A Practical Approach to Web-Based Internet EDI[1]

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Abstract

In traditional business environments, many inter-company processes (such as buying and billing) are performed using paper documents, such as purchase orders and invoices. Electronic Data Interchange (EDI) allows companies to exchange these documents in a structured and computer-processable format. This helps to automate and streamline business by eliminating or simplifying clerical tasks, speeding information transfer, reducing data errors, and eliminating business processes. Although EDI has been successfully employed in specific industries (such as retail) and in some large enterprises, it has not been widely adopted. The primary barriers to widespread acceptance of EDI are the costs of implementation and the costs of communication, which is frequently done using Value-Added Networks (VANs). These costs are generally too high for companies that do not conduct large numbers of EDI transactions.

In this paper, we introduce a Web-based Internet EDI model that provides valued-added functions traditionally provided by EDI over VANs. In this model, users conduct business transactions using Java-capable browsers instead of traditional EDI software, eliminating the costs of VANs and EDI-related applications. The proposed model is especially suitable for medium- and small-size firms that exchange business documents but can not afford to do EDI using VANs.

1. Introduction

All large enterprises, and many small- and medium-sized companies have basic business support systems (Human Resources, financial) or Enterprise Resource Planning (ERP) systems that automate business operations, such as billing, accounts payable and receivable, payroll, and purchasing. These systems, while automating back-office or internal operations, are not designed for commerce, that is, transactions between companies. Over the years, EDI has grown to fill this niche in large companies.

Electronic Data Interchange (EDI) is an electronic mean for companies to exchange business documents (purchase orders, invoices, etc.) in a structured and computer-processable format. EDI has been in use in the United States for more than twenty-five years but its scope has mainly been limited to large companies. Gartner Group estimates that less than 1% of US businesses use EDI [4]. The primary barrier is cost; which includes the cost of implementing EDI software and the cost of communication. In general, only large companies can afford to utilize EDI to conduct business transactions with their trading partners because EDI, in most cases, requires a Value-Added Networks (VAN) to support mailboxing, protocol conversion, standard conversion, implementation assistance, auditing, and other value-added services. These services can be costly. Because of the EDI's cost, most medium and small companies still use traditionally non-automated means (mail, fax, telephone, etc.) to communicate with their trading partners. (Exceptions are those that are induced to use EDI by essential trading partners.)

With the popularity of the Internet, conducting EDI over the Internet offers a low-cost alternative that is especially suitable for medium- and small-size companies. In this paper, we propose a Web-based Internet EDI model that enables companies to engage low-cost EDI business transactions over the Internet as well as supports valued-added functions which traditionally provided by VANs. Additionally, the proposed model offers end-to-end integration that automates the flow of data between trading partners' back-office or internal systems.

[1] To appear in the proceedings of the 19th International Conference on Distributed Computing Systems Workshop (ICDCS'99 Workshop)

The remainder of this paper is organized as follows. In Section 2, we outline the benefits of doing EDI. Section 3 discusses major issues and shortcomings related to the traditional EDI. Internet EDI provides an alternative to the traditional EDI as described in Section 4, followed by our proposed model and its major components in Section 5. Conclusions are given in Section 6.

2. EDI Benefits

In the paper-based business environment, companies conduct their business activities by exchanging paper documents. This is usually time-consuming and costly when the volumes are large. The whole process of document exchanges in a paper-based business environment invites extensive manual processes (data entry and re-entry), manual intervention, interpretation, and manipulation, resulting in time delay, labor costs, and errors.

Traditional (non-Internet) EDI is a set of specifications for formatting documents that is designed to automate business flow among businesses by replacing paper documents with paperless ones. By employing EDI, an application program-generated document (such as a purchase order) can be transmitted over the network and automatically entered into and processed by an application program at a trading partner; in return, the application program at the trading partner can generate and send back a reply EDI document (such as an invoice) which can be incorporated electronically by the application program in the sender company. In the above scenario, the whole process is paperless, requires no human intervention, and is quick. EDI documents, unlike paper documents, are processed electronically by application programs with no human intervention, saving time and costs by eliminating or reducing paper transactions, phone calls, and faxes, compressing document turnaround times, and improving data accuracy by reducing (or eliminating) errors introduced while entering data manually.

The most pronounced benefit of EDI is that it can streamline companies' interactions with trading partners. This can increase inventory turns, decrease inventory, speed flow of information between businesses, improve product and sales forecasting, improve time-to-market, increase customer satisfaction, decrease shipping costs, reduce product returns, improve cash flow, integrate supply chain, and result in improved relationships with trading partners. Automobile manufactures, for example, use EDI to implement just-in-time (JIT) processing, where they exchange EDI transactions with their suppliers to plan and ensure the arrival of specific parts at the product line within 30 minutes of their installation. JIT processing can reduce the inventory and improve time-to-market.

3. Traditional EDI

Traditional EDI system contains two major components: (1) EDI translation software that converts and maps EDI formats to/from internal business applications, and (2) communication channels that deliver EDI documents to the desired trading partners.

3.1 Conversion of EDI Documents

Over the years, different industries (and countries) have developed their own EDI standards. To translate EDI documents, one must first know what EDI standards the trading partner is using.

EDI standards define the document formats that enable trading partners to speak the same language when conducting business activities with each other. Yet, each company usually has its own internal or proprietary data formats, business logic, and business flow which are typically unique. Therefore, a key requirement of EDI translation software is the ability to integrate the incoming EDI formats with internal business applications [6]. That is, EDI translation software basically converts the internal proprietary format to the one that conforms to a standard acceptable to the trading partners; conversely, it maps incoming standard formats into the proprietary formats recognized by internal business applications. The functionality of translation software could be obtained in three ways: lease or purchase software from a vendor; have a third party (such as a VAN) perform the translation; or develop software in-house. The first two alternatives are usually the most cost- and time-effective [2] as they are easy to install, maintain, and expand.

Business documents, once converted by the translator, are ready to deliver via communication channels, as described in the next subsection.

3.2 Communication Channels

Trading partners traditionally exchange EDI documents via direct link, private or proprietary networks, and third-party VANs [1].

Direct link networks, including leased lines, are the most straight-forward communication method. They allow a company to dial up and connect directly to partners' computers. They are most cost-effective alternative for transmitting high volumes of data and are thus very appealing to those large companies that must transmit huge amounts of data daily. With direct link, each trading partner provides its own technical support to address issues such as protocol and speed conversion, because different computer systems use different communication protocols and transmission speeds. In addition, companies must have phone lines available at the same time, deal with substantial administrative overheads to ensure reliable delivery, provide audit control and recovery procedures in case of communication link failure or unavailability, and so on. These issues are compounded when the number of direct-linked trading partners increases. As a result, direct link network is only applicable to large companies that must transmit high volumes of data daily.

A **Private or Propriety Network**, usually provided by a hub company, is a closed network only available to its trading partners (the spokes). The hub handles protocol conversion and administrative overheads so that the spokes can dial up to the hub private network without conversion and pay only the cost of a telephone call. This type of network is limited and is only available to those trading partners that have a close relationship. An automobile manufacturer and its part suppliers are a typical example. When this type of network is used, the hub company provides technical supports to both itself and its spokes.

A **Value-Added Network** plays an intermediary role analogous to a post office or delivery service that provides reliable delivery of documents in a secure environment. VANs provide the following value added services to support EDI: mailboxing, protocol conversion, standard conversion, reliability, security, administration, implementation assistance, etc.

Mailbox services were the initial business provided by VANs, where incoming EDI documents from senders were stored in recipients' mailboxes, from which they could be retrieved at any time, or delivered directly into a recipient's system if requested by the recipient. Building upon mailbox services, a VAN supports administration functions such as audit and control of exchanged documents, message tracking, reports, and billing services. For those companies that do not have in-house EDI translation software, a VAN offers in-network translation services that convert formats between different EDI standards (e.g., X12 and EDIFACT), between EDI formats and proprietary formats, and between EDI formats and other media formats, namely E-mail, FAX, Telex, and a hard copy.

In the traditional EDI environment, most companies exchange EDI documents via VANs. Despite the popularity, convenience, and flexibility of VANs, their costs are frequently the dominant expense of EDI, as described in the next section.

3.3 Shortcomings of Traditional EDI

Implementing the translation software is a one-time expense which typically costs from $5,000 (for PC-based system) to $250,000 (for mainframe applications) [4]. VAN services expenses consist of an installation fee, recurring per-transaction fees, and monthly subscription and maintenance fees (for mailboxing or account) [3, 4]. In general, typical monthly fees are $50, transaction charges are $0.55-$0.70 per transaction ($0.11 in very large volumes). There can be additional charges for value-added services. In summary, as the VAN charges are mainly based on per-document transaction fees, the accumulated costs can be tremendous.

4. Internet Benefits

The Internet's promise as a low cost transport mechanism with standardized formats and protocols offers many companies an alternative. For under $20 a month users can have Internet access via an Internet Services Provider (ISP); which is much less than the VAN's $50 monthly fee, not to mention the additional per transaction fees.

The Internet also offers broad connectivity that links networks around the world, supports ease of use infrastructure, and offers a platform-independent means to exchange information. With worldwide connections, the Internet can dynamically link buyers to any sellers even though no previous trading partnership exists. Gartner Group estimates that by the year 2003, 80 percent of the EDI transactions will be exchanged via the Internet or private and managed Internets, where the number of enterprises able to implement EDI will be close to one million out of a possible 30 million enterprises worldwide [5].

5. Proposed Model

The Internet allows suppliers (spokes) to use Java-capable browsers to conduct EDI-like business transactions with a large enterprise (hub) without pre-

installing EDI software. This eliminates the costs of VANs and the costs of traditional translation software. The architecture of the proposed model, as depicted in Fig. 1, consists of two parts: (1) the server site (hub) and (2) the supplier site (spoke).

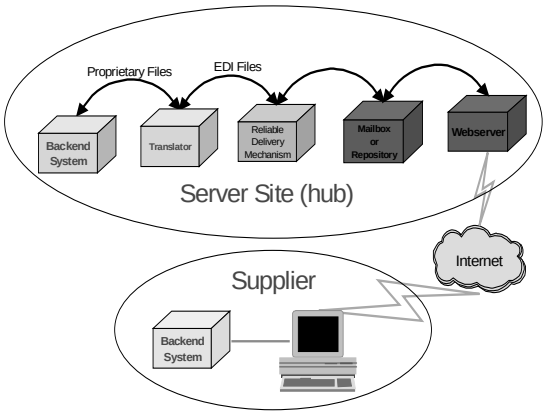

Fig. 1 System Architecture

5.1 Business Documents Flow

Purchase orders and invoices constitute the majority of business transactions among trading partners. The hub site's backend system generates purchase order that must be transmitted to a company that will fulfill the order. As shown in the diagram above, a purchase order in the proprietary-format document file generated for a particular supplier by the hub site's proprietary backend system is converted into an EDI file by an EDI translator. The EDI file is then placed into mailboxing or repository system via a reliable delivery mechanism such as IBM's MQ-Series. The repository system then sends a notification (via E-mail, for example) to the desired supplier. On receiving the notification, the supplier uses a Web browser to login to the webserver, download and view the file. Together with the EDI file, the Web browser also downloads Java applets. These Java applets translate the EDI file into form-based content that is displayable on the browser screen. In addition to the translation and display of EDI files, Java applets, as directed by users, transfer data that can be exchanged with supplier-side's backend accounting systems.

The supplier can prepare a reply document (such as an invoice) either by entering information (such as the unit prices of the purchased items, billing information, and shipping information) manually in the browser or by using a backend system to generate a reply document, which is transferred into the browser by the adapter. The Java applets then send the prepared document back to the Web server. On the Web server side, a stand-alone daemon receives the invoice and deposits it into the repository system. From the repository, the invoice is sent, via the reliable delivery mechanism, into the hub's backend system. Once the invoice is in the hub's backend system, normal business processes are followed in order to match the invoice with a purchase order and pay the supplier.

5.2 Basic Components

Backend Systems

The backend system in the hub site generally contains an application system and its underlying database to operate daily business processes. It has its own internal proprietary data format. To conduct business activities with the trading partners, the backend system generates documents in the proprietary format and accepts reply documents from the trading partners. As the backend system only recognizes its own proprietary format, it requires a translator to convert documents.

A supplier may have its own backend system to manage business activities and generate reply documents. To automate the processes of incorporating the downloaded EDI documents into the supplier's backend system, we provide an adapter.

Translator

A large company (hub) typically exchanges business documents with many trading partners who require either different standards (e.g., X12, EDIFACT) or paper documents. In general, the translator in an EDI-enabled hub takes the responsibility of (1) converting the proprietary data format to a variety of formats or standards, and (2) translating various incoming document formats or standards into the proprietary format. The proposed model does not require any of the paper formats.

Mailboxing or Repository

Mailbox services are the core component of VANs with many value-added services built on top of mailboxing. The proposed model currently utilizes any database for the mailboxes and uses a web server to list and serve up documents and applets. The hub creates and maintains mailbox(es) for each spoke, with each mailbox contains an inbox and an outbox. The inbox stores the EDI documents delivered by the hub to the spoke, while the outbox saves the reply EDI documents from the spoke. By utilizing the access control facilities provided

by the database, the proposed model maintains mailbox and allows each spoke to access only its own mailbox.

In addition to mailboxing, the model also provides other value-added services such as E-mail notification, audit and control, documents tracking, archiving, query status, and reporting. The E-mail notification service sends E-mail to the desired spoke when a new document is placed in the inbox of that spoke. The primary audit objective is to verify that the spoke, after the notification E-mail is sent, receives the transaction document intact. The unread EDI documents with aging (number of days unread or unreplied depending on how urgent the document is) can be used to determine which documents are not being read and which have been read but not replied to. This will aid in determining which suppliers need to be contacted. The document tracking service records the flow of documents to enable recovery when a disaster takes place. To support document tracking, every creation and access of an EDI document in the database will be logged. The archiving service saves documents for a specific period time in the system to support recovery. The hub can also query the status of spokes' mailboxes and a spoke can query the status of its own mailbox. Reports summarize the transaction activities for both the hub and its suppliers. All these services can be customized according to the trading partners' needs.

Webserver

The Webserver provides authentication by requiring that a supplier enter a valid user id (identifying the supplier) and password to logon into the system. After logon into the system, a supplier only accesses its own mailbox and the applets, and has only read privilege to its incoming documents. Web servers also have SSL encryption capability.

Adapter

The adapter is used by the suppliers to import documents (e.g., hub's purchase orders) into their backend system by converting the document into the format accepted by the backend system.

5.3 Supplier Registration

Each supplier goes through a one-time registration via the Web. During the registration, the supplier requests a userid and enters its e-mail address (used for notification) and other vital information (company name and contact phone number, etc.) and picks from a list of supported backend systems.

This registration process requires an administrator of the server to assign a password and runs a script to add a new supplier, providing any additional information required such as the supplier ID to be used for that particular supplier in EDI messages. The script will mail the password to the supplier, setup the supplier userid, enter the supplier information into the supplier list, and set up the necessary authorizations.

5.4 XML EDI

This model allows transactions to be transmitted between trading partners using XML (Extensible Markup Language) [8], a powerful data representation standard for digitized information delivery and formatting. Presenting documents is one of XML's strengths. When compared with traditional EDI, XML/EDI simplifies the translation of documents because new browsers can parse XML documents into structures called Document Object Model trees (DOM trees) which can be manipulated easily. XML documents are easily converted to other XML documents simplifying backend integration. Additionally, XML separates the data from the presentation style. This allows the presentation to be tuned to a wide variety of output devices, including computer screens, a cell phone displays, or audio (text-to-speech) devices.

6. Conclusions

Although traditional EDI has some success in specific industries and certain big enterprises, it has not been widely adopted by many companies (especially the small and medium-sized). The substantial barrier blocking companies from implementing EDI is the costs, due to EDI implementation and VAN services. The Internet is a ubiquitous public network that provides many advantages over VANs, including low cost, worldwide connectivity, platform-independent, and ease of use infrastructure.

For small- and medium-sized companies, our proposed Internet EDI model offers an alternative solution that is less expensive yet offers many of VANs' advantage. It contains the following features:

- it enables suppliers to conduct automated EDI transactions with the large enterprise, using only a PC and a Java-capable Web browser, without installing any EDI software or setting protocols;

- it allows large enterprise (hub) to utilize its existing EDI system to conduct automated EDI transactions with the suppliers (spokes) that are not EDI-enabled;
- it can coexist with the traditional VAN-EDI that large enterprises are already using;
- it offers mailboxing, E-mail notification, audit and control, documents tracking, archive, query status, report, and other value-added services;
- it provides security services such as login security, access control, and SSL transport;
- it provides end-to-end backend integration that automates the business flow between the hub and the spokes; and
- it supports Internet EDI as well as XML/EDI.

Purchasing via the Web is becoming popular. Competitive business pressures will force the companies to facilitate interactive buying and selling [7]. Interactive EDI intends to provide rapid interactive transactions in the front, meanwhile, utilize EDI technology to automate the transactions with the backend system to support rapid response. The proposed model has better chance to provide Interactive EDI as it uses EDI between the Web server and the backend system in the hub site and provides HTML web page to the client side (spoke).

Acknowledgements

The authors gratefully acknowledge the contributions and assistance of Sigmund Handelman, Manoj Kumar, Mohammad Zubair (Old Dominion University), Anant Jhingran, and Stephen Stibler.

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