THE URGENT CASE FOR EDI STANDARDS 1

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ABSTRACT

Electronic Data Interchange (EDI) provides a method for organisations to send and receive standardised business communications quickly, flexibly, cheaply and in a secure manner. It is EDI's document translation standards which distinguish it from other, similar technologies such as e-mail or tape-based file transfer and which enable EDI to offer a standardised internal integration option for utilising organisations. Unfortunately, not all EDI users take advantage of the benefits of standardisation - "quick and dirty" proprietary solutions to document interchange may offer a short-term solution to a company' needs, but will ultimately limit (or even prevent) the integration of multiple EDI schemes.

This paper summarises the background and development of EDI by means of data and document translation standards and points to the benefits to be obtained from the integration of multiple EDI schemes and multiple value-added networks (VANs). The paper then discusses the dangers inherent in short-term proprietary solutions to document and informaton interchange - from both the organisational and national viewpoints - and suggests some possible methods of avoiding these problems.

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INTRODUCTION

The Development of EDI Standards

From its earliest inception, Electronic Data Interchange (EDI) has been concerned with standardisation. The genesis of EDI has been traced back to the 1948 Berlin Airlift, where the task of co-ordinating airfreighted consignments of food and consumables (arriving with differing manifests, languages and numbers of copies) was addressed by devising a standard manifest to be filled in by aircraft before unloading (Brawn, 1989). During the 1960s, rail and road transport industries began to think about standardising documents and replacing paper-based methods of communication.

The U.S. Transportation Data Coordinating Committee (TDCC) was formed in 1968 to coordinate the development of translation rules among four existing sets of industry-specific standards (McNurlin, 1987). A more significant move towards standardisation came with the U.S. ANSI X12 standards, which gradually extended and replaced those created by the TDCC. At about the same time, the U.K. Department of Customs and Excise, with the assistance of SITPRO, (the British Simplification of Trade Procedures Board), was developing its own standards for documents used in international trade, called Tradacoms. These were later extended by the United Nations Economic Commission for Europe (UNECE) into what became known as the GTDI (Guidelines for Trade Data Interchange) standards and were gradually accepted by some 2,000 British exporting organisations (Schatz, 1988).

Problems created by the trans-Atlantic use of two different (and largely incompatible) sets of standardised documents were addressed by the formation of a United Nations Joint European and North American working party (UN-JEDI), which began the development of the EDIFACT (Electronic Data Interchange for Administration, Commerce and Transport) document translation standards. By the start of 1991, however, there were still only two EDIFACT documents finalised (a purchase order and an invoice) - although there is a full range of business documents planned for release over the next five years (EDICA, 1991).

EDI came into being to further trade in one form or another, but now manifests itself in widely varying applications. Some idea of the breadth of EDI's coverage may be obtained from a sample of EDI schemes currently in development or under consideration in Australia. This sample includes the use for EDI for: railway rollingstock monitoring; ship "bay plans" (cargo plans for container ships); ship berthing/scheduling notices; notification of the presence of dangerous/hazardous goods on ships/trains/planes; the exchange of CAD/CAM documents; tender tracking; lodgement of law court documents; notification of the lodgement of archive documents; the exchange and lodgement of trade documents such as ship manifests/airway bills/customs clearances; airline ticket settlements; and the exchange of corporate cash management data - in addition to the more commonly considered exchange of documents concerned with the purchase and supply of goods (such as purchase orders or invoices). EDI, in fact, can be seen to have grown from its original (and somewhat limited) use as the expeditor of the transfer of trade goods, to being the facilitator of standard-format data between any two computer systems.

Standards Are Not (Necessarily) Standard

A major issue in systems development is the growth of standards of all types: from data communications to applications software interfaces. EDI systems have provided further impetus to the development of international standards at two separate levels: not only is EDI responsible for the rise of document translation standards, with the introduction of ANSI X12 and EDIFACT; but it has added pressure to calls for commonality of data communication standards.

The need for standards at both these levels is widely appreciated (Scott, 1988; Carter, 1989; Hollands, 1989) although EDI is more commonly associated with the development of document translation standards (see United Nations, 1987; McGuffog, 1988; Notto, 1989; Finch, 1990). The opportunities for additional value-added services from the integration of EDI and X.400 messaging, however (such as delivery and non-delivery notification, time stamping, multi-destination delivery, grade of delivery selection, deferred delivery and hold-for-delivery) adds weight to the case for truly international data communications standards (see, for example, Dawkins, 1988; Szlichinski, 1988; Hamilton and Fist, 1989; or Yankee Group, 1989) - and thus to the claims of Open Systems Interconnection (OSI): "one of the factors most clearly distinguishing EDI from other IOSs [Inter-Organisational Systems] is the open standardisation of document formats, which enables cross-connection between systems and allows users of one EDI system to join other, similar systems with comparative ease." (Swatman and Swatman, 1989a).

This movement is being accelerated by the imminent completion of Europe's Single Unified Market (the EC'92 programme), which depends for its success on uniformity of both telecommunications and document translation standards: "In fact, the greater standardisation of systems - both those from suppliers and those being used within user organisations - is likely to be one of the most significant consequences of the single market" (Tate, 1989). It appears that EDI, rather than creating technical problems of standardisation, has instead assisted in finding solutions to these problems (Swatman and Swatman, 1989b).

Despite this apparently rosy picture, there are a number of aspects of standardisation which still raise practical concern amongst those implementing EDI systems. These are the failure actually to implement agreed data communications standards, the development of *variations* on agreed document translation standards and the proliferation of proprietary standards which still continue to be developed.

This paper describes the possible levels at which data communications and document translation standards can be developed (scheme-wide, network-wide and open standards) and discusses the lack of true standardisation which currently plagues the EDI community. We then analyse the possible solutions to the problem, providing two quite distinct perspectives - an industry-oriented approach already under development; and a global approach which depends on the development of universal models. Finally, we link these two approaches, demonstrating that the long-term future of EDI depends on the development of and adherence to standardised solutions.

THREE LEVELS OF STANDARDS

Scheme-wide Standards

While the bulk of the literature available on the subject of strategic information systems refers to such systems in a generic manner, it is noticeable that many of the case studies referred to (the U.S. airline reservation systems SABRE and APOLLO, the American Hospital Supply Company's on-line ordering system ASAP, Merrill Lynch's cash management system, etc.) are systems which cross organisational boundaries, linking suppliers and customers in one way or another.

> *"Many of the exemplar cases of the use of information technology for competitive advantage have required telecommunications for their delivery ... indeed, it is probably the telecommunications technology, rather than advances in computing, automation, or software that has so far released most of the strategic gains claimed of IT in the 1980's"* (Runge and Earl, 1988:126).

The difficulties encountered by users of such schemes arose when there was a need to access the databases of two or more supplier organisations (necessitating multiple remote-entry terminals), or when it became apparent that greater benefits could be gained by integrating the data from the scheme into the user organisation's internal application systems. Since these competitive schemes were essentially remote data-entry terminals into the suppliers' own database, such integration (either between multiple schemes, or between the scheme and the user's own systems) were simply not possible. The longer-term benefits for the customer organisations using the schemes proved to be extremely limited (and, in turn, ensured that such schemes have remained limited in scope and number).

This factor is clearly addressed by EDI with its standardised documents which allow an unlimited number of organisations to communicate with one another, so that a small manufacturing organisation can use EDI schemes to supply products to many wholesale and retail outlets - EDI provides the ability to deal with unlimited numbers of trading partners.

An organisation which supplies goods to many different customers will need to have access to many different EDI schemes such as, for example, to:

- manufacturing groups, in the case of EDI schemes such as that used by the automotive industry, where manufacturers use completed products in a value-added chain;
- one or more retail outlets, each of which may have chosen a different document standard and/or a different network provider;
- providers of transportation facilities, who are increasingly making use of "incremental paper trail" EDI schemes such as Tradegate; or
- overseas customers, which may imply a need to connect to the Australian Customs Service's EXIT scheme;
- and many other potential schemes.

Standards-based documents mean that such an organisation can simply connect to the appropriate EDI scheme and transmit the appropriate document, without having to worry about the particular requirements of the document's recipient. It is, in fact, the provision of standards for document translation which distinguishes EDI from other apparently similar forms of data communications (such as electronic mail). Document translation standards allow a message to be constructed in such a way that it can be correctly interpreted by the intended recipient (and therefore understood by that recipient - and later integrated into internal applications software such as inventory or production systems).

Messages can be broken into several components:

! *Syntax* - the set of rules controlling the structure of a message and akin to the function of grammar in a spoken language;

! *Standardised Codes* - which represent plain language and thus simplify the task of processing the data transmitted;

! *Data Elements* - the smallest invisible piece of data, which are equivalent to words in any human language;

! *Segments* - a grouping of related data elements (such as name and address);

! *Messages* - a grouping of segments, arranged according to both the message design guidelines selected by the scheme's designers and the syntax. Each message represents a specific transaction such as an invoice (for a more detailed explanation of these concepts see Yankee Group, 1988; or Emmelhainz, 1990).

In theory, this means that an organisation wishing to become involved in EDI need only discuss the documents to be exchanged with its prospective trading partners, select the fields which are relevant to all parties and, finally, select a network service provider to transmit the messages. Unfortunately, the process of selecting "standard" messages is not always quite as straight-forward as it might be. One of the difficulties of standardisation is that variations on standard documents may well be appearing. Such variations generally fall into one of two categories:

1. *Variations in newly-developed (or developing) documents*. Organisations creating new EDI documents will claim that these belong to one of the recognised standards groups (usually ANSI X12 or EDIFACT). This claim is, however, limited by the fact that ANSI X12 version 2.4 has only 28 complete documents available (with another 150 or so under development), while EDIFACT has so far completed only two documents and has another 16 documents at status 1 (beta test mode). Since it is thus impossible that all scheme creators are using standard documents, there is a danger that the documents they **are** developing may not be accepted by the ANSI or EDIFACT committees, resulting in a number of EDI schemes using non-standard documents. This will create long-term difficulties for members of those particular EDI schemes who later wish to become involved in other systems.

2. *Variations between subtly differing versions of standard documents*. Third-party networks all claim to be using either ANSI X12 or EDIFACT documents, but many use very slightly different versions of that document. This means that when users wish to engage in inter-working, their existing documents have to be "mapped" onto the variation supported by the network supporting their new trading partner's EDI scheme.

A further consideration of the standards issue is the need for a consistent set of codes and identifiers between the various system users. Wilkinson (1989) discusses the problem in the context of an Australian EDI system designed for tracking railway containers, where each State railway authority uses different codes to designate the same items. The Railways of Australia scheme has made use of a simple conversion table to solve this problem and it may well be that all schemes can utilise such a simple solution. Nonetheless, the proliferation of codes of all sorts within and between industries (Universal Product Numbers in the retail industry - which are anything **but** universal, for example) has provided an additional obstacle to be overcome by EDI scheme designers.

Network-wide Standards

The concept of inter-connectivity, which is the hallmark of EDI, can be extended still further by introducing the concept of network inter-connection. This technique enables an organisation to exchange documents with multiple trading partners who are members of many EDI schemes - no matter which network each scheme resides upon. Users and interested trade associations overseas (particularly in the UK where EDI user communities are small), unwilling to subscribe to more than one EDI network, are joining forces to put pressure on network suppliers for inter-connection. Their demands extend beyond simple physical connection, to insisting on consistent quality in terms of security, reliability, service and audit trails (Bidgood, 1988). A key issue affecting users of Australian EDI schemes therefore, will be the capability of their network providers to link up to other networks.

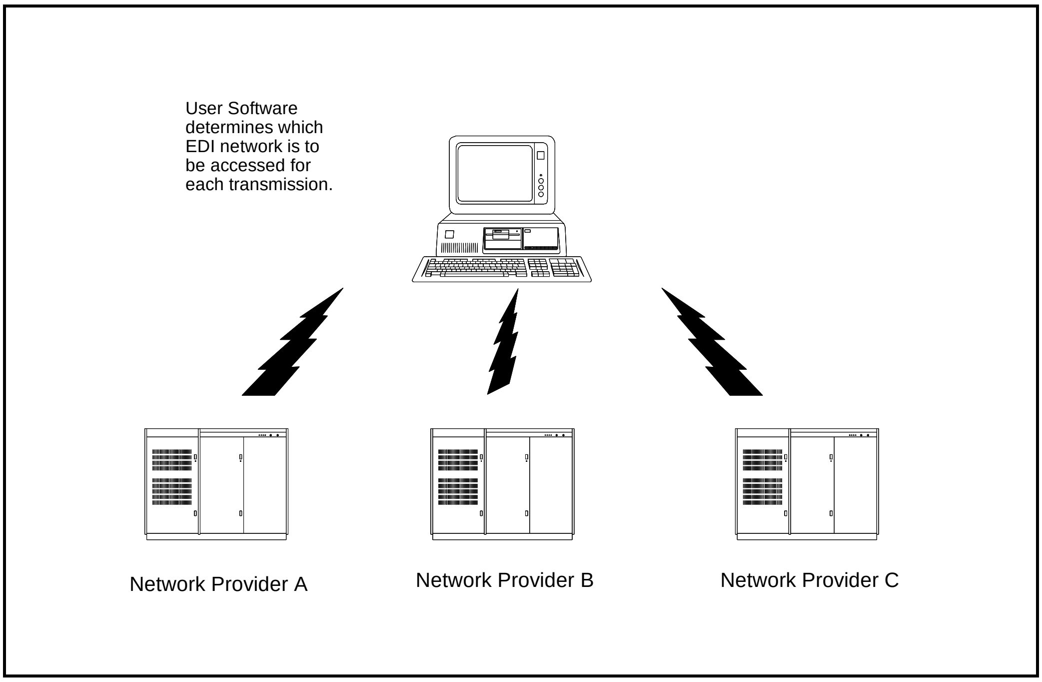

Figure 1 - Level 1 Interconnection: User-based Routing

There are three levels of network inter-connection - of increasing technical sophistication. Even the first (and most limited) of these levels enables a single organisation to trade with an unlimited number of partners on an unlimited number of EDI networks - *provided always that the schemes and documents conform to a recognised standard*.

In 'Level 1' inter-connection the user organisation must itself subscribe to each of the networks with which it wishes to communicate, but can use a single software package to connect to the network appropriate to each transaction. Level 1 inter-connection is illustrated in figure 1, above - all inter-working diagrams were designed by Arthur Wilson of the Western Australian Department of State Services. The advantages obtainable from this single system interface are particularly useful to smaller organisations which, having fewer resources available for systems development, can connect to many EDI schemes without the need to spend vast sums on sophisticated integration software.

While 'Level 1' inter-connection offers real advantages over the pre-EDI situation of having to support multiple trading-partner terminals, it does not solve all the problem of organisations which are increasingly likely to need connections with multiple EDI schemes spread over many networks. There are therefore two further levels of inter-connection which network vendors can provide to cater for network users' requirements. With 'Level 2' inter-connection, the user subscribes to only one network provider. Network providers each maintain a mailbox on the other's system, and when a user sends a message it is passed on to the appropriate network provider for delivery.

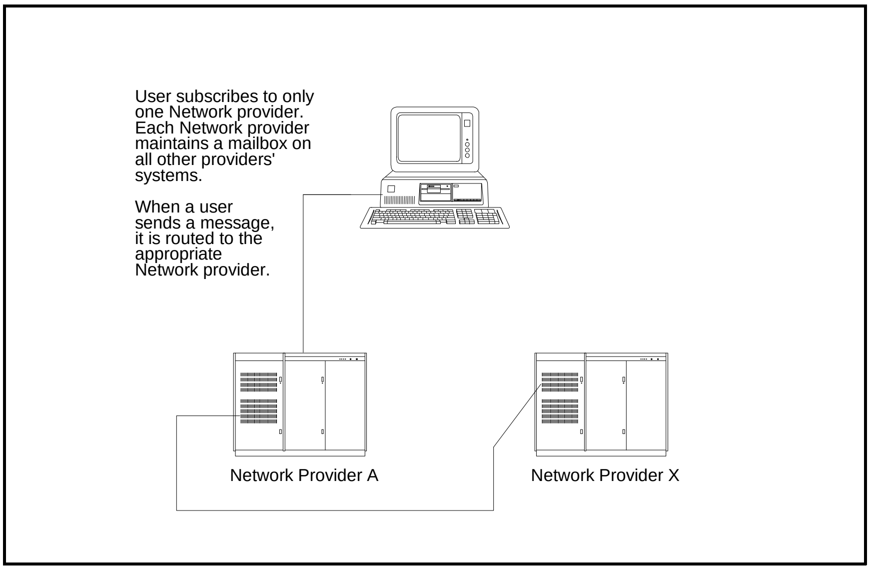

Figure 2 - Level 2 Interconnection: Network Interlinking

This approach has several advantages for a user organisation. It is an easily implemented solution, as the network provider takes care of the delivery of messages to other networks. In addition, the user organisation needs only one subscription (and thus only one invoice) - and only one connection mechanism is needed.

Taking this solution one step further, the ultimate result of increased network integration is total network *inter-working* ('Level 3' inter-connection). Inter-working is much like a national/international telephone system - an EDI message will make its way intelligently across any intermediate networks needed to reach its ultimate destination. Inter-working represents the most realistic solution to the problem of multiple networks and has advantages over and above Level 2 inter-connection:

! a full audit trail of all documents is possible; and
! the links between network providers are completely transparent.

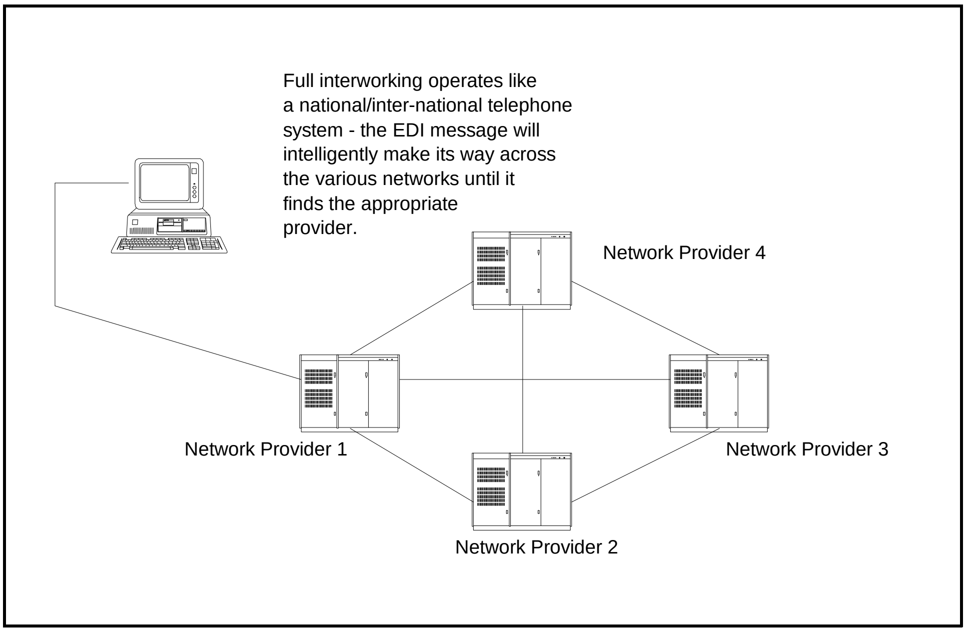

Figure 3 - Level 2 Interconnection: Full Network Interworking

The proliferation of proprietary document translation standards which exist at present, however, hampers both the users and the network providers in the drive towards full inter-working.

Problems Associated with Inter-Connection

The early inter-connection issues facing network providers were primarily problems concerning data communications standards (the set of standards which combine to define a communications system to carry EDI messages, route them to their final destinations and provide security). For example, the specifications of most data communications protocols allow for more than one possible implementation, causing problems in connecting supposedly 'standard' communications links. This sort of problem with data communications standards has, to all intents and purposes, been solved by the major network providers and/or telecommunications carriers' adoption of 'open standards' such as the X.25 packet-switching protocol.

A potentially more serious obstacle to communication between organisations which subscribe to different EDI schemes is the increase in proprietary document translation standards. For every organisation which belongs to a proprietary EDI scheme to communicate with organisations outside that scheme, a set of document translation facilities must be developed. In fact, should the destination scheme be on a different network and also have its own proprietary standard, the message may need to pass through *two* sets of translation software.

As a technical issue facing the network providers, this may not seem too great an obstacle, especially in the case of an organisation having only one trading partner. In the case of an organisation which trades with many suppliers, however, each of which in turn trade with many other organisations, providing this facility becomes far more complex and difficult (and much more expensive for the user!).

The adoption of standard message formats (such as ANSI X12 or EDIFACT) is needed to reduce the number of translations required - and thus reduce costs by allowing the use of standard interface software, rather than bespoke translation software. By implementing standard message formats, the organisations subscribing to each scheme help to ensure their ability to communicate with all their trading partners, irrespective of scheme or network. Those who do not implement such standards jeopardise their competitiveness both nationally and internationally.

A further issue for user organisations is that, while network vendors all support inter-working in principle, this concept is not always widely practiced. Whatever the reason for providers' avoidance of consistency, users wishing to utilise inter-working facilities can find themselves paying for the same message more than once.

Related to this issue is the problem of standardised, single interfaces to multiple EDI networks, in the interval before inter-working becomes a reality. Small users, in particular, may have to connect to many different PC systems and thus have the problem of varying front-ends and approaches to data entry. What is needed is a common front-end interface, enabling the user to specify only the message to be sent and its destination, without requiring knowledge of the particular network to which the recipient is connected - or even which scheme. Front-end software packages of this type are slowly appearing, though not all are truly universal (e.g. Philips has designed an EDI Workstation which "will decode and translate incoming EDI messages into in-house application format and validate message conformance to the standard). Likewise, it will encode and map in-house application records into the appropriate EDI standards" (Anon., 1989).

Open Standards

The problems associated with incompatible proprietary communications protocols has led to a growing world-wide demand for open communications standards, long before proponents of EDI first considered the matter, although the inter-relationship of the two types of standards has since grown significantly. One of the most significant developments in this area has been the creation of the Open Systems Interconnection (OSI) suite of data communications protocols.

The OSI Reference Model

The Open Systems Interconnection (OSI) Reference Model (illustrated in figure 4) has been jointly defined by the International Standards Organisation (ISO) and the Comité Consultatif Internationale Télégraphique et Téléphonique (CCITT), two key bodies involved in the formulation of public (vendor independent) standards. The OSI standards have been designed to allow interconnection and interworking between different computer systems and equipment, regardless of location or vendor. This enables all types of business communications (such as EDI) and information resources to interwork (Toye, 1990).

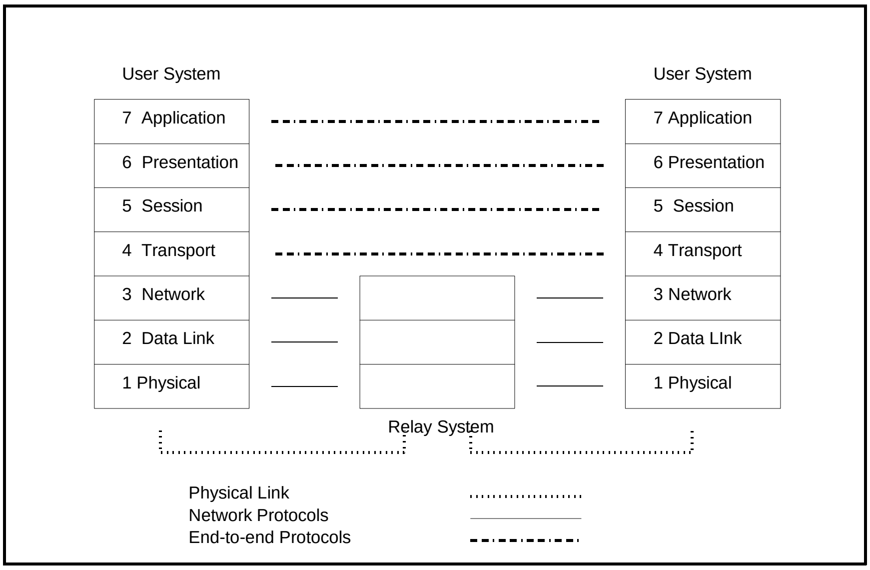

Figure 4 - The OSI Reference Model (adapted from Lions, 1987)

The X.25 and X.400 Protocols

The two OSI protocols most relevant to the transfer of EDI messages are X.25 and X.400. X.25 is a combination CCITT standard defined for layers 1,2 and 3 of the OSI model (referred to as the "Relay System" in figure 4). Most public tele-communications administrations (including Telecom Australia) offer X.25 packet switching facilities. As a publicly implemented standard, X.25 provides an ideal transport service for EDI.

The CCITT X.400 Recommendations define message handling services which enable subscribers to exchange messages on a store-and-forward basis. Basically, X.400 operates by defining message 'envelopes' which can contain EDI messages, together with addressing and status information (Pope, 1990).

The three main X.400 protocols fit into the application layer of the OSI model, outlining the architecture, protocols and message 'envelope' formats which allow messages to be exchanged independently of the systems used or the computers on which these systems run (Hamilton and Fist, 1989). This potential for universal interconnection/interworking is the major reason X.400 is seen as making an excellent delivery service for EDI. In fact, EDI is becoming a driving force for the acceptance of X.400 (Szlichinski, 1988).

GOSIP

Unfortunately, despite the support for open systems, the lack of a complete suite of OSI communications protocols means many companies are being forced to turn to alternatives to OSI, until those standards are finalised and a complete range of products become available. Many vendors are supplying proprietary products now, together with plans to interface with and support OSI standards as and when they become available (Yankee Group, 1989).

On a more positive note, these plans are being hastened by the growing government support for OSI. As an example, both the UK and the US have developed Government OSI Procurement (GOSIP) profiles for use in government contracts. As a response to the need for inter-connection within Europe (highlighted by the imminent completion of the EC'92 programme), compliance with OSI standards is becoming mandatory for many European contracts. In October 1988, the Australian Federal Government endorsed the Information Exchange Steering Committee (IESC) proposal that all future government Information Technology acquisitions support OSI standards. A Policy statement which outlines the government's commitment to OSI standards has been issued by the IESC (Standards Australia, 1989).

Development of EDIFACT

Paralleling the trend towards open standards for data communications has been the development of an international EDI document standard - EDIFACT (EDI For Administration, Commerce and Transport). The impetus to create a truly universal set of document translation standards arose from the multiplicity of proprietary standards in use by various industry groups in the U.S. and U.K., which included such document formats as:

- TDCC (Transport Data Co-ordinating Committee - the original EDI standards, which were created by the U.S. transportation industry);
- UCS (Uniform Communications Standards - the U.S. grocery industry standards);
- WINS (Warehouse Information Network Standards - the U.S. warehouse industry standards);
- VICS (Voluntary Interindustry Communications Standard - the joint standards of the U.S. apparel and general merchandise industry);
- AIAG (Automotive Industry Action Group - the U.S. automotive industry standards);
- ANSI X12 (probably the most commonly-used EDI standard in North America and, until recently, considered to be **the** industry standard).
- GTDI (Guidelines for Trade Data Interchange - the original European equivalent of EDI);
- Tradacoms (the U.K. "commercial trade" standard, developed by the Article Numbering Association as an extension of UN/GTDI);
- ODETTE (Organisation for Data Exchange by Teletransmission in Europe - the standards used by the European motor industry and originally based on the UN/GTDI standards, although now being modified in line with EDIFACT).

The sheer number of possible proprietary document standards complicates the task of EDI communication enormously - particularly for organisations which are likely to have customers/suppliers across many industry groups. Members of the U.S. chemical industry were approached by General Motors in 1984, asking that they begin transacting business with GM by means of its proprietary EDI scheme. The chemical companies realised that many of their large customers would shortly be issuing such requests and that without generic standards they would find life extremely difficult. They therefore used their own bargaining power to ensure that the U.S. automotive EDI scheme made use of the TDCC message standards (McNurlin, 1987).

Open document standards are necessary for communication amongst the major world economic trading blocs. Development of the joint U.S./European EDIFACT message standards (ISO 9735) will eventually provide a truly international standard - of particular use in international trade to overcome the existing problems with varying national document standard formats. Despite what would appear to be the intuitive appeal of trans-national document standards, many industry groups have rejected the concept, distinguishing their own industry's needs in a most parochial way:

> *"Given the argument in favour of one set of message standards for most industries, should the message standards have aimed to provide one international standard? We consciously rejected this approach for several reasons: The TRADACOMS Standards Group did not have the knowledge and experience to understand how each individual economy operates its business practices ... most companies have separate home trade and international trade ledgers and computer systems ... the bulk of business transaction relate, and will continue to relate, to local and regional distribution"* (McGuffog, 1988:42/43).

This short-sighted attitude can be found in many industry groups - similar statements concerning the benefits of proprietary standards have been made by representatives of the U.S. grocery industry (Klima, 1990). The trend is also seen in the development of the British inter-bank cheque clearing system CHAPS, which used completely new standards - unrelated even to the existing SWIFT message sets. This newly-developed proprietary standard was then copied by the Australian inter-bank clearance scheme BITS, ensuring a future translation problem once document inter-change is required between the various national schemes.

TWO PERSPECTIVES ON THE SOLUTION

A Document-Level Perspective on Standards

The scope of electronic communication continues to widen, including such previously unconsidered areas as graphics or CAD/CAM information. Those authors within the commercial arena who have begun to address this issue frequently refer to the wider group of systems as Inter-Enterprise Systems (IES), those inter-organisational systems catering for a wider range of standard transmissions than is generally included under the EDI banner: "IES is an advancement on the method of exchanging information called EDI. IES is a comprehensive standard covering the movement of engineering, scientific, graphic and business information. It's arriving just when open systems are becoming readily available through the promulgation of standards such as open systems interconnect (OSI)" (Ellinger, 1989:31).

Many working groups, within both public and private sectors, have approached the problem of standardisation at a practical level with great enthusiasm. Unlike the industry groups cited earlier which, thinking only of today, believe that their own problems require a totally tailor-made solution, these working groups are looking to a future in which cross-industry communication will be a necessity, rather than a luxury. Such working groups tend to approach the problem of conformance to standards at three different levels, although it will be apparent that there is a considerable degree of overlap between the three approaches:

Intra-industry Working Groups. The most highly publicised intra-industry EDI working group in Australia (and the one which possesses what may well be the most diverse group of members) is the "trade" sector's Tradegate initiative.

The "trade" sector covers all aspects of the transportation and delivery of goods, nationally and internationally. Industry groups involved include:

- exporters and importers who produce, sell and purchase the goods;
- various agents (such as customs or freight forwarding agents) who assist in the process of getting the goods from the exporter to the importer;
- transportation companies moving the goods from point to point (this includes airlines, shipping lines, rail and road transport companies, and such ancillary transport groups as tug operators);
- government agencies involved in the whole complex process (these include Port Authorities, the Australian Customs Service, permit issuing authorities such as the Health Department, the Bureau of Statistics and, potentially, even the Australian Taxation Office).

The major impetus for cooperation amongst these widely varying organisations has come from the waterfront industries, which have been pushing for an inter-industry EDI and value-added service for several years. In 1986, the Federal Government undertook an intensive strategic study of the waterfront industry as a whole, through the InterState Commission. This study was completed in March 1989 and, though many factors influence waterfront efficiency, it was felt that the ability to reduce the flow of paperwork and expedite the processing of cargo would be a key component of any selected strategy.

Prior to the release of the InterState Commission's final report, it had already established the National Communications Working Party (NCWP) to investigate methods of increasing waterfront efficiency through reducing paperwork and expediting cargo processing. This group focused on EDI systems, because of estimates that EDI could save up to A$60 million by streamlining existing paper-based systems.

The NCWP was disbanded in early 1989 and members formed a joint venture company known as "Tradegate Australia", amongst whose principal share-holders are the Australian Customs Service, the Australian Association of Port Management Authorities (AAPMA), Railways of Australia and Qantas. Tradegate is not intended to provide either the network or the services for the system itself - it is a management company, designed to enter into a contract with a network provider; represent the interests of its users in the management of the network; market the network; encourage development of services; and participate in the development of services. (Further detail on trade EDI and the development of Tradegate may be found in Loar, 1988; ACS, 1989; McGrath, 1989; and Wilkinson, 1989.)

Tradegate's managerial functions include the development of standard messages (in conjunction with the other Australian contributors to EDIFACT). There is a growing set of level 1 EDIFACT messages designed to facilitate inter-national trade, known as the

International Freight Transport Message (IFTM) framework. Tradegate takes a part in both the design and the testing of these messages.

Intra-sector Working Groups. Both within Australia and overseas, the public sector is starting to create working groups whose purpose (among others) is the development of guidelines for data communications and document translation standards.

The best-known of these initiatives is probably the GOSIP programme, which is working towards a common goal in North America, the U.K. and Australia. In addition to data communications considerations, both federal and State governments have set up committees to discuss issues such as standards compliance, inter-connectivity and pricing as they relate to the Australian public-sector EDI environment.

An EDI statement was released at the Public Sector Information Technology Procurement Strategies Conference, held in Hobart in March 1990, which proposed that all public sector EDI schemes should be based upon existing ANSI X12 document standards and should have commitments from vendors to migrate to equivalent EDIFACT standards as soon as these become available (Dept. of State Services, 1991).

The State Government of Western Australia has set up committees on both standards and technical issues, with the intention of producing issues papers for the benefit of all departments and agencies.

Co-ordinated Working Parties Supported by National Bodies. The EDI Council of Australia is supporting the development of "Implementation Guidelines" to provide industry-specific specifications of standard EDI messages. Industries currently involved in the development of such guidelines include: agribusiness, banking, communications, hardware, insurance, retail, pharmaceutical, steel, transport, wholesale/distribution, automotive, government, heavy engineering/ mining and minerals processing.

The guidelines are in the form of documents showing which sections of the standard EDI messages should be selected by members of a particular industry. This is necessary because standard EDI messages (whether ANSI X12 or EDIFACT) are hierarchically structured so that information ranging from very general to extremely detailed may be transmitted. The EDICA guidelines aim to analyse the parts of each message which are needed by a particular industry - from the most general down to the most detailed level of data representation - to enable development of a universal implementation for standard EDI messages catering for the needs of all industries.

The basic format of the message implementation specifications within the guidelines follows the recommendation in the American Standards Committee's *X12 Industry Implementation Guidelines Reference Manual*. A hierarchy of segments making up a standard EDI message is presented, with the segments selected for use within that particular industry highlighted. A subsequent segment hierarchy then lists only those segments which have been selected for use by that particular industry, showing the page reference of the relevant segments.

Each segment selected is broken down to its element level, with constituent elements being flagged as Mandatory, Conditional or Required by the particular industry. To provide further functionality, there is also a list of industry-accepted codes which relate to the elements selected. Explanations for the selection of those particular segments, elements and codes are included for ease of understanding.

The formation of industry-specific Working Parties allows representatives from companies within that industry to agree on a method of mapping the data used by relevant internal application systems onto the standards - in such a way that commonality of use and interpretation is achieved within that industry. It is the responsibility of industry Working Parties to look outside their own industry and assess the work being done within other industries, so that the commonality of use and interpretation of standards may be achieved *across* industry boundaries, as well as *within* them.

A System-Level Perspective on Standards

It has now become almost an article of faith within the international EDI community to claim that "EDI is 90% business and 10% technology". A wide variety of writers within both the "trade" and academic sectors have provided support for the view that EDI should be regarded as a strategic issue, rather than as a technical problem (see, for example Patrick, 1988; Hardy, 1988; Wilmot, 1988; Skagen, 1989; Benjamin et al 1990; Swatman and Clarke 1990; Emmelhainz, 1990 and many others). Despite this strategic view, many organisations (particularly within Australia) perceive EDI as a technical issue (Swatman and Swatman, 1991}. In practice, this means that the control of EDI implementation tends to be ceded to the Information Systems Department.

Since the most significant long-term benefits of EDI are gained from the revision of (and integration with) existing information systems and organisational structure, this techno-centric attitude leads to a lack of organisation-level control and a failure to gain the maximum potential available from the implementation. This situation has meant a slower "ramp-up" of EDI in Australia than that seen in North America or (in expectation of the imminent completion of the Single Unified Market) within the EC (European Community). It appears likely that Australian organisations wishing to continue tradign in the North American and European markets will increasingly need to trade using EDI. If they hope to remain competitive in those markets, they must also integrate EDI internally.

Oddly, a factor contributing to the perception of EDI as a technical issue within Australian Industry may actually be *the presentation of EDI as a purely organisational issue*. An organisation presented with such a simplified view may argue that embracing EDI involves *inter alia*:

- computerisation of the manner in which the organisation currently communicates with its customers, suppliers and other trading partners (e.g. Customs);
- connection to a national or international computer network.

Focusing on the question of whether EDI is a technical or an organisational concern, we suggest that the technical aspects of EDI are not absent (or even less important than the organisational and managerial considerations), but that the technical and organisational aspects can be dealt with in isolation and, indeed, largely in parallel. Further, we believe that if it were possible to define an EDI communications system as an Abstract Data Type (after Liskov and Zilles, 1974), the technical problems could be solved once - rather than once for each organisation. We could describe **what** an EDI system can be relied on to do without concerning ourselves with **how** this behaviour would be achieved. Clearly, organisational concerns revolve around:

- whether the proposed behaviour of the EDI system was useful (and, if not, whether a useful behaviour could be specified); and
- whether (and how) the organisation could be remodelled so as to make effective use of the services offered by the EDI system.

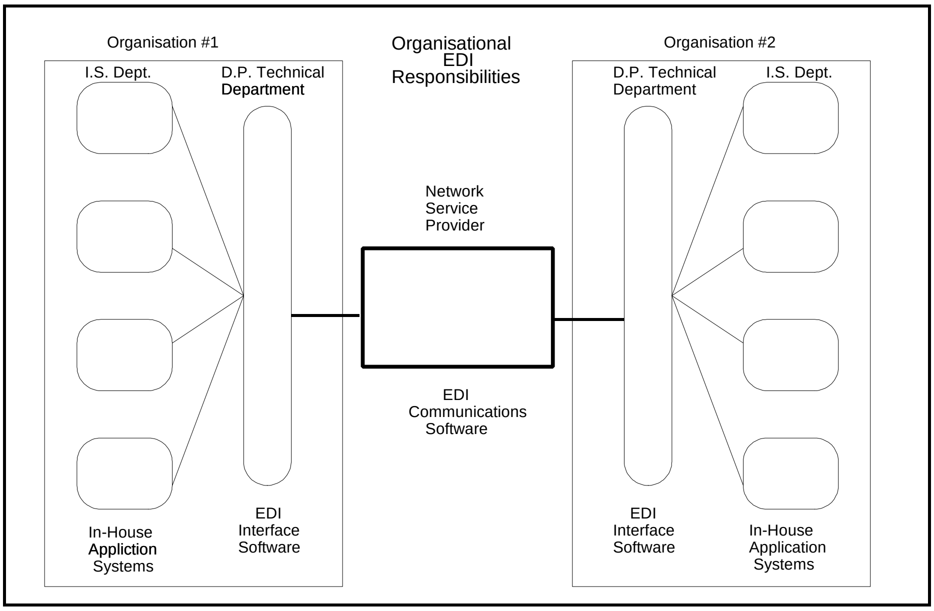

Figure 5 - EDI Software Categories

These technical difficulties are often the first issues to be tackled when implementing EDI - largely because there is no *standard* EDI communications system. Figure 5 shows the manner in which an organisation adopting EDI may be divided into three essentially independent parts:The technical issues, by contrast, purely revolve around ensuring that the EDI system does indeed behave in the specified manner.

While there is still much refinement required before all the problems of in-house EDI software integration are solved, the essential principles of the technology are already in place. A globally-applicable model of an EDI communications system is urgently needed and we propose to show that such a model can, in fact, be developed.

An Informal Model of EDI Communications Systems

The EDI document transmission process can take place in one of two ways - either by linking the two trading partners directly (point-to-point) via modem, or by means of third-party value-added networks: "in essence, what a third-party network provides is the EDI communication skills, expertise and equipment necessary to communicate electronically. In addition, [it] can also provide value added services such as translation to standard, international connections, connection to other third party networks and training" (Emmelhainz, 1990).

Organisations contemplating the implementation of EDI tend to see each scheme as unique, largely because each company involved in a particular market segment transacts its business slightly differently from its competitors. It was this perception that a company's methods of doing business were unique (and thus software to meet those needs must also be unique) which led to the development of so many software variations on universal requirements such as payroll or general ledger. Simlarly, despite the perception of EDI as an ever-new technical problem, EDI communications systems conform to a relatively simple model illustrated in Figure 6 (Swatman and Swatman, 1991).

Figure 6 provides a generalisation of the three part classification of EDI systems suggested by Akerman and Cafiero (1985):

! **one-to-many systems**: These systems typically arise when a (large) organisation wishes to streamline its interactions with suppliers (or customers). The initiating organisation is the hub of the system, while its trading partners form the satellites;

! **many-to-many or ``clearing house'' systems**: A more general form in which there is no single hub but, apparently, many buyers and sellers interacting with each other. Notionally, the system itself forms the hub and all parties are satellites. The development of a system of this type is usually driven by two organisations, each representing an industry group. In a sense, these systems can be considered as one-to-one systems connecting the buyer industry group with the supplier industry group. Although Akerman and Cafiero do not carry this idea further, it is a simple task to extend the concept to allow for the participation of any number of industry groups - each of which may be either supplier or customer.

! **"incremental paper trail" systems**, where documents are amended by a series of participants with additional information being added to the document at each stage in the process, are particularly relevant to the domestic and international trading community. Schemes of this type allow the progress of a shipment from exporter to importer to be covered by a single electronic document to which each party merely adds the appropriate information, obviating the need for bulky and unmanageable documents such as bills of lading or ships' manifests.

Our general model of an EDI communications system incorporates the concept of persistent memory necessary for incremental paper trail documents. Although this diagram shows a single data store for the entire EDI system, we do not imply that the data store could not be implemented as a distributed database. In fact, the current European development of an electronic Bill of Lading (EDI Monthly Report, September 1990) with its consequent need for multiple third-party network providers, seems to indicate that distributed document storage will be the method of choice (if not actually that of necessity). It is now clear that we can redefine EDI at a systems level in the following manner:

EDI communications systems are that sub-class of distributed information systems where the users of the system are organisations rather than individuals and where messages must conform to some standard.

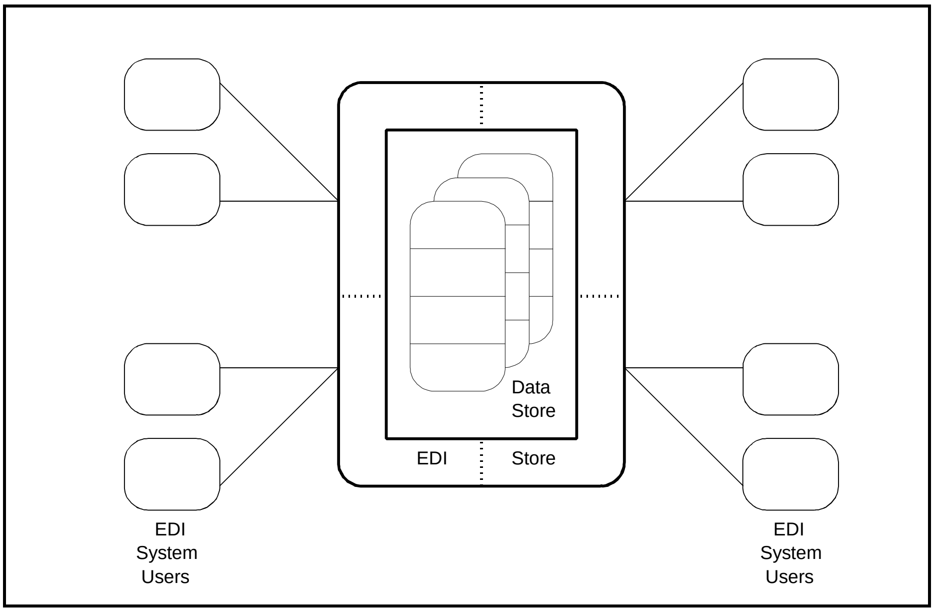

Figure 6 - A Generic Model of an EDI Network

The rapid growth of third-party EDI network service providers (Takac and Swatman, 1989) offers further support for the proposition that the provision of EDI services is, at worst, a solvable and comparatively standard technical issue. The most significant consequence of defining EDI in terms of a single system type is not the fact that this eliminates the difficulty of implementing EDI schemes, but that it debunks the myth of EDI's technical complexity. Clearly, from a technical point of view, the fact that the users of a system are organisations (rather than individuals) is largely irrelevant. EDI offers few technical problems for potential users, *provided that they are able to rely on the network to which they subscribe following the behaviour suggested by our model, irrespective of the location of the document's recipient(s) and any other intermediate contributors.*

CONCLUSION

We have discussed the need for standards from two perspectives - *standard documents* transmitted over *standard networks*. To gain the maximum possible benefit available from EDI, we must ensure that the maximum possible number of organisations subscribe to this mechanism for doing business. The pre-requisites for gaining such a community of users include:

- ease of initial connection to an EDI network;
- ease of integration with internal application systems; and
- ease of inter-connection with more and more trading partners (regardless of the scheme or the network provider).

All these pre-requisites would be met if EDI communications systems conformed to a standard behaviour behind a standard interface. This requires a global approach to both document and system standards.

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