physical means and rekeyed when it moves from one organization to another.

In North America, EDI standards are developed by several different trade industry groups. The most visible EDI standard is known as X12, which is developed by the American National Standards Institute. The X12 standards describe the coding elements for business documents, a protocol for how these elements are interpreted once they are passed from one computer system to another, and several different methods of communicating EDI documents.

Different industry organizations—such as the American Paper Institute, American Trucking Association, Association of American Railroads, Automotive Industry Action Group, Data Interchange Standards Association, Transportation Data Coordinating Committee, Health Industry Business Communications Council, EDI Council of Canada, National Association of Refrigerated Warehouses, The Uniform Code Council, etc.—are all active in defining how the X12 and other standards are to be applied in their respective industries.

In some cases—such as in the automotive, chemical, electrical supplies, electronics, and office products industries—X12 has been used as the basis of exchange standards. Other industries, such as grocery, drug wholesaling, aircraft maintenance and automotive parts, keep a close eye on the X12 standard, but still adhere to electronic standards created before X12 for their specific industries.

Internationally, a set of standards called EDIFACT (EDI for Administration, Commerce, and Transportation) is evolving for use within Europe and for international data exchange.

B
Communications in EDI

The EDI standards process within ANSI has four subcommittees responsible for creating the overall X12 standard:

- X12A—Transaction Set Development
- X12B—Data Mainenance and Liason
- X12C—Communication and Control Structures
- X12D—Public Relations

1. The X12C Subcommittee

The ANSI X12C subcommittee has the overall responsibility of defining X12 communication standards. In performing its work, the X12C subcommittee has built heavily upon the pre-existing communication techniques used by nonstandardized EDI industry groups.

- In practice, for example, the Universal Communications Standard (UCS), which was developed by the grocery industry, has been adopted by most EDI groups as the main method of exchanging EDI documents.

- UCS, in essence, is IBM's binary synchronous communications protocol to exchange batch files directly between computers.

UCS is a lower-level protocol whose intelligence is limited to error-free communication between two computers. It has no application-level intelligence of the type found within X.400. The EDI industry has adjusted to this lack of an intelligent communications protocol by building intelligence within the EDI document itself.

- To give one example, UCS itself has no audit trail to track whether a specific P.O. or invoice was delivered between two user organizations. X12 itself, however, has special documents that acknowledge the receipt of a P.O. or invoice.

- These acknowledgement messages, which are called functional acknowledgements (FAs) within the industry, are created by the recipient's EDI computer after receiving the documents from the sender.

- Although FAs increase the communications overhead for EDI trading partners, they provide for a comprehensive audit trail of EDI documents.

2. Public EDI Service Providers

When UCS is combined with FAs, it provides an effective communications environment for most companies. UCS does have one problem. It requires that companies support the cost of enough communication channels to meet the expected demand of daily transmissions between trading partners. In order to make such direct trading easy, all of the trading partners must either specify times at which the exchanges are to take place or have enough capacity to meet peak load delivery requirements.

EDI service providers solve the problems associated with operating private communication facilities to both send and receive EDI data. These EDI service providers—such as McDonnell Douglas, GE Information Services, Sterling Software, Kleinschmidt, and Control Data—allow EDI data for multiple trading partners to be exchanged with a single phone call.

- The end user calls the EDI service provider using one of several potential protocols, sends all of its EDI data to multiple recipients, and then receives all of the EDI data that has been sent by trading partners.

- The EDI service providers perform this service by sorting the EDI data into "mailboxes" for each subscriber. The service providers can also perform other value-added functions, such as validation checking and file format translation.

Although EDI service providers give users an easy way to send and receive EDI data, the force of competition has created its own problem for the EDI industry.

- EDI is considered to be one of the most important, if not *the* most important growth market in value-added services. As a result, value-added service providers are flocking into the EDI marketplace. Each EDI service provider, furthermore, has staked a claim on certain EDI vertical markets.

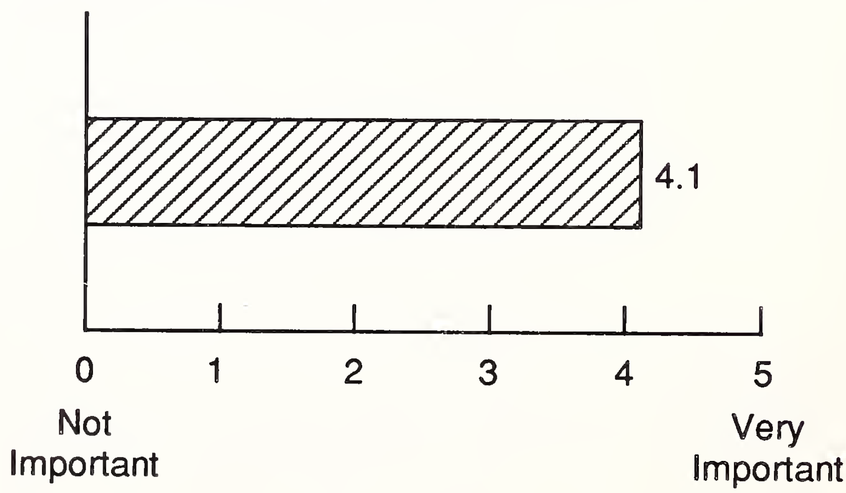
- As a result, user organizations now must typically subscribe to more than one mailbox service in order to obtain full coverage of the companies with whom they must exchange data. As EDI spreads, this problem will only get worse, not better, because the EDI market is now poised for rapid growth, with an increasing number of end-user organizations and service organizations entering the market.

The growing number of service providers has resulted in a strong demand from EDI users to have their data sent to trading partners who have mailbox accounts with other service providers. The largest example is the grocery industry, which is dominated by two EDI service providers—Sterling's OrderNet and McDonnell Douglas' EDI*Net. The grocery industry is also attracting several other service providers.

INPUT's survey research finds that users rate the importance of internetworking very high, as shown in Exhibit III-2.

EXHIBIT III-2

INTERNETWORKING IS IMPORTANT



"On a scale of 1 to 5, how important is it that EDI Networks connect to each other?"

As a result of the demand, EDI service providers have interconnected their services by providing each other with reciprocal or "open" mailboxes. This allows a customer on one service to send documents to trading partners on other services.

Even though the interconnections are far from perfect, lacking such features as an audit trail or secure transmission, they have proven to be very effective in practice because of the Functional Acknowledgements (FAs) that are routinely sent between trading partners. While the two service providers may not keep track of what messages are exchanged, the sender expects to see a FA associated with a specific trade document within a specific time period (typically 24 hours). If the sender does not receive a FA, the sender assumes that the document was not received properly and will resend it.

C The X.400 Standard

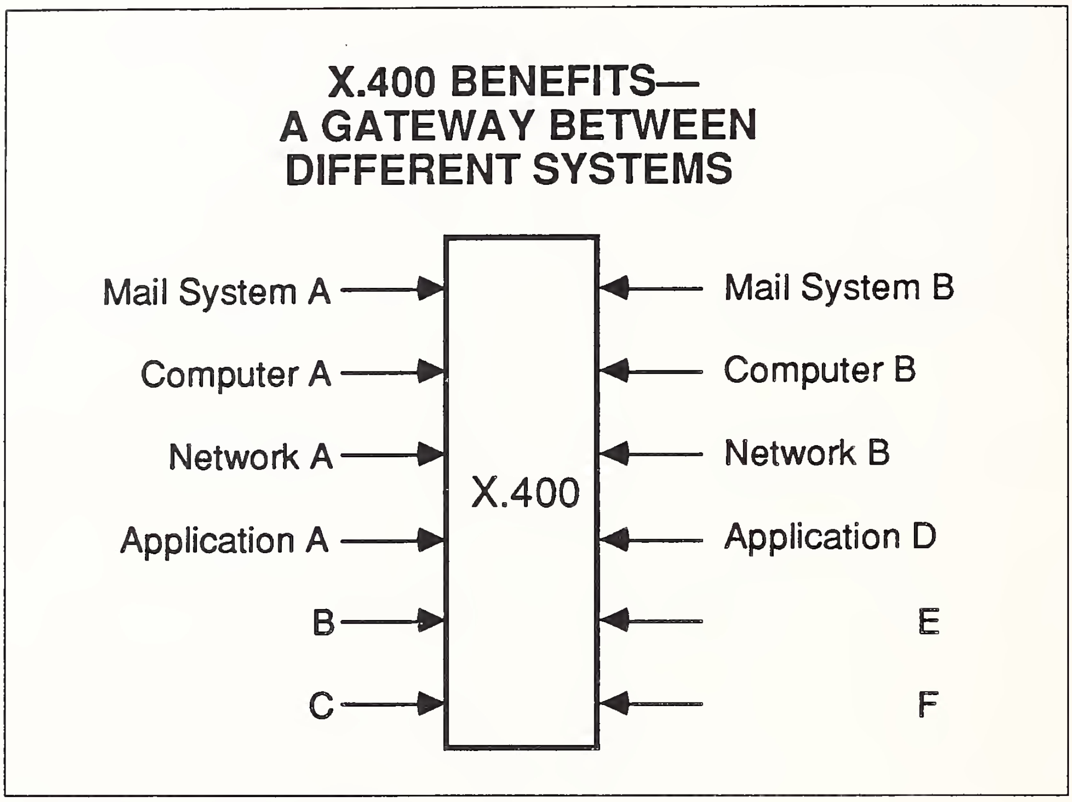
Although the EDI industry seems to function quite well with its existing method of communications, not all users are happy with the Open-Mailbox concept because it lacks features like encryption, audit trails, and security. As a result, experts have proposed using the X.400 Message Handling Standard developed by the International Telephone & Telegraph Consultative Committee (CCITT) to carry EDI data.

From a business viewpoint, X.400's five main benefits are:

- The ability to serve as a highly reliable gateway, so that mail systems from different vendors can exchange information in a standardized environment
- The ability to allow companies to communicate with customers and suppliers without forcing everyone to use the same mail system or without compromising internal security
- The ability to allow companies to develop a private network that links computers from multiple vendors
- The ability to allow companies to plan and implement messaging systems on a decentralized basis across different networks without compromising compatibility
- The ability to evolve into a single network architecture for a wide variety of noninteractive business applications, including personal messaging, document distribution, funds transfer, data base information transfer, financial planning across multiple locations, and Electronic Data Interchange (EDI)

These points are conceptualized in Exhibit III-3.

EXHIBIT III-3



1. Value of X.400 to EDI

From the outset, it is important to delineate that X.400's value to EDI is very much in the eye of the beholder.

- To many communications companies and certain EDI users, X.400 will solve what is perceived as a growing problem associated with EDI interconnectivity.

- Many people presently using EDI, however, do not perceive that they have a serious problem that must be solved. As a result, there is no consensus yet about X.400's value to EDI.

Thus, while X.400 is a promising new communications technology, two factors must be kept in mind:

- First, X.400 is a nascent technology in its first stages of implementation. Although it is supported by virtually every communications and computer company in the industry, it will be several years before its implementation becomes widespread, and at least one year from when this report is published before the CCITT will adopt formal recommendations to integrate EDI and X.400.

- Second, EDI's present method of communications works quite well for most users and certainly cannot be considered broken. As a result, while users and service providers may say kind things about X.400, when it comes time to pay, especially over the short-term, they may well prefer to leave things as they are under the guise that "if it ain't broken, don't fix it."

- In short, X.400 must be viewed as a long-term communications technology that will one day be a worldwide standard, rather than a perfect solution to a serious and pressing problem.

2. Status of X.400

Despite the attractiveness of X.400, there are still numerous questions associated with its ability to handle EDI data. X.400 was developed as a means of exchanging interpersonal information between human senders and receivers. Its developers, however, created an architecture that can be used to send machine-to-machine information. As yet, however, the X.400 standard does not specify how this is to be accomplished.

X.400 also does not specify the business relationships used by service providers to govern interconnections. These business relationships, called settlements in the telecommunications industry, specify how different service providers split revenues for sending messages among and between other service providers.

- Without a standardized settlements system, every time two service providers want to interconnect their services, they must negotiate a specific relationship, which may take years to complete.

- With a specified settlements system, however, all of the issues and contracts are already completed, so that two services can create a relationship quickly, provided they are willing to adhere to the standard settlements agreement.

- At this writing, the standards group within the CCITT that develops settlements procedures is just beginning to deal with X.400.

At present, X.400 has been or is being implemented by almost every leading computer and communications organization.

- A number of the computer industry leaders such as IBM, Digital Equipment, Data General, and Hewlett-Packard—already have X.400 systems available on the market.

- Several leading public message services—such as AT&T, Telenet, BT Dialcom, Telecom Canada, and MCI Communications—have implemented X.400 in their public electronic mail services.

- Interestingly, however, none of the public services in the U.S. use X.400 to interconnect their domestic services. Instead, they use X.400 to communicate to private electronic mail systems or to other services internationally.

Telenet and Dialcom, for example, each have about 20 companies that license their electronic mail software worldwide. Both firms plan to use X.400 to allow these different services to exchange messages.

- Telenet's Telemail and Telecom Canada's Envoy 100, which is licensed from Telenet, use X.400 to exchange messages, while Dialcom in the U.S. exchanges messages using X.400 with the BT Gold service in the United Kingdom. Dialcom is owned by British Telecom.

- Because Telenet and Dialcom are competing tooth-and-nail to be the leading electronic mail carriers worldwide, they have shown little interest in interconnecting their services to date.

EDI, interestingly, could be the vehicle that compels electronic mail services in the U.S. to interconnect via X.400. While few of these services have developed interconnections for their electronic mail services, most of the EDI services now are interconnected via the reciprocal mailbox concept.

- Unlike electronic mail users, who have not placed a lot of pressure on electronic mail services to interconnect, EDI user groups have demanded that their service providers interconnect.

- As electronic mail providers enter the EDI market, they will be faced with the reality of interconnecting their services due to customer demand.

3. Standards Confusion

X.400 at the moment has serious problems associated with its basic development cycle. The standard itself has bogged down in a sea of technical complexity and changes, which will delay its widespread implementation in the marketplace.

When the standard was adopted in 1984 by the CCITT, numerous computer and telecommunications organizations invested more than $1 million each to develop and implement working versions. These organizations have demonstrated X.400 interconnection at several major trade shows in the U.S. and Europe, including the Hannover Fair and the Enterprise Networking show. These companies, however, have implemented the 1984 version of X.400.

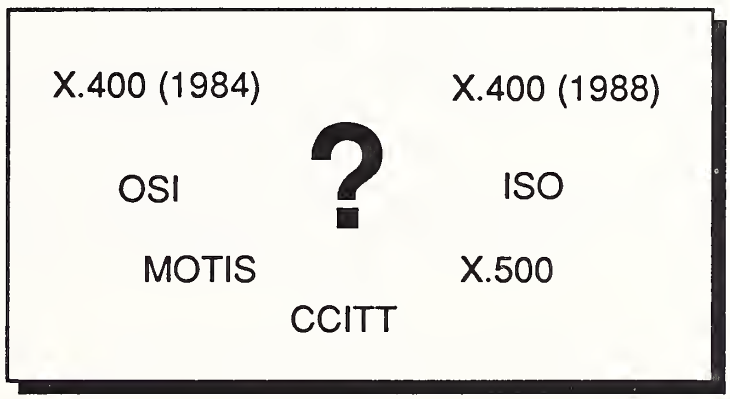
In 1988, the CCITT adopted a new version of X.400 that included several major enhancements. At present, these firms are all working toward implementing the 1988 version. In the same period, the International Standards Organization (ISO) adopted a version of X.400 as its Message-Oriented Text Information System (MOTIS) standard. Unfortunately, while MOTIS and X.400 are similar, they are not identical, which has added an additional element of confusion in the development of a unified messaging standard.

A third area of confusion for X.400 is the development of the X.500 directory standard. X.500 provides directory services for X.400 and, potentially, other communication systems. Not only do organizations have to worry about implementing the 1988 version of X.400, but also they have to worry about X.500 as well. Since X.500 will provide a common directory of users, it is critical for any all-encompassing EDI interconnection service.

This state of confusion is illustrated in Exhibit III-4.

EXHIBIT III-4

STANDARDS CONFUSION



To make a long story short, X.400 is now suffering from growing pains.

- Because it encompasses such a comprehensive vision and has many different companies contributing to its development, there is no clear set of priorities as to how its many features and capabilities should be developed.

- Were X.400 developed by a single company, for example, its many facets would be implemented in staged phases. Since it is being developed by a worldwide community of companies, however, its many facets are being designed in parallel, with no clear plan as to which capabilities should be developed in which order.

- To give one example, X.400 has the ability to provide a wide range of optional protocol translation services. Current X.400 vendors, however, are not implementing these features.

While the priorities for implementing X.400's capabilities are being adopted in a haphazard fashion based upon which capabilities are being implemented by which vendors, this is likely to have a substantial, positive impact on the speed at which X.400 and EDI will be integrated.

- Companies place priority on implementing features that they believe will have a direct impact in the market. Since virtually every company believes that there will be a strong demand to use X.400 to exchange EDI data, vendors will almost certainly rush to meet this demand at the expense of implementing other features.

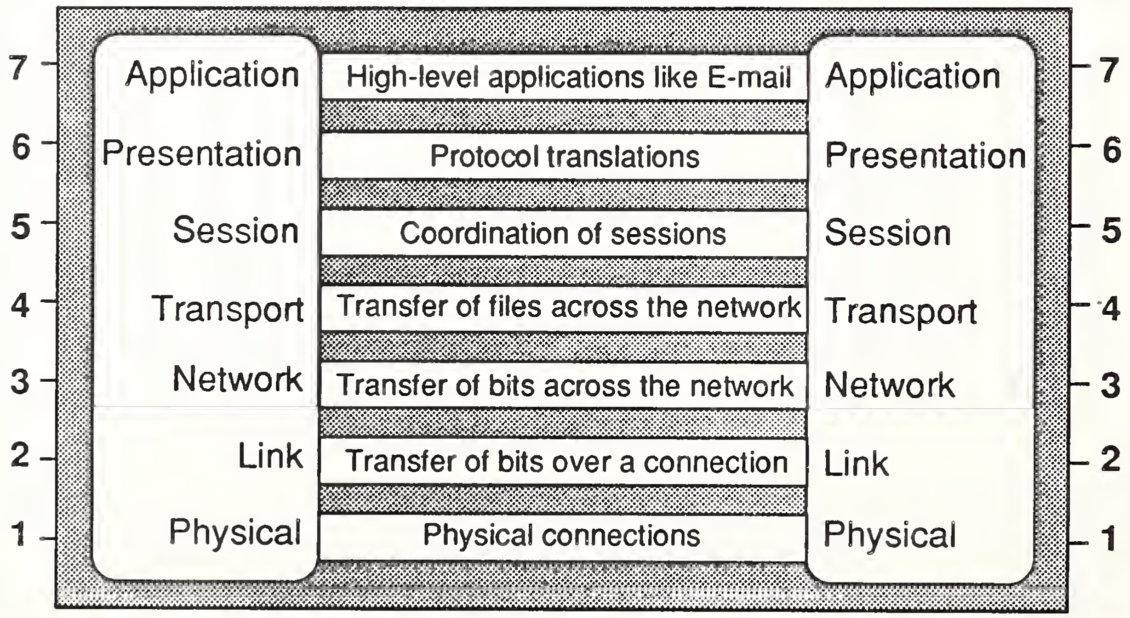
- Thus, while X.400 may be bogged down by the weight of its own ambitious capabilities, there is a strong likelihood that allowing X.400 to carry EDI information will receive the highest priority within the X.400 community.

4. Technical Overview of X.400

X.400's development is closely related to the development of Open Systems Interconnection (OSI) standards within the International Standards Organization (ISO). X.400 and OSI have their roots in work done within the International Federation of Information Processing (IFIP) in the late 1970s. The computer companies took this work into the ISO, while their communications brethren went to the CCITT. Exhibit III-5 shows the OSI seven-layer model.

EXHIBIT III-5

OSI MODEL OF COMMUNICATIONS



a. X.400 & OSI's Seven Layers

X.400 operates at the application (7th) layer of the OSI model. The application specifies how messages are exchanged between sender and recipient(s).

- The messages can consist of text, data, graphics, image, or voice files.
- The sender and recipient(s) can be people or computer programs that perform specific tasks.

Because each layer of the OSI model operates independently of the other layers, it is possible to operate an X.400 mail system over any type of communication roadway.

b. Basic Structure of X.400

X.400 has two major subsystems: the Message Transfer Agent (MTA) and the User Agent (UA).

- The Message Transfer Agent handles the delivery of messages to other Message Transfer Agents or to User Agents within its own sphere of influence.
- The User Agent represents the users, accepts messages on its users' behalf, keeps track of the mailboxes, presents messages to users, and allows messages to be created.

The Message Transfer Agent and the User Agent constructs are separated in OSI's 7th layer, with the User Agent Layer operating above the Message Transfer Agent Layer. In this way, the multiple User Agent Layers can be developed to work with a single Message Transfer Agent Layer, which is critical for the development of a User Agent designed for Electronic Document Interchange (EDI).

c. Message Structure in X.400

An X.400 message has three parts: Message Transfer Agent service elements, User Agent service elements, and the body of the message.

- The User Agent service elements and the body part constitue the contents of the message, while the Message Transfer Agent service elements constitute the envelope.
- Service elements control how the information is handled by both the Message Transfer Agent and User Agent.

- The Message Transfer Agent service elements control the transfer of messages transparently from the contents.

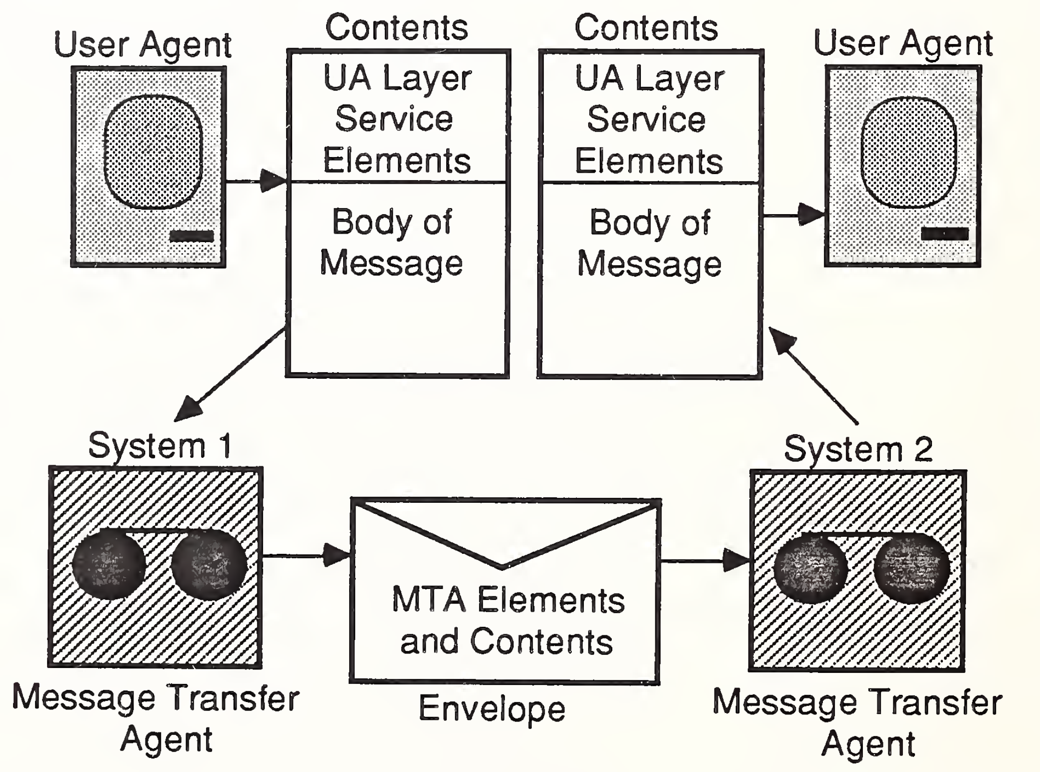
- The User Agent service elements contain the actual header of the message, which specifies the sender, recipient(s), subject, and other options associated with creating and presenting a message. The User Agent service elements created for interpersonal messaging, for example, contain the To, From, Carbon Copy, and Subject fields of the message, along with delivery instructions, such as the message's urgency, time of transmission, and importance.

- The body part of the message contains the information being communicated. X.400 can handle ASCII information or voice, graphic, video, or other formatted data streams. It even has the ability to handle multiple body parts within the same message.

Exhibit III-6 shows X.400's basic architecture.

EXHIBIT III-6

OVERVIEW OF X.400's ARCHITECTURE



d. X.400's Exchange Protocols

The 1984 version of X.400 has three protocols associated with transmitting messages between different Message Handling Systems: P1, P2, P3. The three protocols are structured methods that allow the body parts of the message and the service elements associated with the Message Transfer Agent and User Agent to be exchanged between different systems.

- P1 describes how two Message Transfer Agents exchange information.

- P2 describes how two User Agents exchange interpersonal messaging information.

- P3 describes how a remote User Agent exchanges information with a Message Transfer Agent.

In the 1988 version of X.400, a fourth protocol, called P7, was created. P7 describes how a remote User Agent exchanges messages with a Message Store designed to temporarily hold messages.

- The concept of the Message Store and P7 were developed when it was determined that P3 did not have enough features to support remote personal computers signing on to mail systems with a peer-to-peer protocol.

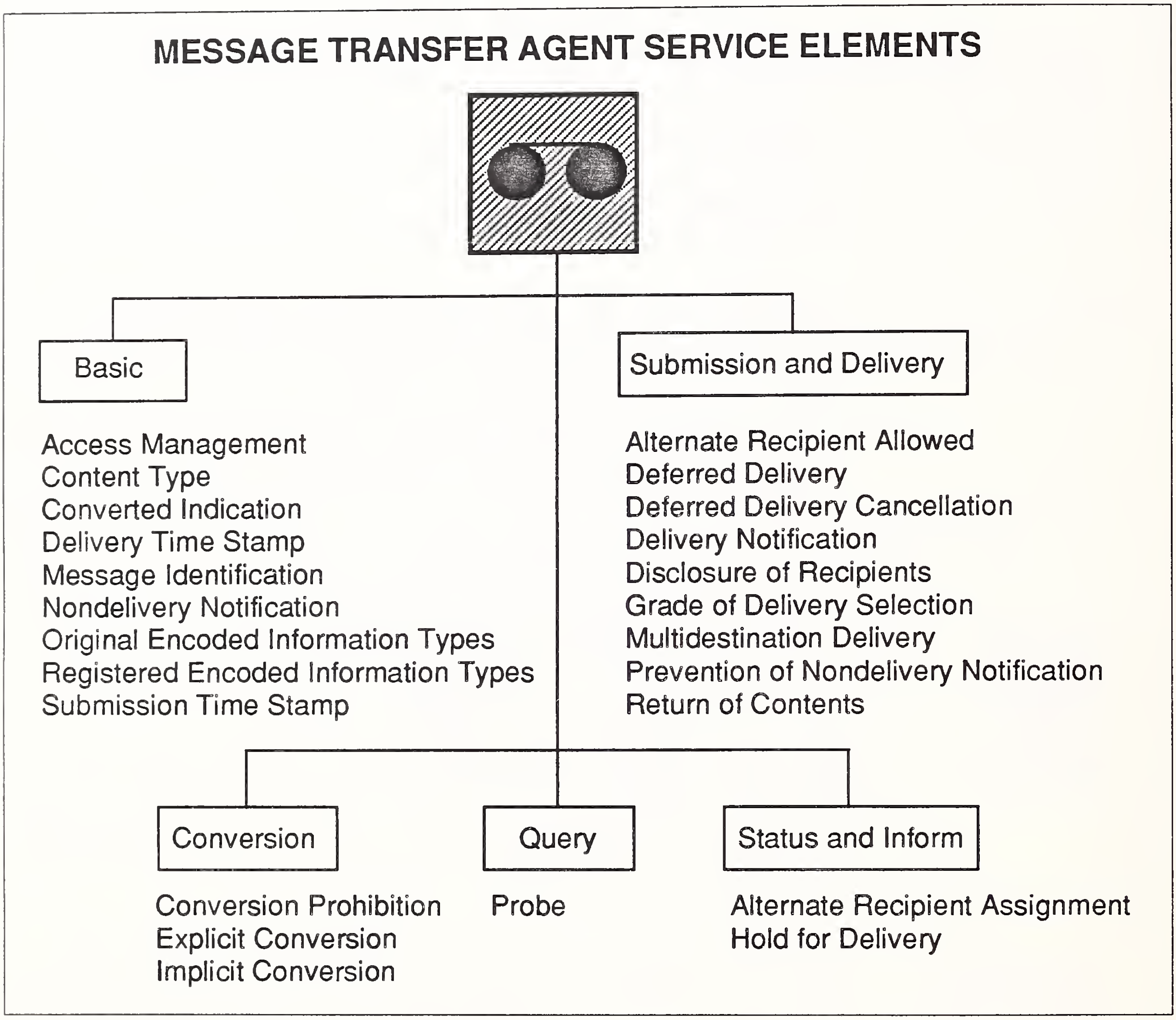
- As a result, P3 will fade into obscurity and P7 will become how personal computers and local-area networks dial into Message Transfer Agents to exchange messages in a peer-to-peer fashion.

e. Message Transfer Agent

The Message Transfer Agent has five parts: Basic, Submission and Delivery, Conversion, Query, and Status and Information. Each of these parts has specific service elements that determine the features available when passing messages. Exhibit III-7 shows the service elements in the Message Transfer Agent.

Two of the Message Transfer Agent's most important capabilities are tracking the content types and tracking the original encoded information types. The content type within X.400 refers to the specific application for the message, not the types of files included in the message. At present, the CCITT has identified two content types: an interpersonal message (IPM) and an interpersonal message status report.

EXHIBIT III-7



The original encoded information type identifies the specific format of the file being transmitted. On an international level, the original encoded information type fields identify several basic types of message formats, including:

- International Alphabet #5, telex
- Teletex
- Groups 3 & 4 facsimile
- Voice
- Videotex
- Mixed mode (teletex and facsimile)

Another message format is what the CCITT terms a simple formattable document (SFD), which is a series of paragraphs that can be formatted for the user by the User Agent. In addition, X.400 also defines formats for an encrypted document and a forwarded document.

The original encoded information types service element, in theory, can be used with the registered encoded information types and converted into service elements to provide automatic format translation between different types.

- This translation works by users registering the types they can receive.

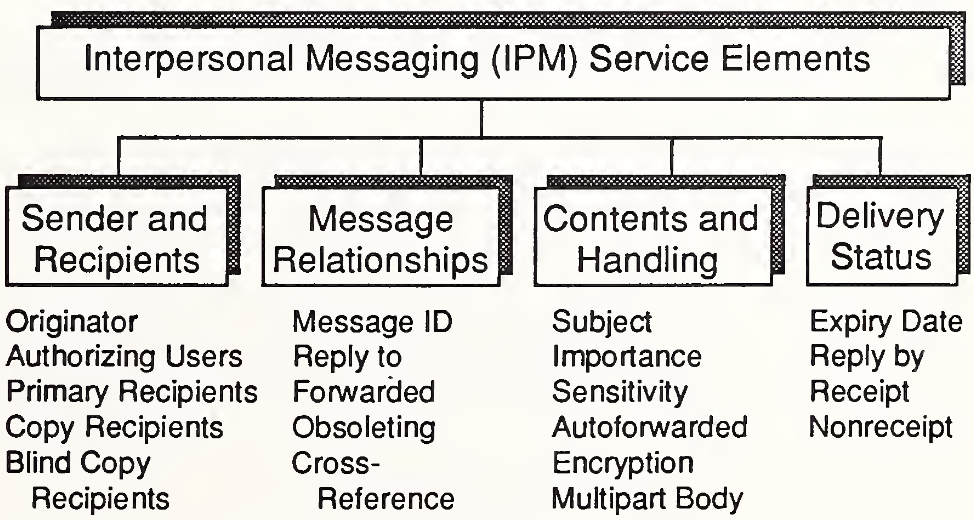
- When the Message Transfer Agent receives a message, it checks the recipient's registered original encoded information types service element and performs any required file conversions. None of the vendors involved have yet implemented file conversion capabilities. Thus, such conversions will be developed as X.400 evolves in the market.

f. User Agent

Two User Agents communicate by service elements, which allow common mail processing functions to be performed across X.400 systems. The User Agent service elements are described in Exhibit III-8.

EXHIBIT III-8

COOPERATING USER AGENT SERVICE ELEMENTS



The best way to understand the User Agent service elements is through the general functions that must be performed when mail systems exchange messages. Each general function has a series of service elements associated with it to perform the tasks required for message delivery. These functions provide information about the:

- Sender and recipients
- Relationship that the message has to other messages
- Contents and handling of the message
- Delivery status of the message

The service elements that provide information about the sender and recipients are originator, authorizing users, primary recipients, copy recipients, and blind copy recipients.

The service elements that describe the various relationships the message has to other messages on the system are the message ID, reply to indication, forwarded indication, obsoleting indication, and cross-reference indication.

The service elements that describe information about the contents and handling of the message are subject, importance, sensitivity, autoforwarded, body part encryption, and multipart body.

The service elements that describe delivery status are the expiry date indication, reply by indication, nonreceipt notification, and receipt notification.

g. Operation of X.400 Message-Handling Network

An important part of X.400 is the domain structure that has been set up by the CCITT. The domain structure specifies how public services and private systems will interact to form a worldwide network.

An Administrative Domain (ADM) is a public mail service operated by an authorized telecommunications organization. In most countries, this will be the Postal, Telephone, & Telegraph (PTT) authority.

A Private Domain (PRDM) is operated by a private organization, such as a large commercial company or government organization.

While the CCITT envisions that Private Domains will communicate via Administrative Domains, the ISO's MOTIS standard, which is the ISO's version of X.400, allows Private Domains to communicate directly, independent of the CCITT's Administrative Domain structure.

h. X.400 and Directories

In order to facilitate a global mail system, the CCITT has developed the specifications for a worldwide directory structure, called X.500, which will allow specific users to be located not only by their distinct system name, but also by their company, department, title, and other personal attributes.

End users will derive two major benefits from the X.500 directory when it is implemented.

- The first benefit is the ability to develop a cohesive directory of all users operating on the company's internal network.

- The second benefit of X.500 will be to allow users to find out the correct address of users on other systems worldwide by using X.500's directory search capability.

i. 1984 versus 1988 Versions

The 1988 version of X.400 adds several important additions to the 1984 version, including the concept of a Message Store, and increased security features—both of which will be important to the EDI industry.

- The Message Store will allow PC-based EDI systems to communicate directly to an X.400 Message Transfer System as a peer, rather than as a slave system. This will free the EDI software on the PC from having to adhere to the specifics of any EDI service.

- The security features will enable EDI documents to be encrypted within X.400's architecture, which is growing in importance to EDI users who are worried about the potential for sabotage and other security-related problems.

The movement to the 1988 version, however, will not be simple.

- Many vendors have already invested heavily in X.400 without any return, only to discover that they need even more development.

- Furthermore, many of these vendors purchased X.400 source code from third parties, only to discover that they had to make extensive enhancements themselves to fit the code into their architectures.

- As a result, although these companies purchased source code to help them with their initial systems, they have performed enough custom work so that source code will not help them implement the new X.400 enhancements.

D
X.400 and EDI

While the above description of X.400 may be tedious for a nontechnical reader, it is important for a good understanding of how X.400 and EDI can interact with each other.

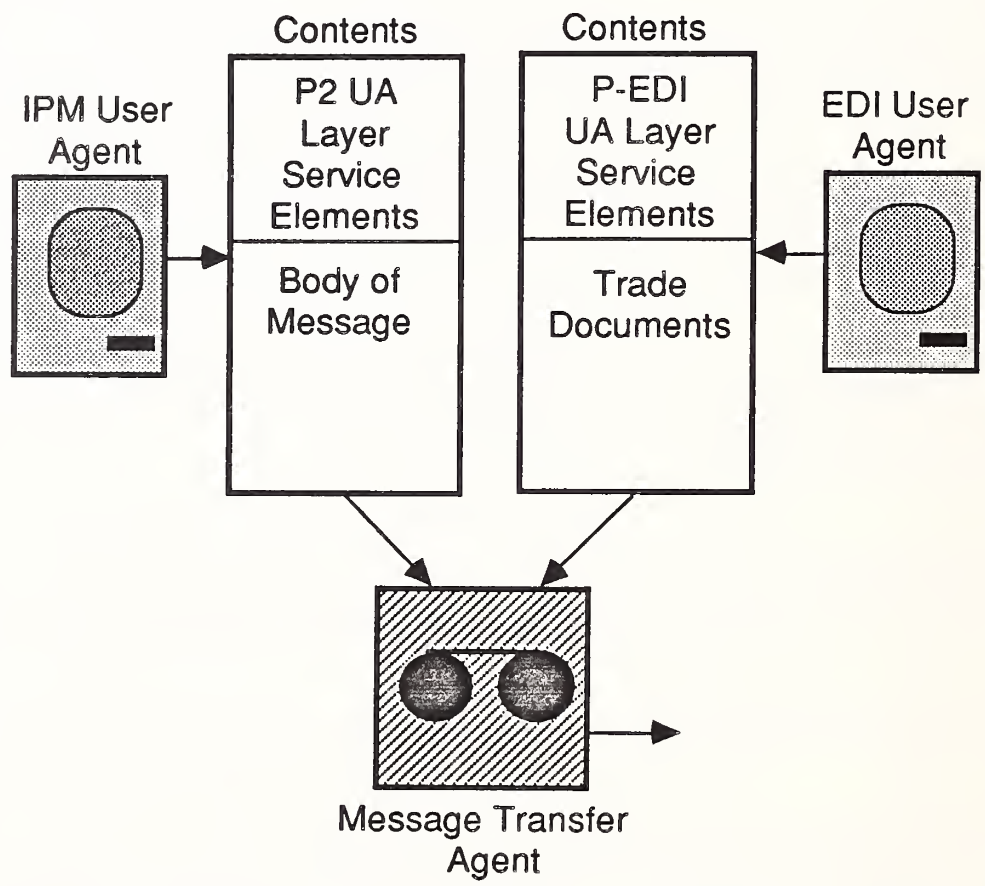
1. Integrating EDI within X.400

The key to integrating X.400 & EDI is the separation of the User Agent and Message Transfer Agent Layers. Multiple User Agents can use the same Message Transport Layer. At present, the only User Agent that has been defined is for Interpersonal Messages. The protocol is called P2.

To integrate EDI into X.400, a new User Agent, now called P_{EDI} within the X.400 community, must be developed. The structure of the integration of EDI and X.400 is shown in Exhibit III-9.

EXHIBIT III-9

EDI AND X.400 INTEGRATION



As the reader can see, within X.400's architecture, EDI can be viewed as another User Agent with its own set of service elements.

- These service elements would define the addressing and processing instructions associated with an EDI document. The actual trade documents would then be placed within the body part of an X.400 document.

- In this way, EDI documents would be placed within an X.400 User Agent and exchanged between systems by the Message Transfer Agent in much the same way that paper documents are placed in envelopes, which are placed in mail bags and physically mailed between organizations.

While this may seem like a complicated process, the basic structure of an EDI document itself provides strong guidelines to developers.

- A basic EDI document contains all of the information required to exchange trade documents.

- The basic strategy for using X.400 to send EDI documents will be to read the exchange information within an EDI document and use it to create X.400 service elements, such as the address header.

- The EDI document will then be encapsulated within an X.400 envelope and transferred using the powerful features with an X.400 MTA.

2. Industry Perspectives on Integrating EDI and X.400

The concept of integrating EDI and X.400 has existed for several years. As early as 1984, electronic messaging planners were looking at X.400 as a vehicle for transferring EDI documents. Such a view was primarily market driven.

- Most of the leading electronic mail public services are owned and operated by telecommunication companies who also own and operate their own packet-switching services.

- Electronic mail is viewed by these companies as an application that generates traffic for the underlying packet-switching network.

- EDI is viewed by these companies from the same perspective. Just as these firms have succeeded in generating packet-switching traffic from their electronic mail services, they also believe they can succeed in generating EDI traffic.

- It is natural that leading planners in these companies would view both personal messaging and EDI as equivalent User Agents for their Message Transfer Agents.

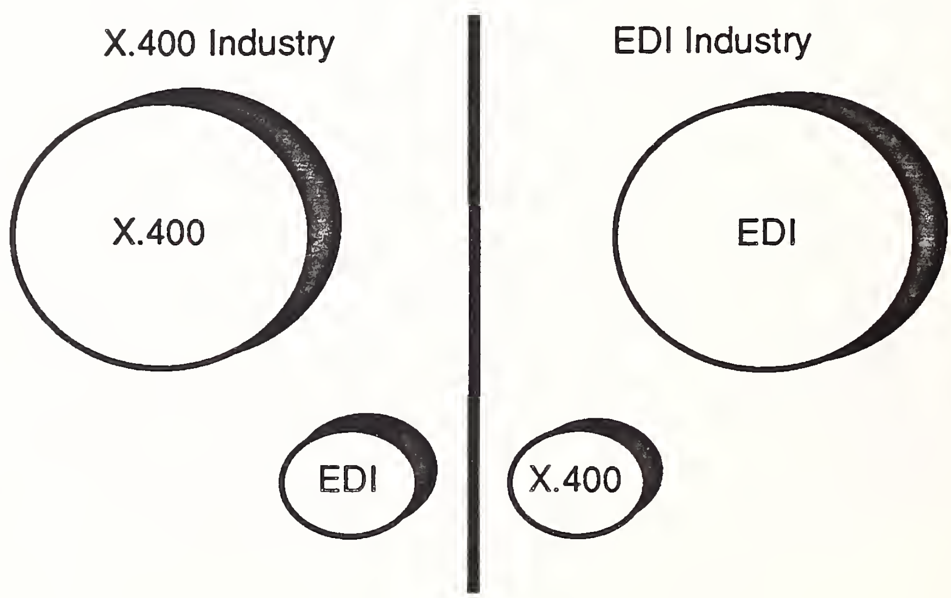
X.400 is now widely viewed within the electronic messaging world as the vehicle for carrying EDI data. The same, however, is not true within EDI circles. The difference, more than anything else, is in perspective.

- Carrying messages is the primary task performed by the electronic messaging industry. As a result, the contents of the information have always been of secondary importance.

- The EDI industry, in contrast, is focussed primarily on the problem of standardizing the trade documents exchanged among companies. The transmission of these documents is essentially a secondary issue, albeit an important one. Thus, the EDI and X.400 worlds see the same problem from a reverse perspective, which is shown in Exhibit III-10.

EXHIBIT III-10

REVERSE PERSPECTIVES OF EDI AND X.400 INDUSTRIES



This situation can be shown very clearly from a meeting held by the Electronic Mail Association in Ft. Lauderdale, FL, in early 1988. The meeting was attended by Paul Lemme, then the Executive Director of the TDCC/EDI Association, and Marshall Spence, President of the EDI Council of Canada. At the meeting, electronic mail representatives waxed eloquently about the potential of marrying EDI and X.400.

Ted Myer, then Director of Consulting Services for Telenet and one of the leading North American proponents of integrating X.400 and EDI, was quoted by INPUT as saying that while X.400 has "awesome potential" for transferring electronic mail, it has "N-times-awesome potential" for sending EDI documents. Note that his quote was in reference to the traffic that can be carried over messaging networks.

Myer also contended that today's method of interconnecting EDI services—the Open Mailbox concept—creates a logjam in the industry. X.400, he argued, would break the logjam.

Marshall Spence said that directly connecting to multiple services via UCS was basically acceptable to Canadian EDI users, who, he said, did not like the Open Mailbox concept because of its lack of security. As a result, he said, X.400 was a clear long-term solution and suggested that it might be valuable within a year for U.S./Canadian EDI links.

Paul Lemme, however, painted a very different picture. Lemme abandoned his prepared comments because he was upset by what he believed was a somewhat insular view of EDI within the electronic mail industry.

- After hearing what he considered to be enough about X.400, Lemme said there were other working alternatives in the market, the most simple of which was to connect directly with trading partners using the UCS standard.

- Lemme contended that UCS is ignored by the electronic mail industry, which still believes there is a serious communications problem in the EDI world. Lemme said, "I think we're looking at a problem which has been solved, and by failing to recognize that solution, we spend a lot of time in meetings and not moving forward very quickly."

While the views of these three people are hardly definitive, they illustrate an underlying tension between the goals of the EDI and communications industries.

- The EDI industry doesn't have any stake in how trade documents are interchanged as long as the solution allows them to do business properly.

- The communications industry, on the other hand, has already invested over $100 million collectively in developing and implementing X.400 and intends to see that it is utilized for as many applications as possible.

3. EDI and X.400 Standards Bodies

There is another subtle, but important, issue associated with the marriage of EDI and X.400: how will such a standard be created?

The EDI industry is structured vertically, consisting of multiple standards bodies, each of which typically operates in relationship to its own industry. The only non-vertical organization directly involved with EDI in the U.S. is the American National Standards Institute.

In contrast, X.400 is controlled by two international bodies—the CCITT and ISO, which controls the MOTIS standard, which is X.400 by another name.

MOTIS and X.400, despite the different names, are largely identical. The major difference is that since CCITT deals with standards for official telecommunications organizations, while the ISO deals with standards for private organizations, X.400 is structured to connect private organizations via public services, while MOTIS is structured to allow private companies to communicate directly.

North American organizations represent themselves directly in both the CCITT and ISO. When voting to adopt standards, however, only recognized telecommunications firms are allowed to vote in the CCITT, while only the U.S. Department of State is officially recognized within the ISO. The U.S. Department of State looks to the National Bureau of Standards (NBS) for guidance on telecommunications issues. The NBS, in turn, looks to specific business and government organizations to define its positions.

For EDI to be incorporated within X.400, it first must be adopted by both the CCITT and ISO, which places it well beyond the span of control of the EDI industry. This is a potentially dangerous situation for companies planning the X.400-EDI standard.

- Unless the standard meets the needs of EDI users and is accepted by the EDI standards community, any incorporation of EDI into X.400 runs the risk of being ignored. To put it simply, EDI users now have solutions to their problems of interconnection, regardless of how imperfect they may be. Even if X.400's planners develop a better solution, EDI users can very easily ignore it and plod ahead using existing techniques of communication.

- In contrast, once X.400 is agreed upon by the CCITT, tremendous pressure is placed on both computer and telecommunication firms to conform, particularly by the European community.

As a result of this market reality, while the X.400 standards community is taking the lead in designing the connection between EDI and X.400, they are soliciting the active participation of EDI standards experts.

- In North America, the two leading bodies studying EDI and X.400 are the National Bureau of Standards (NBS) and ANSI, both of which operate Special Interest Groups on X.400 and EDI activities.

- The ANSI committee on X.400 has met regularly during the last two years and recently recommended that EDI documents should be incorporated within the existing X.400 standard by using a subset of the P2 protocol.

4. CCITT Officially Involved

While ANSI, NBS, and any other organization is free to take any position it wishes on X.400 & EDI, the game really must be played within the CCITT itself.

At the final plenary for the CCITT's 1984-1988 Study Group period (the CCITT works in four-year cycles), Study Group VII, which develops the X.400 standard, approved a Study Question on EDI. On August 1-3, 1988 in Ipswich, U.K., the first formal meeting was held on the issue of incorporating EDI into X.400. Ted Myer, formerly of Telenet, is the interim Rapporteur (leader) of the Group on EDI.

At the first meeting, the Group set a goal that its work would be completed within a two year period and would be published under the CCITT's Accelerated Procedures, which allows a Group to release working standards documents before the completion of the CCITT's traditional four-year study cycle. This means that the CCITT will likely formally adopt a position on EDI and X.400 in the late-1989 or early 1990 time frame.

Exhibit III-11 lists the North American organizations who attended the first X.400-EDI meeting.

In all, 20 firms were represented, several of them by European representatives. Conspicuously missing were official representatives from any of the EDI standards bodies in the U.S., although there were several people who are primarily involved in EDI standards and who have spent several years working on the issue of X.400 & EDI.

At the meeting, several key decisions were made. The four most important decisions were to:

- Create a separate P-level protocol, called P_{EDI} for EDI, rather than make any attempt to implement EDI using the existing P2 protocol for interpersonal messaging

- Develop the new protocol by using as many of the constructs from P2 as possible, including the idea of a separate header and body

- Use the Message Store and security features as defined in the 1988 version of X.400—The Message Store, however, will have to be enhanced to include logging and audit features, which itself will require a change to the 1988 version of X.400.

- Restrict the scope of activity to store-and-forward exchange of EDI documents that adhere to the EDIFACT, ANSI X12, and UN/TDI standards

EXHIBIT III-11

NORTH AMERICAN FIRMS AT FIRST EDI AND X.400 MEETING

AT&T	McDonnell Douglas
Bellcore	MCI International
CNCP Telecommunications	Microtel Pacific Research
Dept. of Telecommunications (Canada)	Pacific Bell
Digital Equipment	Prime Computer
Du Pont De Nemours	Sydney Development
Eastman Kodak	Telenet
Hewlett-Packard	Texas Instruments
IBM	Wang Labs
Motorola	Western Union

These decisions will have several specific impacts. They are:

- No attempt will be made to supplant the UCS standard, which basically describes interactive transfer of EDI documents between two parties. Using X.400 for EDI transfers is viewed within the CCITT as a store-and-forward system, not a system for direct interconnection.

- PC software will be able to interact with X.400 Message Handling Systems in a peer-to-peer fashion, which will allow PC software developers to create one version that, in theory, should work with any public service that adheres to the X.400-EDI standard. It should be noted, however, that if audit trails and logging are required, the X.400 Message Store requirements will themselves have to be changed.

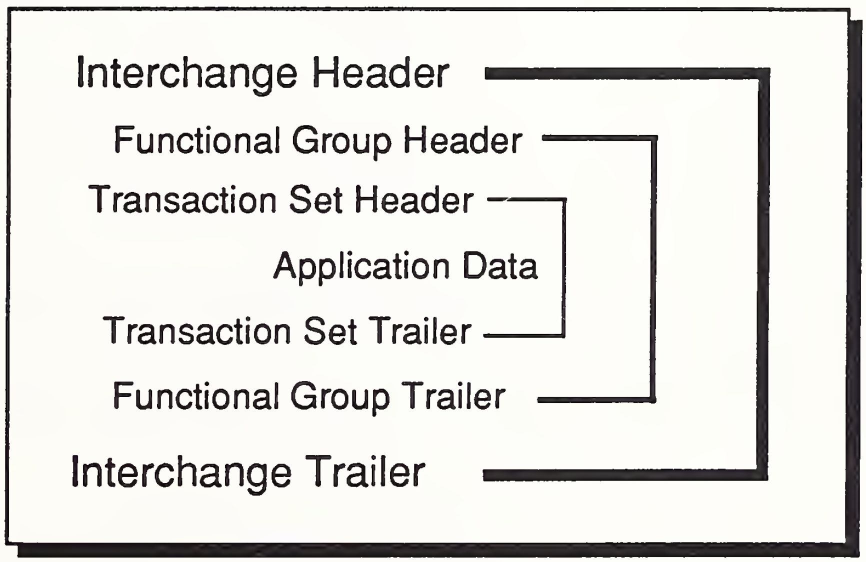
- The work done by the ANSI X12C committee on implementing EDI by using the P2 layer will most likely be ignored. While this will delay the use of X.400 to pass EDI data, it puts to rest one of the key issues of the past few years — whether or not a new User Agent is required. The CCITT has formally decided to develop a new protocol, the specifics of which will be developed in the next few months.

5. X.400 and Efficiency

While there is no doubt that X.400 can be adapted to carry EDI documents, there is a serious question whether end users will benefit by using X.400 directly. When an EDI document is created, it has Interchange Control Information that describes the EDI document. This is shown in Exhibit III-12.

EXHIBIT III-12

EDI INTERCHANGE STRUCTURE



An EDI document, in its simplest form, consists of:

- An Interchange Header, which describes information about the trading partners
- A Functional Group Header, which describes information about the specific EDI trade documents being carried within the overall document
- A Transaction Set, which describes the specific EDI document
- The Application data, which is the information being exchanged

The Interchange, Functional Group, and Transaction Set are building blocks that can be used to create complex EDI documents. As an example, it is possible for a single EDI communication to have multiple Interchange Headers and Trailers, multiple Functional Groups nested within each Interchange Header/Trailer and multiple Transaction Sets within each Functional Group.

Since an EDI document is also self-contained, lower-level protocols like the bisynchronous UCS or asynchronous Kermit are very efficient transfer mechanisms. These protocols merely pass the EDI documents between two systems that have been set up to decode the Interchange Control Information.

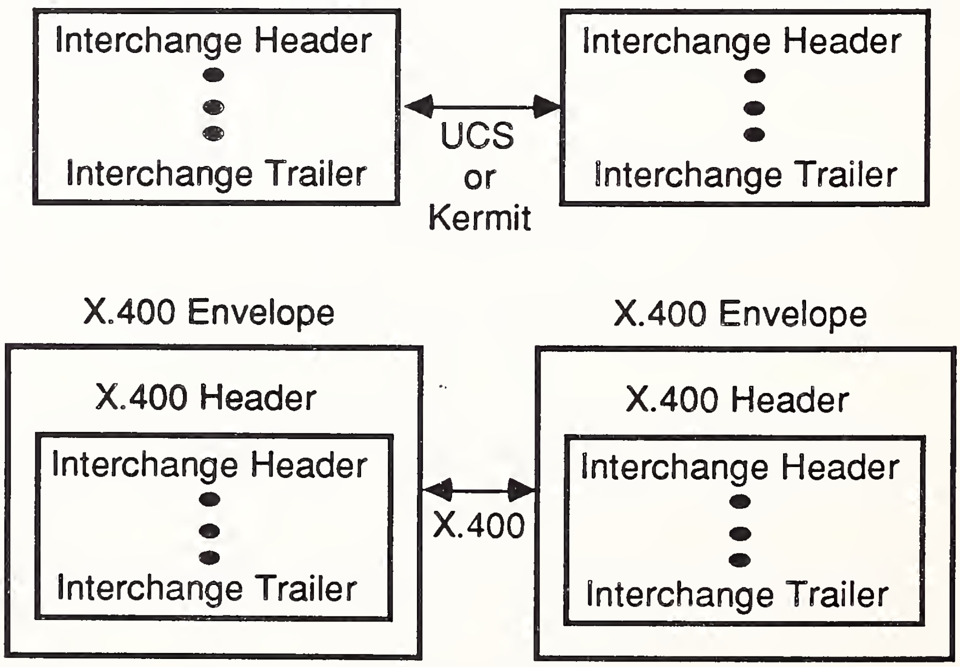
No matter how much the telecommunications industry may try to say otherwise, X.400 is going to add considerable overhead versus UCS or Kermit when transmitting the same EDI documents.

- The X.400 software will read the Interchange Control Information in the original EDI document and reformat the information to create an appropriate X.400 address.
- The EDI document and its control information will end up encapsulated within an X.400 message.

One has to ask why end users will willingly incur extra overhead when UCS or Kermit will result in the exact same information transfer? This redundancy is shown in Exhibit III-13.

EXHIBIT III-13

X.400 REDUNDANCY AND OVERHEAD



This issue has short- and long-term implications.

- Over the long-term, the world will migrate to international communication standards, especially when the standards become entrenched in operation.

- In the short-term, however, the majority of EDI users will not require X.400 to transfer trade data, although there may be some benefits.

EDI service providers have a different viewpoint. The Open mailbox concept, while effective, lacks an intercompany directory, audit trails, encryption and other security measures. The service providers, many of whom are implementing X.400 for their electronic mail users, can use X.400 to exchange EDI data as well, which will allow them to provide better services for their end users.

6. X.400, Mailbox Float, and JIT

X.400 may have one significant advantage over today's EDI systems. X.400 is designed as a forced delivery system in which the sending MTA contacts the receiving MTA to deliver a document.

- If an end-user organization sets up an X.400-based front end processor to its EDI application system, then the user will be able to receive EDI documents directly from another end user or from a public service provider without calling up to check a mailbox. This will eliminate any "mailbox float" that presently exists.

- Assuming that an organization checks its mailboxes once or twice a day, it can speed up the reception and delivery of EDI data by several hours.

- The cost will be in the vicinity of $1,000 per month plus forced delivery charges and the cost of an X.400 gateway, which should be in the vicinity of $10,000 to $20,000. This is a relatively small amount for large or medium-sized firms and can have a significant benefit for just-in-time inventory applications.

7. Rates and Settlements

While the technical aspects of the X.400 standard are obviously important to the success of using X.400 to carry EDI documents, they are only one-half of the overall equation. Of equal importance are issues related to rates and settlements.

The settlements process itself began a century ago when telegraph systems were interconnected throughout Europe. The process was extended to the telephone and telex networks and is the unsung hero in enabling countries to interconnect their communication systems because it mandates policies for making such interconnections.

No set of settlements exists to govern domestic, North American or international X.400 interconnections, which is critical to the long-term evolution of X.400-based EDI services.

At present, EDI service providers must agree upon their own procedures when interconnecting their services. Interestingly, while the service providers are virtually all connected technically, they have done so without reaching any formal business relationships. Instead, the interconnections are based upon what can be called the Agent Theory.

- Basically, the EDI service providers interconnect to each other as "agents" for their customers. During the interconnection, messages are exchanged.

- The service providers, however, have no audit trail procedures to track messages across the interconnections and do not split revenues. While the lack of an audit trail may surprise non-EDI readers, it should be kept in mind that all EDI trading partners use Functional Acknowledgements (FAs) as a means of confirming that documents were received. Thus, when trading partners use Open Mailboxes, the FAs act as positive acknowledgements that messages were received.

- If the sender does not receive a FA within a specified time period, the original document is resent. Thus, while the Open mailbox interconnection does not have an audit trail capability, the end users already have a positive acknowledgement system in place, which provides the same capability.

Despite the lack of formal business relationships, most EDI service providers are creating a *de facto* standard on interconnection that works in this fashion:

- Users who wish to interconnect pay a flat monthly fee, usually $15 to $25

- The sender then pays the service provider's regular rate for sending EDI documents, which is typically based upon time and characters.

- The service provider pays the costs of transmitting messages to other service providers

The idea, of course, is that transmissions and receptions will cancel each other out. Every EDI message generates a minimum of a return acknowledgement and can often generate a corresponding EDI document.

- A purchase order, for example, will generate an acknowledgement of receipt from the recipient, and may also generate a corresponding invoice and resulting acknowledgement. It can also generate a shipping document to the shipper, along with documents to warehouses, etc.

- Thus, service providers believe it is in their long-term interests to generate transactions by allowing interconnections. They have done so, interestingly, by avoiding any formal settlements system with other service providers.

8. X.400 and Interconnection

While X.400 will almost certainly play an important role in EDI interconnection on an international level, it is not clear how important its role will be for domestic communications. EDI service providers already are interconnected and, when TAs are used, basically get the job done. X.400, however, can open up a new vista for EDI service providers and user alike because of its ability to allow a forced delivery network to replace today's mailbox-oriented network.

This has interesting implications for end users and service providers alike. Large end users, for example, will be able to install X.400 front-end systems to send and receive EDI documents from either private trading partners or public services. As X.400 becomes more common, it raises the interesting question of whether today's public EDI services will be pushed out of the market as trading partners exchange documents directly. This critical issue is explored later in this report.

The next chapter examines X.400 trends and their likely impact on EDI.

IV

Trends in EDI and X.400

IV

Trends in EDI and X.400

The emergence of EDI and X.400 are occurring simultaneously—with both technologies coming together from different directions. This section explores the trends in the merger of EDI and X.400.

A
Key Differences Between X.400 and EDI

While X.400 has a lot of promise for EDI, it is important to understand some key differences. There are two major architectural differences between EDI and electronic mail: addressing and auditing.

1. The Addressing Factor

Addressing is a functional, not technical, issue.

One of X.400's strongest boons to electronic mail is the X.500 Directory standard, which will allow a directory of electronic mail users to evolve worldwide. The X.500 directory will allow a sender to find a recipient's address across many different electronic mail systems and will also allow high level addresses to be mapped to specific machine addresses.

This has an underlying assumption: electronic mail users need a world-wide directory. Most experts in the field believe this to be true.

- While most telecommunications industry proponents have assumed that the same situation is true in EDI, there is a structural difference between electronic mail and EDI that brings this into question.

While both electronic mail and EDI public services give mailboxes to their users, the two have very different addressing structures.

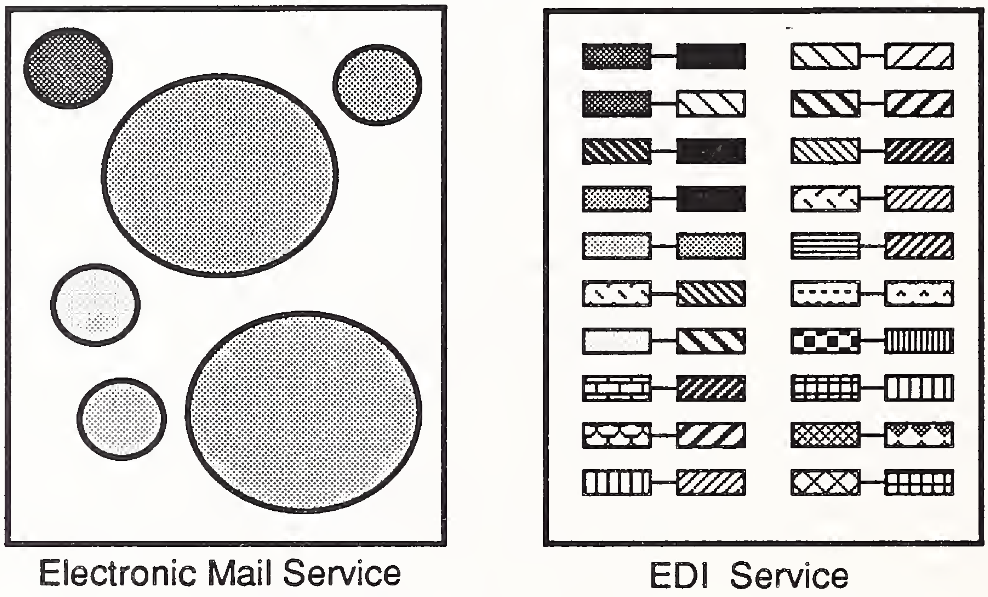
- In electronic mail, each user within a contiguous addressing group has unrestricted sending ability to every other user.

- On most EDI services, in contrast, only defined trading partners can exchange messages. Instead of open pools of mailboxes, like in electronic mail, EDI services are really a series of restricted trading pairs.

Exhibit IV-1 shows these differences.

EXHIBIT IV-1

COMPARISON OF E-MAIL AND EDI ADDRESSING



The underlying business needs show how these differences developed.

In electronic mail, the basic goal is to allow everyone within a defined group to communicate on an "as required" basis.

- In private mail systems, for example, the lowliest employee can send a message directly to the highest employee.
- In theory, this can be extended on a worldwide basis with the X.500 directory in much the same way that directory services exist worldwide for telephone numbers. In fact, X.500 has the potential to replace existing directory services.

In EDI, trade documents are exchanged as the result of a formal business relationship, which is usually formulated by contract specifying that trade documents will be exchanged electronically.

- In-house EDI systems are not set up to receive trade documents electronically from anyone at random. EDI systems would be chaotic and dangerous if they were used in this fashion.

- Both trading partners must know in advance that they will use EDI to exchange documents and will know in advance the proper addresses to use.

- As a result, the concept of X.500, which is so powerful in electronic mail, has minimal, if any, value to EDI in this context.

This is separate, incidentally, from X.400's potential value in connecting different EDI services together, particularly internationally, so that once trading partners agree to exchange information, it becomes easy to link their respective services. It is also separate from other potential functions of an X.500 directory, such as serving as a router for EDI messages when sent to known addresses. X.500's other potential functions are discussed later in this section.

2. The Audit Factor

The second important issue is the audit factor. EDI has a well-defined audit procedure that is insisted upon by end users, so that every trade document is positively acknowledged with a Functional Acknowledgement (FA) at the application level after a document has been successfully entered into the application processing system. This is a critical part of EDI because both partners must keep track of their electronic exchanges in order to manage their accounting functions properly.

In electronic mail, in contrast, acknowledgements function at a different level. Two types of acknowledgements exist—one that says a mail system has placed a message in a specific mailbox and another that says the recipient has extracted the message from the mailbox. Electronic mail does not have an acknowledgement that says the recipient has read and processed the message. This would be done by the recipient generating a reply message.

Neither of electronic mail's acknowledgements are sufficient for EDI, which ultimately requires a positive acknowledgement that the receiving computer has entered the message correctly into its processing system.

- Thus, in relationship to electronic mail, an EDI Transaction Acknowledgement is actually a separate reply message, not a system acknowledgement.

- If a sender does not receive such an acknowledgement within a specified time—usually by the next business day—then the transaction is resubmitted. If the receiving EDI system is late in sending the acknowledgement and a second trade document is received, the receiving system will ideally detect it because the systems can be set up to prevent double ordering, billing and payments.

While this is a subtle point, it is important in relationship to X.400's value to EDI. X.400's concept of audit trails and acknowledgements and will bring a valuable new capability to the electronic mail world that does not exist in most E-mail gateways today. For EDI, however, X.400's audit capabilities are of questionable value because of the existing system of TAs that operate at a higher level.

In sum, the addressing and audit issues, which are very important in X.400's value to electronic mail systems, are far less important to EDI systems, which really work quite well with today's lower level protocols such as IBM bisync and Kermit.

- EDI users and service providers should understand these differences lest there be some serious misunderstandings about the value of X.400 to EDI.

- This caution is especially true for telecommunication companies who may view EDI as being little more than a specific type of electronic mail that will derive the same benefits as other types of electronic mail when carried via X.400.

B X.400's Value to EDI—Front-End Processing

To understand what functionality must be developed in an EDI protocol for X.400, it is important to understand that two of X.400's key benefits to electronic mail—the X.500 directory and audit trails—have substantially reduced value to EDI.

It also isn't enough for X.400 to blindly wrap an EDI document in an X.400 envelope and allow it to be sent between EDI systems. Why would EDI users want to buy relatively complex X.400 software to replace comparatively simple communications software like IBM bisync or Kermit?

What this means is that X.400 must find additional benefits that will attract end users to choose it versus simpler protocols—unless, of course, the only benefit X.400 will have is to allow public services to interconnect in a more formal fashion than they do today.

- While such a benefit is real enough and would have a value to EDI users who do not like the relative lack of security in the Open Mailbox concept, the benefit can hardly be considered sufficient to justify the attention that X.400 is receiving in EDI.

- If network interconnection turns out to be X.400's only benefit, then it will be a huge disappointment for EDI users and telecommunications companies alike.

There are four reasons why X.400 *will* have value to EDI users.

- X.400 will allow EDI, electronic mail, and other transactions to travel over the same backbone network, which can have cost efficiencies in large companies.

- X.400 can be used to create a powerful front-end processor to an EDI back-end application processor.

  - In EDI, there is no restriction on the number of interchanges that can be included within an overall document. One of the major values most EDI public services now provide is to serve as a distribution agent for EDI users, who send the public service one large transmission with multiple interchanges for their different trading partners. The EDI service then separates the interchanges and places them in separate mailboxes.

  - An X.400 front-end processor will receive the same EDI stream from the internal EDI mainframe, but will break up the interchanges into separate X.400 envelopes and then send as many as possible via an X.25 packet network directly to other trading partners. Those that cannot be sent directly will be routed to EDI services.

- By definition, an X.400 front-end processor will solve another problem that is now solved by third-party services—format and speed conversion.

  - While most EDI software on today's market creates standard EDI documents, not every system uses the same communications protocol, which makes it difficult for companies to communicate directly.

  - X.400 will solve this problem by imposing a standard means of communicating via X.25 packet networks.

- An X.400 front-end processor will meet the security concerns now held by many EDI users, who are concerned about having their mainframe computers accessed directly by other companies they are also concerned about having their sensitive data pass through third-party services.

  - The X.400 front-end processor will isolate a corporate mainframe from the communications network in much the same way that a third-party service does, while it will also allow direct transmission between trading partners.

  - In short, while an X.400 front-end processor will not solve every security problem, it solves the two main security issues expressed by many of today's users.

C
Impact of X.400 on Existing Distribution System

Exhibit IV-2 shows today's EDI distribution system, which is dominated by EDI public services—both VANs (Value Added Networks) and RCS (Remote Computing Services).

EXHIBIT IV-2

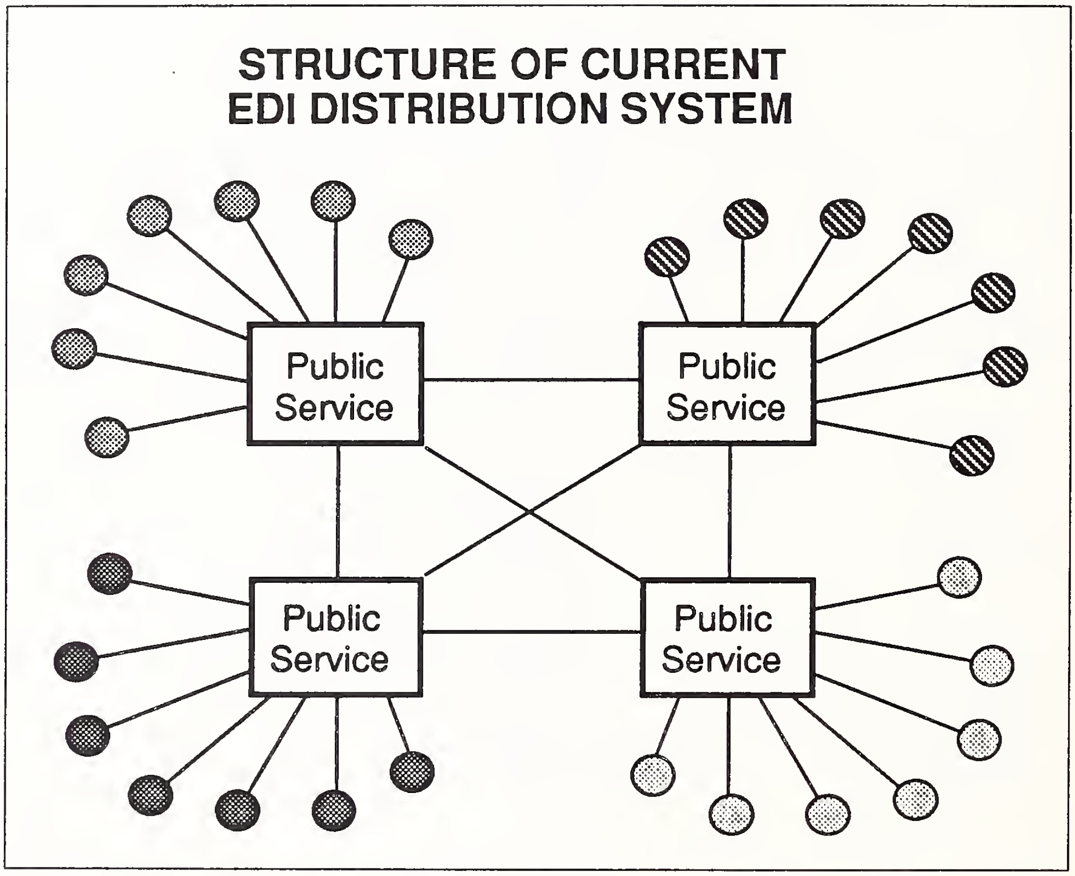
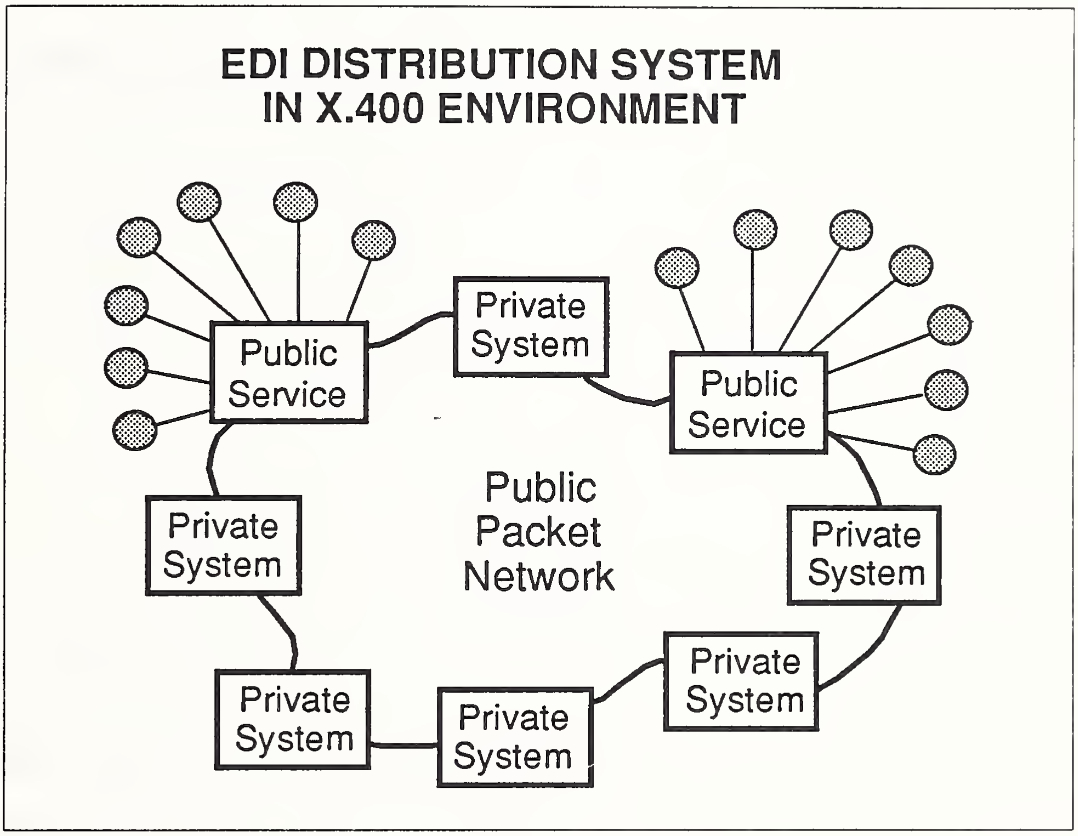


Exhibit IV-3 shows how an X.400 front-end processor can change today's distribution system.

EXHIBIT IV-3



D

Cost Savings of X.400 Front-End Processor

To show the potential cost savings, Exhibit IV-4 compares the costs of sending an EDI document on a public EDI service versus the cost of delivering an EDI document directly between trading partners on a packet network. The public EDI service used for the comparison is Western Union, a low cost provider, while the packet network is Telenet.

As the exhibit shows, transmission charges on a packet network are considerably lower.

- Telenet packet rates are $1.40 to send up to 64,000 characters, while Western Union charges nearly $22 to send the same number of characters to a single trading partner.

- An EDI user, however, incurs a one-time cost of $1,200, plus $600 per month to maintain an address on Telenet. Since the packet network is an order of magnitude less expensive to send characters, however, it will not take high volumes before a packet network connection is cost justified.

EXHIBIT IV-4

PUBLIC EDI SERVICE VERSUS PACKET NETWORK DELIVERY COSTS

Item	Western Union	Telenet
Network Connection		
(Async 9600 bps)	NA	$600/mo.
Installation	NA	$1,200
Traffic	$0.34 per 1,000 characters* $0.10/address	$1.40 per thousand segments**

*Western Union charges $0.17/1,000 characters to send and $0.17/1,000 characters to receive. As a result, a complete transaction is $0.34/1000 characters.
**A segment is up to 64 characters.

E Value of X.500 Directory

The potential value of an X.500 directory can be evaluated in context of X.400-EDI front-end systems riding atop packet networks.

X.500 is a directory standard that allows messages to be routed over a variety of networks. This is quite different than the addressing standard in X12, which is designed to identify trading partners *after* an EDI document has been exchanged.

In effect, X.500 and the EDI interchange have different functions. While the difference may seem subtle, it is very important.

- In an EDI system, interchange information is currently designed to be transparent to the means of communications. The application processor typically creates a single EDI transmission with multiple interchanges and sends them all to a public service, which maps each interchange to a specific end user's mailbox.
  - The address of the public service, typically a single number, and the interchange addresses in the EDI document have no relationship to each other.

- Relating the EDI interchange address to a physical location is handled by the EDI service provider, who places the interchanges in trading partners' mailboxes.

The X.500 directory, in contrast to an EDI interchange address, will house the network addresses of each trading partner.

- When an EDI document is sent via X.400, the trading partners' addresses in the interchanges will be mapped to physical network addresses residing in the X.500 directory.

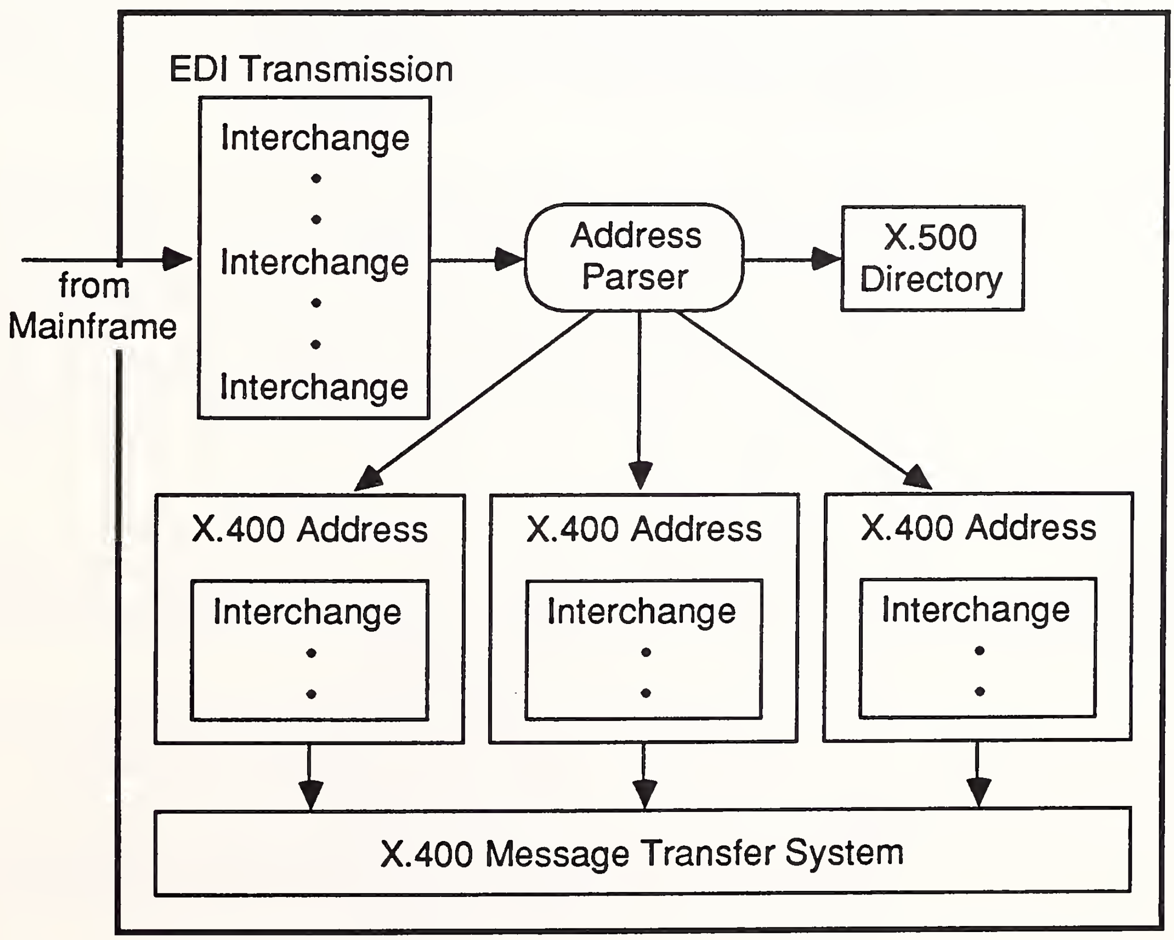
- The interchanges will then be placed within X.400 envelopes and passed to the X.400 Message Handling System, which will deliver the envelopes to the trading partners' X.400 systems or to public services.

- Thus, if an X.400 front-end is programmed properly, it will perform many of the same basic functions now performed by public EDI services.

Exhibit IV-5 shows how such a system might operate internally.

EXHIBIT IV-5

X.400-BASED EDI FRONT-END PROCESSOR



F

EDI Addressing Needs versus Electronic Mail Addressing Needs

Readers should keep in mind that EDI trading partners will not have the same problems that electronic mail users have in maintaining network addresses. One of the main roles of a worldwide X.500 directory system maintained by Administrative Domains, (i.e., public electronic mail services), is to keep up-to-date addresses for their constituent electronic mail users.

Given the random, on demand, nature of electronic mail communications, no single company will want the responsibility of maintaining addresses of millions of users worldwide. Thus, there is a natural opportunity for Administrative Domains to maintain large directories of electronic mail users.

The same situation does not exist in EDI—at least not today. Almost by definition, trading partners have to keep track of each other as part of the normal course of doing business. It is a relatively small extension to existing data base maintenance responsibilities to keep track of a trading partner's network address in an X.500 directory, especially if it will result in up to two orders of magnitude in cost savings when transmitting EDI data.

To give an idea of the number of addresses that must be maintained, in INPUT's recent study on the North American EDI market, the average EDI user had 112 trading partners, with a growth of 74 trading partners per year. If this growth rate is constant for a period of five years, the average user will have about 1,500 trading partners to keep track of in the early 1990s, which is hardly a difficult task.

Even if a large company, like Boeing, which has 58,000 suppliers, were to be faced with the task of keeping track of every network address, it is barely more than a single full-time job to maintain network address changes. Thus, while electronic mail users will certainly not keep track of too many other users worldwide, which will create a need for a public worldwide E-mail directory, EDI users can be expected to keep track of their trading partners' network addresses, which opens the door to direct communication.

G

Impact on EDI Service Industry

The X.400-based front-end processor described above will shift today's balance of power away from public EDI services and towards direct connections between trading partners.

- At present, EDI services dominate the EDI industry and will continue to do so until X.400 front-end processors reach the market.

- When the X.400 front-end processors are available, EDI users will shift towards connecting directly via X.25 packet networks, which will take revenues away from service providers.

The impact, however, will not be felt equally by all EDI service providers.

- The Value-Added Networks (VANs), which have X.25-based public packet networks, will actually gain in power, while the Remote Computer Services (RCS), who do not operate public networks, will lose power.

- In particular, many of today's service leaders, including Sterling Software's Ordernet, Control Data Corp.'s Business Information Services, Kleinschmidt Computer, TranSettlements and Railinc, will be placed on the defensive because of X.400 front-end processors.

In contrast, while the VANs will lose in terms of their EDI services, they will gain by attracting packet network traffic. Telenet, Tymnet (McDonnell Douglas), Western Union, and CompuServe, in particular, will be able to go on the offensive by offering public EDI services and public packet network services. This will make it easy for trading partners to reach other trading partners and public services directly from the same X.400 front-end processors.

The Bell Operating Companies, who all operate local packet switching networks, will also be major beneficiaries of an X.400 front-end processor for EDI.

GE Information Services and IBM Information Network will fall in the middle on this issue. While these firms are classified as VANs, their networks operate in a different fashion from the other VANs.

- GE Information Services' network is not typically used by third parties to connect host computers directly. Instead, GE Information Services uses its network primarily for its own host computers.

- IBM Information Network does not operate using the X.25 protocol. It is an SNA network that links IBM mainframes.

How much will X.400 front-ends impact today's current industry structure? The impact will be enormous, particularly since the public packet networks themselves are also evolving.

- By the early 1990s when X.400 front-ends reach the marketplace, dial-up X.25, called X.32, will be commonplace, and dedicated connections to packet networks will be less expensive than they are today.

- While the relative price for a dedicated X.25 link may remain constant at roughly $1,200 per month plus transmission costs, for example, the actual cost will decline because of inflation.

By 1993, however, X.400 systems will also be able to dial each other directly. If a user can dial an X.25 packet network using X.32, there is no reason why X.400 front-ends will not have auto-answer X.32 cards, so that trading partners can dial each other directly. This will have an enormous impact on small EDI users who cannot afford dedicated X.25 connections.

- Basically, X.400 front-end processors with dial-up X.32 capabilities would operate much like fax machines, except that the information being exchanged would be in computer, not graphics, format.

- Such a development would have the potential of obsoleting most of today's EDI service providers in terms of functionality.

H
Reaction by EDI Service Providers

While X.400 front-end processors will change today's industry structure, readers should keep in mind that the impact will not begin to be felt until the early 1990s and will likely require several years more before X.400 front-end processors sweep the market, especially when inertia is considered. Thus, it may not be until the mid-1990s or later when EDI services begin to fade from the market in much the same way that timesharing declined.

EDI service providers, particularly the RCS, have plenty of time to react to the coming change. These RCS, such as Control Data, Sterling, Kleinschmidt, TranSettlements, and Railinc, have several options open to them:

- Develop X.400 front-end processors that work directly with their existing public services in order to keep their customer base—Since X.400 front-end processors will require as much expertise from the EDI industry as from the X.400 industry, RCS can take the lead in their respective markets, rather than take a defensive posture and watch the business erode.

- Implement packet networks in major cities and in areas where key customers have facilities—While the revenues will be lower per transaction, the resulting networks will still have a significant profit potential.

- Develop joint ventures with Bell Operating Companies (BOC), who have local packet networks and are actively seeking good applications—A small RCS might end up leveraging its marketing 10-fold and very quickly develop nationwide packet network coverage by connecting BOC local packet networks via a backbone network.

These options are summarized in Exhibit IV-6.

EXHIBIT IV-6

EDI SERVICE PROVIDER OPTIONS FOR X.400 BY 1995

- Develop X.400 Front-Ends to Service
- Implement Local Networks
- Work with BOCs

EDI service providers can also add or enhance value-added features to provide incentives for users to continue using the service. These features would not be easily or efficiently replicated by users, or may be uniquely suited for provision by third-party services. Such features may include:

- RCS-based EDI data archiving
- Industry-wide data base creation from EDI transactions for market analysis and other purposes
- On-network translation between different CAD/CAM graphic standards associated with EDI interchanges
- Network-based consolidation of transactions originating from multiple divisions of the same company
- Network-based electronic catalogs to facilitate EDI trading
- Network-based foreign currency exchange tables to convert international financial transactions

These suggested value-added features are summarized in Exhibit IV-7.

EXHIBIT IV-7

POSSIBLE VALUE-ADDED EDI FEATURES

- Data Archiving
- Transaction Data Bases for Analysis
- Graphics Translation
- Consolidations
- Electronic Catalogs
- Foreign Currency Exchange Tables

I X.400 and Graphics Integration

X.400 will have additional value to EDI integration beyond cost savings. There is a movement to add the ability of EDI systems to handle graphics, so that items such as engineering drawings can be included in an EDI transmission. While such drawings have no value to a back-end EDI application processing system that handles invoices, P.O.s, etc., they can be of value to overall electronic trading by allowing RFQs and RFIs to include graphics material that is required for companies to make purchasing decisions.

Imbedding graphics within an X12 envelope is not technically difficult. For X12 to handle graphics, a special functional group and data segments would have to be created that identify a transparent graphical item. Supply Tech, Inc. (Southfield, MI) has created the ability for its EDI software to handle graphics in this fashion. Supply Tech's software can operate directly between trading partners or on public networks. Both trading partners, however, must have Supply Tech EDI software to decode the graphics.

The problem in integrating graphics into X12 or other EDI standards is one of market readiness. Few application processing systems are designed to handle graphics. Furthermore, since EDI now uses low level communication protocols, there is very little hope that graphics can become a part of EDI until application processors are programmed to handle graphics.

An intelligent X.400 front-end would make it easy for a company to allow graphics to accompany EDI documents. The X.400 front-end would identify the graphic segments and route them to another application processor, so they can be retrieved electronically by the recipient. While this would be easy for an X.400 system, readers should keep in mind that the current CCITT Study Group is not likely to deal with the issue of integrated graphics and EDI. It will have its hands full incorporating today's X12 and EDIFACT standards within X.400.

Since X.400 can also handle interpersonal messages, however, it would allow a company to have a single X.400 front-end that receives both EDI documents and electronic mail, which could include graphics. The EDI documents would be sent to EDI back-end processors, while the electronic mail would be routed to a company's mail system.

While X.400 can play a role in EDI by facilitating the integration of graphics into EDI documents, readers should keep in mind that the movement to have graphics integrated into EDI is specialized by industry. Industries such as aerospace and automotive will have an interest in graphics, while other industries, like grocery and warehousing will have little interest. Thus, while X.400 will open the door to integrating graphics with EDI, it will not be required across every industry.

J X.400, EDI, and Third-Party Interconnections

Recently, the aerospace industry—specifically Boeing, Northrup, General Dynamics, and Hughes—provided a strong impetus for X.400 by persuading the U.S. electronic mail service providers to interconnect using X.400.

While the electronic mail suppliers have all endorsed X.400, they have shown little inclination to interconnect with each other directly. The companies involved include AT&T, Telenet, MCI, Western Union, Dialcom, IBM Information Network, GE Information Services, and McDonnell Douglas, all of whom, save MCI and Dialcom, also provide EDI services—and MCI and Dialcom are expected to announce services this year.

The E-mail interconnections will take place in mid-1989 and, initially, will only be available for companies in the aerospace industry. By 1990, however, it is likely that the major electronic mail companies will all be interconnected via X.400 for general traffic, which will also pave the way for passing EDI traffic via these interconnections.

When the electronic mail companies have formal interconnections using X.400, this will impact the "Open Mailbox" concept in which EDI service providers keep mailboxes on each others' systems.

- For EDI users the impact will be minimal. While X.400 will add some security in comparison to Open Mailboxes, it will come at an increased cost.

- More importantly, interconnecting EDI services is a back-office process that end users really have little interest in. Does it really matter whether Open Mailboxes or X.400 is used as long as documents are exchanged? Thus, while it is expected that X.400 interconnections will replace Open Mailboxes, when X.400 is available, EDI end users will see only minimal changes as a result. The real change will come from X.400 front-end processors, not from EDI services interconnecting their services via X.400.

K Pathway to X.400

The evolution of X.400 is not a single event that will change the messaging world at once. Instead, it will be a series of steps that will evolve over a period of a decade or more. Exhibit IV-8 lists certain events that have already occurred along X.400's evolutionary pathway and projects others that will likely occur during the next few years.

The next chapter examines the structure of the information systems industry as it relates to vendors of X.400 products.

EXHIBIT IV-8

EVOLUTIONARY PATHWAY FOR X.400 AND EDI

Year	Event
1984	Adoption of X.400 by CCITT.
1985	First implementations of X.400 in test systems.
1986	Widespread sale of X.400 software by OEM providers. First implementations of Open Mailbox concept for EDI.
1987	First commercial X.400 products reach market. Approval of 1988 Version of X.400 by CCITT Study Group VII.
1988	First X.400 services by telecommunication companies. Widespread release of X.400 software by computer companies. Agreement by E-mail companies to interconnect via X.400. First X.400 software for LANs. Beginnings of formal X.400 User Agent for EDI.
1989	First implementation of CCITT 1988 Version of X.400. Domestic E-mail firms interconnect via X.400. Packet networks announce plans to expand dial-up X.25. Widespread release of 1988 version of X.400. EDI User Agent for X.400 developed by CCITT. EDI documents transferred informally using X.400 to test concept. Agreements by EDI software firms to develop X.400 versions.
1990	First implementations of X.400 EDI User Agent for testing. Dial-up X.25 (X.32) becomes widespread on packet networks. Packet networks announce Dial-out X.25. ANSI formally supports X.400 User Agent for use with EDI. EDI software providers released X.400 Application Programming Interfaces (APIs). Formal transfer of EDI documents between select service providers using X.400. Announcement of international EDI services that will use X.400.
1991	X.400 begins to replace Open Mailbox among EDI service providers. End users start implementing X.400 to transfer EDI documents to public services. First X.400-based front-end processors for EDI users reach market. Dial-out X.25 is implemented in a few major cities. Aerospace leads charge to implement EDI-X.400 front-ends.
1992	EDI service providers who support X.400 abandon Open Mailbox concept in favor of X.400 interconnections. Low cost, X.400 front-end processors that use dial-up/dial-out X.25 reach market for small EDI users. X.400-based front-end processors become popular in aerospace, automotive, and electronics industries. Revenues for public EDI services reach their peak.

V

X.400 Supplier Industry Structure

V

X.400 Supplier Industry Structure

There is a small, but high-powered, industry that has formed to develop X.400 commercially.

- The industry consists of several, specialized software companies who have developed X.400 software and are selling it to telecommunication companies and computer or software companies.
- These customers in turn, are developing X.400 to serve their own customers.

Interestingly, only a handful of the many powerful computer and telecommunications companies worldwide have developed their X.400 software from scratch. Most have purchased software from these specialized firms.

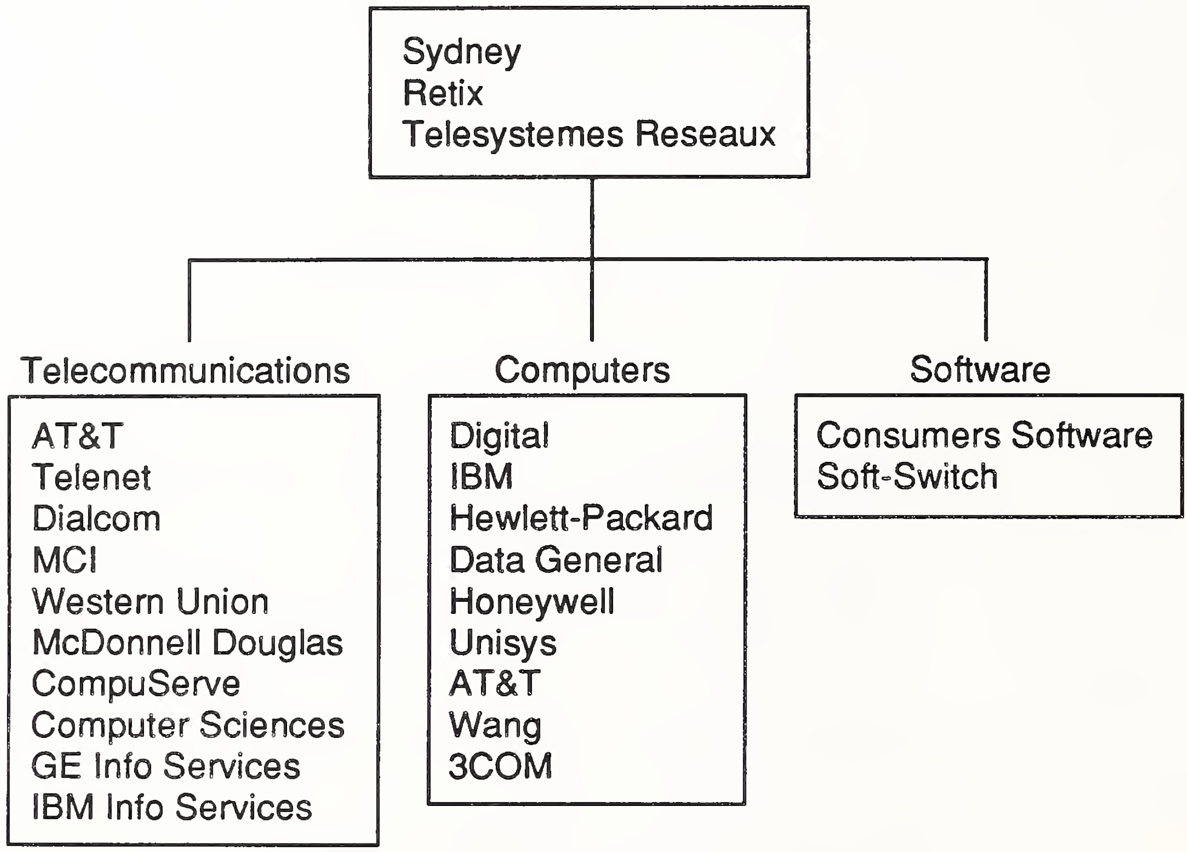
The computer companies are developing X.400 to keep pace with other firms in the industry as part of the worldwide movement to Open Systems Interconnection. Regardless of whether the computer companies want X.400, they must develop it in order to maintain their competitive positions.

The telecommunications companies are developing X.400 as part of a plan to develop public services that will carry electronic mail, EDI and other traffic on a worldwide scale. As part of the CCITT's X.400 plans, the X.400 world has been divided into Administrative Domains (ADMs) and Private Domains (PRDMs). The ADMs will be telecommunications companies operating public services, while the PRDMs will be end-user organizations operating software procured primarily from the computer or software companies.

Exhibit V-1 shows the structure of the industry, along with some of the leaders in each segment.

EXHIBIT V-1

X.400 SUPPLIER INDUSTRY STRUCTURE



A OEM Software Providers

The OEM software segment of the X.400 market has provided software to virtually every player, with some notable exceptions that include Digital Equipment, IBM, Hewlett Packard, and Dialcom.

- Sydney Development Corp. (Vancouver, B.C.) is the market leader and was the first company in the market, introducing its OEM software in 1985. Sydney Development is a $20 million company, with an estimated 50 percent of its revenues derived from X.400 software. Sydney's customers include AT&T, Data General, Telenet, and Honeywell, among others.

- Retix (Santa Monica, CA) is a leading provider of Open Systems Interconnection (OSI) software, with revenues in the range of $20 million. It entered the OEM market for X.400 software in 1987 and is focussing primarily on the Local Area Network (LAN) market. It recently introduced X.400 electronic mail software for LANs that it sells on both OEM and end-user levels.

- Telesystemes Reseaux (Paris, France) is a French company that has entered the U.S. market through an alliance with 3COM to provide X.400 software that will operate on 3COM's local area network systems.

B
Telecommunication Companies

The telecommunication firms supporting X.400 are a Who's Who of electronic mail providers—with virtually 100 percent of the market. At present, however, three of the firms—Telenet, Dialcom, and AT&T—have taken the lead in X.400 by focussing more resources on it than the other firms.

Telenet (Reston, VA) operates a nationwide packet network, sells private packet networks worldwide and also operates the Telemail electronic mail service and TEDI service for EDI users. While TEDI is a new service, Telemail is one of the oldest electronic mail services in the market and is licensed in about 20 countries internationally.

- Telenet has already used X.400 to interconnect a number of its licensees and claims that it is using X.400 to connect private electronic mail systems to Telemail at a rate of one per week.

- Telenet is using X.400 as a key part of its marketing strategy in both the electronic mail and EDI industries.

- In electronic mail, it plans to use X.400 to become the leading Administrative Domain in North America.

- In EDI, it plans to use X.400 as a means of entering the EDI industry, where it is a neophyte.

Because Telenet also operates its own public packet network, it will likely be a strong proponent for X.400-based front-end processors on the theory that what it might lose as a public service provider, it will gain as a public packet network provider.

Dialcom (Rockville, MD) is a strong competitor to Telenet in electronic mail and has sold about 20 licenses for its software worldwide. Dialcom is owned by British Telecom, which was once one of its licensees.

- Like Telenet, Dialcom is making a strong push in the market to interconnect private electronic mail systems to its public network, although it is not focussing exclusively on X.400. Dialcom has proprietary interfaces to a number of popular electronic mail systems, including IBM, Digital, Wang, and Data General.

- To date, Dialcom has not shown a strong interest in the EDI market. When it does enter the EDI arena, it will likely focus on the government and international markets, where its presence is strongest, especially since Dialcom does not have its own domestic packet network.

AT&T (Basking Ridge, NJ) entered the electronic mail market in late 1986 and the EDI market in 1988. Because of its late entry into both markets, it is far from a leader in either one, which explains why it is a strong proponent of X.400.

- By supporting interconnection among the various suppliers, AT&T hopes to gain parity against companies that have far larger bases of users.

- Since AT&T operates its own packet network and has its own UNIX-based computers, it will be a major proponent of X.400-based front-end processors. In fact, leadership in X.400-based front-end processors for EDI could become a key strategic goal for AT&T.

- By focusing on the development of an X.400-based front-end processor, AT&T could attract a significant number of EDI users away from their existing public service providers, which would not only generate a large volume of packet network traffic and revenues, but also open up a specialized market for AT&T computers.

Western Union, MCI, and CompuServe have introduced X.400 products, although their commitments to date have been far less than Telenet, Dialcom, and AT&T. Western Union and CompuServe, however, have both launched significant efforts in EDI and also operate their own public packet networks. Without a doubt, they will be very interested in capturing traffic from X.400-based front-end procesors.

McDonnell Douglas and GE Information Services, two of the leading providers of EDI services, have been relatively weak supporters of X.400.

- To protect their positions in EDI and electronic mail, however, both companies will be implementing X.400 gateways to interconnect with other E-mail providers. They can also be expected to use X.400 for EDI traffic as the industry evolves.

- Of the two firms, McDonnell Douglas is likely to be the stronger proponent of X.400-based front-end processors because it operates the Tymnet public packet switching network. While GE Information Services operates its own network, it has few private hosts attached. Instead, its network is used primarily to support communications for its own host computers.

C Computer Equipment Companies

All of the leading computer companies, including IBM, Digital Equipment, Data General, Hewlett-Packard, Unisys, Honeywell, and Wang, have introduced X.400 products, although only Digital Equipment and Data General have aggressively sold X.400 to their customer bases.

Digital Equipment can be considered the leader in X.400 based on both internal commitment and long-term strategic plans. Digital has developed its own X.400 and plans to make it an integral part of its electronic mail and EDI architectures during the coming years.

- Since Digital is a strong proponent of direct end user to end user networking, it will undoubtedly be one of the firms that leads the charge towards X.400-based front-end processors. In fact, it will almost certainly develop Application Program Interfaces (APIs) that allow IBM mainframes to send their EDI data to a Digital X.400 front-end processor.

- While Digital does not expect to convince end users to switch away from IBM mainframes, it hopes to convince those same customers to use Digital hardware for their communication networks.

Data General purchased its X.400 software from Sydney and has marketed it strongly to its end users. DG has consistently been among the leading proponents of X.400 by participating in field trials and working closely with Telenet, Dialcom, and AT&T, who are the leading Administrative Domains in the U.S.

IBM has introduced X.400 software in both Europe and the U.S., but is not trying to sell it aggressively. IBM has been pushed by its customers to develop X.400 and has done so diligently.

- That does not mean that IBM favors X.400 strategically. Instead, IBM favors the use of its proprietary architecture, including SNA and SNADS, to transfer electronic mail. It will also favor these protocols for EDI as well, although customers will be able to purchase X.400 software for their mainframe computers.

- IBM, however, is not likely to look with favor upon X.400-based front-end processors. While IBM has both X.25 and X.400 software, they diverge from IBM's main strategic plan, which is based around SNA and SNADS.

- Instead, IBM will focus its efforts on using its proprietary architecture to create an alternative to X.400 by using the IBM Information Network directly, so that IBM mainframes can pass EDI data directly to each other or via its own EDI service.

- IBM will only support X.400 for EDI transfer if it is pushed that way by the marketplace.

D

Companies to Watch

During the next two years, the companies mentioned above will drive the process of integrating EDI and X.400. The leading activists will likely be telecommunication companies, like Telenet and AT&T, computer companies like Digital Equipment and Data General, and software companies like Retix and Sydney. The reason is that X.400 still must go through a phase where a specific protocol is developed, and these companies have the resources to help develop that protocol.

In the early 1990s, however, the marketplace will likely broaden to include some of today's EDI software companies and, most interestingly, the Bell Operating Companies.

Today's EDI software companies have not yet entered the X.400 arena because they have little or no reason to participate.

- Since an X.400 user agent is not yet agreed upon by the CCITT, there is no reason to develop a link between operating EDI software and X.400 networks.

- Upon the adoption of an X.400 interface, however, there will be a lot of action between the EDI software firms, the OEM X.400 software companies and the telecommunication companies, including both joint ventures and some mergers and acquisitions.

E

Opportunities for the Bell Operating Companies

The Bell Operating Companies (BOC) will also likely get into the action very quickly. Until recently, the Bell Operating Companies have been shut out of the EDI service industry by regulatory fiat. While they have received permission to offer electronic mail services, and would likely also receive permission to offer EDI services, none has yet to do so. The closest that a BOC has come to EDI is Pacific Bell, which has talked publicly about EDI as a natural extension to electronic mail.

Upon the development of X.400-based front-end processors for EDI systems, the BOCs will have an open door to enter the EDI industry via their X.25 packet switching services. At present, the BOCs all have local packet network services that operate on an intra-LATA basis. Traffic has been relatively minimal because few applications have been developed that fit the characteristics of intra-LATA operation.

X.400-based front-end processors for EDI, however, will be a natural for Bell Operating Company packet networks, particularly in aerospace, manufacturing, and warehousing, all of which have heavy concentrations of intercompany communications at local and regional levels, rather than on a national level.

As traffic builds on BOC local packet networks, there will be more incentive to create X.75 gateways that allow the various packet networks to interconnect on a national level, so that a company with its EDI network on one BOC local network can reach a company on a different BOC network.

The next chapter presents X.400 forecasts as related to EDI, and offers some concluding observations.

VI

Forecasts, Observations, Recommendations, and Conclusions

VI

Forecasts, Observations, Recommendations, and Conclusions

X.400 will have a profound impact on the structure of the EDI market, but for reasons that are far different than many people anticipate.

While many people in today's industry expect that X.400 will increase the dominance of today's EDI service providers by allowing them to interconnect their services with a high-level, intelligent protocol, X.400 will have the opposite impact—it will allow end users to bypass EDI services and send their trade documents directly.

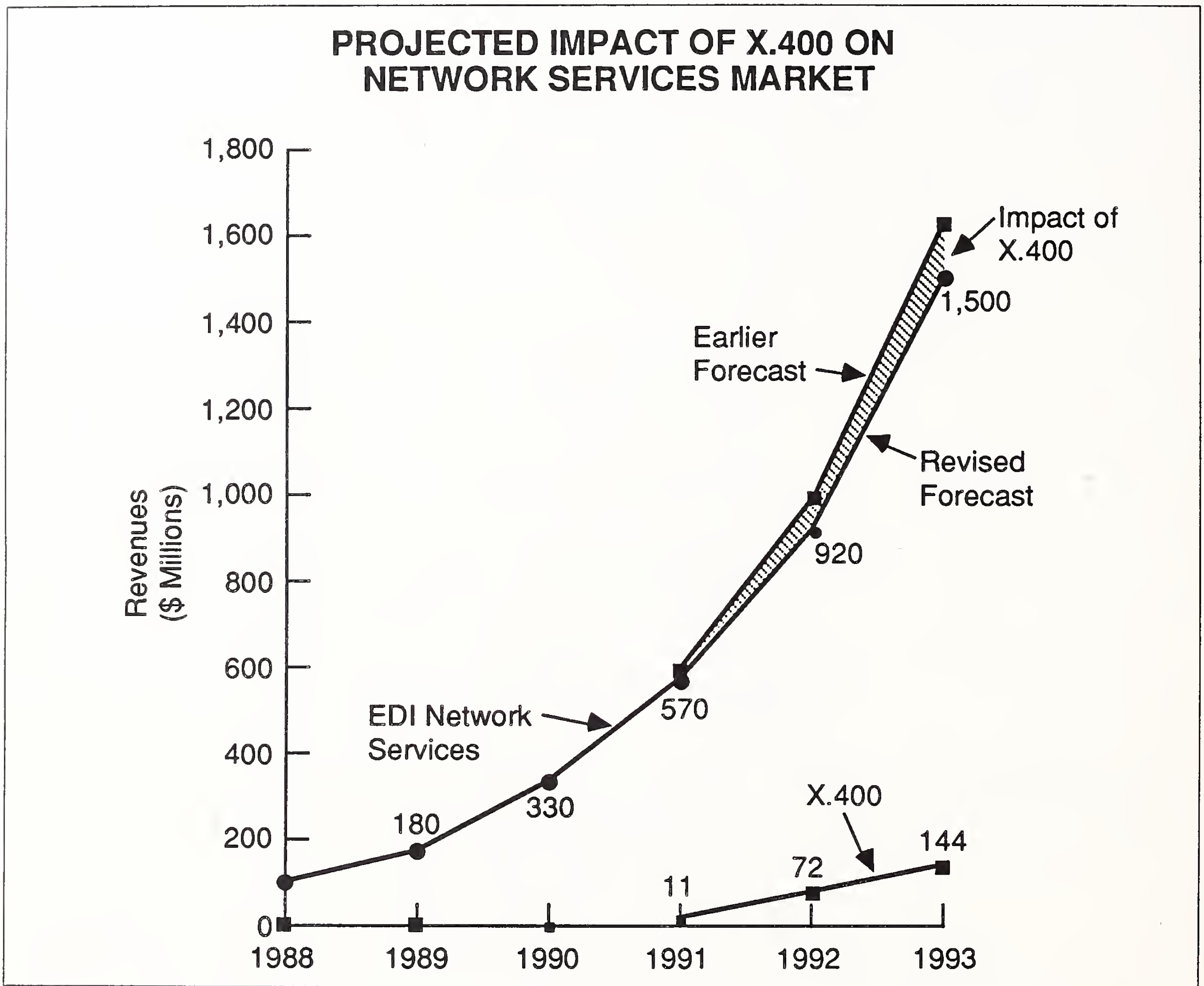
A Market Impact of X.400

X.400's impact on EDI will come in staged phases. The first phase will begin when EDI service providers use X.400 to replace the Open Mailbox concept to transfer data directly among themselves. We expect that this will begin as early as 1990 on an experimental basis, although its first serious impact in the market will not take place until 1991 or 1992. At that point, revenues attributable to X.400 will start to increase substantially.

In the 1992-1993 period, EDI users will also begin shifting to X.400-based front-end processors. Since the initial market will exist among the leading-edge users, the impact on the overall market will be minimal, but it will be an indicator of what we expect to be a major shift in the later years of the 1990s. As a result of the shift, today's network services revenues will shift away from high-level, third-party services and towards lower-level packet switching services.

Exhibit VI-1 projects the overall growth of EDI network services and attributes a portion of the market to X.400. The network services revenue projections come from INPUT's August 1988 report, *North American EDI Service Market Analysis*, which did not factor in the impact of X.400-based front-end processors.

EXHIBIT VI-1



- Readers should note that the revenue figures have been adjusted downwards beginning in 1991 to reflect the difference between X.25 packet switching rates versus EDI service provider rates.

- At present, these rates are different by a factor of about 20. By 1991, however, the rate differential will have closed to what INPUT believes is a factor of five.

- Overall, INPUT expects that X.400-based front-end processors will remove $120 million from the market for EDI network services in 1993. This is just the prelude of what will happen later in the 1990s as end users move away from EDI services and towards direct connection via X.400.

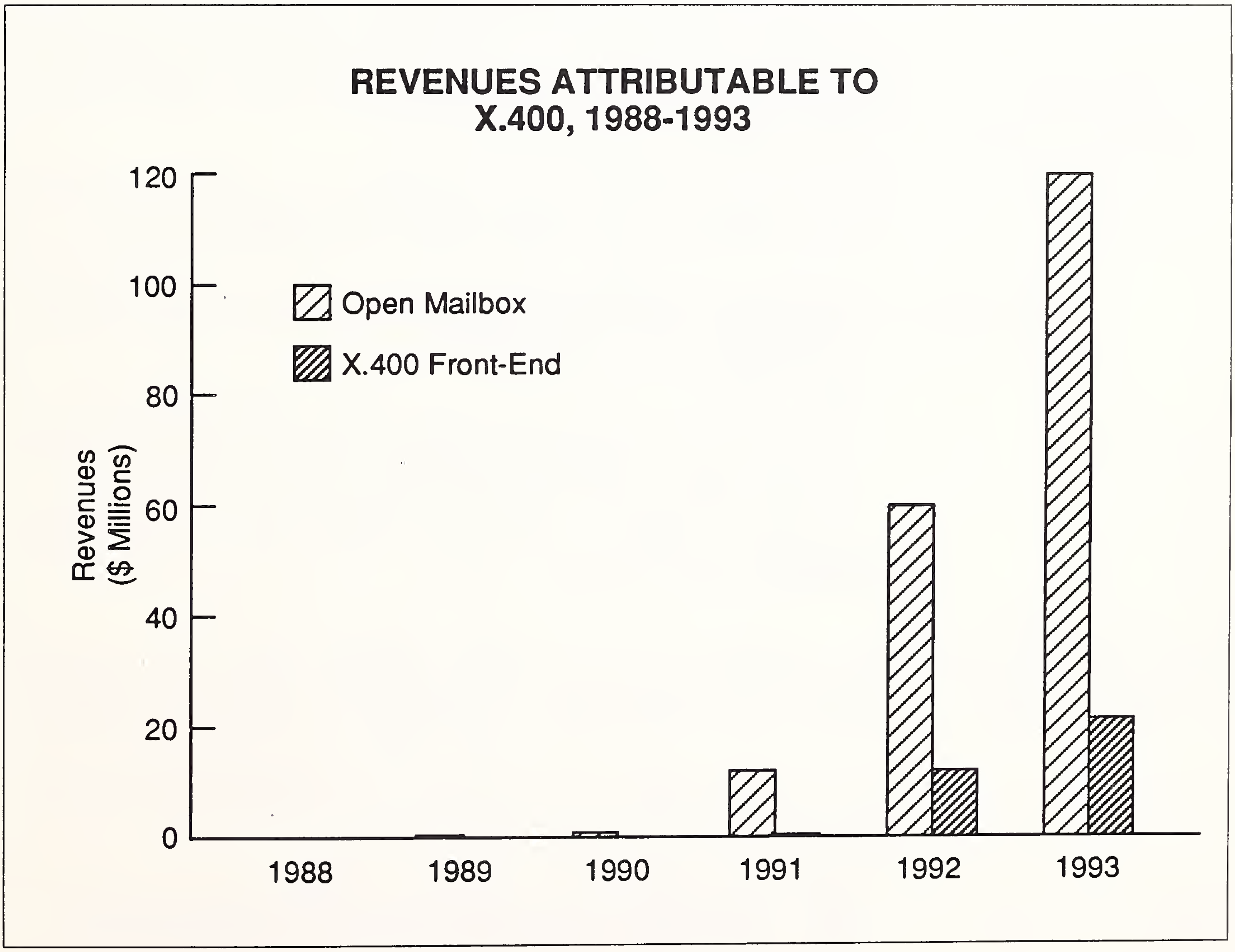
During the next five years, the total EDI network services market is projected to grow from $97 million in 1988 to $1.5 billion in 1993. X.400's impact will be virtually nonexistent until 1991, when it is expected to account for $11 million worth of traffic on network services. In 1992 and 1993, these revenues are expected to ramp up very rapidly as two events occur—X.400 front-end processors begin to enter the market and X.400 replaces the Open Mailbox concept by which service providers currently exchange messages for their end users.

B

X.400 Network Service Revenues

Exhibit VI-2 explores the X.400 portion of network service revenues.

EXHIBIT VI-2



In 1991, X.400-EDI interaction will be in an early testing phase, with some leading edge end users implementing X.400-based front-end processors and the public EDI services beginning to substitute X.400 interconnections to replace the EDI Open Mailbox concept.

- INPUT expects revenues attributable to both activities to account for about $11 million worth of EDI traffic. Of the $11 million, $10 million will come from revenues transferred directly from today's Open Mailbox concept, while $1 million will come from leading-edge users testing X.400 front-end processors.

- Readers should keep in mind that the $1 million in network services revenues is X.25 traffic, which displaces $5 million of EDI service provider revenues.

In 1992, INPUT expects a rapid transfer of traffic from the Open Mailbox concept to X.400 as a means of interconnecting public services. End users will not have a choice in the decision as public services phase out the Open Mailbox. Thus, the market attributable to the Open Mailbox replacement will ramp up very rapidly to $60 million in 1992 and $120 million in 1993.

Revenues attributable to X.25 front-end processors will be considerably smaller—estimated $12 million in 1992 and $24 million in 1993.

- Readers should keep in mind, however, that this traffic will displace what would be $60 million of EDI service provider revenues in 1992 and $120 million in 1993.

- Furthermore, this is only the tip of the iceberg. While EDI traffic will explode in the mid-1990s, there will be a huge shift away from today's EDI service providers and towards direct connection. Thus, by the 1996 time frame, the overall EDI network services market will likely be declining in terms of revenues to full-level service providers despite enormous traffic growth.

C
X.400 Software and Equipment Market

The market for X.400 software and equipment related to EDI is going to grow rapidly, although not until the mid-1990s. During the next three years, a nascent market will be created primarily by leading-edge users.

- In 1989 and 1990 vendors will receive little revenues from end users because they will be developing products.

- OEM providers like Sydney and Retix will receive most of the revenues, assuming that they dedicate resources to the growing market potential for X.400 in EDI.

In 1991, the first X.400-based front-end processors should reach the market—most likely in the aerospace industry. While the cost savings that these front-ends will represent will be highly significant, end users will not rush to adopt them because of the sensitive nature of their EDI operations.

- Most end users will be very content with existing EDI operations and will not rush to introduce change.

- Leading-edge users will prove the concept, a process which will take up to a year.

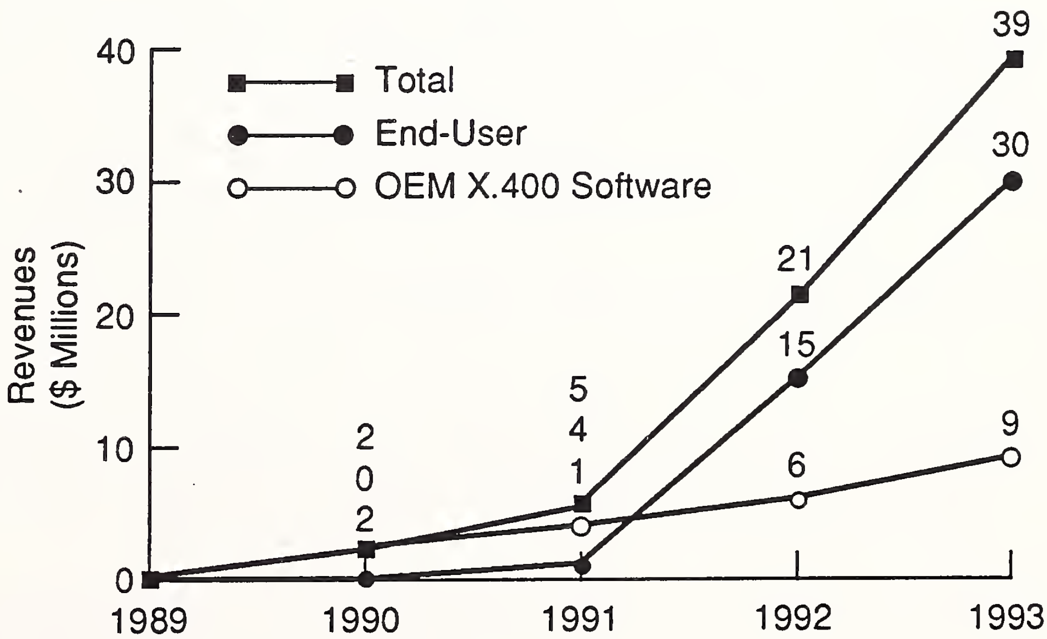
In 1992, however, the X.400-based front-end processor market should begin in earnest, spreading industry by industry.

- The first industries will be aerospace, electronics, and manufacturing—with automotive a likely choice.

- Industries like grocery and warehousing will follow later—primarily because it will take awhile to adjust X.400 front-end processors to handle formats different from X12 or EDIFACT. Exhibit VI-3 projects the software and equipment market for X.400 front-end processors in EDI.

EXHIBIT VI-3

PROJECTED MARKET FOR X.400 FRONT-END PROCESSOR EQUIPMENT, 1989-1993



The market for X.400 front-end processors for EDI is expected to start slowly, with initial revenues of about $2 million in 1990 for OEM software sales to companies developing end-user products. In 1991, the first X.400 front-end processors should be sold to leading-edge users, although the market will be extremely small, amounting to about $1 million. OEM software sales, including royalties, should be in the range of $4, as many computer companies purchase OEM software for their product lines.

In 1992, the sale of X.400 front-end processors should begin in earnest, with sales totalling $15 million. This represents about 200 systems at an average selling price of about $75,000 per front-end processor. In 1993, the market should double to $30 million and be poised for growth into a mature market in the mid-1990s. All told, the market could reach the $200-$400 million range in the 1996-1998 period.

OEM sales should ramp up quickly, reaching an estimated $9 million in 1993. While this is not a large market by itself, it is quite significant in the context of the OEM X.400 software market, which today is in the vicinity of $10 million.

D Conclusions

Here are several conclusions that come from INPUT's study on X.400 and EDI.

- The most obvious conclusion is that EDI service providers, especially the Remote Computing Services, will be very skeptical of INPUT's conclusions, in much the same way that RCS firms did not believe they would be impacted by the personal computer. EDI's precise addressing, however, which is a key difference in comparison to electronic mail, makes direct EDI transfers via X.400 inevitable.

- An X.400 front-end processor is both a threat and a boon to most of today's VANs, who provide X.25 services as well as EDI services. The VANS will win no matter which way the market turns. The RCS firms, however, are directly threatened by X.400 front-ends because they will likely lose all of their revenues, and not see EDI service revenues tranferred to X.25.

- The coming X.400 front-end processor will not be a "pure" X.400 system. It will require both EDI and data base management components as well. This will delay its introduction into the market by about a year in comparison with X.400 as a back-end processor to interconnect today's EDI service providers.

- While X.25 networks will be big beneficiaries, the regular dial-up network will benefit as well. At present, X.400 operates via X.25 networks or Ethernet LANs. By 1991, dial-up X.25, called X.32, will allow small processors to become "instant" packet nodes, so that X.400 front-ends can call each other directly via the regular telephone network. This will be very attractive to small EDI users, who will be able to dial each other directly over the DDD network or dial-up large users on public packet networks. Large users, in turn, will also have X.25 and DDD interfaces.

E Recommendations

- The first recommendation is that today's large EDI users should monitor the activities in the CCITT related to EDI and X.400. It will be roughly one year before the committee reaches any final decisions on an X.400 user agent for EDI, so there is plenty of time to have an input into the process for companies who can afford the cost of participating.

- EDI end users will also not have to worry about the development of X.400 front-end processors. As today's computer companies, EDI and X.400 software companies and VANs realize the potential impact, they will rush to have such a product developed. A delay in product development will come because very few firms have all of the expertise required for such a product in one location. Many firms will forge joint ventures.

- Nobody has to react immediately. The changes will not come for several years. At this point, for example, specifications for EDI user agent have not even been developed. Early reactions should be limited to providing input on an EDI UA, on designs for an X.400 front-end processor and on developing the expertise—either in-house or via joint ventures—to build an X.400 front-end processor.

- RCS firms MUST take the threat of an X.400 front-end processor seriously, especially those who believe they are entrenched in specific EDI market niches. There will be several years before the impact is felt, so these RCS firms, will have time to adopt counter strategies, such as developing X.400 front-end processor software and setting up an X.25 packet network designed to capture displaced traffic.

  - Companies like Control Data, Sterling Software, and Kleinschmidt, for example, could all set up backbone networks that interlink with Bell Operating Company local packet networks.

  - The combination of hardware/software, a backbone packet network, BOC marketing and existing industry expertise could keep today's RCSs entrenched in their markets despite having its characteristics change dramatically. EDI service providers can also offer value-added features, as described in Chapter IV, to stem user migration from EDI services to direct interchanges with their trading partners.

- But the key issue here is not the specific steps that can be taken—merely the need to take the threat seriously. There is no excuse for any RCS who gets caught because he didn't believe the threat was real.

- Small EDI software firms should begin now making their connections with X.400 software companies and with computer or telecommunication companies, many of whom have already invested millions in X.400 with only small signs of early returns. The concept of an X.400 front-end procesor for EDI will attract everyone because it solves a specific problem in an identifiable market. This will increase the value of EDI software firms, who will play an important role in creating X.400 front-end processors for EDI users.

The application of the X.400 messaging standard to EDI will cause changes in the market structure for EDI services and the way those services are used. It is inappropriate to take drastic action to adapt to these changes; rather, it is appropriate to anticipate these changes and create a well-defined plan for a reasoned response.