TECHNICAL GUIDE

March 1998

Internet Solutions
Business Unit

Compaq Computer
Corporation

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Electronic Business: Merchant Considerations for Web Storefronts

This paper provides an overview of the elements involved in establishing a storefront that will enable a company or individual to conduct electronic business on the Internet. The paper targets primarily the merchant contemplating entry into electronic business and the specialist familiar with the Internet who is engaged in building virtual storefronts. The document provides architectural details for a Web storefront, criteria for selecting a storefront, considerations for implementation, an upgradable hardware architecture, and checklists for planning and deploying a storefront.

The storefront solution depicted in this paper is a generic, vendor-neutral solution that has the following functional components: back-end database, tax calculations, shipping services, fulfillment, payment systems, transactional security, order tracking services, administration, and traditional enterprise integration. At the heart of the architecture is the storefront. Its implementation should be considered carefully in relation to the guidelines presented in this document, and taking into account the potential ease of integration with the desired components of the architecture.

The presentation of storefront architecture is enhanced with lists of matters pertaining to the solution that must receive attention throughout the life cycle of storefront creation and maintenance. Included in the lists are guidelines for planning, deploying, and maintaining a storefront solution. These guidelines are supplemented with storefront construction checklists contained in the appendix.

Finally, the paper sets forth an upgradable, scaling Compaq hardware configuration as a platform for running the solution. The upgrade path includes configurations for entry level, high capacity, and array architecture. Each entry point into the solution path provides base components for the eventual growth of the site into a major electronic business focal point with underlying support from a scaling array architecture.

A framework for understanding how Compaq is positioned in the Electronic Business market and the powerful role that its products and services play is available in the following white paper: Compaq: Leading the Electronic Business Market.

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Electronic Business: Merchant Considerations for Web Storefronts
First Edition (March 1998)
ECG010/0398

INTRODUCTION

Electronic business has emerged as the next "killer application" on the Internet. By establishing a virtual storefront, merchants have the means of reaching customers outside their traditional channels. This document provides the merchant with a survey of all the components that comprise effective virtual storefronts. Included in the document are topics related to storefront deployment, a section on hardware selection, a glossary of terms and concepts, and an appendix consisting of a series of checklist considerations for planning and deploying the storefront. A framework for understanding how Compaq is positioned in the electronic business market and the powerful role that its products and services play is available in the following white paper: Compaq: Leading the Electronic Commerce Market.

FACETS OF ELECTRONIC BUSINESS

As the Internet has gained in popularity, the definition of electronic business has expanded to include it. Transitioning existing retail and catalog sales to the ubiquitous Internet infrastructure provides the merchant with a new sales channel. A new definition of electronic business, then, must include use of the Internet, and specifically a website, as a channel to capture, promote, and conduct sales transactions. The transaction may be completed online or via traditional methods such as mail, inbound telemarketing, or a retail outlet. The fact that the Internet was used to promote or entice a sales transaction creates the new definition of electronic business.

Several facets of electronic business have begun to migrate to the Internet. They include shipping services, notification services, tax services, client software (browsers), connectivity to enterprise systems, database connectivity, fulfillment services, and payment system integration. See Figure 1.

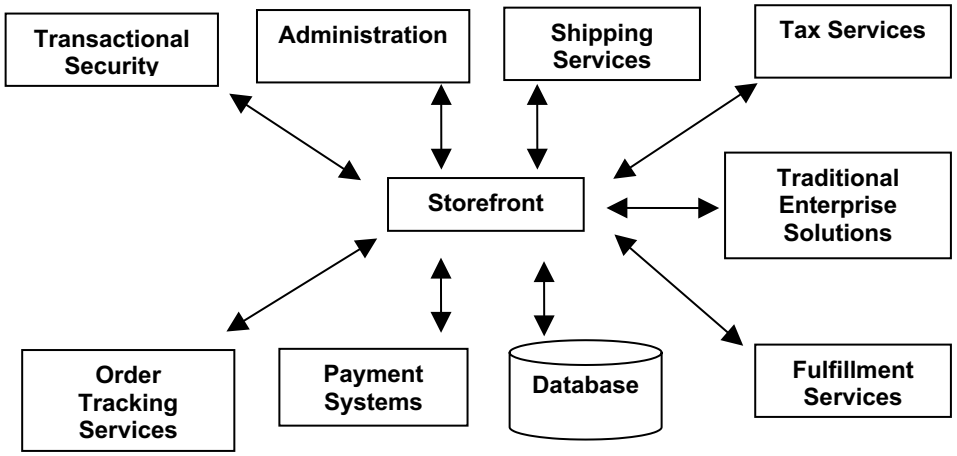

Figure 1. Facets of electronic business that are migrating to the Internet

Storefronts

A fundamental consideration for electronic business is the tool or development environment chosen to develop and deploy the storefront. The assortment of software programs available for creating and maintaining electronic business storefronts is vast. Some programs are highly structured and have numerous tools for carrying out storefront operations. Other programs consist of developer environments with sample code and frameworks for implementing a store. For merchants with extensive experience in website development, or for those who have retained a Web developer, the development environments provide a flexible, modifiable means with which to

achieve their objective. Other merchants intending to develop their own sites may, however, prefer to build on existing templates using specialized software tools and drawing inspiration from sample sites.

Additional characteristics to look for in a storefront software vendor and its offerings follow.

Business Practices

The following business practices of the vendor in question should be evaluated by the merchant:

- Time in the market place – typically, one to two years is average
- Future plans for change – how the software will respond to new customer requirements
- Technical support and training courses – their level and availability
- Availability of reference sites – for determining how others have used the solution
- Pool of developers – a good indicator of the availability of support by third parties

Reference sites and training courses may prove to be two of the most cost-effective methods of evaluating the vendor's product.

Software Features

The following key software features should be evaluated by the merchant:

- Administration capability and reporting features – store traffic, revenue analysis, etc.
- Ease of use for development, deployment, and maintenance
- Ease of integration with the back-office and fulfillment processes
- Pre-assembled stores and the ability to duplicate and modify them
- Ability to interface with third-party software such as tax services, payment systems, etc.
- Data importation tools from existing databases
- Interfaces – graphical and browser-based
- SSL and SET compatibility – SSL support should be considered a requirement
- Remote publishing and administration capability over the Internet
- Digital goods delivery support

An evaluation methodology should include the development of tables in which features are entered and ranked in importance so that a comparison across solutions can be made.

Technical Implications

Specific technical issues to consider include:

- Operating system support (Windows NT, UNIX , BSDI, etc.)
- Web server support (Netscape, IIS, Apache, etc.)
- Database integration (native drivers versus ODBC, vendor database support)
- Functional implementation (CGI, ISAPI, NSAPI, HTML, JAVA, Active Server Pages, etc.)
- Programming language for extension (proprietary, standard open such as C/C++)
- Content generation (dynamic versus static)

Each storefront product requires an environment detailed in the technical specifications. The impact of these requirements may be significant. For example, in a Microsoft Windows NT environment, the use of CGI-based scripts may have a significant impact on server performance compared to the use of ISAPI or NSAPI. Furthermore, native driver support may be a better performer in the selected environment than ODBC support. Any effort to make changes or perform programming in the environment of the storefront software may require knowledge of HTML, JAVA, Active Server Pages, or C/C+.

Tax Services

To carry out transactions on the Internet, it is necessary to calculate taxes on the goods purchased. While it is possible to maintain the tax rates for a particular set of jurisdictions in a table or flat file, because the tax codes and rules change frequently, keeping the information current can be burdensome. Considering the complexity of the U.S. tax codes, the prospect of maintaining the tax codes of foreign countries implies a significant management effort on the part of the merchant. To address this issue, a number of tax services are available by subscription. Such services provide up-to-date tax calculations for purchases made from websites in the U.S., Europe, and other locales. Some of the services are compatible with the programs of the leading vendors of storefront software. Merchants should consider the support of third-party tax calculation services when deploying their sites.

Payment Systems

A payment system is a method of accepting compensation for goods or services. The payment system determines how the merchant gets paid. Payment systems are discussed at some length here because of their strategic importance and potential complexity.

The methods for processing payment of a transaction over the Internet are similar to those used for Point of Sale (POS) transactions in a traditional retail outlet. The key difference is the medium that sustains the transaction. Internet technology provides for all major forms of cash and cash-free transactions. Such transactions include Internet dollars paid for in advance, Internet checks, traditional credit cards, and provision for lines of credit with particular merchants. Since the most common method of payment and the one most familiar to merchants is the credit card, the focus here will be on credit card transactions.

A number of software components must be in place in order for credit card transactions to be carried out successfully. At the consumer side there may be virtual "wallets" that hold the certificates used to authenticate the purchaser's identity and financial and personal information. Wallets are often available from the Internet and are the responsibility of the consumer. (A commerce website, however, should provide the consumer with the opportunity to obtain and set up a wallet if the use of wallets is indicated.) At the Web server or merchant side there is “register” software that accepts payment information and transmits it to the payment gateway.

Considerations in the selection of a payment system include: compatibility with the existing storefront, operating system, and Web server programs, acceptance by the merchant’s bank of Internet transactions, and confirmation that all bank cards to be offered can be processed via the Internet transaction provider that has been selected. Alternatives to automated payment systems should be provided for customers concerned with security. Such alternatives include 800 numbers, provisions for printing shopping cart contents and faxing or mailing the order to the merchant, and mechanisms allowing the consumer to register the payment method by telephone or fax before making a purchase.

Transaction Security

Related to the topic of payment systems is the need for some form of security for business conducted over the Internet. The merchant should clearly explain on his or her website the security

policies that are in effect there in order to ensure the confidentiality of customer information. A written statement will go a long way towards gaining customer confidence.

Two types of security currently are predominant on the Internet: secure sockets layer (SSL) and the evolving secure electronic transactions (SET) protocol. All payment system providers now support SSL and are in the process of incorporating SET version 1.x. Both SSL and SET provide some level of encryption for the transaction. Encryption encodes data such as credit card numbers to prevent people from viewing it as it travels over the Internet. For encryption to be supported, certificates vouching for the authenticity of the merchant must be obtained from a certifying authority. Each entity that wishes to perform encryption must hold a certificate.

SSL provides the simplest approach to protecting data as it flows from the browser to the Web server, and is the most widely implemented approach. If nothing else, SSL should be in place in order to protect the content of Internet transactions. While SSL is widely supported, however, it does not protect data beyond the Web server, that is, as the data travels to a payment gateway for approval. Care should be taken to ensure that the payment system vendor provides encryption between the Web server and the payment gateway. Once the data reaches the server, it may be decrypted and stored locally according to the dictates of the particular payment system and storefront that are in use. Care should be taken to protect critical decrypted data residing on the server against Internet intruders.

SET, unlike SSL, provides strong encryption techniques for end-to-end encryption from the browser through the Web server to the banks' Internet gateway. At each step of the way, information is encrypted in such a way as to protect the appropriate participant. For example, the merchant does not need to see the buyer's credit card number. The merchant's only concern is that the card is authorized for the amount of the transaction. The bank, on the other hand, does not need to see the content of the transactions, only the total dollar amount and the card number. Besides end-to-end encryption, SET has the additional advantage of support by banking institutions, and may provide Point of Sale "card present" rates for Internet credit transactions instead of the higher "card not present" rates to which Internet orders, like phone orders, are subject today. There are drawbacks to SET, however. This security protocol is not widely implemented or accepted yet, demands a considerable level of server resources, and is part of a standard that is continuing to evolve.

Order Tracking Services

Order tracking can be viewed from two perspectives: that of the Internet merchant and that of the Internet consumer. The merchant must be able to track information about orders placed at the website. The consumer needs to have a way to check the status of a placed order. Standard conditions such as back orders and partial shipments must be handled by the system. Additionally, automatic notification by electronic mail that product is being shipped should be considered in any order tracking implementation.

Fulfillment

Once an order has been received, fulfilling the order becomes a matter of first priority. A retailer may have a distribution mechanism in place already, and may simply need to ensure that it accommodates the new sales mechanism represented by electronic business. Other merchants, however, may not have direct customer shipping in place. As an alternative to the potentially burdensome process of shipping goods out of inventory directly to customers, those merchants may wish to consider a fulfillment house whose sole business is to drop ship goods directly to consumers. A fulfillment house acts as a single point of contact for maintaining inventory on behalf of the merchant or for placing consolidated orders from the merchant's business. In the long term, however, it may be to certain merchants' advantage to bring order fulfillment in house.

Shipping Services

Although shipping services may be linked directly to fulfillment and may be handled by fulfillment houses, such services are discussed separately here. Shipping services include shipping charge quotation and package tracking. Most service companies provide some form of online quotation capability that can be plugged into the merchant's own transaction processing system. Service companies also typically provide online tracking mechanisms for packages that have been shipped. This feature can be especially useful to customers who are searching for a package shipped by the merchant. For shipping, as well as for fulfillment, care must be taken to acknowledge the potential audience, and to keep in mind that an electronic business merchant's product and services may have to reach countries that are remote from the merchant's base of operations. The merchant should investigate possibilities for putting any current shipping services that may exist at the disposition of his or her electronic business site.

Enterprise Integration

Large or small, a company may have already invested considerable capital in computer systems for inventory tracking, accounting, manufacturing, and order management. The advent of electronic business on the Internet should be a mere extension of such existing automated business processes. Marrying Internet commerce to existing corporate data systems can save time and money and avoid duplication of effort. The act of combining the two may be a matter of transferring data from a database used for the website to a corporate database server in some form of batch mode operation. However, care should be exercised during the integration process to ensure that unwelcome Internet visitors do not gain access to the corporate infrastructure or manipulate its content.

Administration of the Storefront

Administration of the storefront encompasses a number of activities. Such activities include the following: updating pricing or product information, publicizing promotional events such as discounts, processing placed orders, generating reports on key statistics such as orders per month, and capturing and reversing credit card sales. Such capabilities should be included with the other criteria used by a merchant to judge the suitability of storefront software. The merchant must decide which administrative tasks are necessary for business to be conducted effectively on the website, and must focus the evaluation of available programs accordingly.

CONSIDERATIONS FOR SUCCESSFUL STOREFRONTS

Site Development Practices

The process of developing an electronic business solution based on the generic architecture discussed so far is similar in scope to processes followed for other major IT projects. There are important differences, however. The audience for electronic business is much broader, for example, than the audience for other applications. The components needed for implementation are potentially more dispersed, and are based on newer technologies. The market for electronic business is less understood than markets for other forms of commerce. Nevertheless, electronic business will be pursued by persons with no experience in information technology of any kind, much less with the newer ramifications of that technology involving Web applications. To make things easier for such individuals, the sections that follow detail steps that must be taken and decisions that must be made on the path leading to launch of an electronic business site.

Step 1: Team Building

The merchant seeking to establish an electronic business site should create an interdisciplinary team that can help analyze the electronic business needs of the company and determine which are the "best fit" solutions. Certain areas of the company will have a natural affinity for the project simply because they are most affected by its outcome. Typically, these areas are the following:

- **Marketing**. Members of the marketing department will have a crucial perspective on issues of advertising, sales, and distribution.
- **IS**. Information systems people can provide technical expertise for the project and help ascertain system requirements.
- **Supply chain**. Team members from procurement, operations, and manufacturing will help ensure that the supply chain is fully integrated into the electronic business cycle.

A team whose membership cuts across departments is recommended, because such a team can best foresee and prepare for the far-reaching impact on the company that electronic business will have. In some cases, changes to existing business processes may be required. A diversely constituted team is best able to identify where change is needed and create realistic plans for carrying it out.

Step 2: Outsourcing Appropriate Tasks

The electronic business team should determine how best to balance procurement of resources for the project between in-house personnel and outside labor.

- **Content Creation**. It may be possible for company personnel to build some parts of an electronic business site in-house using off-the-shelf components. Creating content in-house has certain advantages. It allows the merchant to maintain consistency with other media produced in-house, exert greater control over design, and build inside expertise in the new technology. There are, however, many firms that specialize in content creation for websites. It may be easier and even less expensive to contract content creation to such a firm. Several considerations support such outsourcing. Workers from inside the company may not be able to become proficient enough with new tools to create content within an acceptable timeframe. Also, equipment and overhead required for in-house content creation become fixed costs. This accounting consequence may be undesirable if the electronic business program is viewed as purely experimental.
- **Content Hosting**. The merchant must decide whether to host website content on a server maintained by the merchant, or on that of a third-party web hosting service or ISP. In-house hosting offers greater control over content and data generated by Web traffic. To perform such hosting, however, the merchant usually must purchase and install a secure server that encrypts and protects confidential information such as credit card numbers sent over the Internet. Such hosting assumes, also, that the merchant is properly equipped with a full-time Internet connection, a firewall, and a staff to monitor the server. Startup costs for this scenario, including hardware, software, and labor, range from approximately $25, 000 (U.S.) for a small site to $70, 000 (U.S.) for a large site. Instead of making this considerable investment, the merchant may decide to turn the site over to a trustworthy company that specializes in Web hosting. The latter approach helps eliminate the capital investment, and favors rapid establishment of a presence on the Web. The company to whom hosting is outsourced should be well equipped and capable of growing with the merchant's needs. Important services that should be available from the company that provides Web hosting include peak-load balancing and the provision of bandwidth "on demand." These services contribute to the efficient operation of the Web site.

- **Transaction Processing**. When designing a site, it is important for the merchant or the merchant's agent to understand how customer order information will be captured and integrated into the normal flow of order processing. If the merchant hosts the site in-house, and existing transaction processing systems adhere to open standards, it is possible to enable such systems for the Web rather quickly. On the other hand, if existing systems are customized, sophisticated integration may be required, and that process can take time. In such cases, given the likelihood of greater technical complexity, resource consumption, and time spent in development, it may make sense for a third party to host transaction processing.

Total costs for in-house work versus outsourcing can vary considerably, depending largely on the complexity of the site and on certain choices made earlier in the process of building for electronic business.

Step 3: Planning

The third step is to develop a plan that embraces all the merchant's electronic business requirements. This plan should take into account the following essentials:

- **Strategy**. Developing an electronic business program is no different from developing programs that are realized through traditional marketing channels. The online merchant's marketing strategy should consider the four "P"s: **product, pricing, promotion**, and **place**.
- **Rules**. Business rules and linkages should be incorporated into the site. Such rules and linkages include how the site will handle data entry, updating, query and report processing, and programmed connections to other sites.
- **Catalog assembly**. Ideally, the merchant's advertising department or agency will have existing electronic files that can be used to create most of the electronic catalog's content. If not, the department or agency can support the effort involved in creating the catalog.
- **Integration**. A key component of success is the integration of supply chain partners into the electronic business sales plan. Website activity allows merchants to project demand based on actual sales data gathered daily, weekly, or monthly. As volume increases, this data can help procurement and manufacturing teams increase output of the supply chain smoothly. The ability to forecast demand and to control supply is one of the primary benefits of a successful electronic business program.
- **Content Planning and Maintenance.** The presentation of the website's goods and other content should be one of the electronic merchant's primary concerns. The public expects an electronic store to maintain a consistent user interface. It is important that website content be developed by persons with mastery of interface issues. The designer's abilities should reflect a desirable mix of advertising and artistic talent with computing expertise.

  The content of a good website should be refreshed periodically, attracting repeat visitors with new shopping opportunities or new information. The public expects such change in an electronic store, and each return visit increases the possibility of a sale. The merchant must make provision for content updates to occur. Major changes to content or function should be piloted on a development platform when possible so their effects can be observed before they are deployed.

  In addition to content changes such as those described above, the electronic store will require management activities such as the capture, settlement, and reversal of financial transactions, and the collection of orders that accumulate, assuming such functions are not already integrated into the electronic merchant's enterprise.
- **Content Delivery.** The two major types of website content are static content and dynamic content. A merchant must have some familiarity with the particular type of content that will be used. Each has its advantages and disadvantages, which are discussed below.

Static Content

As its name implies, static content consists of Web pages in HTML or comparable format whose information rarely changes except at the hands of a Web-authoring individual. Such content is suitable for an electronic business site whose product offering is small in quantity, and whose structure and presentation remain constant. Necessary changes to static pages are carried out by someone using HTML authoring tools. This approach is simple, inexpensive, and has performed well over time. It provides an ideal platform on which many new electronic merchants with limited requirements can open their businesses on the Internet.

Dynamic Content

Dynamic content is characterized by continual, largely automated, change. In such a system the entire website may consist of database objects and attributes. As they are requested by a browser, the objects and attributes are assembled from a Web server using a back-end database. A less complex variant of the dynamic model may entail lookup in an ASCII file of only the variable information associated with the storefront, information such as prices and quantities on hand. Either way, in most cases an executable program of some type is launched each time a browser attaches to the Web server and requests information. This results in heavier server loads, which can diminish performance when many users make simultaneous demands on the Web server.

The advantage of dynamic content is the increased manageability of product offerings that it provides. The greater control brings the ability to change prices immediately, to create customized content or pricing for a particular audience, to obtain instant inventory levels, and to exploit sales opportunities based on membership. A further advantage is realized when money is saved because the dynamic content mechanism avoids time that would be spent redesigning a static website in order to implement required changes. Dynamic content facilitates relationship marketing based on such tactics as upsales, complimentary sales, and alternate suggestions for out-of-stock inventory. It enables tracking of individual buying habits so that new products can be offered based on previous purchases and customer-provided profiles.

Database Support

Most dynamic implementations rely on relational database technology to provide the structure of the electronic store, including pricing, product descriptions, location of graphics, etc. The use of a database is a natural extension of the dynamic website. The database is further used to track orders, customers, and payments, information that fed into website usage analysis reporting. All the major database products, including Oracle and Microsoft SQL Server, support dynamic websites, providing access by means of ODBC interfaces or, in some cases, native drivers. If the merchant's existing enterprise already uses a particular database product, it is usually best to continue using the same database in the electronic business venture.

- **Site Promotion.** To help users locate the website once it is online, some effort should be spent registering the site with popular search engines such as Yahoo (www.yahoo.com). The merchant should consider using "banner" advertising on popular Web sites, especially on sites that attract the merchant's customer base. "Push" technology can help find new customers, but it relies on customers themselves to subscribe to the service, which may require promotion and education through other channels. Advertisements for the website placed in traditional media such as newspaper, radio, and television, and on business cards, brochures, and other printed matter, are also effective in promoting the site.

- **Web Server Security Planning.** Web server security can be divided into the following categories: physical security, operating system security, network security, Web server security, application security, and transaction security. The extent to which each category of security is provided for determines the general level of protection against fraud and tampering that will be enjoyed by the electronic merchant and his or her customers. Assuring that the server is physically secure, for example, prevents someone from turning the power off, accessing the terminal directly, or tampering with server components. Assuring that the operating system is secure prevents unauthorized access to server content. Assuring that the network is secure prevents all but permitted browser traffic from reaching the server, and may entail installing a firewall and routers. Assuring that the Web server and application are secure prevents theft of sensitive intelligence such as credit card information, and mischief such as tampering with the price of goods. Even with protective measures in place, sensitive information residing on the merchant's Web server may be vulnerable to theft or sabotage. For this reason such information should be routinely removed from the server as quickly as possible. Finally, assuring that transactions are secure protects the exchange of money between merchant and consumer.

Step 5: Going Online

Most merchants do not reach the electronic business marketplace in full bloom. Instead, the process of taking a commercial business online involves distinct steps that may be implemented over a period of months, or even years. Key actions along the way include phased implementation, limiting initial product catalog size, monitoring site performance, and preparing for growth.

- **Implement in phases**. The merchant should avoid "big bang" project rollouts, since these can often lead to a "big bust." The more complex the strategy, the more compelling the case to implement it in phases. Many companies put their catalog online first and continue taking orders over the phone, switching to online transactions only after a suitable introductory period. Three phases of implementation are detailed below.

  Phase I: The Online Catalog. The first step in going online is typically to provide customers with a view of the merchant's products in an online catalog format. This is fairly simple to do and does not require a great deal of back-end transaction processing. The catalog information can be published online as static Web pages, although building a dynamic site from the start will simplify the site's maintenance. Meanwhile, the first phase of an electronic business website will typically continue to route customers off-line to place their orders through more traditional channels such as fax or 800 numbers.

  · **Phase II**: **Online Ordering and Payment Processing**. Once the electronic merchant – and the customer – reach a certain comfort level with the online catalog approach, the next logical step is to add online ordering and payment processing. This consists of a series of online forms that take information from the customer and send it back to the merchant for processing, including customer name, address, ordering information, and payment information including credit card numbers.

  · **Phase III: Back-Office Integration**. The most advanced electronic business sites are fully integrated with the company's back-office accounting processes, so that inventory, ordering, and payment information are all handled by a complete system that smoothly passes the appropriate data in both directions, with minimal human intervention.

- **Limit product offerings**. The initial site offerings should not be so large as to be unmanageable. However, consumers will expect a wide array of choices. Online merchants should strive for a balance between these two imperatives.

- **Monitor site performance.** Monitoring the website's performance will contribute to an electronic merchant's success. Monitoring should be possible by remote means and should include system performance, sales performance, and analysis of Web traffic. Each category

contains indicators on the productivity of the online store. Consistent monitoring will help answer important questions such as: Is it time to upgrade server hardware? Is it time to modify store content? What products, pages, services, and information are most critical to my customers? Am I attaining my business objectives? Which products are selling, which are not? How many people who visit actually buy a product?

Assistance in answering such questions should be available on the Web server through tools functioning at the operating system level. Alternatively, the Web developer can facilitate access to the information through a set of secure browser-based screens. Performance and usage information can be logged to disk for analysis without need for continual human monitoring. Such capability would enable, for example, the tracking of server performance during peak usage over a four-hour period, logging of the information to disk, and the subsequent automatic generation of reports based on analysis of the data. Care should be taken not to monitor a server excessively and collect unnecessary data. Such over-monitoring can lead to additional resource consumption without direct benefits for server analysis.

Remote Site Management

It will be necessary from time to time to gain access to the system console from a remote location in order to carry out certain operations at the operating system level. The operations in question might include restarting Web processes or services, rebooting machines, altering tape backup schedules, and adjusting tuning parameters. There are several ways to perform such activities depending on which operating system is in use. For example, all Compaq ProLiant servers are delivered with Integrated Remote Console software that furnishes remote access to various operating system functions. Compaq servers are also delivered with pre-boot tools for disk configuration, read-only memory (ROM) updates, and system partition utilities for configuring the server. Compaq's Carbon Copy32 provides access to the Microsoft Windows NT operating system through modem dialup and corporate intranets. The Compaq Remote Insight Board is an optional additional piece of hardware that grants complete access to a server even when the server is down. For more information about the Compaq products and their features, see the Compaq website at www.compaq.com. For details on server management in an ISP environment see Compaq white paper number ECG028.0997, Server Management in the ISP Environment

- **Prepare to grow**. It is important to move swiftly once the site achieves its initial goals. The beauty of doing business on the Internet is that it is possible to make quick adjustments to form and content if site performance is not satisfactory. The merchant shouldn't expect too much, too soon. As with any retail outlet, it will take time and effort for the site to attract customers. The merchant should expect traffic to build gradually over time, and be concerned mainly if site traffic stagnates or dips.

Step 6: Feedback

Electronic business gives merchants an unprecedented opportunity to profit from information gathered online, and to fine-tune offers quickly. The Web server keeps detailed information about the path each customer takes through the site and the types of products being ordered. Merchants can use data-mining techniques to analyze this data and reveal patterns that might not be readily apparent because of the sheer wealth of information accumulating in the growing database.

Growth

Internet traffic is growing at a phenomenal rate, and it is vital that teams planning and implementing electronic business are oriented toward the future. Improved technologies and applications will appear constantly, and planners must be aware of new solutions that become available.

In the future, software "agents" will enhance buyers' ability to find products that conform to their tastes and preferences. New devices such as the network computer (NC) and WebTV may become important ways in which buyers can access merchant sites in the future.

As today's relatively slow, modem-based communications are replaced by ISDN, xDSL, satellite, and cable technologies, it will be increasingly feasible to use full multimedia in online content. Innovations such as public kiosks in retail outlets can connect directly to an electronic business website and offer customers products not stocked in the store itself. Besides generating additional sales, kiosks afford further opportunities to study the performance of the electronic business program and assess its effect on volume and traffic in the store.

HARDWARE SELECTION AND RECOMMENDED CONFIGURATIONS

Coupled with the need to plan for growth is the need to provide a hardware platform that accommodates the initial electronic business venture while providing a continuing upgrade path. In this section underlying Web server performance characteristics are discussed. This discussion is followed by a series of hardware configurations that are geared at accommodating growth.

Web Server Configuration and Performance

Assessment of server performance should include the availability and reliability of the server as well as its ability to support transaction volumes. Web servers running electronic business applications are characterized by intense central processing unit (CPU) activity. This is especially true where dynamic page generation supported by a database is involved. An important factor affecting server performance is the amount of random access memory (RAM) installed, because it directly determines how often the server's hard disk must be accessed. Operations that access disk execute more slowly than operations relying exclusively on resources already held in RAM. For a study of Web server performance under differing load conditions see Compaq white paper number 061A/0797ECG, Compaq ProLiant 850R Dedicated Windows NT Web-Hosting Server.

The adequacy of the hard disk drive system also counts heavily in Web server performance. The issue of speed should be weighed, since a faster drive system will reduce the time required for data to be retrieved from the disk. Robustness and reliability are critical, and can be assured with proper levels of redundancy. It is highly recommended that Level 1 or Level 5 of the technology known as Redundant Array of Independent Disks (RAID) be used in the hard disk drive system. Both of these RAID levels enable the server to withstand a single drive failure and sometimes multiple drive failures depending on the configuration. For a comprehensive discussion of RAID and disk drive systems see Compaq white paper number ECG025.0997, Disk Subsystem Performance and Scalability

Compaq recommends that a tape drive be used to back up the server in environments where a centralized tape store is not in use. Should disaster strike, a backup tape may provide the only means of recovering lost information or restoring the entire server, including a merchant’s site and product catalogs.

Any estimate of equipment requirements depends closely on how a website will be implemented. Predicting Web server performance is difficult in situations where page content, application functionality, and database schemas and size vary widely. With such variables in mind, the new electronic merchant should try to measure the performance of the specific server in use after the website has been developed but before going live. In these conditions it should be possible to test processor utilization, the number of requests per second satisfied, and average response time. Such statistics will help estimate the server response that can be anticipated under both "steady" and peak load levels.

Making the Initial Purchase

The new electronic merchant's goal in purchasing a Web server should be to satisfy anticipated demands at startup while leaving room for the system to grow with the business. The merchant should formulate long-term business objectives in the light of an expectation for growth in content, functionality, and traffic. An important component of such planning is the selection of a server that can comfortably support the Web presence. Compaq has three recommended architectures for servers running an electronic business website (for complete details of the configurations please see your local Compaq Authorized Reseller). One configuration can grow logically and naturally into the next, so that no expansion limitation is imposed by the hardware and growth can occur in an orderly and efficient manner. A description of the three Compaq hardware configurations follows.

Entry-Level Configuration

Figure 2. Entry-Level Configuration

The entry-level configuration recommended (Figure 2 above) is an inexpensive server designed to support the merchant's entry into electronic business. It has a single 200-MHz Pentium Pro processor and can be expanded to contain a second such processor. A self-monitoring analysis and reporting technology (SMART2) disk array controller and two one-inch, 4.3-gigabyte (GB), mirrored drives equip the server with sufficient redundancy at the disk level to sustain operations even after a single drive has failed. Maximum capacity for online internal storage with the entry-level configuration is 4.3 GB. Non-mirrored versions of the configuration can have up to 18.2 GB of storage with the CD-ROM installed, or 27.3 GB with the CD-ROM removed (one CD-ROM may be used externally with an additional option kit). Installed with a RAM base of 128 MB, the entry-level configuration is expandable to 512 MB. A tape drive backup system for the entry-level configuration is recommended in environments where a centralized tape store is not in use.

High-Capacity Server Configuration

Figure 3. High-Capacity Configuration

The high-capacity configuration recommended (Figure 3 above) delivers greater capacity and redundancy, compared to the entry-level configuration, for scenarios in which a higher level of server capacity is critical. The high-capacity configuration has two 200-MHz Pentium Pro processors, each of which has one MB of cache for increased application performance. The configuration can be expanded to house up to four processors. A RAM base of 256 MB expandable to four GB provides the capacity for both the Web server and the database. A SMART2 Dual-Port controller with an onboard cache of 16 MB is included in the configuration allowing the server to

support up to seven internally arrayed one-inch drives or five arrayed 1.6-inch drives. The controller can also support external storage. The recommended configuration contains five 4.3 gigabyte drives in a RAID 5 array. An internal digital linear tape (DLT) drive is part of the high-capacity server configuration. The tape drive can back up a maximum of 70 GB of compressed data. The server can accept redundant hot-pluggable power supplies, fans, and peripheral component interconnect (PCI) cards. It can be upgraded to the next generation of Intel processor.

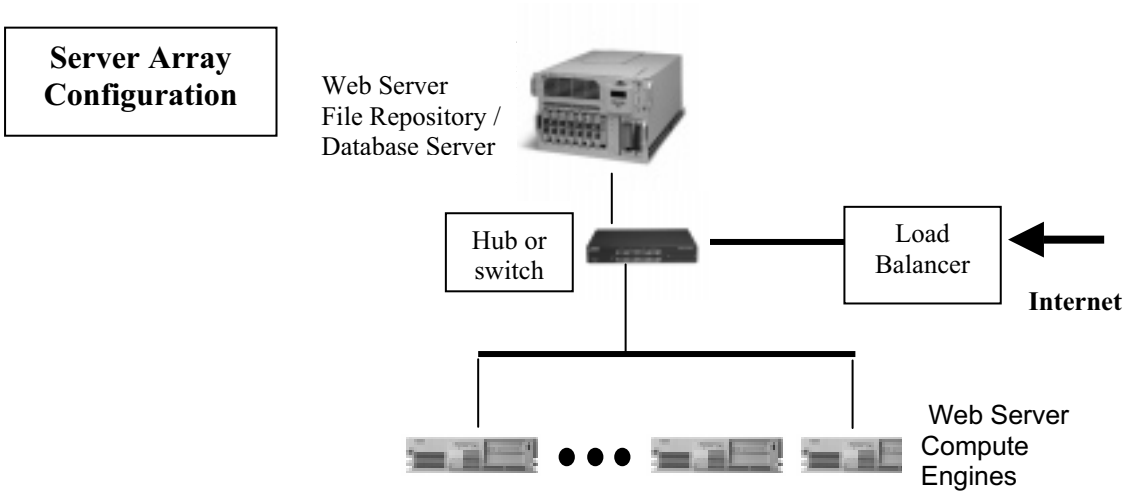

Figure 4. Server Array Configuration

The server array configuration (Figure 4 above) centers around the Compaq server array architecture. This architecture provides a highly scalable, redundant configuration in which additional Web server compute engines such as the Compaq ProLiant 850R can be attached and removed online. Recommendations for the compute engines specify single Pentium Pro 200 processors, 64 MB of RAM, and a single 4.3-GB drive. Recommendations for the file repository and database server specify two Pentium Pro 200 processors, 128 MB of RAM, a SMART array controller, and three 4.3-GB drives in a RAID 5 configuration. The configuration promotes scaling because load can be evenly distributed over the compute engines when Web server delays occur. Scaling capacity to respond to incoming requests should be viewed in terms of two usage conditions: steady state usage and peak usage. Additionally, the configuration highlights redundancy because any number of compute engines can fail and the array will continue operating, provided at least one compute server is still functioning. A choice of load balancer or DNS round robin provides an entry point to the server array.

Of the three server configurations described, the server array configuration is the most easily expandable without downtime. If a merchant's business plan includes a serious commitment to Web commerce where customer use and growth is expected, the merchant should contemplate the server array configuration from the outset. An initial architecture to consider includes a database and file repository that is separate from the Web and electronic business application server. Separating the two elements will make setup of the server array a mere operation of adding Compaq ProLiant 850R servers coupled with either a load balancer or DNS round robin connected by a hub. Downtime, the need for which may very well strike during the busiest part of the merchant's business cycle, can be limited to the brief period required to perform simple network reconfigurations.

In addition to selecting a Web server to act as a production machine, it is advisable for the electronic merchant to purchase a development platform where new and updated content as well as server-related software can be loaded and tested prior to deployment. The arrangement will allow

the merchant to try out new ideas in a safe test environment before putting them in practice, thus sparing the production machine the risks associated with experimentation. Although the production server and development server are separate machines, effort should be made to keep them as similar as possible to one another in order to avoid situations in which problems may appear on one platform but not on the other.

Redundancy and Maintenance

Important features of the preferred Compaq server platforms are redundancy and ease of maintenance. The Compaq ProLiant 850R server can withstand drive failures because one drive is mirrored to another. Since the drives are hot-pluggable, they can be removed while the server is in operation. The Compaq ProLiant 6500R server has all the features of the Compaq ProLiant 850R server plus redundant hot-pluggable power supplies, fans, and PCI cards. The Compaq server array architecture carries the concept of redundant, maintainable Web servers even further. If a unit in the compute farm requires maintenance or fails, it can be disconnected, repaired, and reinserted into the array with only a small effect on the output of the rest of the array and no downtime for the website.

CONCLUSION

This paper has presented an overview of the processes involved in planning, designing, and creating an electronic storefront for conducting business over the Internet. It has described briefly the various components and sub-systems that typically make up an electronic business solution. It has highlighted important points that the aspiring electronic merchant must consider in evaluating tools, allocating resources, and seeking providers of services that enable and support electronic trade. Equally important, the paper has set forth a set of Compaq hardware platforms optimally suited for electronic business applications at varying levels of robustness and scalability. Key points emphasized in the paper are the complexity of the evolving technologies that support electronic business, the importance of a careful, methodical analysis by the merchant of current and future business needs, the crucial nature of well-grounded decisions as to where to procure resources for essential parts of the system, and the benefits of leveraging existing business systems and practices as much as possible in forging a new electronic enterprise.

In addition to this white paper, members of Compaq Internet Solutions Business Unit have written other papers on topics involving electronic business, web servers, and the Internet. Please see the Web page www.compaq.com/internet for more information.

GLOSSARY

Banner ad
A prominent advertisement displayed on screen when an Internet user navigates to a page. Such ads are often seen as a result of searches because they are context sensitive (that is, if the user searches for information on cameras, he or she may see ads concerning camera equipment). Banner ads can be expensive, but have the virtue of providing good visibility sites that purchase them.

BSDI (Berkeley Software Design, Inc.)
The commercial supplier of the high-performance BSD Internet and networking software originally developed at the University of California, Berkeley. It is a UNIX variant that is available for the X86 platform.

CGI (Common Gateway Interface)
A set of rules describing how a Web server communicates with another piece of software on the same machine, and how the other piece of software (the "CGI program") talks to the Web server. Usually a CGI program is a small program that takes data from a Web server and does something with it, such as putting the content of a form into an e-mail message, or turning the data into a database query.

Co-location
An alternative to self-hosting, co-location is a service in which an ISP carries out the task of installing the electronic merchant's equipment on the ISP's premises. The ISP assumes responsibility for providing network connectivity, keeping the server running, backing up the merchant's information on tape, and furnishing firewall protection. The service also may include paging facilities, loan or rental of temporary equipment, hardware maintenance, and provision of technical support at the operating system level.

Dynamic HTML (Hypertext Markup Language)
Browsers execute code on the server retrieving HTML pages. The pages are created upon request, in contrast to static HTML pages that are stored on the server and never change.

E-mail postings
E-mail addresses obtained from Internet companies are used to create e-mail messages to publicize electronic stores or their merchandise. Such e-mail may be extremely unpopular, since it is equated with junk mail.

IIS (Internet Information Server)
A Web server from Microsoft.

Internet sampling and giveaways
The word "free" is guaranteed to attract website visitors. An example of a successful giveaway program is provided by a company named Jelly Belly. For over a year it has announced the availability of jelly bean samples on its Internet site. The response has been such that the company's daily supply of 500 samples is exhausted in less than ninety minutes.

ISAPI (Internet Server Application Program Interface)
An application program interface for Microsoft's Internet Information Server (IIS), a Web server. ISAPI enables programmers to develop Web-based applications that run much faster than CGI programs because they are more tightly integrated with the Web server. ISAPI programs run as threads, not as processes.

NIC (Network Interface Card)
A NIC provides connectivity between a server and the network.

NSAPI (Netscape Server Application Program Interface)
A application program interface for Netscape's Web servers. NSAPI enables programmers to create Web-based applications that are more sophisticated than CGI scripts and run much faster. Such programs run as threads, not as processes.

ODBC (Open Database Connectivity)
A programming interface that lets applications access data in a database management system that uses SQL as a data access standard.

Peak Usage
Represents the maximum burst of simultaneous requests that must be satisfied by the website.

RAID (Redundant Array of Independent Disks)
A technology for storing data across several drives to improve performance and provide fault tolerance.

Search engine registration
A common method of drawing traffic, search engine registration has its place in the website promotion strategy. Services exist that, for a fee, register a website with the top 350 or so search engines. The effective use of search engines involves intelligent crafting of keywords so that individuals using the engines for keyword searches readily find the site in question within the first few pages returned by the search.

Self-hosting
The practice of owning and maintaining one or more Web servers on the corporate premises.

Site ads
A space on another Internet site with established traffic patterns whose content relates to that of the site promoted by the ad. In many cases reciprocal promotion is advantageous for both sites. For example, a golf club website and a golf shoe website might each place an ad on the other site for the mutual benefit of both.

SMART (Self-Monitoring Analysis and Reporting Technology)
A Compaq name for a key part of its storage technology.

Static HTML (Hypertext Markup Language)
See "Dynamic HTML."

Steady state usage
Represents the average demand on the website during normal operation.

UNIX
A multiuser, multitasking operating system that is widely used as the master control program in workstations and servers.

Windows NT (Windows New Technology)
An advanced 32-bit operating system from Microsoft for Intel x86, Alpha, and MIPS processors.

APPENDIX: WEBSITE CONSTRUCTION CHECKLIST

Planning Checklist

- Consider closely the business requirements of the new electronic business store and website.
- Consider the impact of the new electronic business store on your existing business processes.
- Study the internal support capabilities of your company.
- Develop a feature-and-function list of the storefront software programs that are available (see "Storefronts" on page 3 for a list of what to look for in storefront software).
- Search the Internet for reference sites that use the various storefront packages. Contact the sites' creators for information about the storefront software that they used.
- Survey the banking options that exist for the various payment systems. Key questions include: Does the bank accept Internet transactions? Does the bank use a service that accepts Internet transactions? What payment systems does the bank interface with?
- Select a compatible combination of operating system, Web server, storefront program, payment system, and database.
- Determine whether or not the website will be developed in house.
- If website development is sought outside the company, select a developer on the basis of the operating system, Web server, and storefront package that have been chosen.
- Determine where the website will be hosted – in house or co-located with an ISP.
- If hosting is to be by co-location, look for an ISP that can support all or most of the functions of the future website.
- If hosting is to be in house, make provision for developing or integrating the new website with the corporate Internet connection, including appropriate security measures.
- Select the appropriate hardware for the software solution.
- Provide additional hardware for development, separate from the production environment.
- Design the layout, content, and functionality of the website.
- Minimize complex graphics and features that increase page download time. Most Internet users have only a 28.8-Kbps modem line.
- Consider providing links to other applicable sources of product information (a review in an online magazine, for example).
- Provide a search engine that lets customers find products easily.
- Illustrate the store’s hierarchy so the customer is always oriented and can jump to other locations easily.
- Consider allowing customers to place items in a cart and return later to finish purchasing.
- Consider store navigation paths carefully; for example, register customers when they select or buy something rather than when they first enter the site. Customers may be reluctant to furnish personal information initially.
- Post information about your policy regarding the sharing of personal information with other companies. Post information, also, about security and other important company policies.
- Provide multiple payment methods such as 800 numbers, order by fax, offline payment, and online payment.

- Provide a mechanism for customer feedback both online and offline.
- Verify your website's compatibility with all major browsers.
- Ensure the presence of store administrator functionality.

Deployment Checklist

- Prototype the site and verify the design.
- Ensure the security of your site implementation.
- Develop or verify that a backup strategy with a tested restore is in place.
- Make provisions to provide coverage for hardware maintenance and repair.
- Provide for alternative network connectivity should your main network provider fail.
- Bring the site online gradually and test it to be sure that all processes, including payment transactions and order fulfillment, work correctly.
- Announce and promote the site.
- Monitor system performance such as processor, disk and memory utilization, the number of connections occurring per second, and the average duration of connections using OS tools and Compaq's Insight Manager Software.
- Monitor site traffic to determine traffic patterns of the site. A number of commercially available software packages provide a wide range of functionality in the area of traffic monitoring.
- Monitor sales performance, including sales per hour, success of promotions, upsales, cross-sales, demographic correlation, and store layout effectiveness.
- Analyze, enhance, and update the site at regular intervals.