

# **Key Technologies, Concepts, & Standards for Supply Chain Systems & Integration**

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# Key Technologies & Concepts for Supply Chain Systems & Integration

- **Interoperability or Systems Integration**

The ability of application programs and devices to interact and exchange data:

- with software written in different languages and data formats;
- running on different hardware platforms;
- under different operating systems;
- residing on different networks;
- using different network protocols.

When triggered by a timed event, user request, or business process activity, interoperable or integrated systems automatically acquire data in the appropriate applications, apply the proper business rules and logic, and exchange appropriate data in the necessary formats.

- **Client/Server**

A computing architecture that evolved in the 1980s to provide interoperability, and to take advantage of the processing power in personal computers and engineering workstations. An application is distributed across two or more computing devices. Generally, the user interface and direct interaction with the program (typically called the client) are supported locally on a personal computer, workstation, or terminal. The bulk of the application logic resides on one or more remote processors called servers. Data used by the application may reside on yet another server. All are connected via networks.

The popularity of this architecture has resulted in a variety of specialized application processors: database servers, directory and mail servers, network servers, web servers, etc. The terms “thick” and “thin client” refer to the amount of processing and application logic that reside on the user’s computer. A thin client functions more like a traditional computer terminal, with the application executing on a host server. The thin client needs less “horsepower” and maintenance can be focused on the server, thus reducing overall cost. Web-based applications constitute thin client computing in which the browser interface is all that runs on the client. All logic and data reside on servers.

Early (thick) client/server architectures are difficult and costly to maintain -- estimates are \$5,000 to \$12,000 per client desktop/device per year, according to various industry analysts. This is driving the popularity of thin client implementations and web-based applications which can reduce these costs by 80% to 90%. The trade-off is performance, since the network connection between thin client and server must handle more traffic.

- **Scalability**

The ease and cost of adding users or devices to an application, system, or network. Also the ease and cost of increasing transaction rates. Scalability is of particular concern when users are scattered across a wide range of computing environments and geographic locations. Scalability is a big issue when introducing customer- and supplier-direct interactions via the Internet and various forms of EDI (Electronic Data Interchange). Customer-direct activities can easily generate thousands of transactions per hour vs. hundreds per hour or per day in more traditional business-to-business interactions.

- **Software Components & Objects**

Software architectures and development methods that promote and increase re-use of previously developed code. Objects are collections of procedures and logic and the parameter sets or data needed to execute the procedures. Components and objects are encapsulated for ready insertion into larger applications. This is done in ways that reduce or eliminate time that would otherwise be spent editing, compiling, and debugging traditional line-by-line coding and re-coding.

In the latest release of a leading ERP package, 13 million lines of code in the prior version have been reduced to 3500 objects – a ratio of roughly 3700:1.

Software suppliers have developed object-oriented languages and programming tools which allow applications to be interoperable upon deployment. The emerging standard tools are: Microsoft's COM, COM+, and DCOM for Windows and NT; and Java and JavaBeans for "not Microsoft" operating systems, such as UNIX, Linux, and MVS.

- **Deployability**

The speed, ease and cost of installing an application to serve its intended users. Deployability is a major issue in distributed, heterogeneous computing environments – across trading partners, different host processors and operating systems.

By leveraging software components and objects, and interoperability, it becomes possible to publish uncompiled application code from a single "deployment server," and compile as needed on local application servers, each running a potentially-different operating system. In this way, installation, maintenance, and upgrades can be accomplished from a single location, with instantaneous deployment and availability.

Applications written for The Internet and World Wide Web can be deployed instantly and globally to any user or trading partner equipped with a Web Browser. Maintenance and upgrades can be performed on the server, without the need to access or physically visit each client-user location.

- **The Internet and World Wide Web**

The Internet is a global network of computers and networks, in which any connected computer can exchange information with any other computer, provided that the proper permissions have been given. Physically, the Internet includes the facilities of public telecommunications networks.

The Internet is over 30 years old. It was conceived as a way for researchers and defense agencies to exchange electronic information and to share processing capabilities. At the most basic level, information exchange is accomplished using standard procedures called the Transmission Control Protocol and the Internet Protocol, now referred to simply as TCP/IP.

Additional applications protocols make possible advanced forms of communication. The most popular are E-mail and the Hypertext Transfer Protocol (HTTP). The latter is a way of cross-referencing pieces of information and their associated locations. It also provides rules for exchanging files, including text, graphics, images, sound, and video.

The World Wide Web is that portion of the Internet defined by the use of HTTP. The Web is at any moment, the collection of users, devices, applications, and information interacting over the Internet via HTTP.

The popularity of the Web is leading to additional protocols that will extend its use for electronic commerce, trading partner interaction, and supply chain systems integration.

- **Intranets, Extranets, and Virtual Private Networks (VPNs)**

An Intranet is the use of TCP/IP, HTTP, and other Internet protocols to exchange information within an enterprise. It looks and operates like a private version of the Internet and World Wide Web. And, in most large organizations, Intranets make use of the public telecommunications infrastructure that comprises the Internet.

To achieve privacy in an otherwise public system, Intranets employ several security measures and protocols, including: encryption; digital certificates; and special methods of engaging and confirming the identity of communicating devices and applications. In addition, Intranets employ a transport protocol known as “tunneling” which makes otherwise public transmissions invisible to outsiders. This is accomplished largely by establishing secure, point-to-point routes among currently active users -- hence the term “Virtual Private Network.”

The significance of tunneling is that it eliminates the need for leased telecommunications lines in a wide area network. The public facilities of the Internet can be used instead, at much lower cost -- generally between 20% and 40% less than leased site-to-site lines.

When secure private Intranets or portions thereof are made accessible to trading partners and others outside the enterprise, the accessible portion is called an Extranet.

### **Intranets, Extranets, and Virtual Private Networks (VPNs) continued...**

Because the Internet is widely available, inherently scalable, and instantly-deployable anywhere in the world, Intranets and Extranets have become the preferred ways to exchange information between company locations and employees, and with external trading partners. Field offices, mobile personnel, and trading partners can connect via the telephone network for the price of a local call -- a savings of 60% to 80% over long-distance dial-in.

Virtual Private Networks can be configured and maintained by in-house information systems personnel, or these functions may be outsourced to Internet Service Providers (ISPs) and other service firms.

### • **Electronic Commerce**

Electronic commerce refers to the buying and selling of goods on the Internet and World Wide Web, via public transactions or via Virtual Private Network. Electronic commerce uses an expanding set of applications software and enabling standards for data formatting, information exchange, and security. Major forms of electronic commerce include:

- Retail selling -- “E-tailing” or Web “store fronts” and “virtual malls” that display products and/or catalogs, provide a “shopping basket” and the means to price a transaction and make a payment.
- Industrial/commercial selling -- business to business, via defined contracts and agreements, or through auctions and solicited bids.
- Trading exchanges -- independent services, consortia or private communities that buy and sell, or exchange information via Virtual Private Network. Such exchanges may be industry specific (vertical), or specific to set of commodities (horizontal). They may be true exchanges, or simply portals (gateways) to families of trading exchanges.
- E-mail and fax to reach prospective and established customers and trading partners.
- EDI (Electronic Data Interchange) -- Internet based transmission of business-to-business transactions in ANSI X.12 or EDIFACT standard format.

With the exception of already existing EDI based on ANSI X.12, most business-to-business e-commerce is being developed using Java and XML.

### • **Application Programming Interface (API)**

An API is a “public” or external interface to an otherwise closed application program. It opens the program to make or receive requests from other applications, databases, networks, or from the operating system. Applications may employ multiple APIs, each with its own specialized purpose.

### Application Programming Interface (API) continued...

The format or nature of an API is determined by the software author. An API may be unique to an application, or proprietary, or it may conform to industry or defacto standards. But it is always a published format and procedure that can be understood and therefore used by other software authors and systems integrators.

IBM's High Level Language API (HLLAPI) and Advanced Program-to-Program Communications (APPC) are examples of proprietary APIs in the IBM SNA (System Network Architecture) and COBOL computing environment.

Oracle API is an example of a defacto standard -- created as a method of accessing Oracle's database management system and applications built upon it with Oracle development tools. The widespread use of Oracle products makes this a popular way to open up an application. SAP's interfaces to its popular R/3 software are another example.

In client/server applications, The Open Software Foundation's DCE (Distributed Computing Environment) provides an industry-standard way to send and receive using Remote Procedure Calls (RPCs) -- a network-oriented, but synchronous form of API.

- **Asynchronous, Publish & Subscribe Messaging**

Messaging is a way of exchanging data between two applications. It uses the principle of E-mail, in which a directory of addresses, formats, and priorities are maintained for potential senders and receivers. Desired program-to-program exchanges are mapped into the directory. Sending applications "publish" their outgoing exchanges to a central facility where they are queued and dispatched to the intended "subscribers" or recipients. Responses, including acknowledgements, are handled the same way.

The central facility -- a message queuing or message brokering program -- provides a buffer between applications. Exchanges are asynchronous. This means that both applications need not be available or directly connected for the data exchange to be made.

In contrast, other methods such as Remote Procedure Calls (RPCs) require simultaneous or synchronous action of both sending and receiving applications. In an RPC, the requesting program is suspended until the results of the remote procedure are returned. This process can be expedited, and several concurrent RPCs can be executed using a technique known as "threads," but in some situations, the inherent delay and potential failure of the call is unacceptable.

Several hundred commercial software products exist to provide interoperability based upon messaging and message queuing techniques. Given the physical, time zone, and organizational dispersion of supply chain information systems, messaging is fast becoming the preferred approach to interoperability and systems integration.

- **Database Management Systems; Data Warehouses & Marts**

A database management system (DBMS) lets one or more computer users create and access data in a database. It facilitates the separation of application program logic from the data that it operates upon. In this way, data that is common or shared by multiple applications can be managed by a central facility. When implemented in a network, the database management system frees the users and the applications from having to know where the data physically resides. A DBMS also provides methods of assuring the integrity and security of data, replicating and duplicating it in multiple locations for efficient response, and assuring proper updates of replicated and duplicated data.

A data warehouse is a database used to capture and centralize information from a variety of other, specialized databases and applications. A data warehouse is typically an enterprise-wide resource, used to facilitate research and ad hoc (unanticipated) queries.

A data mart is similar to a data warehouse, but is typically smaller and structured for more practical and tactical use by a specific group of personnel within a limited range of subjects.

The growing use of database management systems in client/server computing is leading to the physical implementation of enterprise storage systems -- specialized networks of database servers (disk drives and DBMS), connected to host application servers via very high-speed networks with bandwidths measured in Gigabits per second.

- **Networking & Bandwidth**

Supply chain information systems cannot operate without local area networks. These are the internal collectors and backbone systems that communicate within a local site. They also connect to other sites and the outside world via wide-area networks and the Internet.

More than 80% of all network connections use the Ethernet protocol, making it the de facto standard for networking today. Other types of network connections include: Token Ring, Fiber Distributed Data Interface (FDDI), and Asynchronous Transfer Mode (ATM). The latter is used for desktop video, voice-over-Internet, and in campus networks where distances may introduce unacceptable propagation delays using Ethernet.

Ethernet was invented almost 30 years ago at the famous Xerox Palo Alto Research Center or PARC, where the now standard graphical, point-and-click user interface, the mouse, and an early form of Hypertext (like HTTP) were also invented.

Because it is used by millions of devices, Ethernet is recognized by all popular computer operating systems, as well as the management systems for networks themselves (network operating systems). Ethernet compatibility is provided in all popular inter-networking protocols, including TCP/IP, Novell's IPX, IBM's NetBEUI, and DECnet.

Early Ethernet installations required cumbersome coaxial cable to each device and had relatively short distance limitations. Today, twisted-pair copper can be star-wired from hubs. Using repeaters, bridges, switches, routers, gateways, and wireless base stations, network connections can be made between almost any physical locations.

## Networking & Bandwidth continued...

Network capacity is generally expressed in bits per second. While often interpreted as “speed”, bits per second is a processing rate more correctly understood as bandwidth. This is not quite the same as transmission speed which depends upon traffic and other factors. With growth in multi-media, networked computing; thin client/server; E-mail and other forms of electronic commerce; the demand for more network bandwidth is extreme.

Original Ethernet was 3 Mbps (Million bits per second). The first commercial implementations in the early 1980s were 10 Mbps, followed in the mid 1990s by 100 Mbps -- called Fast Ethernet, and in the late 1990s by Gigabit Ethernet, with a capacity of 1 billion bits per second. (This is about 20,000 times the capacity of a 56 Kbps modem common in high-end personal computers). 10-Gigabit will be the next level of performance. Gigabit Ethernet runs on optical fiber, but will eventually run on twisted pair copper wire. It is used today for enterprise or campus backbone networks. Fast Ethernet can be delivered to a device or desktop.

Typical costs in the late 1990s are: (Source: International Data Corp. IDC)	Price per port	
	Ethernet	Fast Ethernet
• Network interface card (in the computer or device)	\$35	\$75
• Switch	\$215	\$432
• Intelligent Hub	\$71	\$110

- **Wireless networks & mobile computing**

Wireless, mobile computing uses radio transmissions instead of cables to communicate between intelligent devices. In addition to portable computers and laptops, such devices include wearable computers, cell phones, personal digital assistants (PDAs) scanners, printers, sensors, and smart tags and labels.

Tags and labels use embedded or encapsulated semiconductors to hold and transmit data when exposed to a designated radio frequency -- generally described as radio frequency identification (RFID). Smart tags can be used to track and to communicate with vehicles, containers, shipments, and inventoried items.

Wireless networks and products operate in the unlicensed bands of the radio spectrum. For this reason such networks share the spectrum with other transmissions. Ranges, speeds and levels of interference vary with frequencies used, transmission methods, and power levels. These are regulated by governments and a variety of competing standards. These vary by country and region of the world.

The first wireless Ethernet standard, IEEE 802.11, was published in 1997. Under 802.11b, also called WiFi, for Wireless Fidelity, this protocol operates at up to 11 Mbps in the 2.4 GHz frequency range. Typical range is up to several hundred feet, but depends upon the number and nature of walls and barriers. Speeds of 54 Mbps will be available in the near future using the 802.11a protocol and the 5 GHz range.

### Wireless networks & mobile computing continued...

Bluetooth is an emerging technology and standard for short range (30 feet) wireless networks transmitting at 1 Mbps. It eliminates the need for cables between local devices such as scanners, printers, headsets, and computers. It could also be used to communicate with intelligent tags, if these are equipped with a Bluetooth semiconductor chip. Today, such chips do not support Bluetooth.

GTAG (Global Tag Initiative) is a standard governing RFID and communication with intelligent tags and labels. Developed by the Uniform Code Committee (UCC) in the United States and the European Article Numbering Association (EAN), the purpose of GTAG is to promote interoperability among RFID system components and to provide the necessary performance for global item management. Currently this is made difficult by different radio bands, transmission rates, and power levels permitted in the U.S., Europe, and Japan.

The International Standards Organization ISO standard 18000-6 is a competing standard for supply chain and item management. It prescribes higher frequencies, faster transmission rates than GTAG. It should also operate at greater ranges and with less interference.

Numerous additional standards govern wireless communication with cell phones, portable modems, PDAs and other equipment used by mobile workers in the supply chain.

# Key Technology Standards for Supply Chain Systems & Integration

- **COM/DCOM and ActiveX**

Component Object Model/Distributed Component Object Model and ActiveX are Microsoft's Windows-oriented methods for developing and supporting interoperable program component objects. Together, these tools provide ways for Windows-based applications to interact and exchange data. Through the latest versions of the Windows operating system and its various server products, Microsoft hopes to extend the use of COM and DCOM from their early roles in desktop and personal computing to full-scale enterprise applications. These tools are an alternative to CORBA and the Java technologies below. They are not compliant with the CORBA standard, so gateways must be used when interacting with the "CORBA world." While DCOM supports the TCP/IP protocol necessary for Internet- and web-based data interoperability, it has proven difficult to use and rely upon for this purpose. As a result, Microsoft is now advocating the use of a newer method called SOAP (Simple Object Access Protocol) for web-based applications.

- **CORBA/IIOP**

Common Object Request Broker Architecture/Internet Inter-ORB Protocol. CORBA is an industry standard from the Object Management Group -- largely the UNIX/Linux/not Microsoft community. Client programs send requests to a common interface called the Object Request Broker. The ORB sends each request to the appropriate object (application code and data) and returns the results. The standard allows this to be accomplished in a distributed computing environment, across languages, operating systems, hosts and networks. CORBA is essentially a messaging protocol and has helped promote the use of messaging (store & forward/publish & subscribe) as a technical approach to systems integration.

IIOP makes CORBA usable on a TCP/IP network (the Internet). CORBA objects can be embedded in a Web page and executed via Java applet. This allows a Web page to be interoperable with remote applications accessible via the Internet.

- **Java, JavaBeans, Enterprise JavaBeans**

Java is a hybrid programming language and operating system designed to run on any computing device, thus providing interoperability across platforms and networks. It was developed at Sun Microsystems. JavaBeans are independent Java modules or components from which distributed applications can be built. Enterprise Java Beans are being developed for a variety of common, business-oriented applications.

Java is Sun's and the not-Microsoft community's alternative to COM and DCOM. Microsoft supports a form of Java but has been sued by Sun for its variations to the published standard.

- **ODBC, JDBC**

Open Data Base Connectivity is a Microsoft standard for data exchange between Windows applications and databases running on UNIX, Linux, and other non-Windows platforms. Java Data Base Connectivity provides the same function for Java applications.

- **EDI (Electronic Data Interchange)**

### **Standard Transaction Sets**

Broadly speaking, EDI is the computer-to-computer exchange of formatted electronic messages called transaction sets. The most widely used formats are specified in a U.S. standard, ANSI (American National Standards Institute) X.12, and in an international standard called EDIFACT.

An EDI message contains a string of data elements, each of which represents a piece of information, such as a price, or model number, separated by delimiters. The entire string is called a data segment. One or more data segments, framed by a header and trailer form a transaction set, or message. A transaction set usually corresponds to an equivalent paper document or form, e.g. Set 850 Purchase Order. For security, messages can be encrypted.

Creation or reading an EDI transaction can be programmed into a software application such as Order Management, or this can be done with separate EDI software devoted to this purpose. With forms-based software, including Web pages, users can create or display an EDI transaction in a familiar way, without needing to know the transaction number or any details of the underlying formats.

### **Proliferation & Translation**

EDI developed slowly over a 30-year period, beginning in the late 1960s with the efforts of the Transportation Data Coordinating Committee, now called the Electronic Data Interchange Association (EDIA). The initial TDCC standard for EDI addressed the needs of the trucking and rail transportation industries. The model provided by TDCC was used by the grocery industry to develop the UCS (Uniform Communication Standard) in the late 1970s. Together with bar coded labels, this form of EDI enables collection of Point-of-Sale data and its subsequent up-stream use in a variety of supply chain information systems. In the 1980s, similar efforts in the warehousing industry resulted in the WINS standard for EDI.

During the 1980s, as the X.12 national standards were defined, it became clear that the transaction sets were too generic, or included many data elements not needed in a specific industry. So various committees have convened to define industry-specific subsets of X.12. A typical example is the AIAG (Automotive Industry Action Group). Similar committees were formed for textiles, paper, chemicals, electronics, aerospace, hospital supply...

### EDI continued...

During the 1980s, a number of early adopters applied EDI before workable industry standards could be developed. They published their own, proprietary standards which their trading partners were expected to use. These private formats included: Kmart, Walmart, Sears, McKesson, and General Motors, among others. Some are still in use, even though universal and industry-specific standards have arrived.

Proliferation of formats and subsets -- national, industry-specific, and private -- has resulted in complexity and the need for format translations when serving multiple trading partners in multiple industries. Software and service providers have emerged to provide this translation.

With the use of the Internet and World Wide Web as a medium for trading partner information exchange, the core concept of delimited data elements is being supplanted by the use of XML (eXtensible Mark-up Language) tags. XML is described below. Its use will increase flexibility, expand the scope of application, and reduce complexity in the next generation of EDI. Current ANSI X.12 transaction sets will be given XML translations.

Even after 30 years and the definition of several hundred transaction sets, traditional store-and-forward EDI still does not address many business-to-business processes used in supply chain management. With the popularity of the Web, it is probable that most if not all future transaction development will use XML. For the foreseeable future, both will co-exist and translation will be needed.

### Data Exchange

EDI defines data formats for electronic communications. EDI software at each trading partner packages an EDI message for transmission across a network. But EDI does not define the method of transmission itself. Physical sending and receiving of information are accomplished across public and private networks using various networking protocols.

Historically, the most popular way to exchange EDI transactions has been via a Value Added Network or VAN. In addition to connectivity and transmission, the VAN service company provides a mailbox for each trading partner. Messages can be independently sent or retrieved 24 hours a day, without each trading partner needing to maintain 24-hour availability of its local EDI applications. The typical VAN also provides any necessary format translations.

The cost of sending a message on the Internet is less than the cost of a VAN. Estimates of VAN costs range from \$1 to \$20 or more per EDI message. By comparison, the effective cost of an Internet transaction is measured in pennies. This fact, plus the ability to establish Virtual Private Networks on the Internet is leading to new forms of EDI across the Internet, and making EDI cost effective for smaller companies.

- **XML (eXtensible Markup Language)**

### **XML as a data tagging method**

XML was developed as a way to tag or identify pieces of data within a file or Web page. It is a subset of a 20-year old language called the Standard Generalized Mark-Up Language (SGML). XML is similar in form to HTML (Hypertext markup Language) which describes the content of a Web page in terms of how it is to be displayed (text and graphics) and interacted with.

By inserting < tags> XML flags and describes the data in a file or Web page. The resulting XML file can be processed in several ways. It could be sent as pure data to an application program. It could be displayed like an HTML web page. Or it could be sent to a database. Thus, <PRICE> would indicate that the following data was a price. This data could be used to compute a running total for an open shopping basket; or used to confirm that a contractual discount is being given; or sent to a comparative file of <PRICE>s from other suppliers.

XML is called extensible because it defines only the techniques of tagging. The markup symbols themselves and their relationships or schemas are unlimited and defined by their users. In this way XML provides a flexible language or way of expressing information -- unlike EDI transaction sets which define specific data elements and their meanings. However, XML's flexibility has given rise to many industry-specific and proprietary vocabularies. These now threaten its potential to serve as a single, global standard for exchanging business-to-business electronic transactions.

### **XML as a document exchange method**

The user interface to tagged data is generally a business form or electronic version of a traditional paper document. Thus, the use of XML is ideally-suited for business-to-business document exchange, with HTML pages providing a human-readable view of the data, while tagged data triggers automated processes. The construct of a Document Type Definition (DTD) formally describes the information structure in an XML document.

Just as different companies and industries use a variety of different documents and terms to accomplish the same transactions, so must XML be adapted to the specifics of a company or industry practice. By some estimates, more than 30 industry-specific initiatives are underway.

RosettaNet is a good example of industry-specific standards being developed upon XML. This consortium of 40 companies in the computer industry have published XML dictionaries for 50 partner interface processes (PIPs) related to catalog updates, pricing, order management, purchasing, and inventory availability. Another 100 PIPs are planned.

Another consortium, The Open Applications Group, Inc., has developed PaperXML for paper industry transactions, and SMDX for semiconductor manufacturing. The Chemical Industry Data Exchange (CIDX) has defined more than 700 data elements and 50 transactions based upon XML.

### XML continued...

#### Proliferation and translation

Proprietary versions of XML abound -- for example, Ariba's cXML and CommerceOne's xCBL, both for procurement, and Microsoft's BizTalk, a general purpose development tool for XML-based applications.

With the proliferation of XML implementations and versions has come the need for translation software and services. These generally employ schema libraries and dictionaries that translate tag and data meanings, and templates that map one XML document to another.

#### XML standards

XML is a language and capability, but not a standard. Several organizations are attempting to standardize various aspects and applications of XML. Prominent among these are: The Open Applications Group, Inc. (OAGI), The WorldwideWeb Consortium (W3C), The Internet Engineering Task Force (IETF), the Organization for the Advancement of Structured Information Standards (OASIS), and the United Nations Center for Trade Facilitation and Electronic Business (UN/Cefact). The latter two organizations are responsible for the publication of EbXML, a version of XML specific to electronic business.

#### XML as an integration tool and programming environment

Due to the rapid growth of web-based e-commerce and the utility of XML tagging, XML has evolved from a tagging method and document exchange tool into the leading cross-platform technology for managing data in distributed, web-based, and client/server applications.

The software industry has developed various programming extensions to XML. Examples include: XQuery, XSL (eXtensible Stylesheet Language) to automatically transform documents from one format to another, and XLANG, for workflow descriptions. With these and many other extensions, XML is poised to become the predominant form of data representation, data transport, and e-commerce applications programming.

In the software industry today, the term "XML" is often used loosely as an "umbrella" acronym for all of the technologies, capabilities, and services built upon the underlying use of XML tags.

- **Microsoft .NET**

.NET is the latest line of Microsoft products and services aimed at enterprise and web-based applications. .NET is the successor to the company's Distributed interNet Architecture (DNA) and DNA 2000. .NET includes developers' tools and roughly a dozen different kinds of server products to perform the various computing functions required for distributed computing across the Internet and World Wide Web.

### Microsoft .NET continued...

.NET products presume the use of the Internet Explorer web browser, JavaScript, XML, and SOAP (see below) as the principal methods of Internet-native integration and data exchange. BizTalk Server 2000 is a .NET product that provides schema guidelines for XML-based definition, routing, and exchange of business documents. It also supports the XLANG programming tool for workflow applications.

.NET and BizTalk are not industry standards as such, but are worthy of awareness because of Microsoft's dominance and market presence in the software development community.

- **SOAP (Simple Object Access Protocol)**

The Simple Object Access Protocol is a method for achieving interoperable applications across the Internet. It is a less-sophisticated alternative to Microsoft's DCOM and the "not Microsoft" IIOP.

SOAP is based upon XML. It is essentially a remote procedure call (RPC) that uses HTTP as a base transport mechanism and encodes requests and responses as XML documents. SOAP is thus operable across firewalls in Internet-based applications. Developers can use SOAP by simply using HTTP and XML, both widely-accepted in the Internet community. DCOM and IIOP were both developed in the era of thick clients and before the popularity of the Web and XML. They are much more difficult to use. As a result, neither are widely used in e-commerce applications.

- **MIME (Multipurpose Internet Mail Extensions)**

MIME is an extension of the original Internet e-mail protocol, SMTP (Simple Mail Transport Protocol). In addition to the ASCII text covered by SMTP, MIME defines the exchange of images, audio, and application programs across the Internet.

A MIME header inserted at the beginning of a Web transmission tells the receiving application what services or "player" will be required to process the data being sent.

- **Secure Sockets Layer (SSL)**

SSL is a way of securing transactions between a web browser (client) and a web server. It was developed by Netscape to secure credit card and other payment transactions on the World Wide Web.

"Layer" refers to a program layer between an application -- in this case the Web browser -- and the layers of TCP/IP (the transmission protocol of the Internet). SSL keeps confidential information in this special layer. "Sockets" refers to a method of passing data between a client and a server program. (A socket is an endpoint or stub in a program).

### Secure Sockets Layer (SSL) continued...

SSL uses encryption and digital certificates developed by a company called RSA, founded by Rivest, Shamir, and Adleman, inventors of the most widely-used encryption technique.

SSL has become the most widely-used form of Web security for electronic commerce transactions. It has been proposed as a standard protocol to the World Wide Web Consortium (W3C) and the Internet Engineering Task Force.

SSL does not encrypt EDI or other forms of Internet protocol (IP) traffic such as might be found in a Virtual Private Network or trading exchange, or in remote access to corporate networks.

- **IPSec & IKE**

IPSec is an emerging standard protocol for encrypting any form of Internet protocol transmission and authenticating the devices involved. IPSec uses tunneling to secure IP sessions, i.e. the pipe -- as opposed to the transactions in and out. IPsec can thus secure e-commerce transactions or any other form of trading partner data exchange.

In early implementations of IPSec such as that of the Automotive Network Exchange (ANX), trading partners use "shared secrets" or common passwords to access secured sessions. In the future, shared passwords will be replaced by digital certificates automatically issued by a certificate authority within the one of the trading partners, or by a third party such as VerSign. Such certificates must access a public key infrastructure (PKI) to decode encrypted transmissions. Interaction with the PKI will be governed by the Internet Key Exchange (IKE), a companion protocol to IPSec. Both are issued by the Internet Engineering Task Force (IETF).

As with many so-called standards, IPSec software products differ in their implementations of the protocol, including the manner in which they issue digital certificates. Therefore IPSec products may not interoperate without special programming.