

XML and E-Commerce

Opportunities and Challenges

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I. Executive Summary

eXtensible Markup Language (XML) is a “next-generation” language that allows users to define information about data structures and content inside a document, in a standard way. XML offers some of the strengths of Electronic Data Interchange (EDI) and HyperText Markup Language (HTML), as it allows data to be processed by machines as well as be easily displayed in human-readable form. It also allows for the exchange and validation of data structures interactively.

Some of the other characteristics that make XML a promising technology for enabling E-Commerce solutions include:

- *Internet-centric* – The Internet-centric nature of XML allows it to be read by Web browsers, referenced inside documents and used for Web-based search and retrieval.
- *Business Applications Flexibility* – Communities and/or vendors can define their own XML-based vocabularies that meet their specific business needs. This makes it possible for XML to be used across a diverse set of business applications, industries and communities of interest networks (COINs).
- *Proliferation of XML-based Standards* – Several industry organizations and vendors are in the process of creating standards that accommodate their business requirements and that are backward compatible to existing standards such as EDI.
- *Industry Awareness and Availability of Resources* – Attention from several industries and institutions is leading to the creation of a large pool of resources that are familiar with XML.
- *Improved Integration Paradigm* – Distribution of XML-based data definitions, schemas and/or implementation conventions over the Internet promises to lower the barriers to application-to-application E-Commerce.

Driven by these characteristics, there is now strong momentum for XML to be a “next-generation” language for E-Commerce. Leading vendors such as Harbinger have started deploying XML-based solutions. It should be noted, however, that XML is still a relatively new technology and is in the “early adopter” stage of its evolution. It is also important to note that XML, like any other emerging technology, is not a panacea for all of the issues associated with the exchange of data within, and between, organizations. However, XML does hold the promise to provide software vendors, service providers and businesses a modern foundation that addresses some of the limitations of older technologies.

Harbinger believes that XML will continue to gain acceptance as a mainstream standard for business to business E-Commerce and has moved quickly to support XML in its products and services. This strategy is consistent with Harbinger’s goal of migrating all customers to Internet-based solutions, centered on *harbinger.net*, the company’s real time B2B E-Commerce portal. By December 1999, more than 5,000 customers had switched to the Internet-based version of Harbinger TrustedLink, Windows Edition, which includes XML support for both inbound and outbound business transactions.

Harbinger’s data transformation products are being enhanced to enable companies to send, receive and publish documents in XML format, while *harbinger.net* will offer on-network transformation services for transparent conversion of EDI to XML and XML to EDI. Harbinger will act as an intermediary for customers who want to use a single data format (EDI or XML) to exchange documents with a wide range of business partner and E-Commerce portals, all of whom may have adopted different XML vocabularies and conventions. Finally, Harbinger will introduce, by the end of 2000, a new class of data transformation product, based on XML, which will provide real time collaboration and data exchange between all participants in the supply chain.

II. Introduction To XML

XML provides businesses and service providers unprecedented flexibility when exchanging data between machines as well as humans. By combining the strengths of several existing technologies, XML allows for data to be exchanged with, or without, human intervention. For example, using XML a business can:

- Define a document such as a purchase order (PO) with a valid data structure.
- Display the XML PO to employees through a browser or any other “XML Parser.”
- Integrate the XML document with internal applications such as an electronic catalog.
- Communicate the XML PO directly to trading partner(s) or to an intermediary who can interpret the document without any prior knowledge of the data structure.

Business-to-business global data exchange standards were first established more than a decade ago by the American National Standards Institute (ANSI X12) and by the United Nations (EDIFACT). These standards have evolved as a result of the changing requirements of business-to-business E-Commerce. However, the emergence of the Internet has fueled the need for technologies that allow for real-time application-to-application, Web-to-application and Web-to-Web document flow and integration. XML fulfills these requirements for real-time, IP-centric solutions, as it provides businesses a flexible, extensible and dynamic environment for integrated, interoperable data exchange.

Internet-centric

As the Internet evolved and its potential for data exchange became clearer, the World Wide Web Consortium (W3C) developed XML to overcome some of the limitations of HTML. The Internet-centric nature of XML provides users several capabilities:

- XML separates the content of a document from its presentation. Whereas HTML is mainly concerned with how a document is displayed, XML documents describe the data inside the document. The way data is displayed – if indeed it is to be displayed at all – is determined by a separate style sheet.
- XML is easily viewable by humans. XML viewing can be achieved by converting XML for applications that can display HTML, or by using modern applications that can interpret XML directly. This XML-based capability can allow E-Commerce to be extended beyond large companies to small- and medium-sized businesses. By deploying XML-based Web E-Commerce solutions, trading communities can increase the penetration of E-Commerce.
- HTTP communications and security infrastructure can be used to exchange XML. All Internet Web browsers, and most communications systems, support HTTP, so communicating XML to users with Internet access involves minimal additional effort.
- Search and retrieval of XML documents is faster and more efficient than searching through HTML, as XML is easier to arrange into an indexed repository. Most major database vendors such as Oracle, Informix and IBM are planning to use XML for data storage.

eXtensible Markup Language (XML) – a computer language developed by the W3C to facilitate the exchange of data between applications and/or humans

Document Type Definition (DTD) – a description of the content of an XML document that can be industry, application or business specific.

XML Schemas – provide structure definition and validation capabilities similar to those provided by DTD’s.

eXtensible Stylesheet Language (XSL) – a proposed standard that allows Web developers to apply formatting rules to XML documents. A browser uses an XSL stylesheet to display the contents of an XML document on the screen.

eXtensible Stylesheet Language Transformations (XSLT) – new W3C standard for converting XML documents from one schema into another

eXtensible Query Language (XQL) – facilitates the searching of XML documents

XML/EDI - standards that combine XML and EDI for organizations that are deploying EDI programs that also leverage XML

Shared by Different Business Applications and Communities

XML provides available communities and/or vendors the flexibility of developing their own XML-based vocabularies that meet the implementation needs of an application or a community. These XML-based vocabularies are called schemas and can be stored and distributed via the Internet. There are several formats for schemas, the earliest being Document Type Definitions (DTDs). All schemas (including DTDs) allow documents to be validated for proper content. The schema might specify, for example, that a purchase order must contain a Ship To address. The newer schema formats allow XML documents to be type checked as well as content checked. For example, not only must the document contain a Ship To address, but also the address must be no more than 50 characters long and be alphanumeric. An XML document will typically identify its schema or DTD and may even include the schema as part of the document. The emerging standard for schemas, overseen by the W3C, is known as XML Schema Definition Language (XSDL).

XML schemas can meet the needs of several different categories of applications because of the flexibility available in developing vocabularies to address the needs of varying implementation conventions. For example, an EDI/XML agent, workflow agent, Web browser, search engine and/or ERP application can all process an XML-based purchase order. In addition to being shared by different business applications, XML can also be adopted by a cross-section of trading communities engaging in E-Commerce. Using XML, communities can implement conventions specific to their business needs, but can still exchange documents that are interoperable with minimal additional effort.

It is important to note that even though several classes of applications can share XML, most XML-based transactions need to be converted to conform to business-specific requirements, as XML-based vocabularies can vary. It is extremely important for users of XML to consider deploying “XML translation” systems that can convert XML to commonly used E-Commerce formats such as EDI, flat-file, etc. Businesses require different data types; meeting the needs of a wide range of customers and suppliers is essential when deploying E-Commerce.

Industry Awareness and Availability of Resources

XML is receiving attention from several industries including publishing, telecommunication, automotive, electronics and banking for several areas of deployment including E-Commerce, electronic Catalog Data Management, enterprise application integration and documentation. As a result of this widespread awareness about the potential of XML, many XML-based software tools, such as parsers and document editors, are available today. There are also several resources for information on XML on the Internet, and training on XML is widely available. This is all resulting in an increase in the pool of resources available for deploying XML-based solutions, thereby enhancing the likelihood of the widespread adoption of XML.

Improved Integration Paradigm

The data that defines an XML document (DTDs or schemas) can be sent with an XML document or can be referenced in an XML document. This capability allows for the creation of XML-based repositories on the Internet that can be made available to a worldwide audience. This improved paradigm of distributing “data definitions” and/or “implementation conventions” over the Internet promises to lower the barrier to businesses engaging in integrated application-to-application E-Commerce. In addition to this opportunity, by using XML, businesses can also reduce the number of “maps” they need to create and maintain since the document definition is available from the document itself.

XML, like any other emerging technology, is not a panacea for all of the issues associated with the exchange of data within and between organizations, however, XML provides software vendors, service providers and businesses a modern foundation that addresses some of the limitations of legacy technologies.

III. Increased Momentum and Activity

There is strong momentum for XML to be an important “next-generation” language for E-Commerce. Leading vendors such as Harbinger are building XML support into software and network offerings, and several companies have started deploying XML-based solutions. While it may take some time for XML-based standards and technologies to mature, XML is destined to be an important part of the technology enabling E-Commerce. It is also clear, however, that the explosion of XML activity may lead to a fragmented market that will create issues of interoperability and confusion among less technically-savvy businesses.

Industry Initiatives

Several industry organizations are working to define XML-based vocabularies that will help their members conduct business electronically. Some of the major initiatives currently underway include:

RosettaNet – This consortium of companies is developing a dictionary of XML-based definitions and a framework to define products and other components of business transactions exchanged by the Computer Electronics industry. RosettaNet published the first 10 “Partner Interface Process” documents in December 1999, and many member companies began exchanging PIP-based documents, as part of a series of pilot programs, in February 2000. Members of the RosettaNet managing board now include major industry players such as Cisco Systems, Compaq, Hewlett-Packard Company, IBM and NEC Technologies.

Automotive – The automotive industry has traditionally been an “early-adopter” of E-Commerce technologies. Several major automotive industry players, such as the Automotive Industry Action Group (AIAG), General Motors (GM) and DaimlerChrysler, have stated their intent to adopt XML for E-Commerce. GM has launched GM TradeXchange as an XML based web site enabling GM business partners to buy and sell goods as well as take part in online auctions. Ford has created a separate marketplace, AutoXchange. In late February 2000, General Motors, and DaimlerChrysler jointly announced that they planned to combine their efforts to form a business-to-business integrated supplier exchange through a single global portal.

Open Applications Group (OAG) -- The Open Applications Group is a non-profit consortium focusing on XML content for eBusiness and Application Integration. The OAG membership is composed of software vendors, EAI vendors, Systems Integrators, and end-user associated organizations, including AT&T Wireless, Ford Motor Company, and PriceWaterhouseCoopers. As of the first quarter, 2000, OAG stated that at least 26 members were participating in live XML-based pilot programs.

Voice XML – AT&T, Motorola, Lucent and several other telecommunications giants are sponsoring Voice XML (vXML) to drive the adoption of voice-enabled applications. vXML is expected to make it easier to develop Web applications that incorporate voice access.

Open Financial Exchange (OFX) – In early 1997 CheckFree, Intuit and Microsoft founded Open Financial Exchange to develop data standards that facilitate the electronic exchange of data between financial institutions, businesses and consumers over networks. Several banks, financial institutions and other organizations have since implemented XML-based OFX.

International Alliance for Interoperability (IAI) – This consortium of architecture, engineering and construction firms is sponsoring development of aecXML, XML schema for project and business-to-business communication for architecture, engineering, construction, and facility management transactions.

In addition, various “eMarket Makers” – companies that have established Internet sites to facilitate E-Commerce within vertical trading communities – are promoting their own XML specifications to enable member companies to exchange documents. One such example is e-Steel, a B2B exchange for the global steel industry, which has announced that it will develop and publish Steel Markup Language (SML) schema designed for the special needs of steel companies.

Cross-Industry and Government-Sponsored Initiatives

While different industry groups create their own XML specifications to fit their industry's requirements, the issues of XML standardization are also being addressed by various groups who seek to establish standards which span across industries and countries. Their members are made of corporations, academic institutions and, frequently, government bodies.

World Wide Web Consortium (W3C) -- The W3C is a consortium of companies, universities and other organizations involved in the development, improvement and evolution of the World Wide Web. As such the W3C has been central to the development of HTML and all aspects of XML, including DTD, XSL, XSLT, and, most recently, the publication of XHTML, designed for developers wishing to migrate from HTML to XML.

ebXML – The United Nations body for Trade Facilitation and Electronic Business (UN/CEFACT) and the Organization for the Advancement of Structured Information Standards (OASIS) have joined forces to initiate a worldwide project to standardize XML business specifications. The Electronic Business XML initiative (ebXML) will develop a technical framework that will enable XML to be utilized in a consistent manner for the exchange of all electronic business data., with the goal of establishing a set of standards for conducting business over the Internet. The ebXML effort, which is chaired by Klaus-Dieter Naujok of Harbinger, has a target completion date of May 2001.

CommerceNet's eCo Project – CommerceNet, a non-profit consortium of 500 organizations dedicated to their growth of E-Commerce, is sponsoring the eCo Project, which is defining a framework for interoperability of XML-based E-Commerce systems. The framework will include specifications for business documents as well as for registries for allowing companies to describe themselves and the products they offer in a standard manner. Harbinger is among thirty-five companies participating in the eCo Working Group.

XML/EDI – The XML/EDI group is developing recommendations that combine XML and EDI for organizations that have existing EDI programs and that also want to leverage XML. The XML/EDI effort seeks to represent the structure of EDI document within XML. This will allow companies to leverage their investment in EDI technology while communicating via XML with non-EDI capable trading partners. The Gartner Group estimates that by year-end 2003 XML/EDI will account for 30 percent of EDI transactions, with a further 30 percent supported via XML-to-EDI gateways. The remaining 40 percent will be supported via traditional EDI.

Initiatives by Software and Services Providers

It is always in the interest of a software vendor to establish their technologies as de facto standards. It is not surprising, therefore, to see that several companies are spearheading initiatives to define XML standards which they hope will be widely adopted.

BizTalk – Primarily a Microsoft initiative, the BizTalk organization (<http://www.BizTalk.org>) offers an XML Framework designed to help companies exchange business documents using XML. Version 1.0 of the BizTalk Framework was published in December 1999 and describes how to create a BizTalk document. The BizTalk Framework does not attempt to define particular business transactions—any well-formed XML document is acceptable—but it does specify how the BizTalk document should identify the schema on which the document is based, and how the document should be routed. A BizTalk server will use this information to validate the XML documents and transport them between trading partners.

XML Jargon

Tag – A description of an element of an XML document, for example the address of the supplier or price of an item. Each element has a start-tag e.g., <address> and an end-tag, e.g., </address>

Well formed – an XML document that complies with the XML standard e.g., each element is properly tagged

Valid – an XML document that is compliant with a DTD or schema. An XML parser will validate each document and alert the user if, for example, a mandatory element is missing.

The BizTalk web site features a library of XML schemas based on the BizTalk Framework developed by many companies for the purpose of exchanging data within their business communities. Microsoft is developing a Windows 2000-based BizTalk Server (currently delayed until mid-2000) and numerous other software companies have pledged to support BizTalk in their products.

Commerce XML – Led by Ariba, Inc., several software vendors have adopted Commerce XML (cXML) to facilitate the exchange of content and transactions over the Internet. cXML is a set of “lightweight” XML DTDs that have been formed in line with the requirements and vocabulary of E-Commerce process. The specifications appear well suited for procurement transactions.

XML Common Business Library (xCBL) – Defined by Commerce One, xCBL is a set of XML-based building blocks and a document framework that helps developers create business documents in various schema languages.

Trading Partner Agreements Markup Language (tpaML) – IBM, a Harbinger business partner, has submitted specification for tpaML to the international standards body OASIS. The foundation of tpaML is the Trading Partner Agreement (TPA). A TPA is an electronic contract that uses XML to stipulate the general contract terms and conditions, participant roles (such as buyers and sellers), communication and security protocols, and business processes (such as valid actions and sequencing rules).

The Role of an XML Intermediary

As indicated at the start of this section it is likely that early adopters of XML technology will end up implementing XML in different ways, based on which of the emerging standards they select, and how they interpret those standards. It is inevitable that two companies wishing to exchange XML data will need some form of mapping between their XML implementations as well as easy access to each other’s DTDs. The interoperability problem will be compounded as trading communities expand: some trading partners will wish to maintain their EDI infrastructure, while others will push forward with XML.

Harbinger Corporation’s goal is to become a trusted intermediary that can help resolve interoperability issues. By providing on-network data transformation, we can ensure that our customers can exchange data in their formats they wish. Harbinger will convert XML to EDI and EDI to XML as well as translate one flavor of XML to another. We can also make it easy for our customers to transact business through multiple portals and exchanges, by providing a single point of access.

Harbinger is actively pursuing the use of XML for E-Commerce solutions since lowering the barriers to entry to E-Commerce, and adopting promising new technologies are key elements of our mission to provide IP-Centric E-Commerce solutions. The next section describes our strategy and product plans in detail.

IV. Harbinger's XML Strategy

Harbinger has made significant investments to move its customers to XML and Internet technologies and has begun delivering on its commitment to support XML throughout its product lines and services. In 1999, we embarked on an enterprise-wide campaign to migrate all our customers to the new Internet-based technologies, and, as an indication of our success, December 1999 marked the 5000th customer of TrustedLink, Windows Edition, which supports EDI to XML conversion.

Harbinger's slogan -- *We make business-to-business e-commerce work* -- is backed up by Harbinger's ability to provide comprehensive solutions in the following areas:

- mission-critical data transformation and integration
- electronic catalog content rationalization and management
- business community integration and trading relationship management
- electronic marketplace enablement with our portal technology and back-office e-commerce infrastructure

XML plays a role in each of these areas.

Data Transformation and Integration: *harbinger.net*

The heart of Harbinger's value proposition is *harbinger.net*, the company's B2B portal that facilitates trading communities by providing comprehensive transaction services, including on-network data transformation, seamless interconnection between the Internet and all Value Added Networks (VANs) and real-time customer care capabilities.

Throughout 2000, *harbinger.net* will phase in a range of XML services, including:

- ability to process, archive and track XML documents and route them to business partners on any network worldwide
- on-network data transformation of business documents between XML and EDI
- on-network data transformation between different XML document types, for example between a cXML-based document and a RosettaNet PIP
- a transformation repository for storing XML data type definitions, style sheets, schema and so on, so that it is easy for customers to access specifications for the data formats of their trading partners and industry portals

These capabilities available via *harbinger.net* will allow businesses to leverage XML-based technologies at their own pace, without requiring their business partners to move in lock step. For example, a company that is asked to support a particular XML format can send EDI data to *harbinger.net*, where the document will be converted to XML and routed to the trading partner. In this way, the company can continue to leverage its investment in its EDI infrastructure.

Data Transformation and Integration: Harbinger TrustedLink e-Version 5

TrustedLink is Harbinger's premier translation, integration and communications software suite, available on Windows, UNIX and AS/400 platforms. TrustedLink currently converts application data formats to and from EDI standard messaging formats and also supports numerous non-standard data definitions for EDI and non-EDI translation. Starting in late 1999, we began shipping TrustedLink e-Version 5 that provides EDI-to-XML conversion and integration capabilities. Future releases will support XML-to-EDI as well as support XML mapping and stylesheet creation.

The new TrustedLink XML functionality will be particularly useful to companies with a large number of business partners that are not EDI capable. Documents can be processed through TrustedLink in the normal way and TrustedLink will either send data in EDI format or as an XML attachment to the trading partner email address. The recipient simply double clicks on the attachment and the document will open in their Internet Explore browser, from where it can be read or printed. In effect, this process is a cost-effective and simple replacement for EDI to FAX.

TrustedLink's XML capability is also useful for sharing documents internally. Incoming EDI documents can be converted to XML and posted to an Intranet web site, so that multiple departments – shipping, accounting, executive management, etc. – can see daily purchase orders as they are received.

Data Transformation and Integration: Harbinger Express

Harbinger Express is a forms-based Internet solution that allows companies to quickly expand their E-Commerce programs by using the Internet and Web-based technologies. With Harbinger Express, trading partners can exchange business documents economically using only a Web browser or an easy-to-use desktop application and an Internet connection. All EDI translation is handled on the Server. Harbinger Express will also benefit from the emergence of XML, as it will convert EDI and non-EDI data to XML for easy viewing by trading partners using an XML-capable browser. XML will also allow Harbinger Express documents to integrate easily with business applications that are XML-enabled, thereby bringing the true costs savings of integrated E-Commerce to even the smallest business partner.

Data Transformation and Integration: Harbinger Labs

Harbinger Labs is focused on the delivery of new technologies for Internet-centric E-Commerce. To achieve this goal, Harbinger Labs is developing sophisticated, scalable and powerful technology that bridges new and existing E-Commerce products. The first Labs products, due to market in late 2000, are being designed from the ground up as real-time, Web-oriented E-Commerce enablers that will complement TrustedLink solutions. The exploitation of XML and the fulfillment of its promise of leveling the playing field for all segments of the E-Commerce market are key elements of the Harbinger Labs product strategy.

Electronic Catalog Content Rationalization and Management: Harbinger Knowbility

Harbinger Knowbility content management services and software help businesses build and maintain accurate data within E-Commerce applications such as Operating Resource Management (ORM) catalogs. As more business applications and databases start storing data in XML format, it will be easier for businesses to send data to customers in XML format. In addition to facilitating the aggregation of data from applications, XML also enables the collection of data from Web sites. Harbinger Knowbility products and services will simplify the deployment of ORM solutions by collecting and converting XML into the desired format for a catalog application. Harbinger Knowbility is also leveraging XML today for data aggregation, retrieval and management.

Business Community Integration and Trading Relationship Management

For the past fifteen years, Harbinger has been lowering the cost and complexity barriers that have limited adoption of large companies' E-commerce programs. We have marketed several generations of low-cost EDI software and developed an effective methodology for educating trading partners, implementing their software and network services, as well as providing certification and rollout services to the trading community sponsor. We have distilled this experience into our current Business Community Integration (BCI) program, which comprises comprehensive outsourced trading community management. As deployment of XML becomes more widespread, this technology will be increasingly central to our BCI programs.

Consider a company that has developed its own RosettaNet-based specification for doing business in real time with its suppliers. Harbinger's BCI program would contact each supplier, and ensure that each company had suitable XML software or, alternately, would use *harbinger.net* EDI to XML transformation services; we would provide mapping services as needed to ensure integration between the supplier ERP system and XML. And the BCI program manager would provide regular, Web-based reports on the progress of the community rollout.

Electronic Marketplace Enablement: Portal Technology and Back-office E-Commerce Infrastructure

Harbinger has built a world-class electronic commerce infrastructure, well suited for hosting industry portals. Our infrastructure includes interfaces to document tracking, data transformation, billing and customer database management, as well as an industrial strength network that guarantees 99%+ availability. We currently host two dozen communities, ranging from GroceryLink (<http://www.grocerylink.net>), a community for food brokers and grocery and packaged goods manufacturers, to AutoChain Online (<http://www.autochain.com>), a supply chain management site sponsored by the Automotive Industry Action Group (AIAG).

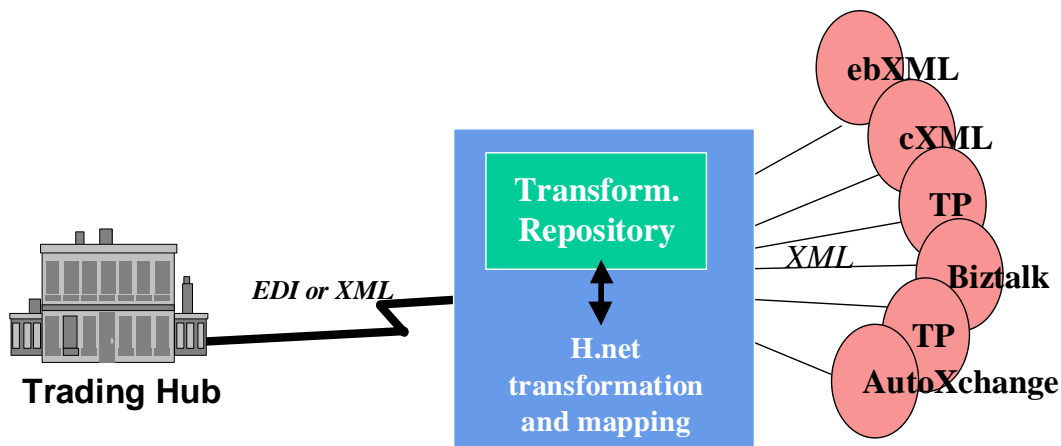
Harbinger expects that most of its portal market makers will employ XML technology for enabling collaboration between its members, and harbinger.net is well suited to meet this requirement. Already, GroceryLink is deploying an EDI to XML fax solution.

Electronic Marketplace Enablement: The *harbinger.net* On-Ramp

As was evident in our description of the various XML initiatives, many organizations are attempting to establish XML standards. Although it is likely that XML conventions will become better understood and standardized as the technology matures, it's clear that in the short term, there will be several ways of implementing XML. The challenge for companies dealing with multiple business partners is to accommodate a range of standards and implementations in a cost-effective manner.

Consistent with our mission to enable E-Commerce marketplaces, Harbinger is establishing itself as a trusted intermediary to facilitate trade between multiple communities. Harbinger is creating a repository of XML schemas and stylesheets to enable companies to quickly locate and map their own documents to the guidelines published by any other trading partner or portal. Harbinger offers its services to provide the EDI to XML, XML to EDI and XML to XML transformations required to conduct electronic business with all trading partners. We can make XML or EDI documents available in HTML format to small trading partners who do not have their own integrated E-Commerce systems.

In order to facilitate easy connectivity to *harbinger.net*, Harbinger is rolling out a *harbinger.net* On-Ramp program that makes available Harbinger's secure Pipeline technology to third party business partners and portals. This will enable users of such products as BizTalk Server to easily register and access *harbinger.net* services, including data transformation and document tracking.



V. XML Deployment Opportunities

XML alone cannot meet all the needs of an enterprise deploying Internet and/or E-Commerce solutions. However, when combined with other business re-engineering projects, such as enterprise application integration, XML can be exploited to increase the enterprise's efficiency and competitive position.

Most businesses need to integrate Enterprise Resource Planning (ERP) applications, databases or other systems to enable E-Commerce solutions. Several major application and database vendors are in the process of accepting XML directly into their systems. XML thus becomes a useful intermediate form for Enterprise Application Integration. A natural extension is to make XML also the basis of Business Community Integration, that is, to use XML as the basis for business transactions with all trading partners. It is important to realize that the lessons learned in the EDI world apply equally to XML: XML specifications developed by one business may not necessarily meet the needs of another business. Despite the efforts of standards bodies, it is inevitable that there will be some incompatibilities between the way different organizations described their business documents. Therefore, most solutions will require some level of XML translation and mapping in order to accommodate the diverse requirements of a large business community.

XML, combined with other E-Commerce technologies can help businesses deploy Application-Application, Application-Web and Web-Web E-Commerce solutions. XML facilitates such solutions as it allows businesses to:

Define Data Structures – using XML schemas, businesses can incorporate their implementation conventions in transactions. This allows businesses to add their unique business rules to documents exchanged.

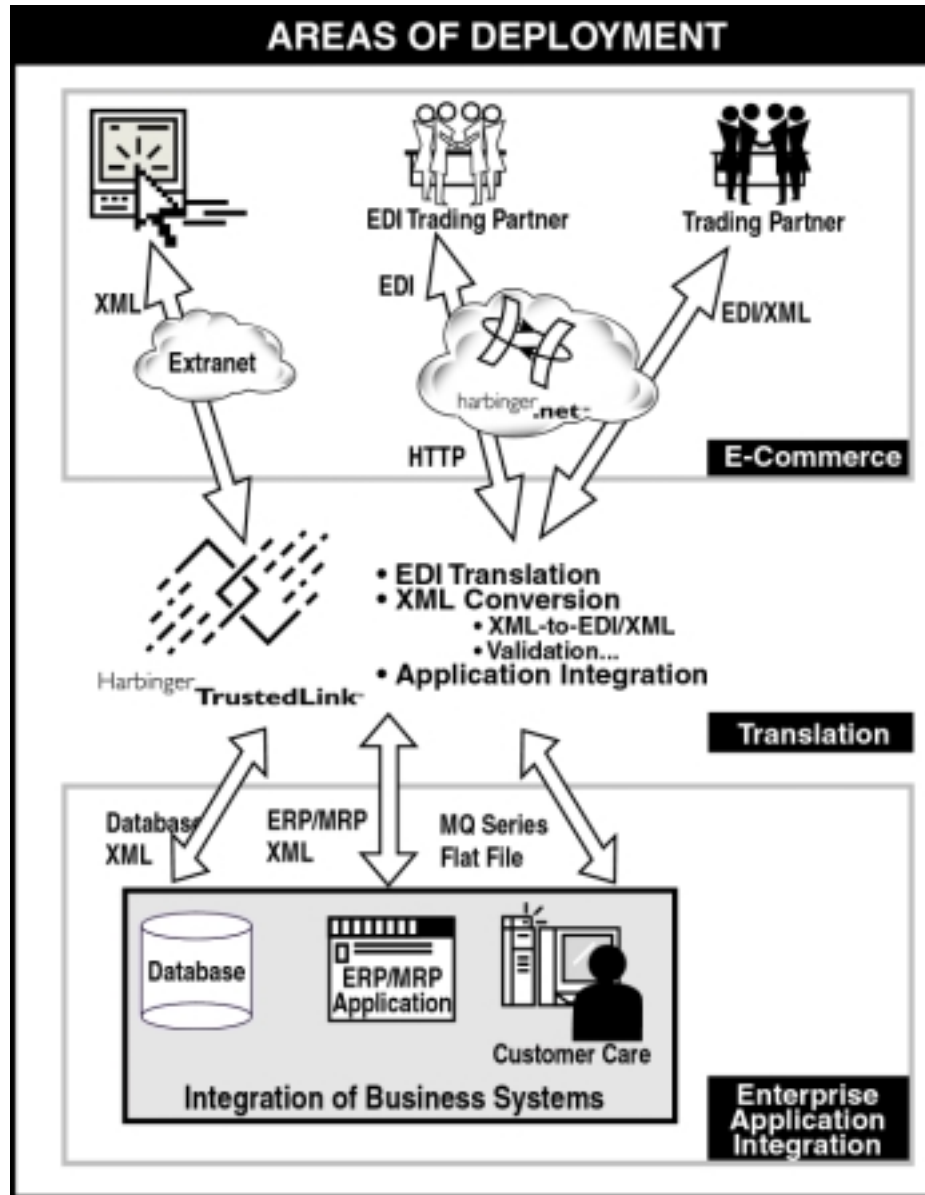
Distribute Data Structures - once a business, or a community has created a set of schemas that conform to their business requirements, they can distribute the schemas and implementation conventions via the Internet. New standards such as gXML are emerging to facilitate this process and many organizations, including Harbinger, have declared their intention to provide open repositories for publishing schemas and related XML documents.

Communicate Securely over the Internet – XML transactions can be sent via the Internet using HTTP, sHTTP or other IP protocols to trading partners worldwide. If a business wants 3rd party services such as archiving and time-stamping, the transactions can also be routed via an E-Commerce Portal such as harbinger.net.

Validate Content – XML-based transactions are unique as they can carry data as well as information describing the structure of the data. This allows systems with XML-parsing capabilities to validate the content of a transaction spontaneously, and allows for XML to be used for structured data exchange over the Web.

Display via a Browser – XML-parsing capabilities available in Browsers can be used to display documents to end-users. Use of XSL style sheets can enhance the design and presentation of XML documents.

Process for Application Integration – For trading partners integrating transactions, XML can be converted into an acceptable format such as EDI, Flat-File etc “on-network”, or by using an XML Translator.



XML-based technologies can be used to enable varying types of E-Commerce solutions. The following examples illustrate some of the capabilities of XML, and the types of solutions that may be deployed using XML and other E-Commerce technologies:

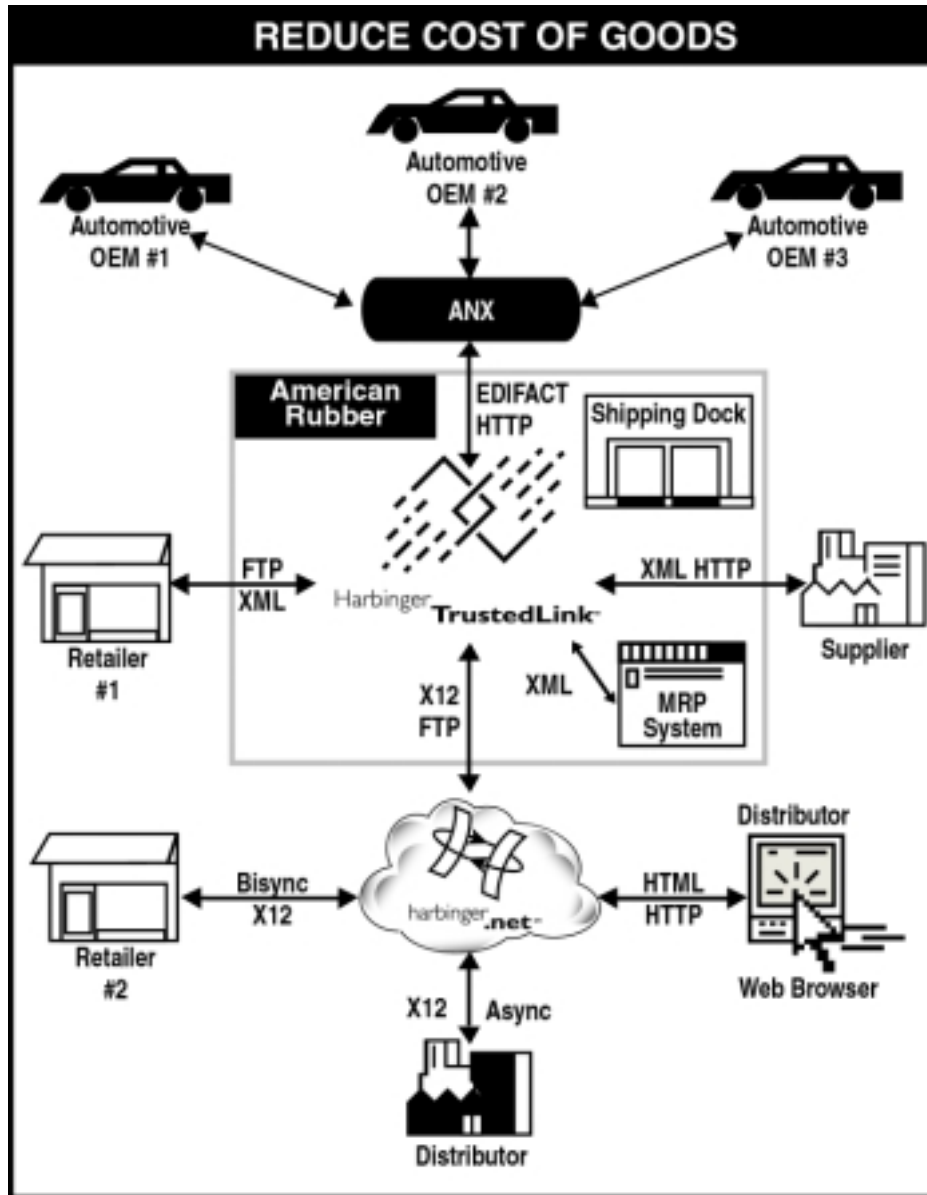
Reduce Cost of Goods to Stem Shrinking Margins

In this example, a company manufactures rubber-based parts that are sold to Automotive Original Equipment Manufacturers (OEMs) such as Ford, Chrysler, or Retailers such as The Home Depot, Loews and Pep Boys. The company sells directly to customers in USA and in Canada, and through a network of distributors overseas. For the purposes of this example, the company can be called “American Rubber”.

American Rubber needs to lower its costs of goods sold by engaging in E-Commerce with its customers, and by enabling all its suppliers. American Rubber can lower its cost of goods by deploying a solution that will incorporate:

- Real-time integration with the MRP system as transactions will need to be sent to its Automotive OEM customers on a “real-time” basis
- Exchange of EDIFACT documents with Automotive customers via the Automotive Network Exchange (ANX) using HTTP
- Exchange of X12 documents with Retailers via harbinger.net
- Posting of XML documents to a Web Site to allow small-to-medium size suppliers to access Purchase Orders and other documents using a Web Browser
- Posting of XML documents to the American Rubber Intranet, so workers on the Shipping Dock can view documents, print and respond to documents using a Web Browser
- Real-time integration between the shipping docks and the Automotive OEM’s need advance shipping information from American Rubber before a shipment can be accepted

American Rubber can deploy an E-Commerce solution that meets the needs of its diverse base of trading partner by spanning Application-Application, Application-Web and Web-Web technologies. Using XML for real-time integration with the MRP system, and the posting of documents to a Web site will allow American Rubber to rapidly deploy an E-Commerce solution that meets the needs of its small-to-medium trading partners. However, in addition to deploying XML-based technology, American Rubber also needs to exchange X12 and EDIFACT with its customers who are using EDI technologies. In such a scenario, American Rubber will need to deploy a solution that spans existing and emerging E-Commerce technologies.



Control Purchasing Costs

In this example, an organization that provides business consulting services needs to streamline the purchase of operating resources such as pens, paper etc. The company (B Consulting) is spending more on purchasing than competitors, which is resulting in lower profits per partner. B Consulting wants to lower purchasing costs by allowing employees to order supplies such as pens, pencils, staples etc. via a Web-based catalog that will be available to its employees through the company Intranet.

Deploying an ORM solution will allow B Consulting purchasing to spend more time on negotiating with suppliers, and will lower the total cost per transaction. The solution needs to include capabilities that allow for:

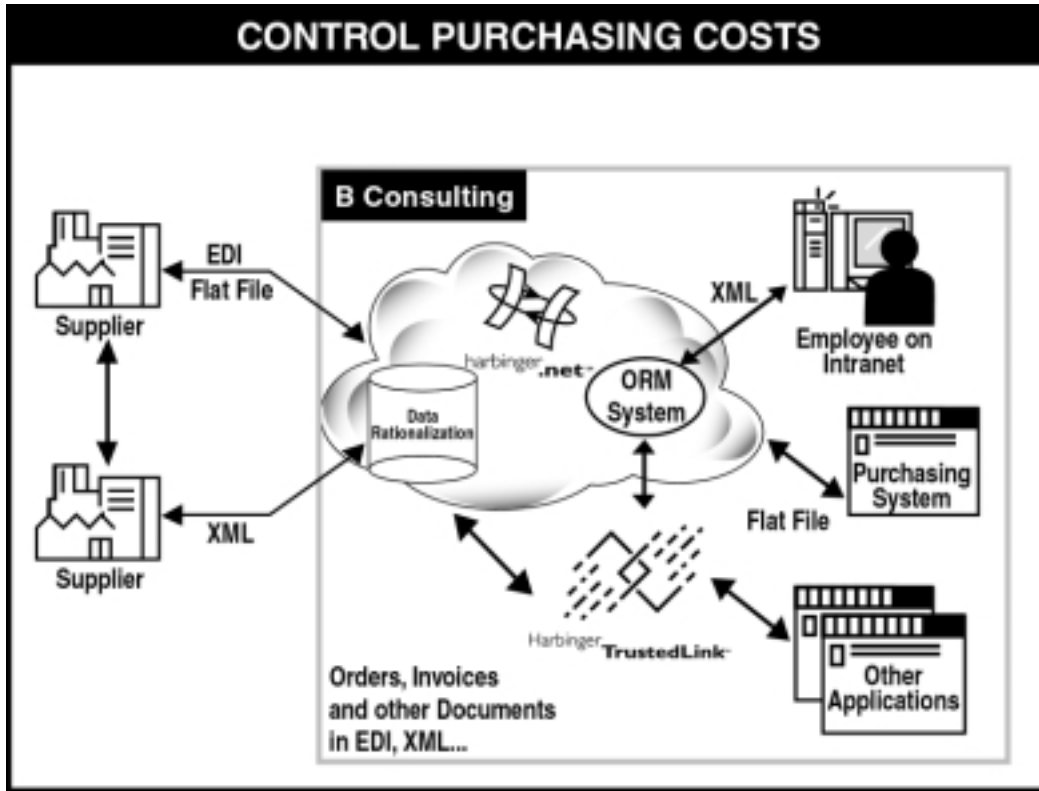
- Display of catalog to employees through a Browser
- Creation of a catalog with items, prices and business logic that is specific to the purchasing contracts between B Consulting and its suppliers
- Regular updates from suppliers that include the latest product information such as price, models, colors and availability
- Automation of the exchange of purchase orders, invoices etc. between B Consulting and suppliers for the items ordered by Employees

An XML-based solution has several advantages for BConsulting as using XML will:

- Allow suppliers to send their product data securely over the Internet, thereby facilitating the collection and update of catalog data
- Minimize the amount of effort required to collect information before transmission as several databases and applications are planning to store data in XML
- Facilitate the display of catalog data to Employees through a Browser or software suite such as Office 2000 over the company Intranet.
- Facilitate the automation of order back to suppliers through a Web site and/or other formats

The first step in deploying the solution will involve creating the catalog specific to B Consulting prices, item descriptions, contacts etc. This process usually involves the collection of data from suppliers in multiple formats that are “rationalized” to a standard format and loaded into the Catalog System. XML is an ideal medium for the collection of data from suppliers as it can be loaded into most databases, and can be prepared for display with minimal extra effort by using XSL for display and formatting. While most suppliers may send their product data in XML, other may have their data in flat file, or other formats, and all of these data formats usually need to be rationalized.

In addition to rationalization, this type of solution is most effective when the system is integrated with other Application Systems and when Orders and other business documents can also be sent back to suppliers electronically. These data conversion and integration services can also be provisioned for such a solution via a system that can provide XML-to-Flat-File, XML-to-EDI and other types of data conversion and integration. Such a solution can help any business make accurate purchases, eliminate maverick purchasing, cut transaction costs by eliminating time and money associated with paper-based and telephone-intensive processes, and reduce inventory costs and procurement cycle time.



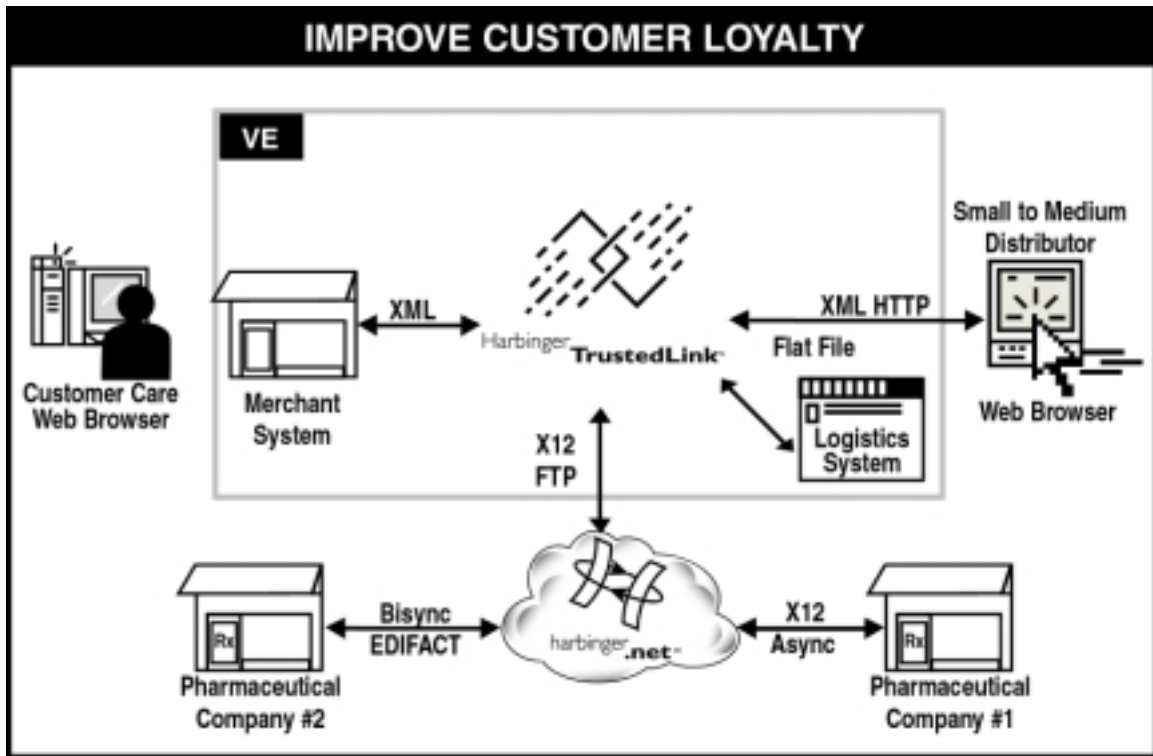
Improve Customer Loyalty

In this example, a business is a “Virtual Enterprise” (VE), i.e. the business sells non-prescription pharmaceuticals over the Internet at discounts over major drugstores. VE wants to improve customer loyalty by providing them with tracking information on their purchases. VE expects this capability to result in improved customer loyalty and stimulate repeat purchasing, as VE’s competitors do not offer tracking information on customer purchases. VE also wants to lower costs by automating orders, and other transactions placed with its suppliers.

The solution needs to include capabilities that allow for:

- Integration with the Logistics System
- Fast and accurate response to VE customers via a Browser
- Conversion from the Merchant System’s “proprietary” Flat-File format to X12 and EDIFACT per the Pharmaceutical Manufacturers implementation conventions
- HTTP and VAN Communications

VE will deploy an E-Commerce solution that will be integrated with its systems to provide customers accurate and timely information on their purchases. This capability will differentiate VE from its competition and will result in increased revenue for VE. In addition to increasing revenue, such a solution will also allow VE to lower its cost of goods by automating purchases.



VI. Conclusion and Recommendations

Although relatively few companies are using XML in a production environment today, it is clear that XML holds great promise for becoming a cornerstone technology for Internet-based E-Commerce. Literally dozens of organizations and vendor coalitions are developing XML-based specifications for business transactions. It will be many months before the smoke clears and widely accepted standards emerge.

Companies that do not consider themselves on the "bleeding edge" of technological innovation must deal with the dilemma of how to proceed with XML. The tremendous growth of E-Commerce in the past two years has taught them that they cannot defer their E-Commerce programs if they hope to stay competitive. But they also cannot afford to invest in a technological dead end.

Harbinger offers a way out of this dilemma. Our experience with standards-based EDI, combined with our aggressive investment in Internet-based E-commerce technologies, makes us an excellent partner in helping companies chart their way through this period of rapid change. Harbinger can provide XML conversion services for customers that wish to maintain their investment in their existing EC infrastructure. And we can provide solutions that allow our customers to extend the capabilities of their EC software to incorporate XML. Most importantly, we will work with our customers to create XML-based programs that can be deployed across their entire trading community, thereby bringing closer the day when essentially all routine business transactions will be done electronically, over IP protocols, in real-time.