Electronic Commerce Strategy Task Group's Report on Emerging Technology Strategies

Uniform Code Council, Inc.

Electronic Commerce Strategy Task Group's Report on Emerging Technology Strategies

Prepared for:

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The Drummond Group

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Electronic Commerce Strategy Task Group's Report on Emerging Technology Strategies

Section 1:

Executive Summary

Contents

Overview

The Drummond Group was retained by the Uniform Code Council, Inc., to develop, in collaboration with the Electronic Commerce Strategy Task Group, an electronic commerce strategy for UCC members. The strategy will leverage new emerging business-to-business interface technologies in conjunction with existing UCC supported traditional EDI technologies.

The first task was to identify emerging technologies that could impact the UCC Electronic Commerce (EC) Strategy. Examples of these technologies are HTML for presentation, S/MIME for security, Object Oriented EDI and XML for data format, LDAP and X.500 for directory services, general object technologies for databases and database access, and finally HTTP, IIOP and SMTP for transport. The definitions for these may be found in the Glossary.

The second task was to identify current problem areas where emerging technologies could help. This was accomplished through interviewing ten members of the Task Group. Based on the interviews, thirty key discussion statements were prepared. A summary of the interview information and all discussion statements are found in *Appendix A: Summary of Interviews.* The most important statements from the top thirty were selected for further analysis. Finally, the most important of these were distilled into three problem areas.

The third task was to analyze the three problem areas and make recommendations on how the technology could facilitate supply-chain information exchange. The recommended technologies and methods taken as a whole solve a large majority of the problems associated with historic EDI implementations.

This strategy paper recommends significant, yet achievable modifications to the way EDI is currently conducted. It recommends changes to the process and technology that defines and maintains EDI standards. It recommends philosophical and technical changes to the method of transmitting and sharing data

between trading partners, especially product data. It recommends changes to the current stated direction on the use of Web-EDI forms in UCC represented industries. It notes that the goal of a totally integrated electronic data supply-chain is not achievable if small and medium enterprises (SME's) are not represented in the EDI and electronic commerce strategies and standard setting efforts. They have not participated in the past and EDI and electronic commerce strategies often do not offer SMEs sufficient direct payback to self-initiate either EDI or EC implementations.

Finally, the team throughout the process has been cognizant of the fact that the risk with any technical analysis of this type is the dependence on technology to solve problems that technology cannot solve, such as poorly defined processes and data element definitions and human nature.

EDI Challenges and Major Recommendations

Electronic Data Interchange (EDI) has achieved most of its goals. It is the leading electronic commerce application in the world, helping companies share and exchange information in a way that never existed before it's conception thirty years ago. However, it has some challenges, and these are becoming more evident in recent years as industries have moved to the integration of supply-chains with tens of thousands of hub and spoke participants and away from the current smaller hub-specific implementations. The challenges fall into three areas, each with a different set of drivers and solutions. They are: 1) complex mapping required, 2) insufficient data synchronization, and 3) the lack of penetration into small and medium enterprises (SMEs).

Challenge 1: Complex Mapping Required

Complex mapping is often required when a legacy application that does not support EDI is tied to EDI translator software. The EDI expert must understand both the data semantics and syntax of the legacy application and the EDI standard before mapping may begin. There are often hundreds of data element meanings that must be mapped between the EDI and legacy application, formed into records, which are then packaged into a transaction. Further aggravating the complex mapping issue is that the EDI standards were developed through a bottom-up consensus process and often need slight non-standard adjustments (implementation conventions) to make them conform to the requirements of the legacy system. Furthermore, because of the complexity and the need for implementation conventions, most commercial application vendors have not included EDI as a standard part of their off-the-shelf products, which would reduce the need for mapping to zero on these systems.

Many EDI experts feel that a top-down process-oriented approach will solve many of these complexities—i.e., the transactions and the EDI mapping issues for both the legacy and commercial off-the-shelf application software developer. The top-down process

approach will use recent developments in modeling tools (Uniform Modeling Language—UML) and business process reengineering (BPR) techniques in the same general manner being proposed by the X12 Strategic Implementation Task Group's (SITG) OO-edi efforts. The output of this process will be EDI objects that are simpler than the current transactions and well-defined inter-organizational processes.

Recommendations for UCC action:

- Establish a process modeling team to make mapping simpler by defining process models, simplifying transaction sets, and building and distributing standard objects.

- Include in the pilot representatives from all business sectors, a professional data modeler and a business process reengineering (BPR) expert.

- Use Uniform Mapping Language (UML) as the basic modeling tool and the interim finding of the X12 SITG and CEFACT Techniques and Methodologies Work Group (TMWG) efforts.

Challenge 2: Insufficient Data Synchronization

EDI is built on 1970 technologies—data exchange protocols and batch-oriented legacy systems—that do not support real-time exchange of data. The time delays between a system that has recently changed a piece of data and other trading partner systems that require that piece of data cause internal databases to be out of synchronization for long periods. These data synchronization discrepancies are especially noticeable in product data such as product prices, availability and promotions. Data synchronization is becoming more critical as the volume of EDI transactions has rapidly increased. The increased frequency of data modifications and increased use of EDI means that dis-sychronization errors will occur more and more often.

Dis-synchronization errors will decrease in the short term by implementing real-time protocols and reengineering internal batch systems to real-time application—forgoing the historic mailbox protocols, periodic private line use and the internal batch processing. With this strategy, a modification to a piece of data on one trading partner's system is propagated rapidly to the other

systems, which significantly decreases the chances of trading partner databases being out of synchronization.

However, these real-time protocols do not solve the long-range data synchronization problem, but only delay the inevitable. Whenever there are copies of data in several places, they will be out of synchronization as changes ripple across them. The long-range solution is a new philosophy of data sharing—one that does not use copies of data, but retrieves it from the single valid source as needed. This guarantees that data, such as product data, is to be correct to a very high degree. (There are still cases when data may be out of synchronization, such as when a purchase order is created with source data, but is not sent for a few days. Availability and price information becomes out of synchronization between the Purchasing system and the source product database.)

The "real-time" philosophy will require the implementation of real-time database-to-database and program-to-database accesses through new distributed object and web (XML and HTTP) protocols. A purchasing agent will no longer use an internal copy of product data, but instead will transparently and directly access the source product data on the vendor's/distributor's remote system, ensuring data is correct at the time of access.

Recommendations for UCC action:

- Promote implementation strategies for real-time database-to-database access for source data.

- Define standard objects, select standard access methods (CORBA, IIOP and X.500) and select standard security, based on public key infrastructure. UCCnet (http://www.uccnet.org) is developing this. (See glossary.)

Challenge 3: Lack of penetration into small and medium enterprises

This is the most glaring challenge, in that while data synchronization and mapping are working, SMEs (small and medium enterprises) have very little to show for it. What little SME penetration there is, happens because large trading partner customers encourage SMEs to implement EDI. SMEs implement EDI to survive not because of Return On Investment. In many cases only the large enterprise benefits.

With over 50% of all supply-chain participants being SMEs, it is critical to trading partners that SMEs be capable of using EDI technology in a technically and economically effective manner. This has not been the case to date for a large majority of SMEs—primarily because the ROI is low, to non-existent, for EDI implementations. There are several reasons for low ROI, depending on the type of EDI implementation the SME is considering.

Case 1: ROI is low—an onsite EDI translator

The ROI is low for small trading partners with low EDI transaction volume. The savings normally associated with EDI do not significantly offset the initial investment and ongoing support for an onsite EDI translator. If the EDI transaction volume is low, it costs more to implement and support the translator with expensive technical talent than it will save in manual administrative talent.

Case 2: ROI is low—Web-EDI Forms

While a large trading partner offering a standard Web-EDI form server for SMEs may seem to alleviate payback problems with the onsite translator system, it creates a new investment problem. Unless industries standardize on a single web-EDI interface to the supply-chain—not just an interface to a single trading partner—the SME will have to support multiple web-EDI applications.

Because there is no agreement between the supply-chain members on a standard Web-EDI form interface, many hubs are implementing their own interfaces to support the SME. This works for a SME trading with one hub, but becomes onerous for the SME to participate in a supply-chain environment with many hubs. They will be required to use multiple interfaces and lose the ability to track transactions in a uniform consistent manner from a single application interface. Their investment in personnel increases because they must learn to interact with several unique systems.

Case 3: ROI is low—VAN charges

VAN charges can be a significant cost to SMEs. The use of Internet for exchanging EDI documents may reduce this to about 1/3 of the current cost. The "Uniform Communication Standard Internet Mail Pilot" has just recommended that the IETF (Internet Engineering Task Force) recommendations on "Secure Internet EDI" become part of the UCS communications standards.

Case 4: ROI is low—Not mapped to internal system with Web-EDI

In all cases, unless the SME can easily transfer data into and out of their internal systems, the payback achieved by the larger trading partners is not realized by the SME. XML a new technology may be used for transferring data from Web-EDI systems to internal systems.

Recommendations for UCC action:

- Work with Standard Maintenance Committees to develop standards for: 1) a single uniform set of Web Forms for Web-EDI, 2) a Web-EDI flat file XML interface syntax and semantic for information transfer to source SME systems. These will make EDI simpler and cheaper for the SME.

- Promote off-the-shelf SME systems with object-oriented interfaces so that mapping is not required.

- Promote adoption of EDI over the Internet (S/MIME - EDIINT) following the UCS Communication Standard.

Conclusion

The technical and procedural recommendation contained within can facilitate the exchange of timely and accurate data between trading partners and lower the cost to participate. If however, the SME is not involved up-front and in an ongoing manner in the strategy and standards process, resulting implementations will not produce expected saving for many small, medium and large enterprises.

Lack of up-front and ongoing SME involvement is the greatest peril to achieving the objectives, since they represent over 50% of all trading partners.

Finally, further use of individual Implementation Conventions will only aggravate the communications complexity between trading partners over time, becoming a significant EDI inhibitor as participants in supply-chains and distribution channels rapidly increase in number.

Submitted by:

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Section 2:

Analysis and Recommendations

Contents

1. Objectives

The first objective was to identify emerging technologies that impact the UCC Electronic Commerce Strategy.

The second objective was to identify current problem areas where emerging technologies could help. This was accomplished through interviewing ten members of the Task Group. Based on these interviews, thirty Discussion Statements were prepared. A summary of the interview information and all Discussion Statements are found in *Appendix A: Summary of Interviews.* The most important statements from the top thirty were selected for further analysis. Finally, the most important of these were distilled into three analysis areas.

Our third objective was to analyze the three problem areas and make recommendations where emerging electronic commerce technologies may help solve. That information is contained in this section.

2. The Requirements

Through an interview process with the Task Group members, key requirements were defined. The key requirements were derived from a list of over thirty initial interview statements. The key requirements were matched to the problem categories and are shown below in Table 1.

Problem areas identified from the interview process.

CATEGORY	STATEMENT
Complex Mapping	• Transactions should be further streamlined to reduce the number of syntax and semantic options in X12 and EDIFACT by removing all segments that are not needed, yet trading partners should be willing to accept more information than is necessary for our internal systems.
Data Synchronization	• Solutions for shipment, sales and inventory data (dynamic data, fixed data accuracy), forecasting (CPFR), based on open standards-based architecture should be addressed. • A shared supply-chain data repository can reduce errors, improve accuracy, enhance tier-participation by offering 24*7 access, providing company level security, common data formats, and common access methods. • Security certification authorities should be implemented to support: authentication, encryption, digital signature, and signed receipt. • A shared supply-chain data repository should provide ordering and pricing information to include payment, invoice information, shared applications, video clips, security, and sound.
Lack of SME Penetration	• Supply-chain optimization should drive out costs, time and unnecessary decisions from the process. • It is important to eliminate humans from repetitive tasks to gain paybacks. • Encryption of EDI transactions on the Internet is very important. • Internet-based EDI—we must implement VAN-type value-added services to support our requirements.

Table 1 – Interview Priorities

3. Summary of EDI Challenges and Major Recommendations

3. 1 Introduction

The recommendations for each problem category (Complex Data Mapping, Data Synchronization, and Lack of SME Penetration by EDI) are presented along with the analysis. Please note that some problem categories have multiple problems defined and some problems have multiple solutions.

3. 2 EDI Challenge: Complex EDI Mappings

Problem: Getting data into or out of the pipeline—complex mapping is required.

Recommendations

- Establish a process modeling team with representatives from all sectors, including professionals in business process reengineering and process modeling, to define Object-oriented EDI constructs and simplify existing EDI transaction sets.
- UCC must ensure that migration from existing EDI technologies is supported by the resulting object-oriented EDI constructs.
- UCC must facilitate the refinement of the business process, reengineering and process modeling techniques to ensure they are refined and well focused.
- UCC must promote the benefits of the forthcoming EDI object standard to software developers for complete integration into their off-the-shelf applications.

3. 3 EDI Challenge: Data Synchronization

Problem: Data synchronization between participant databases—access to timely and accurate source data not available to outside organizations.

Problem: Not real-time—batch oriented / store-and-forward transports.

Recommendations:

- Endorse the UCCnet concept. Three technical alternatives, which singularly, or in combination, could form the basis of the UCCnet Pilot project, are discussed. They are X.500 technology (and LDAP), Object technology (CORBA and DCOM) and Web technology (HTTP, HTML and XML).

3. 4 EDI Challenge: Lack of SME Penetration by EDI

Problem: Lack of traditional EDI penetration into the SMEs manifested by: complexity hurdle, cost to implement, cost to support, cost to transfer data, and a lack of integrated applications.

Recommendations:

UCC should facilitate:

- Standard supply-chain wide Web-EDI forms so that SMEs may have a single interface into the entire supply-chain.

- A standard flat file interchange semantic and syntax based on XML, for Web-EDI forms, so that data may be transferred from the Web-EDI application to the user's business applications.

- The development of off-the-shelf business applications by software developers, which interface directly to EDI objects, removing the need for application mapping.

- The acceptance of Secure EDI over the Internet as an addition to the UCS Communications Standard as supported by the UCC Mail Pilot, which was recently completed.

- UCC must ensure that SMEs are heavily involved in all areas discussed in the Analysis paper to obtain significant ROI from implementing any of the directions recommended as part of the analysis.

4. State of the EC Industry

EDI is primarily a "push" technology while web is a "pull" technology.

Humans work both ways—push and pull.

The historic electronic commerce application is EDI. Until recently, with the advent of Internet and specifically the web technologies, all EC (Electronic Commerce) was accomplished by EDI. The EDI model is one of "push" technologies, in which data is predominantly delivered via a push of the message/ transaction to the other party. EDI has worked very well for corporations with the financial resources to implement all of the EDI components, and who have in-house experts on the intricate mapping that EDI translators require.

With the advent of the web, we are now able to implement "pull" technologies, which allow participants to retrieve data, as they need, instead of waiting for it to be "pushed" to them. These new technologies add new capabilities to the historic EC applications by supporting additional access methods and means to conduct business. For the large corporations, where EDI has worked so well, the Internet offers access to an infrastructure with previously unavailable technologies resulting in lower EDI participation costs for the SMEs (small and medium enterprises) and LEs (Large Enterprises) alike.

New Electronic Commerce products are coming to market that compete with historic EDI.

Many products are coming to market from the EC world—but without taking advantage of the vast knowledge base established by the EDI community over the last twenty or so years. These products target two broad areas: 1) business-to-business and consumer-to-business catalogs, and 2) supply-chain facilitation.

The business-to-business focuses on helping the buyer, either consumer or business find and purchase products. The technical foundations of these implementations are often based on database, XML, security, and web technologies, focusing on the human interface and retrieval of data, and not automated database-to-database interactions. They support human shopping on the Internet.

Supply-chain facilitation products purport to solve supply-chain problems by using web and object technologies to help businesses sell and purchase goods in a real-time manner. They often implement the processes supported by EDI such as purchase

orders, invoices, shipping and receiving. They often involve buyer catalogs and inventory information sharing systems. The problem with these solutions is that they are not really supply-chain products—they are proprietary hub-to-spoke implementations and require a like product at each end of the exchange. They do not integrate well with the existing legacy systems, and therefore, will not solve the supply-chain information sharing and exchange problems businesses are now encountering.

Our focus is on integrating existing EDI processes using the new technologies...

The technologies for our solutions are the same; however, our focus is on integrating existing EDI processes using the new technologies to support both the LE and the SME. The technologies that have the most impact on future EDI implementations are web, XML, objects (OO-edi), object databases, and secure Internet EDI. These technologies have the capability of fulfilling EDI's original objectives across small, medium and large enterprises —facilitating business by conducting business electronically instead of via paper. Figure 1 shows the technologies often involved in electronic commerce. Our specific technology focus for this Analysis is on S/MIME for Secure EDI over Internet, X.500, LDAP, Object, XML, HTML and HTTP for Web and Shared Supply-chain Data Repositories.

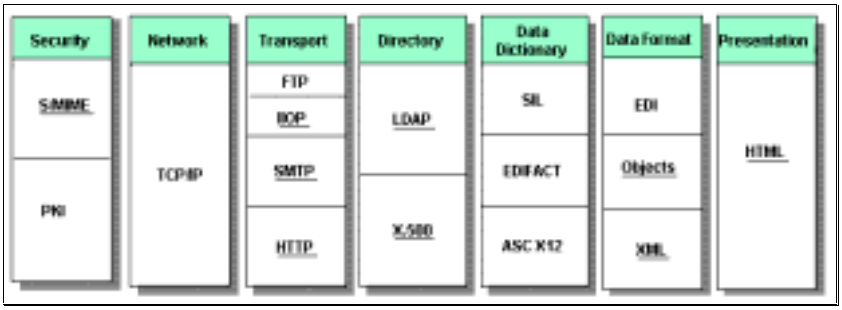


Figure 1 – Electronic Commerce Technologies

The following briefly summarizes each technology that is underlined in Figure 1 including current supply-chain findings.

4. 1 Web – HTML and HTTP

The Web is a "pull" technology—you can pull information any time you want.

The Web includes several of the underlined items. Because the web offers a robust and widely available means for people to interact with data in a "pull" manner, it offers several areas of support to EDI. For example, it is a means for people to access accurate and timely information such as product data, invoice

status, and online implementation conventions from other supply-chain members in a straightforward manner. It facilitates this by offering a "pull" mechanism for data query, using a standard access mechanism (HTTP), and a standard display (HTML) mechanism. Additional information on these technologies may be found at www.w3c.org.

4. 2 XML

A recent addition to the web environment, XML, offers a means to tag data in a manner that facilitates its movement between diverse applications. Vendors such as Oracle, IBM, Lotus, Microsoft, and many others make it easy to exchange XML data through interface translations or by incorporating it directly into their architecture. Additional information on XML may be found at www.w3c.org.

4. 3 Objects - IIOP

Object standards provide a way to exchange data between diverse applications and databases.

With the advent of object standards from the Object Management Group (OMG) in CORBA (Common Object Request Broker Architecture) and Microsoft in DCOM (Distributed Component Object Model), we now have a standard means to exchange object data between diverse applications and databases. The primary Internet transport for this is IIOP. With Uniform Modeling Language (UML) we now have a standard means to describe processes and generate object code, transactions, and data element definitions in a straightforward and succinct manner. Information on standard objects may be found at www.microsoft.com and www.omg.org.

4. 4 Object Databases – X.500 and LDAP

Most new software development is based on object technologies.

Object database technology is available from various database vendors who use either X.500 (also LDAP), CORBA or DCOM. These offer a means to access distributed databases in a secure manner, so that data may be easily shared across supply-chain participants. Information may be found at www.itu.ch, www.ietf.org, www.microsoft.com and www.omg.org.

4. 5 Secure EDI over Internet – S/MIME

Secure EDI specifications provide a lower cost means for moving data.…

Specifications for Secure EDI over Internet will soon be coming from the IETF. These specifications provide a lower-cost means for moving EDI data in a secure manner over the Internet. These EDIINT recommendations will be included in a forthcoming

version of the UCS Communications Standards proposed by the UCS Internet Mail Pilot Workgroup. Additional information may be found at www.ietf.org.

4. 6 Supply-chain Process Endeavors

A key finding from the Supply-chain Council is the sequential nature of information flow causes problems…

The EC community is striving to implement technology that can: reduce errors in EC exchanges, ease the implementation hurdles associated with historical EDI, reduce support requirements for SMEs using EDI and help manage supply-chains and distribution channels. For example, a major undertaking at the Supply-chain Council (http://www.supply-chain.org) is focused on describing and revamping the processes that support supply-chains to make them more efficient and amenable to EC. One of the key pieces of information resulting from this work is the sequential nature of information flow for forecasting and replenishment often causes perturbations that preclude effective fine-tuning of the supply-chain.

More than two tiers in the supply-chain creates problems— information is passed sequentially, not simultaneously…

In the case of two-party supply-chains, such as a vendor and a supplier, there is no perturbation caused by how forecasting requirement needs are conveyed. As the supply-chain increases in depth with three or more participants, as shown in Figure 2, "Current Supply-chain Information Flow," severe problems in forecasting can occur. It appears that problems are created because information is being passed sequentially, rather than simultaneously, from A to B and from B to C. An article, "*Thoughts on supply-chain management*," written in April of 1998 by John Layden, the General Manager of the Symix/Pritsker Division in Indianapolis, identifies examples of where forecasting errors cause the projections for the second and third tier suppliers to fluctuate wildly for months.

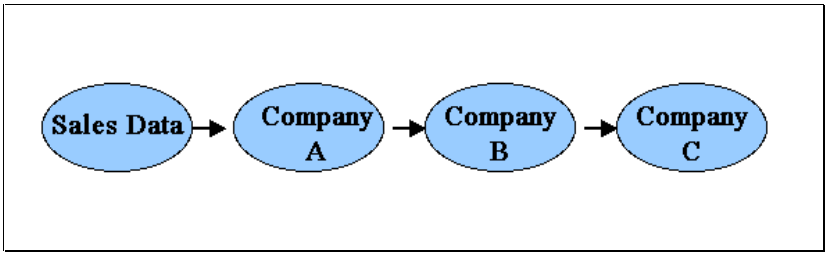


Figure 2 – Current Supply-chain Information Flow

A suggested way around this problem is to pass information faster and in a parallel manner from the source to all participants. While the product flow remains a sequential chain, the information flow projecting demand and product needs should be parallel—with A passing information simultaneously and directly to B and C as shown in Figure 3.

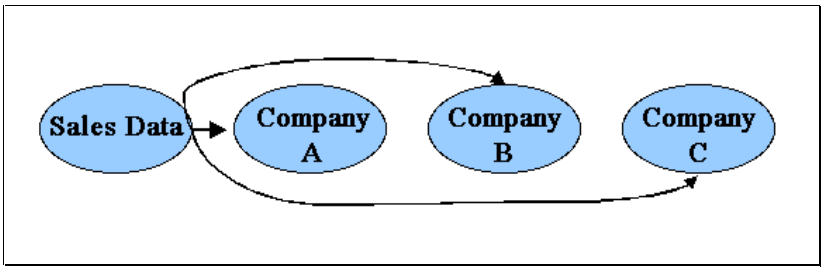


Figure 3 – Suggested Supply-chain Information Flow

Catalogs are a means to distribute data in a parallel manner

With this view, retailers pass projected customer demand information in a parallel manner not only to its direct suppliers, but to all second and third tier supply-chain components who are feeding the first tier supplier. One way to provide simultaneous information is with product information catalogs. These catalogs can provide dynamic product data such as availability and forecast information, as well as traditional static product data. All of this information can be provided directly to all members of the supply-chain.

Our solutions help address the problem of supply-chain data sharing as shown above by directly offering data to those who need it and by sharing product data and status information for areas like invoice status and forecasting. The solutions support shipping and receiving of products, logistics, and buying and selling of products using a combination of catalogs, EDI, web, and shared databases. Additional information on this subject may be found at www.supply-chain.org.

4. 7 The Interaction of XML and Objects

Note: XML is rapidly becoming object-oriented and as such should be considered part of the object technology.

XML, a new standard from W3C, and objects are highly interrelated. XML is a means to store persistent object data in a straightforward manner. Object data is easily convertible to XML and XML instances are easily convertible to object data. Objects often use various binary encoding to store the data and methods

(object-specific programs) and are not easily interpreted by humans without special tools. XML stores data in ASCII (UNICODE) and is more easily interpreted by humans without special tools.

XML is very friendly to web formats and data exchanges between disparate object and non-object programs. It will be used extensively in the exchange of data between catalogs, databases, and programs that do not implement object technology. Because of this we will see both XML and object technology heavily implemented in the supply-chain environment and the generic inter-organizational environment.

4. 8 Summary of New Technologies

The technologies summarized above offer a means to solve some of the current EDI challenges.

These technologies offer a means to facilitate EDI by helping solve some of the current EDI barriers and inhibitors such as: 1) complex mapping of data required for internal system formats, 2) the inability to synchronize data easily between trading partners, and (3) costly and complex issues for SMEs. These technologies offer a means to help conduct electronic commerce in a manner which moves data real-time, allows controlled secure access of data across the supply-chain, and greatly decreases synchronization errors between trading partners. Each technology will be explored in more detail throughout the remainder of Section 2*: Analysis and Recommendations.*

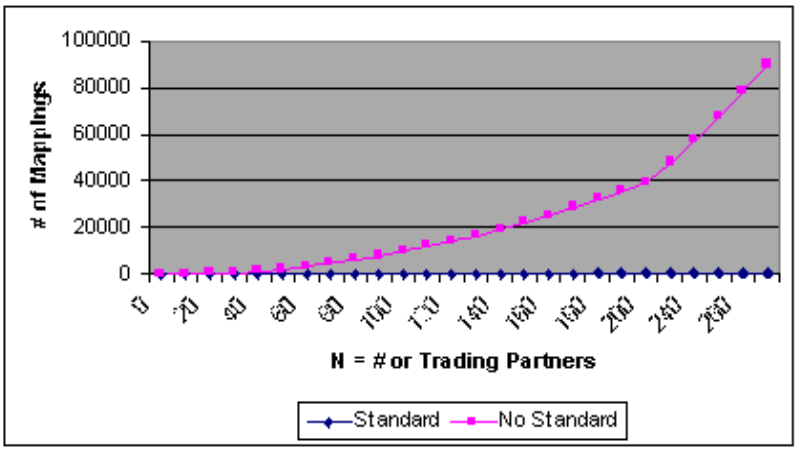
5. Traditional EDI Overview

5. 1 Introduction / Model

To reduce complexity, a standard EDI interchange format was developed.

Traditional EDI implemented a means to exchange information between companies in a standard way—between legacy systems with vastly differing data formats, structures, and data meanings. Before EDI, companies who wished to exchange data were defining the semantics and the syntax in a pair-wise manner, which works well for a few companies involved in a trading relationship. However, as the number of companies increases, the number of mappings across all companies increases at the square of the number of trading partners involved. For 10 companies the number of mappings across all 10 total 90 [10*(10-1)]. This increases rapidly until for a thousand companies the total mappings across all thousand companies in the supply-chain are 1000*(1000-1)—almost a million mappings to implement the supply-chain. Clearly this is not supportable for a large number of trading partners.

The continued use of Implementation Conventions will be disastrous to EDI and EC as the supply-chain grows in the number of trading partners.

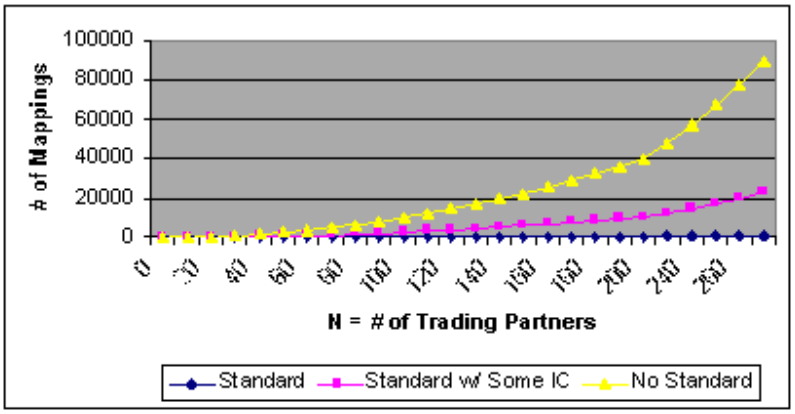


Graph 1 – Comparison of Standard versus Non-Standard Mappings

To resolve this problem the EDI community formed groups, which standardized the mapping within an industry. Each trading partner maps their systems to a single standard system versus mapping specifically to individual trading partners, which decreases the

The real problem is that one function is linear and the other is a quadratic. This means that as the number of trading partners increase, the quadratic increases much more rapidly than the linear.

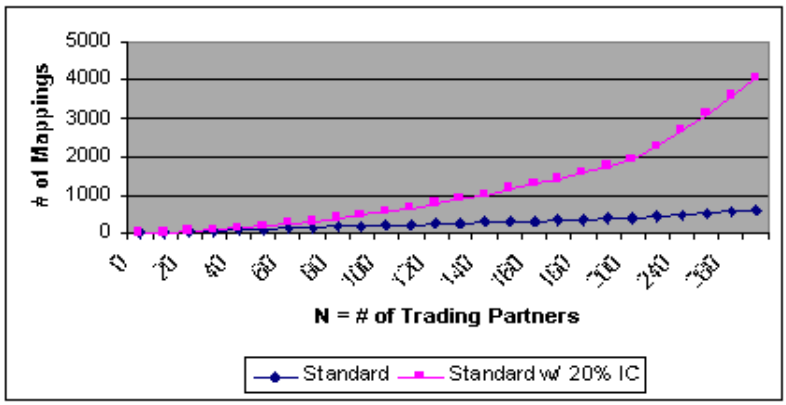
number of mapping required to N (N = number of trading partners) from the much higher number of N*(N-1). Graph 1 shows how many more mapping are required when a single interchange standard such as EDI is not in place. Unfortunately, while this significantly decreased the number of required mapping this increased complexity in the definition of the EDI exchange because all the participants having to agree on the single EDI exchange format.



Graph 2 – Comparison of Standard, Non-Standard and Standard with Implementation Conventions Mappings Numbers

As long a company do not follow and implement the EDI standards exactly by continuing to do their own slight variations to the standards through individual Implementation Conventions (IC), we have not solved the problem of keeping the number of mapping across the supply-chain to a minimum. As Graph 2 shows the number of mappings across a supply-chain when individual Implementation Conventions are frequently used, resembles more the case of no single EDI standard than it does the case of a single EDI standard. That is, it resembles the N*(N-1) function more that than the N function. This has serious consequences for EDI and EC in general. If this trend, the use of individual Implementation Conventions, continues it will be disastrous to EC and EDI implementations as the supply-chain grows to support worldwide commerce. This is because the amount of work to integrate all members in the supply-chain increases much more rapidly when IC's are used than when everyone follows exactly the standard without modification. Even for a small supply-chain, as Graph 3 shows, of three hundred trading partners the amount of mapping work for the entire supply-chain is four times higher with individual IC's than without IC's. This size difference increases

rapidly as the number of supply-chain participants grows. With four thousand supply-chain members, with twenty percent implementing individual IC's, the increase in mapping work could be hundreds of times greater than without the use of IC's.



Graph 3 – Example of Standard versus Standards with IC Mapping Numbers

We should learn from the Internet Email and the Web standards.

If they allowed individual companies to implement IC's there would be no universal Email or Web.

Organizations and individuals could not communicate freely.

One final point. If Internet Email let companies implement individual IC's, that required other companies to map in order to communicate, there would be no worldwide Email. The amount of effort would be just too high as Graph 1 indicates.

Industries such as Grocery and Transportation were the drivers in this standardization effort. In the early 1980s, these American industry groups saw the need to standardize EDI transactions even more by creating the ASC X12 Standard Organization under ANSI, which further standardized transaction, sets across industries. The focus, as before, was to establish agreement on the structure of the interchange documents and their contents, in a manner that facilitated the exchange of information between companies, and across industries. In the late 1980s, it became apparent that an internationalization of EDI following the model of the North American X12 group was necessary. This produced UN/EDIFACT (now UN/CEFACT), which is the international organization for EDI.

The EDI community continues to establish clear sets of document formats (transaction sets) and data meanings (data elements) that may be exchanged between companies participating in electronic commerce. The transaction set definition methodology has strengths and weaknesses—in many cases from the same thing.

The major strength of traditional EDI is that it standardizes the information exchange across industries, reducing the number of mappings required by a company to move data into and out of the EDI pipeline. The primary weakness is that the creating and maintaining of this standardized information is very complex and requires lengthy time periods to create new versions through consensus. Figure 4 highlights what traditional EDI does well and where it has some challenges.

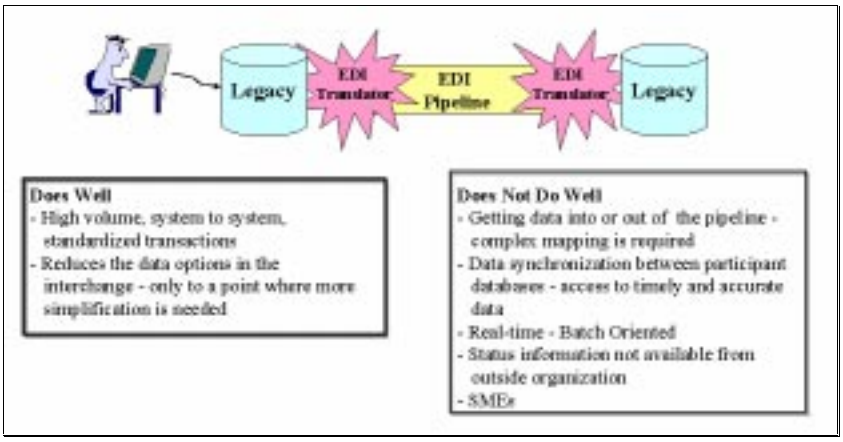


Figure 4 – Traditional EDI

5. 2 Challenges for the EDI Community

Three EDI challenges

Based on the UCC Task Group interviews we have identified three challenges that the traditional EDI community must address in order to lower the barriers for additional entry and participation in electronic commerce.

Challenge No. 1

Challenge 1: Simplify complex mappings

The transactions, because they now span multiple industries, are often complex and difficult to interpret, requiring a significant learning curve. Further more, because of the number of companies involved in the standard's definition, the process can be cumbersome and slow to ensure buy-in by the thousands of participants.

A detailed understanding of the document structure and the meaning of the data elements is necessary before inter-company exchanges may take place, in addition to significant knowledge

about the internal legacy systems themselves. Getting data in and out of the EDI pipeline is an arduous task because it requires an understanding of the EDI transactions, each data element's meaning, and their analogues in the internal legacy systems.

Most system software developers have never embraced the EDI data semantic model…

This is further complicated because, even after years of having the standard inter-system data descriptions available, most system software developers continue to use their own internal data representations, forgoing the agreed-upon work in already defined EDI exchange components based on the business knowledge of the EDI community. For these vendors to base their products on EDI in the first place would require a very steep learning curve for their development staff. Instead, they have chosen to ignore the need to facilitate the standardized exchange of information, maintaining their system as stand-alone.

New technologies that may make the definition of the inter-business information exchange easier to define, maintain, and incorporate into existing off-the-shelf systems are now being produced. These are based on object technology and modeling tools, which support the rapid development of standard objects and XML definitions.

Challenge No. 2

Challenge 2: Ensure data synchronization

A secondary challenge regards a failure of the current EDI methodology—since exchange of data between companies is not closely synchronized or timed—the data describing the same products or processes are not always the same. The mismatch between company databases causes problems that require human intervention to reconcile. Most experts agree that it costs over $400 USD to fix an error in an EDI exchange between companies. Data synchronization will remain a problem until all company intercommunications use accurate source data and not out-of-date copies of the data. This shift requires rethinking the technical mechanisms now used for exchanging data to ensure that the data being used be from the source—the data creator and maintainer – and not from a copy.

Most experts agree that it costs over $400 USD to fix an error in an EDI exchange between companies.

Challenge No. 3

Challenge 3: Facilitate EDI penetration in SMEs

The final challenge for the EDI community is addressing the steep learning curve required to implement EDI, especially for the SMEs. It is clearly offset by the efficiency and well-documented process paybacks in areas where transaction rates are very high. Most agree that the implementation of EDI for the exchange of a

purchase order (and other documents) shows a saving of at least 10 to 1 over manual paper methods. If a paper purchase order costs $100 to process then with EDI the cost drops to $10. The savings and return on investment (ROI) are only significant when the transaction volume is high. However, the ROI is low if the transaction volume is low.

ROI is low when transaction volume is low.

For small trading partners to receive benefits from implementing EDI, they must either reduce the costs of implementing EDI or have a minimum threshold of transactions to show appropriate ROI. Many small companies just do not have the volume to produce the payback, and as such, the EDI communities must seek means to reduce their implementation costs to produce an acceptable ROI. This is especially important in today's electronic commerce environment in that it is projected that over one-half of all companies involved in business are small or medium companies, which are hard pressed to show an internal payback to participate in EDI.

6. Problem Category: Complex Mapping

Overview

Problem

- Getting data into or out of the pipeline—complex mapping is required.

Strategy

Make things simpler by:

- Defining process models,
- Simplifying transaction sets, and
- Building and distributing standard objects.

Recommendation

- Establish a process modeling team to accomplish the strategy. Include representatives from all sectors and a professional data modeler/ BPR expert

6. 1 Problem: Getting data into and out of the pipeline—complex mapping is required

Established semantics are the real "gold" of EDI.

The EDI standards have put in place a standard exchange pipeline with standard transports, transaction sets and data element definitions that are usable across multiple companies and industries. These standards define the best current semantics for electronic commerce, by detailing the meanings of data elements and their relationship to other data elements. This is the real "gold" of EDI and will be the basis for ongoing Internet electronic commerce—*if it is promoted to, and used by, the systems vendors*. Because these standards are usable across multiple industries, their definition is complex and requires a significant learning curve to understand and use. The complexity required to support multiple industries must be reduced. This will allow integrators and product developers to more easily tie internal systems to the EDI pipeline, in a supportable and readily attainable manner. The issue is highlighted in the following scenario.

Mapping is arduous and requires extensive knowledge.

SCENARIO: An internal specialist must first understand the internal systems' data elements and inter-relationships. The specialist must also understand the EDI transaction sets, including the segments and data element relationships and meanings. Then the specialist must match common elements and segments (records and objects) across the interface so that data transfer takes place. This, in industry parlance, is called "mapping." This means mapping the data element "d.price" in the internal system to "discount price" in the EDI transaction sets.

Moving beyond the data element mapping, the internal specialist must then compose records (segments) which link appropriate data elements together in a manner that makes sense with both the internal and the EDI transaction sets. These records are then grouped in a manner that has meaning to both the internal systems and EDI transaction sets. The internal specialist may be required to pull and/or push data from more than one application to construct and decompose the appropriate EDI transactions.

Currently, extensive knowledge is required for a specialist to map information between legacy systems and EDI. We must decrease these prerequisite knowledge requirements. This also applies to

decreasing the knowledge requirements for off-the-shelf software developers to integrate EDI into their products.

Simplify … simplify …simplify.

The following must take place to reduce the learning curve and implementation complexity. We must further simplify the EDI transaction sets, removing any unnecessary complexity by re-examining required segments, data elements and transaction sets. The best way to do this is to use nascent tools based on object technology—tools such as UML (Uniform Modeling Language)—which help define the exchange elements and transaction in a top down, process-oriented approach. This must be done in a manner that facilitates the incorporation of these simplified transaction sets into legacy systems and into off-the-shelf applications. The transaction set definitions and the maintenance process must be simplified.

UML, the Uniform Modeling Language, is the best tool for generic object development we have at this time.

6. 2 Technologies and Directions

UML is based on several pre-existing modeling languages.

The primary technologies that may impact this area are XML, object-oriented technologies, and a new modeling language called the Uniform Modeling Language. UML may help the definition of interchange data and the standards maintenance process concurrently. It is based on the combination of several pre-existing modeling languages each with a slightly different focus. The best of each of these, many believe, have been incorporated into UML. They are:

1. Booch's object-oriented development language
2. OMT (Object Modeling Technique)
3. OOSE/Objectory Fusion (an object definition method) that extends the definition of operations and object interaction
4. Coad/Yourdon,, often called OOA/OOD, for object-oriented analysis
5. UML contains tools for normal system development such as Requirements, Analysis, Design, Programming, and Testing. The only thing UML is missing, which is required to define the interchange data and the supporting maintenance process, is the Business Process Reengineering (BPR) precursor to the UML system development process. BPR should be used as the

precursor to UML projects to implement a full process definition through development and testing methodology.

6. 3 General Responsibilities for Action

UCC—Process definition
X12—Process analysis and object definition
CEFACT—Process analysis and object definition
Trade Associations—Process definition

6. 4 Long Term Direction

The view must shift from the traditional paper document flow, which is the current EDI model, to one of process orientation. By the term "process orientation," we mean a shift from the current "bottom up" definition of documents into a "top down" definition of processes.

Currently, business requirements are usually and predominantly defined on a "paper document type" basis, such as a purchase order or an invoice, as opposed to object-oriented technology or "process orientation," such as where the business requirements will be met within object classes. These two processes are significantly different.

For example, the processes for Purchasing or Accounts Payable may be similar enough across organizations that general high-level object-oriented type descriptions that work across (between) all organizations can be defined. So, what we now call a "Purchase Order document" would be represented in the process orientation model by a series of objects, which together contain the data of a purchase order—instead of being contained in a single object.

Business Process Reengineering must precede the use of UML to define the processes.

After the process is investigated using BPR methods, information is fed into object-oriented system development language such as UML, which defines the data elements, their relationships and their meanings. This will require the EDI standard's bodies to reorient their focus from the current standards processes into a process based on new object-oriented techniques.

6. 5 Near Term Direction

The object-oriented approach must be backward compatible to the existing EDI technology base. It should generate simpler transactions while using the current legacy systems and give the

existing EDI users a means to transition over the next five to ten years to the new "transaction sets" defined in the object-oriented technologies.

6. 6 Resource Requirements

UCC—Personnel to promote and guide the process and techniques in this area, ensuring that these new tools and methods are refined and documented.

Individual companies—UCC select personnel to participate in the Business Process Reengineering and UML activities to define the process and the resulting objects.

Standards organizations—UCC should select personnel and an organization infrastructure to maintain the evolving processes and the object definitions.

6. 7 Implementation Specifics

Defining Process Models

Can we: define the process well enough to construct useful objects, and describe objects well enough so that object mapping to the legacy system is not necessary?

Organizations, industries, and countries all have developed process models for conducting business that are codified in law. The law, as well as ongoing relationships, provides the foundational support for the buying and selling of products and services. These processed models have evolved, and continue to evolve, to fit the variety of business, legal, accounting and auditing requirements for conducting business. The models vary somewhat across states, industries, and countries. Countries with process models based on capitalist systems that have been in place for many years have a lot of similarities. Those based on other systems, or that are new to capitalism, may not be as similar. Whether the process model is old or new, the task of process reengineering will be resource-intensive.

The key question is, "do we have to detail the last 20% of the processes— which will often be for internal use only—to support the external, inter-organizational exchange of data?"

Those who conduct process-reengineering endeavors within a company know that it is easy to define the macro process, the first 80%, with a few knowledgeable individuals. They also know that the subsidiary, frequently invisible tributaries to the process require a lot more time and effort to discover and detail.

Defining the new object-oriented process model will be the same in the inter-company EC environment. It will be easy to establish the first 80% of the process, but will require considerably more effort to detail the last 20%. *The key question is, "Do we have to*

detail the last 20% of the processes—which will often be for internal use only—to support the external, inter-organizational exchange of data?" Can we develop standards-based objects from the 80% described in the process? Will these be sufficient and detailed enough to support the external business requirements without inhibiting internal requirements that impact the external exchange of information? If we cannot, then internal users will be required to construct interfaces to these standards-based object exchanges to be able to support their internal specific processes—requiring arduous mapping between applications and not solving the problem.

Now, we are back to where we started—requiring internal experts to patch together external and internal processes—this time through object technology. Inheritance, an essential part of object technology, should make modifying objects to fit internal processes easier than the current process of doing ICs (Implementation Conventions), but the problem remains to a significant extent.

We should not expect the process-oriented approach to solve all problems associated with the exchange of information. Also, we expect differences of opinion and intense discussions inherent with any attempt at defining worldwide processes.

6. 8 Risk Assessment

Realistically, object technology only comes into play after the processes have been defined by business process reengineering (BPR)—then identified and detailed in the UML "Use-Case." The Use-Case describes the process from which the object model is generated. The primary risk is in the formation of the Use-Case, not the application of the object technology. If several groups, working from the same information, define the Use-Case and the resulting object model, there will be several object models; some being optimal and some less optimal—yet all being correct—if they apply the techniques and modeling tools correctly.

The risk is in NOT doing Business Process Reengineering before modeling begins.

We should be careful and diligent in adjusting our Use-Case process description so that it refines the process description methodology by enhancing it, rather than expecting it to be a total solution. Business process reengineering is only 10 to 15 years old. A lot of uncertainty remains—with the key inhibitors being:

- inappropriate people are involved

- inappropriate level of expertise
- inappropriate expectation of the time required to complete the process.

6. 9 Outstanding Issues

The main inhibitor to moving to new technologies is the inability of the existing infrastructure and processes to adapt.

The process described above is based on a top-down approach which, in turn, is based on business process reengineering techniques, object tools and methods. The output of these tools must be used to simplify existing EDI technology in a manner that allows those with legacy systems to take advantage of the gains made in the object definition projects. This will not be easy, since the object definition projects will generate new transaction forms, composed of different elements and constructs than current EDI.

The creators of the new process should align with existing EDI standards, where appropriate, to help migration. The alignment should not force aberration in the object models and definitions, but should make it easier for the migration from existing EDI systems. We must remember that the main inhibitor to moving to new technologies is the inability of the existing infrastructure and processes to adapt. If the "bar" is too high for transition, it will slow or inhibit the migration to the object-oriented world.

6. 10 Time Frame

The UCC should launch a pilot project to define a simple process in object-oriented terms.

Process definition pilots should commence as soon as possible. These should be designed to determine an efficient way to define the processes to a sufficient level, and then feed the process definition into an object-oriented tool such as UML. This will require an iterative process that will take many years to complete in the international environment.

6. 11 UCC Implementation Actions

RosettaNet's product data definitions have been defined.

The UCC should launch a pilot project to define a simple process in object-oriented terms. This will provide the opportunity to analyze the process definition tools and the subsequent object methodology. It also provides for feasibility testing and allows for adjustments and refinements as necessary before more complex processes are attempted. A simple suggested starting point is the definition of product data objects in object or XML technology.

RosettaNet (www.rosettanet.org) has already completed the definition of standard product data for the computer resellers in XML. These definitions should be reviewed for relevance to the UCC objectives.

6. 12 Interdependencies with Other Areas

Many organizations are attempting to define the processes more clearly. The Supply-chain Council, X12, CEFACT, and others are looking at areas such as ECR (Efficient Consumer Response) or DSD-2 (Direct Store Delivery). The information on how to approach the process reengineering and definition process should be shared widely and adjusted as appropriate.

6. 13 Key Success Factors and Inhibitors

Large organizations must support these areas with appropriately educated personnel to define the "80% process" in a manner which facilities the generation of objects. Their success depends largely on how well the implementations scale to large and small enterprises.

SMEs must be involved!

The SMEs must be a part of this process, and their involvement may be enhanced by the support of large enterprises. If over 50% of all EC businesses are SMEs, then they must be included—which is not the case today. The UCC could accomplish this through the inclusion of SME industry associations and trade groups.

6. 14 Operational

EDI object definitions must support legacy systems.

The object pilot projects must delineate the ongoing definition processes, standardizing them so they may be used in subsequent phases or pilots. The process must incorporate object maintenance.

6. 15 Migration

The objects and resulting EDI definitions must be constructed in a manner that facilitates into the current legacy infrastructure and facilitates migration in the future.

6. 16 Summary

For success, software vendors must use objects and XML in their off-the-shelf products.

The strategy is to simplify mapping to EDI by implementing objects and simplifying current transaction sets, in a manner that facilitates implementation and migration from the existing standards to the next generation of object standards. The risk is that we depend too much on the technology to solve problems which technology cannot solve, such as well-defined processes and well-defined data elements. Additionally, the key to success in this area—and there will be no success if this does not happen—is that software vendors use the objects and XML constructs in their off-the-shelf products. This will require ongoing, highly visible promotion of these solutions to the software development community.

7. Problem Category: Data Synchronization

Overview

Problem

- Data synchronization between participant databases—access to timely and accurate source data not available to outside organizations.
- Not real-time—batch oriented / store-and-forward transports.

Strategy

- Real-time database-to-database access for source data:
  - Define standard objects,
  - Select standard access methods (CORBA, IIOP, and X.500) and
  - Select standard security—public key infrastructure.

Recommendation

- Endorse the UCCnet concept.

7. 1 Problem Category Discussion

NOTE: The UCCnet project team, a new endeavor of UCC, will make the final recommendations in this area. The following is the UCC EC Strategy Team's findings and identified alternatives in this area for the UCCnet project team.

UCCnet will make the final decision for the data synchronization problem category.

One of the primary problems with today's implementation of EDI/EC is that timely and accurate data is not easily and readily available to all participating parties. This problem has many guises; several are caused by the techniques used to implement EDI in the past when implementation options were limited by existing technology. These problems relate not only to EDI, but apply to any EC technology that purports to closely coordinate information between participants. The data synchronization problems are well known and were identified by UCC as a major issue several years ago. The problems are becoming more evident as we move from the hub-and-spoke type of implementation strategy into total supply-chain strategies, where spokes communicate with many hubs, and data exchange volumes rise rapidly.

The discussion is divided into two problem areas:

- EDI is not real-time; it is based on batch and store-and-forward technologies.
- Data synchronization between participant databases—i.e., access to timely and accurate source data and status information—is not available to outside organizations.

7. 2 Problem: Not real-time—batch oriented / store-and-forward

7.2.1 Technologies and Direction

Batch processing inhibits data synchronization.

The implementation techniques used in EDI have perpetuated the data synchronization problem. The first is the batch nature of the information flow caused by the inherent difficulties associated with integrating internal legacy systems. The second is the technology used to move EDI data between companies—often store-and-forward.

In the first, many of the legacy systems are batch-oriented; a job is run with its output being the input to another batch job. These jobs are often synchronized by time rather than by an event (event-

driven.) For example, a batch run creates an output file, which at some predetermined time is used as input to another batch job. The second batch job is not initiated by the event of the completion of the first, but is initiated at a designated time. This technique causes delays in the processing, as data is stored and is not supportive of real-time processing.

Store-and-forward technology inhibits data synchronization.

The second, is the use of a store-and-forward messaging technology to move data between companies—the mailbox approach. In this approach, the EDI data is created and at intervals posted directly to the destination or to a third party VAN or network, where it waits to be picked up by the recipient. Both of these create time delays and promulgate synchronization issues. While data may have changed on the source system, the recipient system may not be updated to reflect these changes until some time later—minutes, hours, or days. These intervals have been tightening over the last few years; where once data may have been updated daily, now it is updated hourly. However, as systems move more and more data, more and more frequently, even an hour of "dis-sychronization" will cause a significant number of synchronization errors. A current UCS method, direct connect, does not exhibit these delays and is used by many EDI users. However, this method is too costly for SME to support.

Batch-Oriented Processing

This area is not easy to solve since the batch orientation is based on the capabilities of the internal systems, which are batch-oriented and not event-driven. Those who have event-driven systems should implement processing in a manner which maintains the data integration between internal systems and transmits and receives EDI data in a more timely manner. Some types of data require the event-driven environment. Others do not. ASNs (advanced ship notices) should be implemented in an event-driven manner, while purchase orders and invoices may not require real-time processing, and may be left as batches.

Store-and-Forward Transports

Secure Internet EDI using HTTP for real-time information transport.

The movement of EDI data between companies in a more real-time manner may be conducted over Internet, using HTTP protocols based on the HTTP/POST command. HTTP naturally allows the downloading of data files to the initiating systems. We use this every day to download program updates and documents. The IETF EDIINT workgroup will shortly release specifications that

detail how to move EDI data over Internet in a real-time manner, using HTTP instead of the SMTP store-and-forward method.

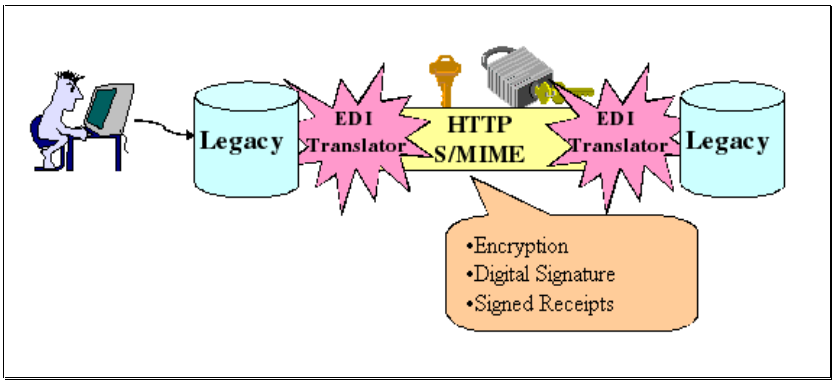


Figure 5 – Secure Internet EDI using HTTP/POST

HTTP may replace store-and-forward SMTP to offer a real-time data exchange.

The EDIINT HTTP specifications show how to post EDI transactions using encryption, digital signatures, and request signed receipts. (See Figure 5.) The initiating host connects to a web server acting as a web browser. The machine-controlled browser uploads using the HTTP/POST command. The exchange waits for a response from the destination in the form of a signed receipt before terminating the connection. While this solves the problem in the movement of data between companies, it does not solve the problem in each translator unless the translator is event- and not batch-driven. The internal system translators will require event-driven processing instead of the historic batch file processing. This specification may be found at http://www.ietf.org/internet-drafts/draft-ietf-ediint-as2-00.txt.

7.2.2 General Responsibilities for Action

The Uniform Code Council should promote to the membership the use of real-time system design for new applications and for exchange between existing applications. The UCC should pilot the HTTP version of the recommendations for SMTP Secure EDI over Internet (EDIINT) that have been previously verified by the UCC and recommended to become part of the UCS Communications Standards.

7.2.3 Long Term Direction

Internal systems must become event-driven and not batch-driven. This, in many cases, will require new internal software implementations or the purchase of new off-the-shelf event-driven

software. Additionally, we must offer real-time information transfer between companies in addition to the historic store-and-forward transports.

7.2.4 Near Term Direction

Same as long term direction

7.2.5 Resource Requirements

Individual companies will be required to plan and install real-time software and/or implement the reduction of batch processing timing in very short intervals. Additionally, the purchase of HTTP/EDI communication software to interface to existing translators will be necessary.

7.2.6 Implementation Specifics

Problems encountered in moving from batch to real-time processing are specific to each installation, but the use of HTTP to replace the current store-and-forward inter-company exchange should be transparent to existing EDI implementations.

7.2.7 Risk Assessment

The implementation risk is low from the supply-chain view. The Internet HTTP technology is well known and has many implementations. From a participant's view the risks are somewhat higher, in that supporting an event-driven data movement internally, in addition to batch, will often require re-architecting internal systems and/or purchasing new off-the-shelf software which delivers both batch- and event-driven real-time movement of data.

7.2.8 Outstanding Issues

UCC must develop a business rationale to show expected ROI to members to help them sell the need to executives.

The SMTP version of Secure Internet EDI (EDIINT) has been implemented by several leading vendors, unlike the HTTP version which is expected to in 1999. The programming changes between a SMTP and a HTTP implementation are minor. Indicating that existing SMTP implementations can form 90% of the HTTP programming effort.

7.2.9 Time Frame

Real-time processing within a company will take years to implement across the supply-chain. HTTP-based EDI may be

implemented in a pair-wise manner between trading partners transparent to the other supply-chain members—indicating a short time frame for its implementation.

7.2.10 UCC Implementation Actions

UCC must promote real-time processing and pilot the use of HTTP/EDI so that it may be included in the UCS Communications Standards.

UCC must develop a business rationale, based on expected/proven ROI that will help company information technology professionals sell the need for new real-time systems within their companies.

7.2.11 Interdependencies with Other Areas

Existing batch-oriented system architectures will make this a tough area to solve.

7.2.12 Key Success Factors and Inhibitors

The cost to implement event-driven real-time architectures for small, medium and large enterprises may be high and will slow the supply-chain wide implementation.

7.2.13 Operational

If internal systems remain batch-oriented, even if the inter-company communications move to store-and-forward technologies, then this will operationally inhibit real-time data movements.

7.2.14 Migration

Migration to event-driven internal systems, and away from batch systems, may be technically transparent to the other members of the supply-chain. However, entities that lag in implementing event-driven systems should be identified so that trading partners can analyze the effect of access to untimely data. Technically, the migration issues are minor for the store-and-forward side, in that it is merely a new communications module for the translators and is transparent to all other software.

7.2.15 Summary

Moving from batch and store-and-forward systems to real-time, event-driven implementations should enhance data synchronization

across supply-chains. However, it will not completely solve the data synchronization problem, because there still remain transmission delays, causing transitory inaccuracies between trading partner data.

7. 3 Problem: Data synchronization between participant databases—access to timely and accurate source data is not available to outside organizations

Detailed Description

The problem has roots in the non-real-time legacy systems and store-and-forward technology frequently used to move EDI data among companies.

The original design of legacy systems and the subsequent EDI implementations to exchange data are at the root of the data synchronization problem. In the current EDI model, data moves from legacy/internal systems to other internal systems. Human access to the data is via the internal system software by internal users. Non-internal users, such as trading partners who wish to verify a purchase order or invoice status or retrieve timely product data, do not have ready access to the internal systems. Instead, they must phone or email internal personnel to have them retrieve data.

If a user has the source product data on their internal system, uploaded via a store-and forward EDI transaction such as an 832—often fed by batch processing—timeliness of the data is suspect. Data synchronization issues will only go away when humans and other systems are allowed access to the source data in a secure, timely and direct manner.

At this time, leading trading partners have implemented a partial solution to the information access problem.

Some trading partners support access to internal data via web browsers.

Some are now allowing access to internal system data via web browsers, significantly decreasing their resource requirements to support outside queries. However, this technique has one serious flaw in the significant probability of transcription errors introduced by the user as the information is posted in the initiating internal system from the web page. (See Figure 6.)

Use of source data, not copies, is the only way to solve the data synchronization problem.

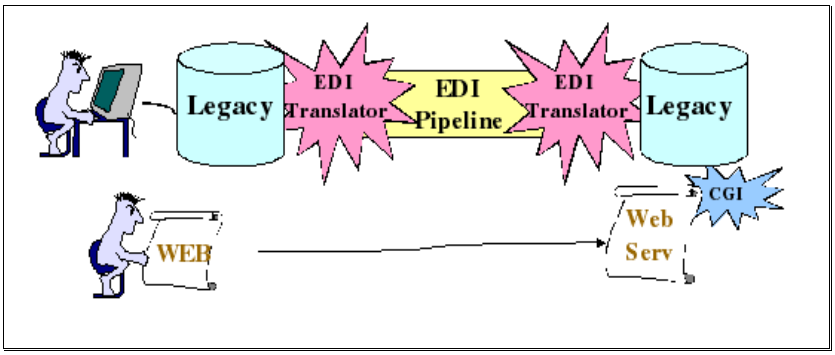


Figure 6 – Current Method of Web-based Status Inquiry

The only way to guarantee data synchronization is to use a single data source that is assumed accurate and timely. In this way, data synchronization is no longer a significant problem, because several databases need not be synchronized. There is only one database on which a piece of data resides—the source database. The access requirements are to support 1) human-to-database access such as a web query and 2) direct database-to-database access without human intervention.

This data synchronization model has some inherent problems. The data source must be highly available and accurate. This will require key source data be implemented in a manner which ensures availability by using redundant systems and hot backups. It will require that source data be highly accurate to ensure that errors do not propagate throughout the supply-chain.

Requirements

Requirements for solving the data synchronization problem.

- Implement direct database access from the outside world to source data residing on internal systems in a controlled secure manner.
- Provide a single view of the data across the supply-chain.
- Provide a single access method.
- Provide a single view of security.
- Control data by the owner.
- Ensure complete control of the data and its access by the Owner Company.
- Support human and machine queries to the source databases and systems.
- Implement a supply-chain directory, which shows all participating companies the location of their product data, and the location of their internal systems, to give a total view of the supply-chain data.

7.3.1 Technologies and Directions

There are three primary means of implementing direct access to internal systems from outside, in a standard manner. They are X.500 Directories, Object Databases, and Web, a mix of object and web technologies.

7.3.1.1 Alternative 1: X.500 Directory Databases

X.500 offers a method to structure data in a meaningful manner and should be investigated further as an addition to the normal web-based catalog interface. X.500 is one of only two object-oriented, distributed database standards available which implement secure access controls to all data, as well as providing the source company with complete control of data sharing. It supports both the human-to-database and database-to-database access requirements. Additionally, it fulfills all of the requirements defined earlier in this section.

X.500 meets all of the data synchronization requirements defined above.

X.500 was created for human searches and helps organize data so that it is easily searched across multiple cooperating X.500 databases. Either LDAP (Lightweight Directory Access Protocol) or DAP (Directory Access Protocol) can be used by humans or machines to access the X.500 distributed database structure.

LDAP is included in most new web browser software.

LDAP is a subset of X.500. It has been implemented in most web browsers and is an IETF standard. LDAP has most of the functionality of DAP but is less complex to implement, and unlike DAP, it is also usable for searching non-X.500 databases/directories. Since X.500 is an object-oriented structure built on database technology, many vendors of X.500 products also support access via CORBA protocols. Figure 7 shows an example of an X.500 implementation.

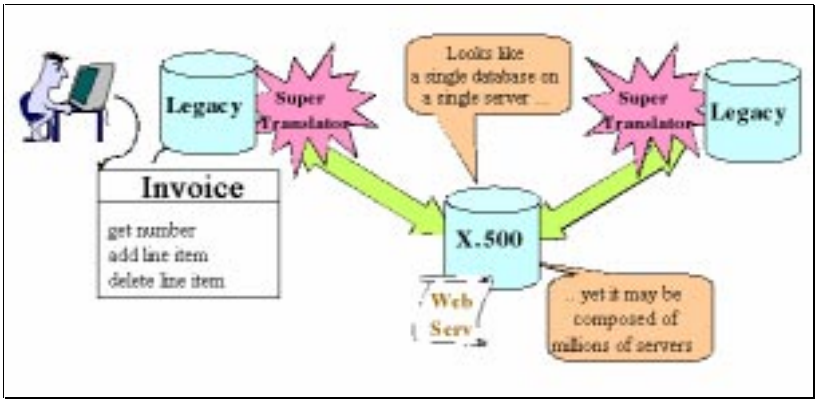


Figure 7 – X.500 in the Shared Supply-chain Data Repository

7.3.1.2 Alternative 2: Objects—CORBA and DCOM

Many X.500 products also support a CORBA interface.

There are no general implementations at this time in the EDI world of object technology for information exchange between companies. However, new software architectures are implementing inter-company object based, data exchanges in some historic EDI

supply-chain areas. The best known is the Value Chain Initiative (VCI) from Microsoft, which uses the Microsoft DCOM inter-system distributed Common Object Model to directly access and update data on other systems. However, this only works between systems that implement DCOM, which is not heavily implemented in the legacy world.

CORBA is a standard object technology.

Another technology that will help direct database-to-database access is the international standard by the Open Management Group (OMG) called CORBA (Common Object Request Broker architecture). CORBA and DCOM are reportedly interoperable to some extent now, and should grow in interoperability over time. See Figure 8 for a schematic.

The solution must support both human-to-database and database-to-database access.

Database-to-database access allows for automatic system retrieval of required information. For example, a purchase order needs current prices, SKUs, or UPC codes to ensure accuracy. The internal system (transparent to the user) queries the source data system for the information, retrieves it, and enters it into the purchase order transaction. Access controls ensure that only data relevant to a specific user is retrieved, and not data for another user. The source databases can be a shared supply-chain database of product information or another company's internal system. While complex to implement technically and management-wise, this ensures that data is timely and accurate—since it is the actual source data.

Direct database-to-database access, CORBA, and/or DCOM should be used to access data between databases, using protocols such as IIOP or DCOM's remote procedure call mechanism. Figure 8 shows the architecture for CORBA. DCOM's components are very similar.

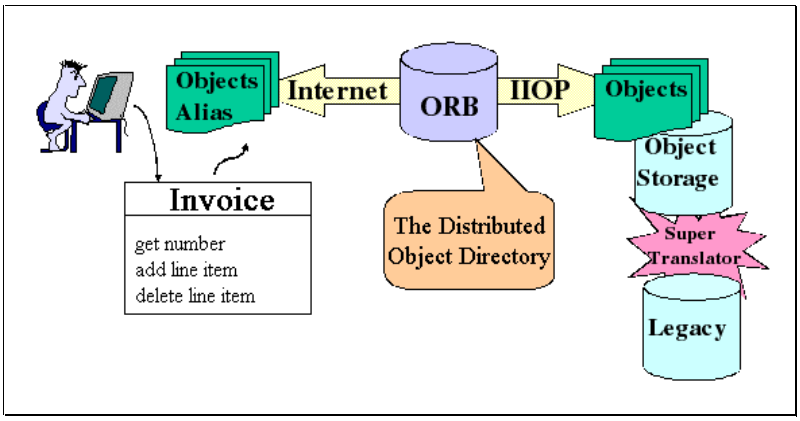


Figure 8 – CORBA Objects and IIOP for the Shared Supply-chain Data Repository

A directory service showing distributed objects will have to be established to support the requirements.

In all cases, for both human-to-database and database-to-database access, the objects must be defined; data access control methods must be implemented.

Direct database-to-database access will require support for both human and machine queries. In the human query mode, a human-oriented directory will be required to help search for trading partners or the needed data. In the machine access mode, pointers to data location are required, but not to the same extent as with a human-guided search. Some database vendors offer direct support to their database from web browsers, while others do not. CORBA and DCOM both implement an object directory that is used by the object applications to find and access other remote objects. Access to this directory may be necessary to support the human-to-database access requirements.

7.3.1.3 Alternative 3: XML and Web Server Database Interface

A combination of XML and HTTP may support the database-to-database access requirements.

Several vendors are implementing web browser interfaces to their databases, which allows people to query data on demand to check invoice status, forecasting data or product data. This is straightforward, and many vendors offer this capability. The implementation is human-to-database and rarely database-to-database.

A query protocol must be created for this option.

However, this technology may be used to also implement the database-to-database access method. This access method will be based on XML, HTTP, and HTML technologies. Figure 9 shows how the legacy database is interfaced via CGI (Common Gateway Interface) script to a web server, with the web servers exchanging commands in XML or other exchange languages.

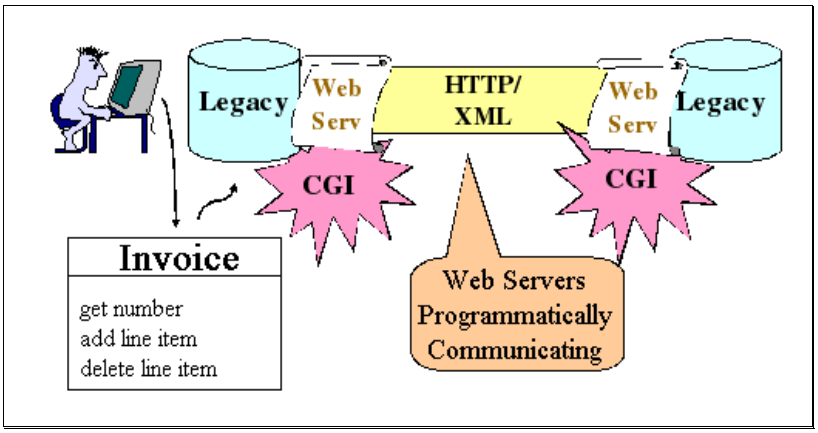


Figure 9 – HTTP & XML for the Shared Supply-chain Data Repository

This alternative meets all the requirements expressed earlier in this section.

Each legacy or object database in the supply-chain is interfaced to a web server through CGI, SQL, SIL or other automated methods. The database web servers at each site exchange well documented, yet-to-be created objects in XML, to request and retrieve information from other database web servers at other sites over HTTP transport with SSL security.

This will require the definition of an exchange protocol based on XML or other languages to implement the query response protocol between the database web servers. The databases may be object-oriented or legacy. This supports both human and database access to databases.

This strategy is not an object-oriented strategy at this time, even though the databases involved may be object-oriented. Currently XML is not completely object-oriented. Two new proposals, Schema and SOX (Schemas for Object-oriented XML) have been submitted to the World Wide Web Consortium, (http://www.w3c.org) and may be used to implement a full object-orientation in XML. After these proposals, or others like them, are accepted the exchange between the web servers is completely object-oriented. However, this will not solve the need for the establishment of a protocol query language between the database web servers.

7.3.2 General Responsibilities for Action

Uniform Code Council's UCCnet project team is responsible for the selection and implementation of the technologies used to solve the data synchronization problem.

7.3.3 Long Term Direction

The goal should be to implement distributed database services, based upon XML, Web and/or object technology, or as a combination. This functionality should support access-controlled updates and queries of source data—to the field level—from both humans and machines. All three of the above alternatives require the definition of objects through the process discussed in the first Problem Category outlined in this analysis.

This will require participating companies to move to distributed object-oriented databases, either source or mirror, using standard UCC-defined or supported objects which detail basic information components. Depending on which alternative is selected, companies will be required to implement web server-to-database connections, X.500-to-database connections, or object data-to-legacy connections.

Standard objects should be defined, and in the case of the third alternative, query protocols to be used between the web servers should also be defined.

7.3.4 Near Term Direction

The goals will be defined by the UCCnet team after they select a technology architecture to support the UCCnet implementation.

7.3.5 Resource Requirements

Purchase of object-oriented and X.500 database or web server-to-legacy-database technology by each vendor.

- Training of internal personnel on the technology.
- Participation in the development of the object definitions.
- Participation in extending the X.500 directory structure objects.
- Participation in the definition of public key infrastructure to support authentication, digital signature, and encryption.

7.3.6 Implementation Specifics

Evaluate CommerceNet, RosettaNet, CEFACT and OO-EDI efforts for modeling techniques.

The objects, which identify the information to be shared, must be defined in a logical and process-oriented manner. The techniques being developed by the CommerceNet eCo Framework Workgroup, RosettaNet, and CEFACT OO-edi Workgroups should be used and adjusted as appropriate to refine the process.

Object database products should be investigated as to functionality and interoperability, based on the following minimal criteria:

- Do they support CORBA and IIOP?
- Do they support X.500 mechanisms and structures such as LDAP or DAP?
- Do they support data element read, write, and delete access controls?
- Are they interoperable in a distributed manner using the above?
- Will they support both object data and methods in internal storage?
- Are they scalable to hundreds and thousands of participants?

A key component of all three alternatives is the use of off-the-shelf web browsers and server software, which supports access to the distributed directory for human queries.

Since the UCCnet project team is initiating a pilot in this area, other implementation issues will not be detailed.

7.3.7 Risk Assessment

The risks of the alternatives…

Risk: Medium—X.500

Risk: Medium to High—Objects

Risk: Medium to Low—Web

Interoperation of object-oriented databases is "leading edge," especially over the Internet and will require serious interoperability testing and vendor coordination to ensure that the required capabilities are interoperable. They must implement, at a minimum, the requirements spelled out in "Implementation Specifics."

7.3.8 Outstanding Issues

No issues, since this area is being investigated further within the UCCnet project team and is their responsibility.

7.3.9 Time Frame

This is the UCCnet Project team's responsibility.

7.3.10 UCC Implementation Actions

UCC must establish guidelines for availability, security and reliability.

The implementation of object technology will require the ongoing coordination and participation of the EC community in training, object definitions and maintenance, access control, and determination of a common data display format.

UCC must establish guidelines for data availability, security and reliability to ensure that accurate source data is available on demand.

7.3.11 Interdependencies with Other Areas

The architecture is based on XML, Web, and CORBA standards. The other competing standard is DCOM from Microsoft. Each of these must work together to support the SMEs, whose systems will often be based on Microsoft software.

X.500 functionality is used in LDAP to support access methods and to provide a simpler X.500 directory architecture. This must be closely watched to ensure that the appropriate X.500/LDAP interaction is implemented.

XML Web server-to-database access will require the definition of query protocols.

IIOP, CORBA's Internet process-to-process communications mechanism, is not seen as being secure and efficient enough to offer high transaction rates between processes. Additionally, it does not work well with firewalls. The architecture team must be sensitive to these issues.

7.3.12 Key Success Factors and Inhibitors

Large enterprises must agree to use the objects in such a way that it does not cause undue hardships on the SMEs. Implementing object-oriented conventions will slow new EDI implementations across the supply-chain, specifically in the SME area.

Implementation of direct access to source data assumes that the source data is ALWAYS available—meaning that participants must implement their database in a 24*7 manner with the appropriate hot backups and with the appropriate ISP. The use of poor-performing ISPs should be discouraged. This will ensure appropriate levels of performance and availability across the supply-chain.

SMEs must be involved or this effort is not going to meet the goals.

The UCC Strategy Task Group is composed only of large enterprises, and does not involve the SMEs. Implementation of these recommendations MUST ensure that SMEs are able to participate and contribute their unique perspective, to guarantee that what is implemented "lowers the bar" for their initial or ongoing EDI participation.

7.3.13 Operational

The UCC must implement procedures to define and maintain the data objects. They should also offer interoperability testing for new software and/or new versions. They should implement a process for periodically gathering performance data from an overall supply-chain view, so that supply-chain-wide issues may be identified and corrected.

7.3.14 Migration

The migration responsibility is the UCCnet project team's.

7.3.15 Summary

The implementation of combinations of Web, X.500 or object-oriented technologies that support both human-to-database and database-to-database access in a secure, timely manner to source data is a requirement. These suggested alternatives were detailed, as input to the UCCnet project team.

8. Problem Category: Lack of SME Penetration

Overview

Problem

- Lack of traditional EDI penetration into the SMEs manifested by:
  - Complexity hurdle
  - Cost to implement
  - Cost to support
  - Cost to transfer data
  - Lack of integrated applications

Strategy

- Make traditional EDI simpler and cheaper by:
  - Standardized Web Forms for EDI (XML)
  - Web-EDI with flat file interface to source SME system (XML)
  - Off-the-shelf SME systems with object-oriented interfaces
  - EDI over the Internet (S/MIME - EDIINT)

Recommendation

- UCC should facilitate the standardization process of the above items. UCC should also facilitate the inclusion of these items in commercial, off-the-shelf packages.

8. 1 Problem: Lack of Traditional EDI Penetration into the SMEs

While the large enterprises can frequently show the ROI in implementing EDI, the SMEs usually cannot. There are several reasons for this. The primary reason is that the investment to implement and support EDI is too high and the payback, if any to them directly, is too low, or too far in the future.

The ROI for many SMEs is too low to support EDI implementations.

To implement EDI with a hub, the SMEs must first investigate EDI and what it means, then further investigate the specific implementation conventions of the hub. At this point, they must choose a translator vendor, and train personnel to implement and support the translator. This is a sizable investment in terms of manpower and capital.

If the SME is small, the number of transactions with the hub may be small. Any savings from converting their paper-based invoicing and purchasing systems to EDI is small, since they do not generate enough transactions to receive the payback from the initial investment. Furthermore, because hubs usually have specific, unique implementation conventions, the investment is not entirely reusable with other trading partners. This is why a large majority of SMEs that respond to a hub and request to implement EDI never integrate it into their internal system. The transaction volume is not high enough to warrant the initial implementation costs or the ongoing support.

Re-keying data frequently introduces errors—at $400 per error to correct.

In most cases, EDI implementations for SMEs are no better than exchanging data with the hub using faxes. In essence, SMEs have become data entry clerks for the hub—yet not receiving direct savings from the implementations themselves. Additionally, they must re-key data from their internal systems into the EDI application, and errors are frequently introduced—errors which cost over $400 each to correct.

We must lower the "bar" for SME participation by reducing the capital and ongoing costs to implement EDI. Also, we must facilitate ways to help them integrate the EDI environment into their current systems. This is becoming more critical as we move to a supply-chain environment where half of all participants are SMEs—SMEs that must communicate with multiple trading partners and hubs.

8. 2 Solution: Standardized Web Forms for EDI (XML)

8.2.1 Technologies and Directions

Many VANs and some hubs now offer web-based EDI interfaces to their SMEs. These are web applications, with data entry and output forms, that let the SME conduct EDI with their trading partners, without the need to purchase and support an EDI translator. These implementations have major payback for hubs, but little for the SME, since they may communicate with many hubs.

Under the current Web-EDI scheme, an SME will have to use a different Web-EDI interface for each trading partner.

Currently, if an SME is conducting business with several hubs, it may be required to use separate web-based applications—one for each trading partner. So, while the cost of implementing EDI has been greatly reduced, the support costs for learning and maintaining multiple Web-EDI applications has increased. This may be worse than just implementing an EDI translator, in that at least the translator receives and stores all correspondence in the same interface, while the separate Web-EDI interfaces store, monitor, and retrieve information from many places.

On the surface, Web-EDI seems like a way to help the SMEs, while it may in fact exacerbate the problem. The solution is to make it easier and less costly for SMEs to participate in the supply-chain. This problem becomes greater as additional third parties become involved, such as the case of a food manufacturer, a distributor, and restaurant attempting to interact.

Establish a single, standard Web interface to support all communications from the SME to the supply-chain.

Web-EDI offers significant payback to the SME that is only communicating with one trading partner; the payback rapidly decreases as it communicates with multiple trading partners. To maintain the payback of Web-EDI the web interface must be standardize. One application can support multiple hubs, VANs, or implementations. Accordingly, the SME may retrieve and input all documents in one place and retain a single record of transactions. This will require standardization on the interface, supply-chain-wide or third party service bureau offering of Web-EDI services to the SME. Services will have to be reasonably priced and offer solid end-user support. This further means that the Web-EDI application may not post information directly to the destination database, as is now sometimes in practice. Instead, it must generate an EDI transaction that is receivable by any of the trading partners.

Figures 10 and 11 graphically demonstrate the differences between Web-EDI without standard web forms and Web-EDI standardized with web forms. In the former case, a SME had to log into a different form interface for each trading partner. In the latter case, they logged into one interface, which communicated to the supply-chain.

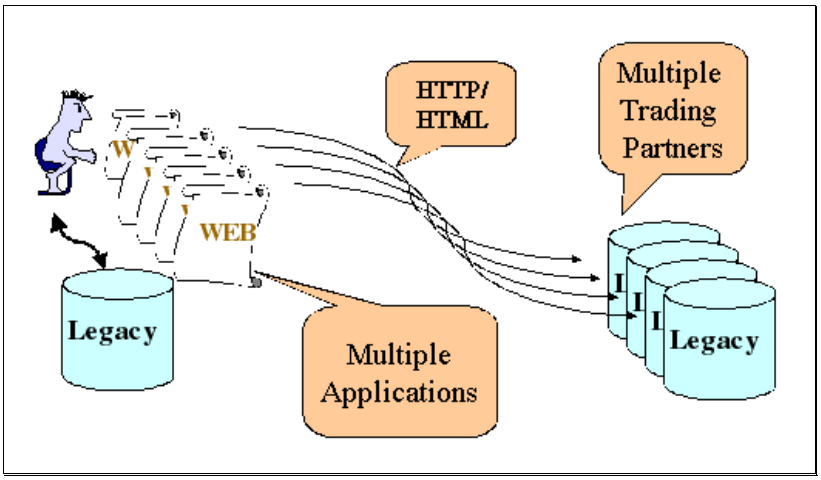


Figure 10 – Web-EDI Forms Without a Standard Web-EDI Form

If Web-EDI is standardized across the supply-chain, using standard forms and facilities, then SMEs may participate in the supply-chain in an effective manner. They will not have to use multiple Web-EDI interfaces, but may use one to send and receive data with all hubs. If Web-EDI is not standardized across the supply-chain, then Web-EDI does not help the SME, and only makes their participation more arduous in the supply-chain.

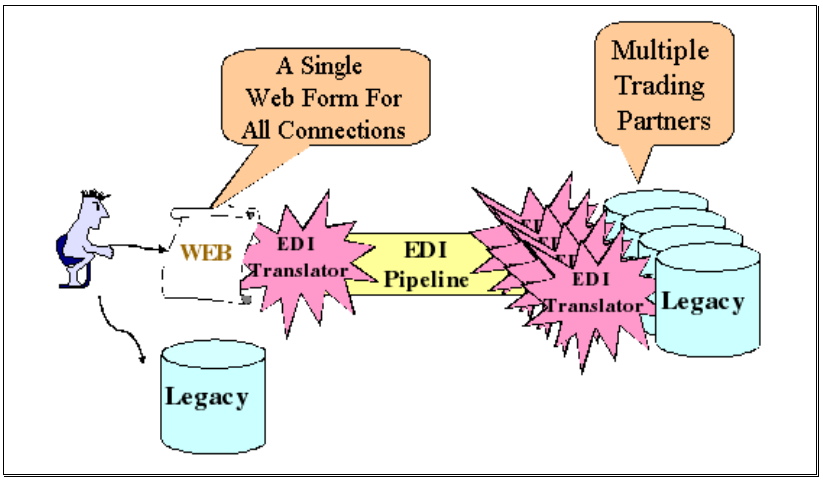


Figure 11 – Web-EDI Forms With a Standard Web-EDI Form

Coordination with other associations in the definition of the standard Web-EDI interface is important.

This will require the industry—the UCC membership—to support the effort and not implement single, hub-oriented Web-EDI applications. Coordination with other associations such as AWMA (American Wholesale Marketers Association, http://www.awmanet.org) to coordinate the application interface and its functionality is appropriate.

8.2.2 General Responsibilities for Action

The UCC must facilitate the formation of this direction by:

Promoting a single entry point to the supply chain offers more payback to the Small, Medium and Large Enterprises than any of the other areas in this analysis.

- Continuing dialogue with hubs to standardize the interface applications in a manner which facilities a single point of interface into the supply-chain environment for the SME. This is quite possibly part of a later phase of the UCCnet project, which implements SME standardized Web-EDI interfaces to the UCCnet.

- Identifying SME industry associations for involvement in the decision-making process. Associations such as VICS, AWMA, EAN, and standards organizations like X12 and CEFACT should be involved. All of these organizations are already involved in the usage, or have a vision in the Web-EDI area.

8.2.3 Long Term Direction

The goal should be to implement Web-EDI in a manner that promotes a single entry point into the supply-chain for the SME, as Figure 9 shows. UCC should facilitate the definition and introduction of Web-EDI, using standard forms and access

methods that help SMEs inter-operate efficiently with many hubs. This offers more short-term payback than any other solution: payback for the SME because it simplifies their supply-chain involvement and payback to the LE in that it reduces their support costs for the SME.

8.2.4 Near Term Direction

The near term direction is the same as the long term direction.

8.2.5 Resource Requirements

The UCC should encourage vendors and supply-chain participants to produce products that support this single Web-EDI view.

8.2.6 Implementation Specifics

Promotion of the requirement is the key to success.

The single point of entry into the supply-chain for the SME must be secure, and allow for the storage of sent and received documents. The interface must ensure that an audit trail is established that proves the SME received or sent disputed documents. Access to the SME interface must be secure and guarantee that others cannot access the facilities.

The implementation steps for this area are:

1. Establish the data contents for Web-EDI for Purchase Orders, Invoices and Advanced Ship Notices. This may be either a reduced complexity EDI document, or support the normal EDI transaction sets.

2. Promote the implementation of this functionality to EDI vendors. The Web-EDI system should support one or more users, each communicating with many supply-chain partners, using either their Implementation Conventions (IC) or the new reduced complexity EDI document resulting from Section 4 implementation.

3. List products, which meet the requirements in a manner where the SME may easily identify them for use.

8.2.7 Risk Assessment

The risk is very low to zero

8.2.8 Outstanding Issues

A standardized Web-EDI form is a change in direction for the large enterprises that previously agreed not to standardize on Web-EDI forms and interfaces. Management in SMEs must be made aware of the Web-EDI products, issues, and resulting benefits.

8.2.9 Time Frame

Should commence as soon as possible in order to show benefits to the SMEs and LEs. This is a very high payback area with short-term benefits.

8.2.10 UCC Implementation Actions

UCC must facilitate the definition of these products by promoting their development and standardizing the interface at the appropriate level. UCC must ensure that appropriate audit trails and security are implemented as part of the package.

8.2.11 Interdependencies with Other Areas

Secure Internet EDI may be a key component of the Web-EDI products.

Internet EDI may be the basis for the Web-EDI application's communication with other parties. Public key infrastructure (PKI) may be used to facilitate the exchange. However, PKI is not necessary if the exchange protocol implements its own internal PKI support.

Additionally, new standards are soon to be submitted to W3C that will allow signing of these submitted forms. This shows solid non-repudiation of submission and produces a strong audit trail for the SME and the LE alike.

8.2.12 Key Success Factors and Inhibitors

The large enterprises must stop using their own proprietary Web-EDI interfaces, and work to define and promote the use of standard interfaces to the supply-chain for SMEs.

8.2.13 Operational

The Web-EDI products, if administered by third party service bureaus, should be highly available and reliable, to ensure that there is minimal disruption of service to the Web-EDI users. Secure audit trails, backups and recovery should also be offered and supported.

8.2.14 Migration

None

8.2.15 Summary

Implement standard Web-EDI forms to give SMEs a single interface into the supply-chain to reduce participation costs. Risk is very low in this area for the SME and the LE alike. This area shows the greatest short-term payback to the SME and LE of all the solution areas.

8. 3 Solution: Web-EDI with flat file interface to source SME system (XML)

8.3.1 Technologies and Directions

A major issue with Web-EDI is that it does little to reduce transcription errors.

While the preceding case solved the implementation costs associated with implementing and supporting onsite EDI software, it did not solve the transcription error problems introduced by the requirement to print and transcribe data between the internal systems and Web-EDI applications. Data entered or retrieved on the web sites are not easily moved to the internal system. The synchronization of the SMEs system with the Web-EDI system requires that the data be reentered, thus increasing the possibilities of transcription errors. A means to help the SME move data to and from the internal system must be found. Additionally, if the data format and data representations are standard enough, UCC may be able to promote implementations that support data input and output from standard off-the-shelf software packages.

XML is a standard Meta language, which allows one to define new syntaxes and semantics in an application specific manner.

At this time there are no standard semantics for moving the data between the Web-EDI and the internal system. A work effort sponsored by X12, CommerceNet and the Graphics Communications Association recommended ways to use EDI semantics in XML. The resulting semantics are one-to-one with the EDI semantics and are very "human readable". XML is a supportable means to convey information between the Web-EDI and the internal systems. UCC should define the transaction semantics for conveying data between the applications in XML.

XML is the best and only globally standard syntax for moving data back and forth between applications. XML is a language that allows the description of data and its format to be identified in a standard, easily understood manner. It has the possibilities of "lowering the bar" for off-the-shelf system developers so that they may integrate it into their systems. XML standards are from the World Wide Web Consortium (www.w3c.org).

Figure 12 shows how Web-EDI with file transfer would work. Note it is the same architecture as the Standard Web-EDI, but has the additional ability of being able to export data from the Web-EDI application to the internal application.

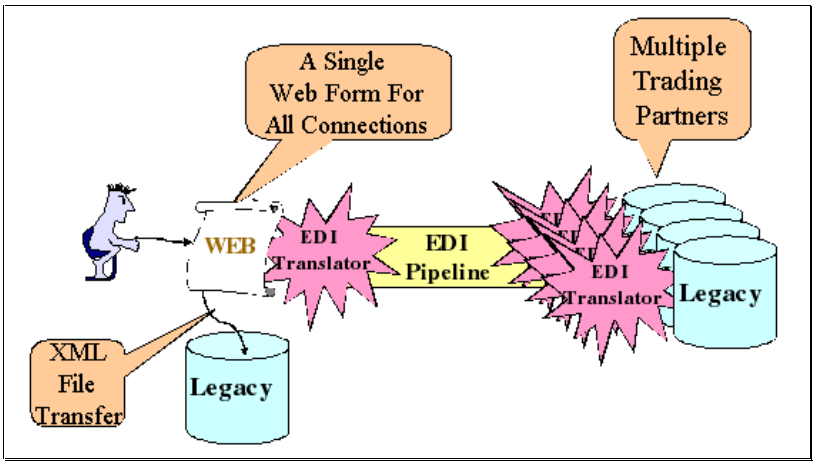


Figure 12 – Standardized Web-EDI Forms with File Transfer

The only existing work in XML based semantics for EDI is that done by the XML/EDI Joint workgroup created by CommerceNet, X12 and GCA.

To implement this, we must first simplify the key transactions such as the Purchase Order and Invoice, and derive the XML data formats from the object-oriented definition process discussed in *Problem Category: Complex Mapping*. We must also reduce the complexity and variability of the Implementation Conventions (ICs) so that the vendors find it economical to implement interfaces to the XML data file within their commercially available, off-the-shelf systems.

8.3.2 General Responsibilities for Action

UCC must facilitate the semantics and the syntax of the XML file to be used to transfer data between the Web-EDI application and the internal application.

8.3.3 Long Term Direction

Promote the use of a standardized Web-EDI application that works across the supply-chain and has an easily understood XML exchange format that SME system vendors may incorporate into their products. This can be converted to object technology relatively easily, should that be the future direction for intersystem exchanges.

8.3.4 Near Term Direction

Near term direction is the same as the long term direction.

8.3.5 Resource Requirements

- Definition and maintenance of the XML exchange formats.
- The UCC Web site support for listing compliant products.
- Promotion to system developers for the inclusion of XML in their products.

8.3.6 Implementation Specifics

The HTTP transport protocols may transfer the EDI transaction without additional functionality enhancements.

The resulting XML file containing the contents of the received or sent transaction may be downloaded using standard HTTP file transfer facilities. This is the same process currently used for downloading software and files using web technology. SMEs may then map the data to the internal system or purchase off-the-shelf system products that incorporate XML mapping.

8.3.7 Risk Assessment

Low risk to the SME. The risk is higher to the systems developer because SMEs may not choose to implement the file transfer functionality.

8.3.8 Outstanding Issues

None

8.3.9 Time Frame

This effort may commence now by using the XML/EDI semantics or by UCC members defining new ones.

8.3.10 UCC Implementation Actions

Commence either now using the XML/EDI semantics or after new ones are defined by UCC.

UCC must promote this endeavor to EDI vendors and to application vendors so that the functionality will be developed and applications developers will incorporate XML import and export into their products.

UCC must lead a project to define the XML semantics and syntax for the information conveyance.

8.3.11 Interdependencies with Other Areas

XML has object-oriented forms which make it very easy to use in the object environment. As object exchange becomes more common, an XML interface will easily convert objects for both Web-EDI and the internal systems.

8.3.12 Key Success Factors and Inhibitors

Promotion of this effort and its benefits to the Small, Medium and Large Enterprises must be continuous.

Large enterprises must promote the use of standard Web-EDI forms and not promote the use of their specific interfaces.

SMEs must be made aware of products that implement this functionality and the benefits of using XML.

8.3.13 Operational

These implementations are transparent to the existing legacy EDI implementations.

8.3.14 Migration

None

8.3.15 Summary

The standard Web-EDI implementation should support the transfer of data to the internal system using standard XML syntax and data semantics. The effort should be promoted by UCC to gain visibility in the developer ranks of the requirements and the resulting benefits.

8. 4 Solution: Off-the-shelf SME Systems with Object-oriented Interfaces

8.4.1 Technologies and Directions

This will happen in an evolutionary manner, as more and more vendors implement products using object-oriented technology. UCC must promote the use of the forthcoming standard EDI objects for inclusion into the object-oriented products. If this is not done, object-level translators will have to be developed to convert internal objects to EDI objects.

8.4.2 General Responsibilities for Action

UCC and all members must promote and support the standard EDI objects in the off-the-shelf software.

8.4.3 Long Term Direction

As this area is implemented, system software used by the SME will be able to inter-operate in the supply-chain by direct database-to-database access via the object model—reducing synchronization issues to a minimum.

8.4.4 Near Term Direction

The near term is the same as the long term direction.

8.4.5 Resource Requirements

UCC resources to promote to SME system developers the direction for inclusion in their off-the-shelf software.

8.4.6 Implementation Specifics

Ensure that vendor products implement the security, access, and transport standards detailed in the previous problem statement.

8.4.7 Risk Assessment

The risk is low to zero.

8.4.8 Outstanding Issues

None

8.4.9 Time Frame

This will only happen after vendors start releasing object-oriented EDI system products.

8.4.10 UCC Implementation Actions

The UCC should encourage software vendors to develop EDI-capable object-oriented products for SMEs.

8.4.11 Interdependencies with Other Areas

XML is an object-oriented language that will impact this area. At this time, it offers an easier method for moving data between object and non-object systems than object technologies.

8.4.12 Key Success Factors and Inhibitors

This area will take years to achieve, because it assumes a new object-oriented infrastructure exists.

The use of object-oriented technology across the industries by Large Enterprises will help promote the integration of object technologies in the Small and Medium implementations. UCC must continue to promote this effort for several years to the system and application developers of SME software and to the SMEs.

8.4.13 Operational

The implementation of this area is too far out to note operational issues at this time.

8.4.14 Migration

The implementation of this area is too far out to note migration issues at this time.

8.4.15 Summary

This area requires the use of object technology across the supply-chain. It is an infrastructure issue that may only be solved as all participants implement object technologies.

8. 5 Solution: EDI over the Internet (S/MIME - EDIINT)

Secure EDI over Internet uses standard encryption and digital signature technologies.

Because this technology uses Internet, the cost of transferring data is minimal, as in the case of existing direct connection methods such as the telephone, unlike the current VAN environments that charge on a per-character basis. The technology merely wraps an EDI transaction in an Internet MIME envelope and transports it over the Internet to its destination. The EDI contents are not touched or modified in any way. Secure MIME (S/MIME) further offers the ability to encrypt and digitally sign the contents to protect them from alteration or viewing during transmittal. The technology also offers a signed receipt mechanism to ensure to the sender the receipt of the message by the intended recipient. These mechanisms may be used to implement non-repudiation of sources and non-repudiation of receipts, thus ensuring a dependable audit trail of the transactions.

Secure EDI over Internet allows translators to use an additional transport medium, Internet, in the same manner a translator now supports multiple VANs and direct connections, as is seen in Figure 13.

A UCC pilot has been conducted on products that implement EDIINT. EDIINT has been proposed as an UCS Communications Standard.

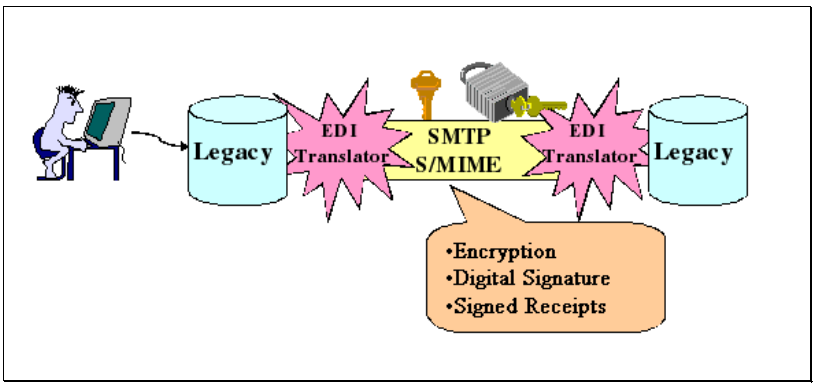


Figure 13 – SMTP Based Secure EDI over Internet

8.5.1 Technologies and Directions

Several key EDI vendors have implemented off-the-shelf EDIINT functionality.

The only standard means of conducting Secure EDI over Internet is via the IETF's EDIINT workgroup recommendations. The UCC has piloted this technology and it has been proposed as an addition to the UCS Communications Standards.

The current recommendations detail how to do encryption, digital signature, and signed receipts over either SMTP (store-and-forward) or HTTP (real-time) transports. These are both primary transport mechanisms for moving data over Internet.

Several vendors have implemented or are implementing these recommendations based on S/MIME, and offer off-the-shelf, interoperable products integrated with their existing translator software. Several major EDI and EC application developers have released interoperable products for these specifications. Others are expected over the next year.

The EDIINT compliant modules look like a normal communications interface to the translators. All that is required for using this technology is that both ends of the communications pipeline use the technology. However, this does not mean they must both use the same product, just products that implement the standard.

Since EDIINT recommendations are based on Internet Standards, it is relatively easy to implement additional value added services.

These EDIINT standards do not implement VAN services such as backup and recovery, retransmitted and trading partner coordination. However, they do implement mechanisms, which give an audit trial, non-repudiation of source and non-repudiation of receipt. In the case of SMTP transport—backup, recover, and retransmitted—can easily be accomplished, if they are not already in the existing product. This can be done using existing Internet protocols and services such as IMAP4 email servers, which can retain the transmitted and received data as an audit trail, or as a means of re-transmittal in the case that a transaction was lost.

IMAP4, as used on email servers, implements a standard file-cabinet, which may be managed by an IMAP4 email client. The file cabinet is normal in that it stores messages in inboxes, sent, and outboxes for later management.

Newer forthcoming EDIINT recommendations implement the above functionality-using HTTP instead of SMTP. Messages flow in a real-time manner between trading partners and are never lost during transport. With the HTTP transport alternative, archiving and retransmitted facilities would have to be developed, if they are already not in the product, on the HTTP server side, to retain documents. This would require a minor implementation effort to store sent and received documents in an organized manner.

With these new products, the only unique functionality that VANs offers is trading partner coordination and translation. All other functionality may be implemented using standard Internet protocols.

8.5.2 General Responsibilities for Action

UCC should promote the use of these new technologies for incorporation into VAN infrastructures and the general membership.

8.5.3 Long Term Direction

Move the transmitting of EDI exchanges to Internet using these new technologies that reduce costs and widen the connectivity to other industries.

8.5.4 Near Term Direction

Near term is the same as the long term solution.

8.5.5 Resource Requirements

No resources are required, because these are off-the-shelf products.

8.5.6 Implementation Specifics

None. These protocols can be used, in addition to VANs, to move data between trading partners, transparently to those who continue to use VANs.

8.5.7 Risk Assessment

If high quality Internet Service Providers are selected the risk is small.

8.5.8 Outstanding Issues

This area does not preclude VANs from participating. They will have to move their systems to the Internet protocol stack to maintain market share. So, they should also support this functionality.

8.5.9 Time Frame

It can take place at this time. There are no infrastructure or other interdependencies.

8.5.10 UCC Implementation Actions

Promote the use of these new protocols.

8.5.11 Interdependencies with Other Areas

The only interdependence is that these protocol suites need not, but may, use public key infrastructure to retrieve certificates for encryption and digital signature support.

8.5.12 Key Success Factors and Inhibitors

EDIINT may significantly lower the transmission cost for SMEs.

Large enterprises should support the protocols on the translator interfaces so that small and medium enterprises may use this low cost method of data transmittal. This is especially important, and is the supporting protocol, to those implementing the standard Web-EDI applications discussed previously.

8.5.13 Operational

None. These implementations are transparent to the existing legacy EDI implementations.

8.5.14 Migration

None

8.5.15 Summary

Internet EDI, based on the IETF's EDIINT workgroup's recommendations offers a lower cost alternative to current VAN infrastructures. VANs will implement these protocols with additional services to support supply-chains. These services offer secure transmittal of EDI over Internet protocols.

Section 3:

Glossary

ASC X12	Accredited Standards Committee of ANSI – Committee X12
BPR	Business Process Reengineering.
CEFACT	Centre for Facilitation of Practices and Procedures for Administration, Commerce and Transport.
CGI	Common Gateway Interface used to interface Web servers to other applications.
CORBA	Common Object Request Broker Architecture—the architecture that defines how distributed objects interoperate. The specification is from the Open Management Group (OMG).
DAP	Directory Access Protocol—a substandard of X.500 describing the services and protocols used to access the X.500 directory.
EC	Electronic Commerce.
EDI	Electronic Data Interchange
EDIFACT	EDIFACT or UN/EDIFACT -- United Nations Rules for Electronic Data Interchange For Administration, Commerce and Transportation (UN/EDIFACT) is the worldwide organization for EDI of which ASC X12 is a part.
EDIINT	EDI Integration—the name of the IETF workgroup which defined the Secure Internet EDI recommendations.
FTP	File Transport Protocol is an Internet protocol used to move files over Internet.
HTML	HyperText Markup Language—the language used by web applications to describe how the contents of a web page should be displayed.
HTTP	HyperText Transport Protocol—the protocol used by HTML to communicate between the web browser and the web server.
IC	Implementation Conventions.
IETF	Internet Engineering Task Force—the international standards-setting organization for most Internet protocols.
IIOP	Inter-ORB (Object Request Broker) Protocol—the protocol used by CORBA to facilitate distributed object access over Internet.
LDAP	Lightweight Data Access Protocol—a lighter weight directory access protocol derived from X.500's DAP and defined by IETF.
LE	Large Enterprise.
Object	A programming structure which reflects a real world item. It may contain both data and methods that describe how the object should act.

OO-EDI	Object-Oriented EDI—EDI objects defined and derived by object techniques.
PKI	Public Key Infrastructure—The access methods and directory structure necessary to support encryption and digital signatures through digital certificates.
ROI	Return On Investment.
S/MIME	Secure MIME is an IETF protocol designed for the secure packaging of document based data over Internet. It offers digital signature, encryption and signed receipts.
SIL	Standard Interchange Language
SITG	Strategic Implementation Task Group is an ASC X12 effort focused on implementation issues of OO-edi. Recommendations from this group go to the TMWG.
SME	Small and Medium Enterprise.
SMTP	Simple Mail Transport Protocol is the protocol used in Internet electronic mail.
TCP/IP	Transmission Control Protocol/ Internet Protocol offers the basic facility on which other Internet protocols use to move data.
TMWG	Techniques and Methodologies Work Group – an EDIFACT workgroup which is the main developer of OO-edi.
UCC	Uniform Code Council.
UCCnet	Uniform Code Council's network for Electronic Commerce Integration. The virtual community being established will provide data sharing capabilities, using an "extranet" architecture that incorporates UCC/EAN standards and provides a seamless view to all participants.
UCS	Uniform Communication Standards defined by the UCC.
UML	Uniform Modeling Language.
USD	US Dollars.
VAN	Value Added Networks are network vendors who offer EDI mailbox and other services to EDI users.
W3C	World Wide Web Consortium (www.w3c.org)—the international standards organization focused on web technologies such as XML, HTML, and XML schema languages.
Web	General name for applications which use HTTP and HTML to view and communicate data.
X.500	An international standard from the International Telecommunications Union (ITU) which describes a worldwide directory based on a common,

	distributed, secure object database technology.
XML	eXtensible Markup Language from the World Wide Web Consortium (W3C).

Appendix A:

Summary of Interviews

Contents

1. The Interview Process

Ten members of the EC Strategy Task Group were interviewed in August, 1998. Those interviewed were: Paul Singer, Tim Hale, Walt Gudselak, Gerry Owens, Ron Deslauriers, Carol Edison, Thomas Sample, Rick Rowan, Glen Price, and Dennis Epley. The interviewees represent various segments of the electronic commerce market such as retail, wholesale, distribution, and manufacturing. Each person has different levels and areas of expertise in the electronic commerce field, as well as in current and emerging technologies.

The ten telephone interviews were approximately one hour in length, and focused on a set of questions that were designed to determine the following for each participant:

- The status of EDI implementations in the organization.
- Any recent or planned enhancements to the EDI system.
- Specific problems being encountered.
- The level of understanding and/or interest in various new technologies.

As anticipated, perspectives and responses varied widely, based on the following factors:

- The organization's industry.
- The stage the EDI implementation process is in at that organization.
- The interviewee's primary responsibility in the organization, such as responsible for the "buying" or "supplying" side.

The information from the interviews was integrated, and statements were developed that described the areas of concern and interest.

These may be found in Section 4. The Task Group members then reviewed the statements, and the top thirty statements were selected for further analysis. These may be found in Section 3. Finally, the Task Group voted on the top statements from Section 3. The results are the statements in Section 2. These statements form the primary focus of the analysis.

2. Statement Voted as Most Important to the Analysis

The following statements were chosen from those in section 3 as having the highest impact on EDI implementations.

DS56.0 We want to implement certification authorities (security) to support our security requirements of authentication, encryption, digital signature and signed receipt. Encryption of EDI transactions on the Internet is very important. Votes=6

DS3.0 Supply-chain data repository may facilitate electronic interaction between businesses (including SMEs) by presenting uniform data access, data views, and data entry methods. Votes=5

DS20.0 We should further streamline transactions by removing all segments that are not needed, yet be willing to accept more information than is necessary for our internal systems. Votes=5

DS73.0 If we start using Internet-based EDI we must implement VAN-type value added services to support our needs. Votes=4

DS24.0 We should aim to globally reduce the number of options in X12 and EDIFACT in areas such as syntax and semantics. Votes=4

DS15.0 The major areas this study needs to focus on are: shipment, sales and inventory data (dynamic data, fixed data accuracy), forecasting (CPFR), and open standards-based architecture. Votes=4

DS14.0 It is very important when optimizing the supply-chain to drive out costs, time and unnecessary decisions. It is important to eliminate humans from repetitive tasks to gain paybacks. Votes=4

DS13.0 The characteristics of shared supply-chain data repositories are improved accuracy, 24*7 access, common data formats, and common access methodologies. Votes=4

DS11.0 A shared supply-chain data repository could reduce errors and enhance participation. It should include ordering, pricing information to include payment, invoice information and possibly shared applications, video clips, security, sound, etc. The database should have access control in place. Votes=4

3. Statements with a Significant Level of Agreement Within the Group

The following statements were deemed most important and discussed in detail during a one-day meeting.

DS1.0 Internet marketing catalogs for purchasing goods may be a high payback area. This does not imply that buyers should interact less directly, face-to-face with vendors.

Agree _4___, Neutral __1__, Disagree ___1_

DS1.5 The supply-chain database repository (item databases) need a common user interface/methodology to make it easier to use.

Agree _7___, Neutral ____, Disagree ____

DS2.0 Electronic catalogs are important to support purchasing for direct store delivery, and non-strategic supplies in a uniform manner. (Note to Rik: OBI?)

Agree _7___, Neutral ____, Disagree ____

DS3.0 Supply-chain data repository may facilitate electronic interaction between business (including SMEs) by presenting uniform data access, data views, and data entry methods.

Agree __7__, Neutral ____, Disagree ____

DS4.0 Marketing/buying catalogs provided by manufacturers and distributors for retailers and consumers may offer high payback.

Agree __7__, Neutral ____, Disagree ____

DS5.0 Supply-chain data repository may be helpful in reducing SKU, carton size, UPC, and weight errors.

Agree __7__, Neutral ____, Disagree ____

DS6.0 For CPFR to be successful it must be based on uniform implementations of standard security, data standards, and communication protocols. CPFR needs a standard technological implementation.

Agree __7__, Neutral ____, Disagree ____

DS7.0 CPFR's payback is not clear at this time.

Agree ____, Neutral __7__, Disagree ____

DS8.0 Achieving timeliness and accuracy is essential on ASNs and is a major area for cost reductions and revenue enhancements.

Agree __6__, Neutral __1__, Disagree ____

DS9.0 When placing an order it is important that we know at that time: availability, ship date, price, weight, size, etc.

Agree __7__, Neutral ____, Disagree ____

DS10.0 To maximize the benefit of web forms (Web EDI) we must standardize layouts across the industries to reduce support and education costs. (This is not practical, though.)

Agree __7__, Neutral ____, Disagree ____

DS11.0 A shared supply-chain data repository could reduce errors and enhance participation. It should include ordering, pricing information to include payment, invoice information and possibly shared applications, video clips, security, sound, etc. The database should have access control in place.

Agree _6___, Neutral _1___, Disagree ____

DS12.0 If we implement shared supply-chain databases we will not need QRS or UPC*Express type products.

Agree ____, Neutral __7__, Disagree ____

DS13.0 The characteristics of shared supply-chain data repositories are improved accuracy, 24*7 access, common data formats, and common access methodologies.

Agree __7__, Neutral ____, Disagree ____

DS14.0 It is very important when optimizing the supply-chain to drive out costs, time and unnecessary decisions. It is important to eliminate humans from repetitive tasks to gain paybacks.

Agree __7__, Neutral ____, Disagree ____

DS15.0 The major areas this study needs to focus on are: Shipment, sales and inventory data (dynamic data, fixed data accuracy), forecasting (CPFR), and open standards-based architecture.

Agree _7___, Neutral ____, Disagree ____

DS16.0 In our industry people use common processes for 80 to 90% of the supply-chain.

Agree __7__, Neutral ____, Disagree ____

DS19.0 We should change our view of the supply-chain/ distribution channel (SC/DC) to that of a "super company" and implement a uniform view of the SC/DC, with SC/DC-focused access, usage, reporting, and maintenance using common databases. (Merge with #11 when done)

Agree __7__, Neutral ____, Disagree ____

DS20.0 We should further streamline transactions by removing all segments that are not needed, yet be willing to accept more information than is necessary for our internal systems.

Agree _6___, Neutral ____, Disagree __1__

DS21.0 It is not clear if Eforms (Web EDI) show payback for SMEs from the Hub's point of view. We believe this warrants further investigation.

Agree _7___, Neutral ____, Disagree ____

DS22.0 Whatever we implement for SMEs, it must show direct benefits for them, not just for the large enterprises.

Agree __7__, Neutral ____, Disagree ____

DS23.0 The key to reducing errors on brokered items is to integrate EDI between manufacturers and brokers in addition to between brokers and distributors.

Agree __7__, Neutral ____, Disagree ____

DS24.0 We should aim to globally reduce the number of options in X12 and EDIFACT in areas such as syntax and semantics.

Agree __7__, Neutral ____, Disagree ____

DS25.0 The same process for buying non-strategic products should be used for direct store deliveries. Don't know the ROI, but the concept is easy to sell. Combine this with an earlier one.

Agree __7__, Neutral ____, Disagree ____

DS26.0 If we start using Internet for EDI we should define a set of performance, security, reliability, and availability criteria.

Agree __7__, Neutral ____, Disagree ____

DS73.0 If we start using Internet-based EDI we must implement VAN-type value added services to support our needs.

Agree __7__, Neutral ____, Disagree ____

D27.5 We require security of encryption, signature, and data access control to all data.

Agree __7__, Neutral ____, Disagree ____

DS42.0 Both the push method (using 888s and 889s—normal EDI) and the pull method (catalogs) are important to support our processes.

Agree __7__, Neutral ____, Disagree ____

DS56.0 We want to implement certification authorities (security) to support our security requirements of authentication, encryption, digital signature and signed receipt. Encryption of EDI transactions on the Internet is very important.

Agree __7__, Neutral ____, Disagree ____

DS57.0 Combined with DS57.0

4. Statements Which Were Not Deemed as Significant

The following statements were not deemed as describing the primary focus of the analysis.

DS27.0 Data accuracy.B. It is very important to maintain item maintenance files to increase ASN accuracy.

DS28.0 Data accuracy.B. There are significant accuracy problems in ASN with UPC codes not matching and shipment level data missing.

DS29.0 Data accuracy.G. Errors in order processing between data item codes (SKUs and UPC codes) are problematic.

DS30.0 Data accuracy.G. It is critical that we increase data accuracy in the supply-chain.

DS31.0 Database.D. The lack of data synchronization between all internal databases is an ongoing problem.

DS32.0 Misc.B. We should make changes in our internal systems transparent to trading partners so that they do not have to change as we change.

DS33.0 Misc.C. The most important transactions to implement are POs, invoices and ASNs.

DS34.0 SMEs.B. Implementation of SMEs is generally problematic.

DS35.0 SMEs.F. It may be more beneficial for SMEs to call in orders to data entry personnel than to use Eforms.

DS36.0 SMEs.I. Implementing VSMEs (Very Small and Medium Enterprises) on EDI is not worth the effort because training and support costs are too high.

DS37.0 Standards.A. The use of open standards is very important to our success.

DS38.0 Technology.D. VCI from Microsoft is important to look at.

DS39.0 Technology.D. The impact of XML/EDI is currently indeterminate.

DS40.0 Technology.E. If we do OO-EDI it will require up-front process reengineering projects.

DS41.0 2k.H. Y2k should be part of this process.

DS43.0 Catalogs.G. Consumer-oriented on-line catalogs are important.

DS44.0 CPFR.C. OBI (Open Business on Internet) in combination with CPFR to support ECR methodology is important.

DS45.0 Data accuracy.C. Discrepancies between POs and invoices are a big data accuracy issue.

DS46.0 Data accuracy.A. Errors on ASN are often created during the picking process.

DS47.0 Data accuracy.B. We need to move from batch to real time ASN receipts to gain maximum benefit.

DS48.0 Data accuracy.E. Resolving product identification issues is very important.

DS49.0 Database.B. Database synchronization and audit trails are very important to shared databases, including feedback mechanisms like: "applied," and "did not apply."

DS50.0 Database.D. It is very important that data be accurate before it is entered into shared supply-chain databases.

DS51.0 Mgmt.H. With standards changing every year, we must keep information for the IRS for 7 years and prove that we did what we said we did. We must do this across standards.

DS52.0 Misc.A. POs should never be a surprise.

DS53.0 Misc.A. Queries on status of POs, invoices and ASNs should be available on-line to the suppliers.

DS54.0 Misc.B. Implementing EDI with new vendors is very slow.

DS55.0 Misc.H. Internet is not a silver bullet that will solve all communications for everyone and replace traditional EDI.

DS58.0 SMEs.C. Small or seasonal SMEs or small grocery stores are problematic.

DS59.0 SMEs.G. Internet EDI may be very positive for SMEs by reducing VAN costs.

DS60.0 SMEs.I. Secure EDI over Internet offers benefits to SMEs.

DS61.0 SMEs.I. The problem with SMEs is not implementing technology it is ongoing support.

DS62.0 Standards.A. We need to create a process that establishes EDI standards with the speed of Internet timing—not the speed of EDI as it has been implemented in the past. (It takes 2 years to add a data field to EDI.)

DS63.0 Standards.C. Large companies force some to use their implementation conventions, which do not always follow standard EDI.

DS64.0 Standards.E. It is very important that everyone use the same standards.

DS65.0 Technology.A. We should completely leverage the technology in place and not obsolete it.

DS66.0 Technology.C. Extranet usage may help solve database synchronization issues across the supply-chain/ distribution channel.

DS67.0 Technology.C. We need to implement scan-based ordering and scan-for-pay methodologies.

DS68.0 Technology.C. We should implement technologies in a manner that lowers costs and makes things more efficient.

DS69.0 Technology.D. We should look at Simple-EDI.

DS70.0 Technology.E. If we implement Extranet as part of this study, fees should be flat-fee based and not usage based.

DS71.0 Technology.E. Inter-company calendaring and workflow may be beneficial.

DS72.0 Technology.G. As we implement these technologies we should make them mandatory not optional.

DS74.0 Technology.G. XML may be a key technology for integrating Microsoft Word Office and EDI for SMEs.

DS75.0 VAN.F. VAN costs are too high. We need to reduce VAN charges.