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Pressure Grows For E-Business Infrastructure—Companies seek ways to create framework that will let them add functionality as needed.[1]

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The pressure is enormous to pull together an E-business infrastructure fast, on the fly, from new and existing parts and outsourcing. Managers will be doing it nearly blind, with only vague notions about where they're headed or their ultimate E-business destination.

What IT managers absolutely must have, and often don't, is the time and wherewithal to create a framework that will allow them to almost immediately-and certainly ceaselessly-add layer upon layer of new functionality.

An E-business infrastructure must address four criteria: scalability, availability, security, and manageability. Any E-business strategy must also be able to support a phased implementation approach, recognizing that companies don't have the time or knowledge to build the infrastructure all at once.

For this article, infrastructure refers to all the system components-hardware, software, services-that enable businesses to run their E-business applications. In effect, an E-business infrastructure includes everything but the company's applications, content, and data.

Infrastructure is nothing new. The Hurwitz Group, a research firm, often describes the E-business infrastructure as the E-business solution stack, which consists of a series of five infrastructure layers.

In general, an E-business infrastructure requires more scalability, availability, and security than infrastructures for business systems. The E-business infrastructure will also be more outward facing, able to interoperate with systems that reside outside the enterprise and are beyond the company's control.

The classic method for building a systems infrastructure is first to painstakingly analyze the business and design the systems architecture.

However, E-business doesn't allow for the kind of time it takes to follow the classic approach. Speed requires an iterative approach that will get the business

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started, avoid any killer problems organizers can anticipate early on, and be flexible enough to go wherever the business needs to go without having to redo the entire thing.

But some initial analysis is required. At the least, managers need to answer basic questions about the kind of E-business the company envisions. Is it business-to-consumer, business-to-business, or both? How big can it realistically grow? How fast? Is it informational or transactional?

Most managers often can't answer these questions with any confidence. Whatever the company intends to do in E-business is likely to change six, nine, or 12 months later. Companies that intend to put up a business-to-business site to streamline the supply chain may soon find themselves forced to add business-to-consumer elements they rejected six months earlier. There's no way anyone can predict what the company will need to do on the Internet a year from now.

Instead, the managers must make realistic guesses. Is tenfold traffic growth reasonable? Probably. Is 100-fold growth possible? Maybe. To get the architecture and infrastructure off the ground in a timely way, managers must make some realistic assumptions and educated guesses.

Companies use a variety of shortcuts to pull together an architecture fast and jump-start their E-business effort. These include architecture by legacy, architecture by product, and the old standby, architecture by accident.

To design an architecture by legacy, start with what is extant and assume those vendors can take the company into the E-business world. With this approach, it's possible to have some level of confidence that whatever is added in the E-business arena will integrate with what already exists. If the company's legacy environment is based on something from one of today's big vendors such as Compaq, IBM, or Oracle, this is a pretty safe starting point.

For architecture by product, companies pick a key E-business component because it has some features or capabilities they want. The most likely products are the application server or the commerce platform.

With one or the other or both in place, the rest of the architecture and infrastructure can fall into line around them. There is the risk that the initial product chosen won't scale or will be proprietary, which could hinder development down the road, but a careful evaluation should uncover the most egregious problems before the company is fully committed.

Architecture by accident happens when a company essentially wings it. Typically, it starts with a Web server and is built backward, with additions of an application server, a commerce platform, middleware, and more. The risk is that a poor

choice at some point creates a dead end, leaving either a proprietary piece of technology or something that doesn't scale.

If a company sticks to standards-based products and financially stable vendors, however, it probably won't go too far wrong. At worst, it may have to jump from one standards-based platform to another vendor's platform based on the same standard.

Christmas 1999 proved a watershed for E-business, highlighting the problems companies have handling growing volumes of business. Orders were lost. Items arrived later than promised-and some didn't arrive at all. It became apparent that E-business success depends more on capable back-end fulfillment systems than on flashy Web sites. Customers want to enter orders, know that the item is available, get delivery estimates with reasonable assurance that delivery will occur on or before the promised date, receive status updates along the way, and be able to return the goods if unsatisfactory.

The lesson that came out of the 1999 holiday season for both forms of E-business is clear: the E-business infrastructure must incorporate robust, industrial-strength core business production and fulfillment functionality. For companies that have this functionality as part of their legacy environments, the challenge is to integrate it into the E-business infrastructure.

The primary candidates for E-business legacy integration include the transaction and production systems, inventory management, warehousing and logistics, shipping, customer-relationship management programs, the call center, supply-chain management, enterprise resource planning, and databases. By integrating these systems into the E-business initiative, companies can deliver a consistent, high level of service to customers, both online and off.

This isn't easy to do. Most of these systems are inward facing, while E-business requires outward-facing systems. Traditional call centers, for example, weren't designed to handle E-mail or Web-originated customer-service requests. Logistics and shipping systems may not be capable of handling high volumes of items purchased in small quantities and shipped to individuals.

The alternative to integrating existing legacy systems is to follow the startup dot-com approach and recreate these systems expressly for E-business, using a combination of third-party services, specialized fulfillment packages, and custom-built components. Although the dot-com approach offers some short-term benefits, in the long run, it can create serious problems, such as the inability to deliver a fully integrated customer experience. For example, a customer who buys an item online doesn't think it unreasonable to return the item to the company's physical store. Only integrated systems stretching from the E-business to the back end will ensure this happens smoothly.

The E-business environment is an n-tier, component-based systems environment. In its most simplified form, it consists of a customer or partner accessing a Web server (the presentation tier), which passes requests to an application server and specialized process servers (the logic tier).

The logic tier passes requests it can't handle itself to the back-end production systems and databases (the data tier). Along the way are one or more firewalls. Middleware enables the passing of requests and the exchange of information among the disparate systems. Microsoft portrays this E-business infrastructure as a fabric.

Recently, E-business planners have begun preparing for a proliferation of wireless devices that will be capable of accessing E-business sites, in what has been dubbed pervasive computing. These clients include IP-enabled handheld devices, cellular phones, Palm Pilots, and other personal digital assistants. Gartner Group, projecting 1 billion wireless devices by 2003, calls wireless the growth hormone for E-commerce.

Accommodating these devices will be tricky. The standards aren't settled. The devices themselves have displays of varying sizes and shapes. Converting E-business applications for pervasive computing requires rethinking each application. Automated transcoders convert HTML and Extensible Markup Language code to Wireless Markup Language (WML) and other languages used by the wireless devices, but the application still needs to be redesigned for the tiny screens, limited bandwidth, and the user's situation and circumstances.

If an E-business gets to the point where it can no longer integrate new technology, new partners, new functionality, or new customers fast enough, then it's dead. Integration doesn't happen just once when building the site and connecting it to back-end systems and initial partners and customers-it's a continual process. Also, back-end systems must be integrated with one another, as well as with the E-business systems.

The E-business infrastructure must be built from the start to accommodate continual integration. This requires an infrastructure based on published APIs, widely accepted industry standards, standards-based components, flexible middleware, and open systems. It means being able to expose standard interfaces and avoiding proprietary technologies wherever possible. A host of conventional enterprise application integration (EAI) vendors and new business-to-business integration vendors are jockeying to fill E-business integration needs.

E-business requires standards. The primary standards for E-business include TCP/IP, the networking standard; HTTP, the Web transport protocol; and HTML, the Web display protocol.

XML and a suite of related standards are assuming great importance in the E-business space. XML lets companies identify a piece of information in ways that let other systems recognize that information.

XML will identify a string of numbers as a part number, a customer number, or a ZIP code, for example. Without XML and the accompanying document type definition, which explains what each XML tag means, those different numbers are digits that could mean anything or nothing.

XML doesn't do any integration. Instead, it needs something, such as the Simple Object Access Protocol to enable it. Soap is a proposed Internet Engineering Task Force wire protocol specification that defines how systems can make calls (invoke methods) to servers, services, components, and objects using XML. It lets programs running on different operating systems initiate actions and exchange information via HTTP and XML.

Other standards that will be increasingly important in the E-business infrastructure are the Wireless Application Protocol, WML, and the Lightweight Directory Access Protocol. WAP and WML address wireless devices such as IP-enabled cell phones; LDAP lets programs and users get information from LDAP-compliant directories. The use of standard directories will become increasingly important in E-business, particularly for such critical tasks as security and personalization.

For application development and deployment, the industry appears to be settling on two standards, Sun Microsystems' Java and the Java 2 Enterprise Edition, and Microsoft's Component Object Model and Digital Network Architecture. Both are evolving into full E-business application development and deployment environments based on their respective component object models. Java and Java 2 Enterprise Edition offer more platforms and portability; COM and DNA remain essentially a pure Microsoft Windows play.

The E-business infrastructure must address four critical areas-scalability, availability, security, and manageability-if the company has any hopes of moving beyond the most rudimentary E-business efforts. Some would also include extensibility and performance on that list.

Scalability is the ability to handle more users doing more things. There are two dimensions to scalability: vertical and horizontal.

Vertical scalability occurs when a company replaces one server with a much larger one. For example, the company might replace a midrange database server with a large enterprise or parallel-processing database server as the size of the database and the number of database transactions increase.

Horizontal scaling refers to the ability to add more servers, more instances of the application, to accommodate increasing amounts of traffic. An automatic load balancer is required to spread the traffic across the servers.

The E-business infrastructure should include the ability to scale both vertically and horizontally-but scalability involves many subtleties. The way the load is distributed, the way the database is designed and partitioned, how session state is managed and shared, how the application is written, whether database connections are pooled, and more all affect scalability.

Availability is usually described in terms of the amount of downtime a company can tolerate. Because the E-business environment operates round-the-clock year-round, every moment of downtime can mean lost business, lost productivity, and dissatisfied customers, depending on how busy the site is.

Availability is closely related to horizontal scalability. The multiple instances of the server that provide horizontal scalability also provide a measure of high availability. If a server goes down, the load is redistributed across the remaining servers, although there will be corresponding performance degradation. For high availability, the E-business infrastructure can also include clustering, mirrored storage, multiple Web sites, and redundant everything. In addition, every component-application server, commerce platform, and database-should be optimized for online maintenance and fast restart in the event of failure. Of course, everything the company does to ensure high availability of its most-important enterprise systems also applies to the E-business world.

E-business security today typically takes the form of Secure Sockets Layer-encrypted transactions for commerce and password-based authentication and authorization. Looking ahead, security will increasingly entail digital certificates and incorporate public key infrastructure.

While a firewall between the E-business site and the back-end systems is a given, increasingly, companies are adding a second firewall between the Web server and the application servers, creating a secure buffer zone in front of the back-end systems.

Manageability addresses system and network management as well as application management and Web-site performance monitoring. A host of tools are being introduced to address the various aspects of E-business management and system-performance measurement. In addition, conventional enterprise management solutions are being extended to include the Web and E-business.

Extensibility is addressed through components. A component-based E-business infrastructure makes it easy to add functionality. To enhance performance, the E-business infrastructure may employ caching to eliminate the need to go to the back-end systems for frequently requested information.

In addition to specifying standards and platforms, the E-business infrastructure includes a number of components, which can be classified as either enabling technologies or supporting applications.

Enabling components include the core technologies that let a company get its E-business applications up and running. The primary components include the Web server, application server, an E-commerce platform, middleware, content-management tools, testing tools, and application development tools.

The Web server is the front line of E-business. It displays a company's Web pages, takes requests from visitors, and passes back the results, usually in HTML format. Out in front of the firewall, it primarily handles display. For everything else, it passes the request along to other components, usually the application server, and displays results.

The application server today forms the heart of the E-business infrastructure. The major application-server vendors are cramming as much functionality as they can into the products to turn them into comprehensive E-business platforms. Mainly, the application server runs business logic in the form of components, orchestrates other middle-tier components, and provides the connection to back-end systems.

Increasingly, application servers provide development tools, management utilities, and E-business application functionality in the form of components. They also handle the underlying plumbing for everything from network communications to transactions.

The E-commerce platform, however, is emerging as a rival to the application server as the core E-business infrastructure component. The E-commerce platform provides a suite of applications and utilities for running and managing commerce activities. It includes a shopping cart, transaction-management capabilities, online auctioning, catalog management, credit and payment processing, bid management, integration with fulfillment systems, and more. Of course, the E-commerce platform must also deliver scalability, availability, and security. Eventually, the E-commerce platform and application server will merge into one component of the E-business infrastructure.

Although the application server provides some middleware capabilities, such as Open Database Connectivity or Java Database Connectivity, the E-business infrastructure may require more specialized middleware to connect with legacy systems. Such middleware includes message-queuing systems, transaction-processing monitors, and various EAI offerings. Since integration is such a central part of E-business, middleware will be pervasive throughout the infrastructure to smooth over the boundaries between one system or technology and another. A growing class of specialized business-to-business integration

middleware is also emerging from vendors, including Extricity Inc. and Mercator Software Inc.

E-business is about content, the information and applications that comprise the E-business itself. Content may take the form of information, catalogs, or services (delivered as applications). In an E-business initiative, as opposed to a static Web site, the content changes frequently, even every day, hour, or minute. And with the trend toward personalization, the content may differ for every user.

The task of assembling, organizing, and delivering content that is both accurate and timely has moved beyond what is possible to do manually. Automated content-management and deployment must be part of the E-business infrastructure. This may be as simple as a basic version-control system, or as complex as integrated object-management systems.

Testing is continuous for E-business. E-business apps must be thoroughly tested before they're deployed, but they also must be re-tested as the content and traffic load changes.

E-business testing typically includes functional testing, load testing, and integration testing. The number of disparate pieces, some controlled by third parties, complicate E-business integration testing.

Application development for E-business increasingly consists of the assembly of components and integration. Most application-development tool vendors have introduced online and E-business-enabled versions of their tools. Application-server vendors also often include application-development tools. In addition to application development, E-business development calls for the creation of Web pages, which entails Web-authoring tools. The latest Web-authoring tools incorporate XML and Active Server Pages or Java Server Pages.

In addition to the basic enabling components, an E-business infrastructure must provide for such supporting functions as CRM, customer service, personalization, collaboration, fulfillment, and business intelligence. These capabilities and more can be delivered as applications running on top of the E-business infrastructure, or can be integrated into core components, such as the E-commerce platform, or delivered by outside service providers.

Finally, the E-business infrastructure has to address storage. E-business very quickly generates massive amounts of information that must be captured, stored, and readily accessible. Storage may take the form of conventional server-attached storage, storage area networks, network-attached storage, or outsourced storage. Regardless of the storage format, massive scalability, high availability, and security are paramount.

Services play an increasingly bigger role in the creation of the E-business infrastructure. In addition to the Internet service provider, which provides the gateway to the Internet, almost every element of the E-business infrastructure can be outsourced or purchased from a service provider.

The challenges of building and running an E-business infrastructure-the unknowns, continuous change, the demands for scalability and availability, the lack of skilled people-are driving many companies to use service providers to handle much or all of their E-business efforts.

The most likely elements to be delivered through a service provider are the E-commerce platform and some of the supporting functions, such as CRM, although the entire E-business infrastructure can be outsourced with the E-business providing only the content and marketing.

Other services address E-business performance. These include services that will host content at servers around the country or the world, which puts the content closer to the user, or host specialized content, such as streaming media.

A full E-business infrastructure is too complex to tackle all at once, especially given the need to move fast. Instead, companies can break the job into a series of phases: fast start, growth, differentiation, and E-business offensive. Through all phases, integration is a constant.

Fast start means getting the E-business up and running rapidly. Focus on a limited set of simple functions and a manageable amount of content. It can be expanded later.

In the growth phase, a company must consider scalability, both vertical and horizontal. This is the time to add features and functionality, expand content, and see traffic increases that will continue through subsequent phases.

After the company has absorbed the early growth, it's time to focus on differentiating the E-business. This involves personalization, CRM, and the integration of partners who will bring enhanced services.

Now the company is ready to go on the E-business offensive, to shift from reactive or defensive mode, which is how most organizations begin their E-business efforts, to an offensive strategy in which they pursue new opportunities. This will require yet more integration of new and different partners, as well as the possible adoption of new technologies, such as wireless or streaming media. This phase will test the scalability and flexibility of the E-business infrastructure, but this is where the big payoff, the big return on opportunity, comes.