Chapter 9: New Types of Products and Services

"The best way to appreciate the merits and consequences of *being digital* is to reflect on the difference between bits and atoms."

"The information superhighway is about the global movement of weightless bits at the speed of light."

Nicholas Negroponte, *being digital*, p. 11 and p. 12, New York, NY: Alfred Knopf, 1995.

Prologue

When the head of MIT's famed Media Lab wrote the words above, the term 'information superhighway' was still relatively new, not the cliche it has become. In many ways, by his pioneering and simple contrasting of bits and atoms, Negroponte captured the essence of the information revolution and the new economy. "What is a bit, anyhow?", he asks, and gives the answer, "It is a state of being on or off, true or false...In the early days of computing, a string of bits most commonly represented numerical information."

Negroponte goes on to point out something that we take completely for granted just five years later, that not just numbers, but all kinds of information, including any audio and video, can be reduced to bits, that is, can be digitized. Computer scientists, of course, know all about how to digitize, how to take a sound wave, for example, and record it as a stream of numbers, which are then turned into bits. When those strings of bits are run through the reverse process, we hear something that is indistinguishable from the original music.

Of course atoms do not become irrelevant in this world of digitization. The equipment to record, convert, store, transmit, reconvert and play the music/information is all very solid indeed. So what exactly changes? Philip Evans and Thomas Wurster, in their book *Blown to Bits*, put it this way, "the pure economics of a physical 'thing' and the pure economics of a piece of information are fundamentally different". They talk about how information can be sold without ceasing to own it, how information can be replicated at almost zero cost, and how it never wears out.

Yet information as an economic good is embodied somehow. Even an electronic file has a physical existence. A music file on the Internet may have a very different existence than one trapped on a CD, but how exactly is the link between bits and atoms broken and how is it remade? Beyond recognizing the characteristics of 'being digital', what kinds of products and services can be digitized? What innovations are possible? How do the digital and physical worlds connect in e-commerce?

Read on, for at least the beginnings of some answers!

9.1 Introduction

If e-commerce is built on being digital, we must understand what this means in practical terms. We begin by describing the key properties of digital creations. At a physical level, digital entities live as electronic files. This means they are virtually indestructible, easily modifiable, and almost costless to copy. We describe these basic characteristics and their implications in Section 9.2.

How does one go from the technological characteristics of digital files to economically meaningful products and services? At an abstract level, any digital file contains 'information'. For this information to be useful to humans, though, it must translate into something we can absorb with our senses: news, entertainment, and instructions represent the most basic kind of digital product, delivering familiar content in a familiar form (words and pictures) with new technology. Other physical entities may also be replaced by digital files. Electronic files can eliminate the pieces of paper that we use to pay for our purchases, get on an airplane, or show that we have a hotel reservation. These also carry information, but not the kind of content as in the first category of products: they are tokens of exchange. The third and final category of the digital economy is electronic processes and services. An enormous variety of economic interactions and information flows can be automated and connected without requiring manual intervention. We discuss all these types of digital products and services in Section 9.3.

The different ways in which different types of digital products are used imply different sources of value creation. A content product can be used by someone without using it up (unlike an ice cream cone). What does this shareability imply for the economics of creating and selling such products? In what other ways does the use of digital products differ from their physical counterparts? How are electronic processes and services different from content products in their structure of value creation and value capture? We explore the answers to these questions in Section 9.4.

In Section 9.5, we examine how digital technology allows new types of products and services to be offered to users. Products can be split up and combined in ways that would otherwise not be technologically feasible or economically viable. Articles from magazines can be sold individually. Groceries can be combined with informational and sorting services. Individuals can be paid directly to watch advertisements. This area is, in some ways, the most exciting, because so little is known about what will ultimately succeed in winning a permanent place in the new economy.

Section 9.6 brings many of the earlier themes of the chapter to bear on understanding the economics of the infrastructure that supports the digital economy. Much of this infrastructure is physical, essentially different kinds of computers and connections. However, the hardware is useless without the knowledge embodied in the increasingly complex software that makes everything work, and work together. Thus the economics of information products is fundamental to the development of those products and services without which there could be no Internet, and no digital economy. Section 9.7 concludes the chapter with, as usual, a summary and a look ahead.

9.2 The Meaning of Being Digital

Digital products can be replacements for physical products, or products without physical analogues. A music file downloaded from the Web is a pure digital product, existing as a file on a storage medium. It replaces the CD music single I might otherwise buy from a traditional store. Most digital products have physical analogues. Sometimes the digitization has already taken place in the manufacturing of the physical product. The song on the CD is already digital: in that case we just have to buy the disc, the case, and the other marketing paraphernalia with the electronic file. The morning newspaper is not digital, but it is created as a set of digital files before it is printed.

Digital products may not have physical analogues, but often in such cases they replace tasks carried out by manual processes. Online search engines, which were the first digital products to make their presence felt on the World Wide Web, carry out tasks that could conceivably be done manually, but never have been – it would take close to forever! Tasks such as clearing checks or stock market transactions were once done manually, but are now carried out by software that has been created and sold as a product.

In some cases, digital products might have physical analogues that are sold only as part of larger products. A single article from a magazine, or a financial report on a single company may be purchased online, while it would never be economical for them to be offered as individual products in their traditional physical form.

All digital products have three basic physical characteristics. They are virtually indestructible, they are easy to modify, and they are almost costless to copy.[1] We discussed some of the consequences of these properties, particularly the ease of copying, in Chapter 3. These three characteristics create obvious problems for the owners of intellectual property.

Indestructibility Once created, a digital product can last for a very long time. Any digital product has to be stored in a physical medium, which may itself be subject to wear and tear. However, the 'essence' of the product is unaffected by use. If it has been 'backed up', it can survive practically forever if properly stored. Here the property of almost costless duplication is critical in ensuring the long life of the digital product in practice.

As for any durable good, a producer of a digital product competes with its own past sales, in the following sense. After selling initially at a high price, the producer has an incentive to cut price in the future. If consumers anticipate this, they will not buy right away. So durability erodes market power. This argument is explored in more detail in Chapter 14, Section 5. Even if the price is not pushed down over time, durability means a shrinking market over time, since replacement due to wear and tear does not take place. Firms can get around this problem created by durability by updating and upgrading digital products. This is one reason why software seems to be have new versions always coming out!

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[1] These three properties are discussed by Choi, Stahl and Whinston in *The Economics of Electronic Commerce*, but with a somewhat different emphasis.

Modifiability Digital products can also typically be changed very easily (if one has the know-how). Since they exist as zeros and ones stored electronically or magnetically, modification can be accomplished with a few clicks of the mouse. The ease of word processing on a computer, contrasted with the problem of making changes in the days of manual typewriters, illustrates this phenomenon. Sometimes this modifiability can be a problem. A file attachment to an email may get mangled in transmission, so that it is no longer readable by the recipient. As another example, the producer of the content that is digitally stored may not want the content to be modified.

Makers of digital products can use technologies that prevent modification. Files on a music CD can not be modified, unless they are copied to another medium. Formats such as Adobe System's PDF allow reading and printing using a freely available piece of software, but not modification. Here, too, the 'cut and paste' properties of today's graphical user interfaces allow even the content of such documents to be transferred to another format where modification is easier.

The best that a producer may be able to manage is using technologies that verify if a file has been modified (see Chapter 2). These technologies are especially useful for checking that the content of a file has not been tampered with in electronic transmission, but are less able to prevent modification after receipt. Legal approaches may also be used against content modification that violates intellectual property rights (Chapter 3), if it can be detected. In many cases, the maker of digital products may be best off accepting modifiability and working around it. For example, a PC game maker may introduce capabilities that allow users to modify game scenarios, create characters, and so on.

Low Cost Copying This characteristic is in many ways the most important aspect of digital products. Low cost copying makes the indestructibility and modifiability of digital products work in practice. It also makes the Internet possible, since electronic files are literally copied again and again as they move over the network from source computer to viewing destination. This is not really an economic issue, since it has no effect on the market for or the economic value of the product. However, copying by potential users without payment strikes at the heart of the economics of digital products. We will examine this in detail in Section 9.4.

We may note the technological reasons why low cost copying has become a much greater problem for makers of digital products. The cost of storage in mediums that can be written on has fallen dramatically in the last few years. The typical size of desktop computer hard drives has gone up by a factor of ten or twenty over four years. Rewritable CDs are commonplace and inexpensive in consumer markets, whereas four years ago they were not even available. Compression technology has also advanced, allowing music files to be reduced in size, making storage and transmission much easier. Furthermore, the ability to transmit electronic files has expanded tremendously. Copying and distribution over the Internet, via services such as Napster (Chapters 3 and 17) is possible on a scale and at a speed unimaginable a few years ago. Low cost copying in this

case has quite a different meaning than recording a friend's music CD's in the pre-Internet era.

Makers of digital products have three remedies. They can try to update and upgrade products to reduce the value of copies, or try to bundle digital products with other services that can not be accessed by owners of illegal copies. Alternatively they can incorporate technologies that prevent copying. Finally, they can pursue legal remedies, trying to increase the costs of copying by raising the chance of being caught and the punishment if caught. All of these avenues have their place in the strategies of makers of digital products. We pursue these issues further in Chapter 17.

The three physical characteristics of digital products may be supplemented with a fourth aspect, which involves time. A central property of anything digital is speed of access and interaction. In one way, this is obvious, and is a property of anything electrical, not just restricted to digital products. However, the rapidity with which large amounts of information can be accessed, processed, and transmitted makes this point worth emphasizing. Modification and copying can be done rapidly. Playing games on a computer, alone or online, requires instructions and results to flow back and forth in a constant stream. Any activity involving a digital product relies on the underlying speed of these flows of electrons. We will examine the consequences of speed in the context of the economics of information products.

9.3 Types of Digital Products and Services

Digital products are information products. In an abstract sense, anything that is coded in ones and zeros is information. Typically it will be stored in some electromagnetic medium: a computer hard drive, a removable magnetic disk, or some kind of optically-read CD. However, this use of the term 'information' does not give us any sense of the nature of the product that it characterizes. Instead, information products are best classified and understood according to the uses to which they are put. We can distinguish three broad classes of information products: content products, tokens of exchange, and processes and services.[2] The dividing lines between these classes may not always be clear, since products can fit into more than one category, or change over time.

Content Content products are the most basic type of information product, and the most common. We can divide them further into three groups, according to their purpose: news, entertainment, and education. Again, these categories are not hard and fast. Traditionally, all these different kinds of information products have been obtained in different ways. Newspapers are delivered by paper boys or from newsstands; magazines by mail or from stores; books from bookstores; product manuals with the products purchased; music over the radio or on CDs from stores; visual entertainment in movie theaters, on television, and from video rental stores. All these content products are now digitized or can be if so desired. The Internet and the World Wide Web allow any digital product to be accessed, once it is made available on a computer that is connected to the

[2] We have adopted a modified version of the classification used by Choi, Stahl and Whinston in *The Economics of Electronic Commerce.*

Internet, and that has the right software to permit access. The explosion of content of all kinds on the Internet is what we are most familiar with. We are also familiar with the fact that large amounts of this content is free.

The free availability of content on the Web partly reflects its purposes and nature. Much of the information serves as advertising by firms and by individuals. Much of it is content that is provided by those who derive value from its creation or its publication (sites devoted to personal interests, family photographs, etc.). However, much of the content that is available in digital form is of value to those who view it, and yet it is free. In other cases, the content is restricted. Some content on new sites is available only to print edition subscribers. Many business web sites have significant portions that are available only to employees, customers or partners. We discuss some of the economics of these varied practices of access to digital content in the next section.

Of course, some content is not made available in digital form on the Web by its owners at all. Since copyright laws protect the original content, buying a music CD, for example, gives you the right to listen to the music, and to make a back-up copy, say, but not to share it with others (at least not on a large enough scale to matter). Yet the digital content on the Web can be copied by thousands of people in very little time. Thus copyright owners have no wish to make this kind of digital content available at all (see Chapters 3 and 17, on Napster). They would prefer that it be bought fixed on CDs, either from physical stores, or online.

Content will always be the bread and butter of the Internet. The World Wide Web is designed to make content available easily. The essence of the Web is hyperlinks that connect content from widely different locations. The problem for content providers is making money from what they provide. One of the themes of this book is how they can do so.

Tokens of Exchange Content is simply delivered or accessed and used (to be informed or entertained). Tokens of exchange instead represent certain kinds of contracts. Digital tickets and reservations replace paper tokens for guaranteeing access to airplane flights, hotel rooms, concerts, and sporting events.

A ticket represents a claim to a particular service, while ordinary cash represents a claim on anything we choose. Thus paper money is also a token of exchange. Checks, stock certificates and bonds are also traditional financial claims that can be replaced with digital information. All financial instruments are really just claims that can be recorded as digital information, without the need for any paper record. Digital financial information can be stored on computer hard drives or on ‘smart’ cards with magnetic strips. It can be transmitted over the Internet, or over dedicated connections.

Thus digital tokens of exchange play two roles. Financial tokens can be used to pay for products and services, which may be digital, and may be delivered digitally, or they may be physical products which are also delivered. Finally, services that have to be enjoyed at a future date (concerts, airline flights) require a token (ticket) to be provided

in the reverse direction. This token can easily be a digital 'product', representing a claim to a service to be consumed at a specified time in the future.

Processes and Services Digital tokens automate a particular segment of a transaction. Electronic processes and services take this automation further. Any interaction that can be digitized becomes a digital process. This digitization has been at the heart of a transformation of modern business that is older and much broader than the Internet. Firms have been using Electronic Data Interchange (EDI) and Enterprise Resource Planning (ERP) software[3] well before the Internet added greater B2B connectivity, as well as allowing customers, partners and suppliers to join in creating more comprehensive business networks.

Digital processes are governed by software, which is itself a digital product. The technological distinction from content products is in the function of the software. A document in PDF format, for example is viewed on a screen, or after printing out. Once the software to display the document has been triggered, our human senses complete the value chain – we read the document or view the picture. Digital processes are based on software carrying out tasks that otherwise might have required human implementation. In a pure digital process, the underlying software does not have the primary function of making content available to a human user. Its primary function is to trigger automatic actions – ordering, updating customer and inventory databases, executing financial payments and updating accounting records, and so on.

However, even though the scope of digital processes continues to increase, most digital processes involve some human review of content, and human actions. Numerous examples of such processes can be given: filling out online forms, reading and responding to emails, bidding in online auctions, distance learning, and computer games. While we might wish that some actions, such as filling out forms online, required less human effort, in other digital processes, the human component is essential. Playing games and learning online are two important examples. In other cases, the incentives for digitization and automation differ on the two sides of an interaction. If I send in an email query to, say, my online broker, I would prefer a human to type in a specific response by email. Instead, I may well get a computer-generated email that fails to answer my question. This example illustrates the difficulties for computers in dealing with 'natural language', which represents the last major barrier to digitization of processes.

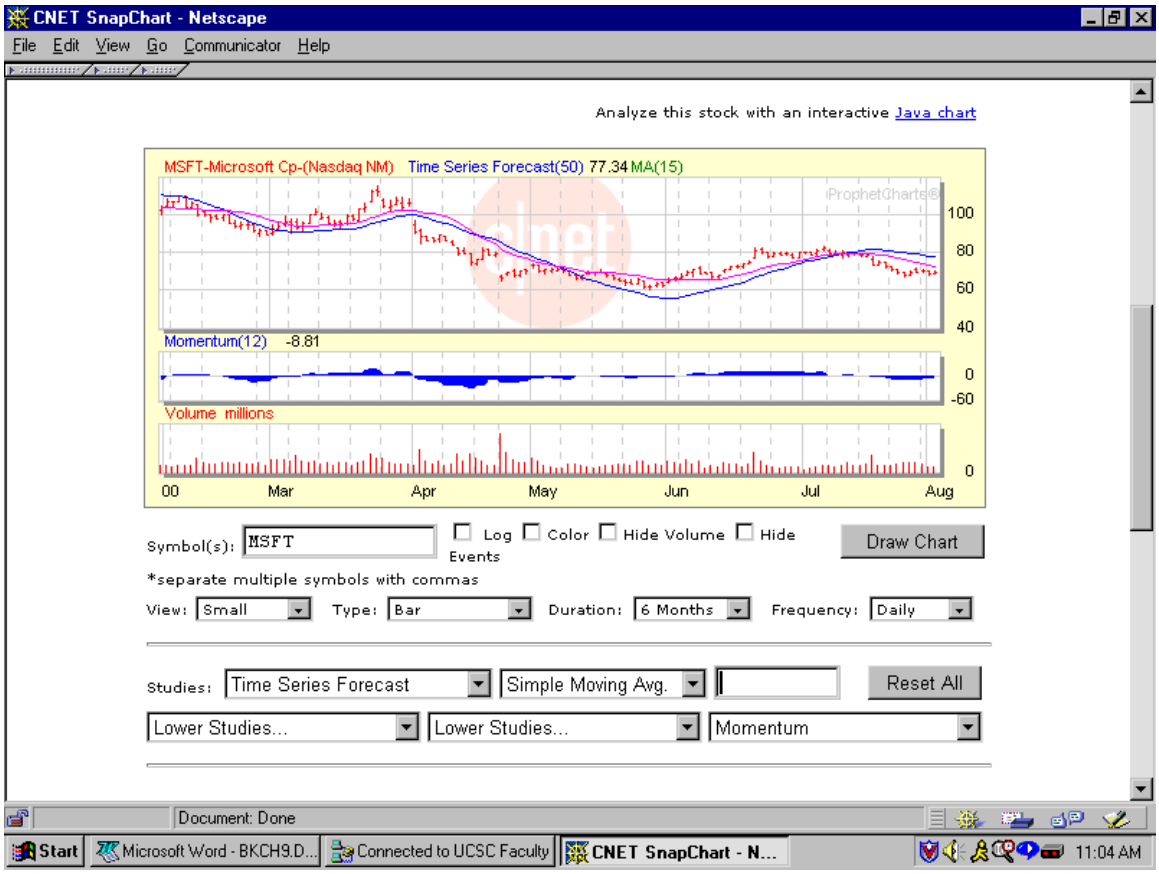
The boundary between content and processes is fuzzy because digital processes include human review of content, though as part of a process of interaction. Thus digitization of processes has certain limits. The boundary is also becoming fuzzy from the other end. Content delivery continues to become more and more interactive. Hyperlinks represent a simple aspect of this, in that they allow moving from one document to another based on the content viewer's choices. The viewer's overall experience can therefore vary greatly. CD-ROM encyclopedias illustrate the same kind of blurring of content viewing and interactive process. Links are provided not only to

[3] See the technology overview in Chapter 2.

related articles within the CD-ROM, but also to Web sites where additional information and updates are available.

A more significant example of the development of interactivity in content viewing is the use of Java-based applets, which allow digital processes to be embedded into content viewing. A good example of this is in the provision of financial information. Figure 9.1 shows Java charts analyzing various aspects of Microsoft's stock performance, from the CNET Investor Web site. The options include at least a dozen possible charts that require complex computations. The viewer can choose the stock, which charts to display, what ranges to choose, and so on. An interactive process is incorporated into the viewing of content.

Figure 9.1: Interactive Java Charts

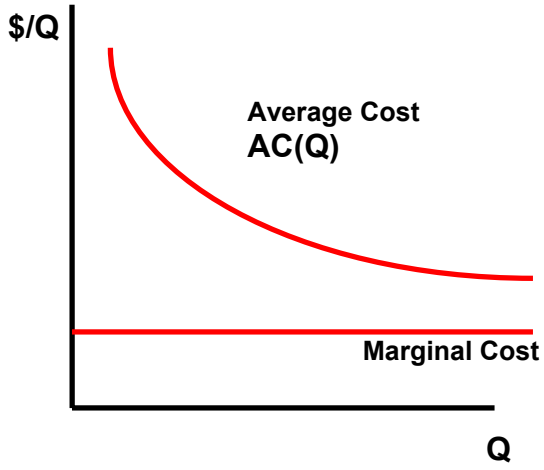


If the technological boundaries between types of digital products and services are blurring, the ways in which digital products are used, the value that is thereby created, and the methods that can be used to capture that value become especially important. We explore this next.

9.4 The Economics of Information Products

A fundamental economic characteristic of information products is that they are shareable. If one person uses an software program, it does not use it up. It is still available for use by others. One part of this availability simply reflects durability. What is even more important is that more than one person can use the software simultaneously. This relies on the property that digital products can be copied at low cost. Thus, for example, a copy of a desktop operating system may cost tens of millions of dollars to develop, but only a few dollars per copy to duplicate and install on millions of computers. The production of these kinds of information products is thus subject to economies of scale, as shown in Figure 9.2. Here if the fixed cost is $F, and the marginal cost is $c per unit, the total cost of output Q units is F + cQ dollars, and the average cost is F/Q + c dollars per unit.

Figure 9.2: Economies of Scale for Information Products



The consequence of this cost structure is that perfect competition may not be supportable as a long run industry structure. In perfect competition with free entry, firms must make zero economic profits. Hence it must be true that the firm's price is equal to average cost (at least for the marginal firm – see Figure 4.25a), or P = AC. However, any profit-maximizing firm chooses an output such that marginal revenue and marginal cost are equal. Since a competitive firm has no market power, its marginal revenue is the same as the market price. Thus we have P = MR = MC for a perfectly competitive firm. Putting these conclusions together, we see that perfect competition will require AC = MC. But this can never happen in the situation shown in Figure 9.2.

The impossibility of perfect competition does not mean that only one firm can survive in the industry, but it does favor a structure with a few large firms (oligopoly) that can take advantage of the economies of scale. Firms with market power can charge prices above marginal cost, and thereby cover their average costs and stay in business. Free entry may still keep economic profits low.

The oligopoly story becomes quite rich, because firms may compete through differentiating their products (Chapter 13), with different pricing schemes (Chapter 14), through marketing and advertising (Chapter 15), through strategies to achieve lock-in (Chapter 16), and still other strategies. We postpone a discussion of these strategies to those chapters, and in this section discuss further the economic characteristics of information products.

The shareability property of information products applies as much to content as to executable programs. News stories and songs can be sent around the world to any number of others. An automatic program can send electronic files with such content to thousands, if not millions of recipients in very little time, using email technologies. Each recipient gets a copy of the file and can read, view or listen to the content that it contains. The copyright owner of the content may have a hard time preventing such widespread sharing, or collecting payment for use of the content.

The problem of the copyright owner is based on the shareability of the digital product, which allows more than one user to enjoy it. Shareability is a consequence of the durability and low-cost copying characteristics of digital products. However, the copyright owner's ultimate problem is the inability to control the copying, or exclude people from enjoying the content without payment. A large swimming pool may be a shareable good, so that many people can simultaneously enjoy swimming in it without reducing each other's pleasure, but if it is inside a fence and one has to pay to get in, then the pool provides an excludable service.

Creating excludability for digital products is certainly technologically feasible. Electronic files can be constructed so that they are copy-protected, in which case standard methods of copying will not work. Those who are determined and knowledgeable can get around these barriers, however, and once a barrier come down, copying subsequently becomes low cost again. Still, such protections can prevent casual copying: some content on the Internet is certainly protected in this way, and can not be downloaded.

An alternative approach for some kinds of content is to wrap content in a way that only authorized users can view or listen to it. This is somewhat like encryption, but it acts beyond the initial recipient, so that an authorized viewer or listener can not pass the content on 'unwrapped'. We discuss this further in the context of digital rights management, in Chapter 17.

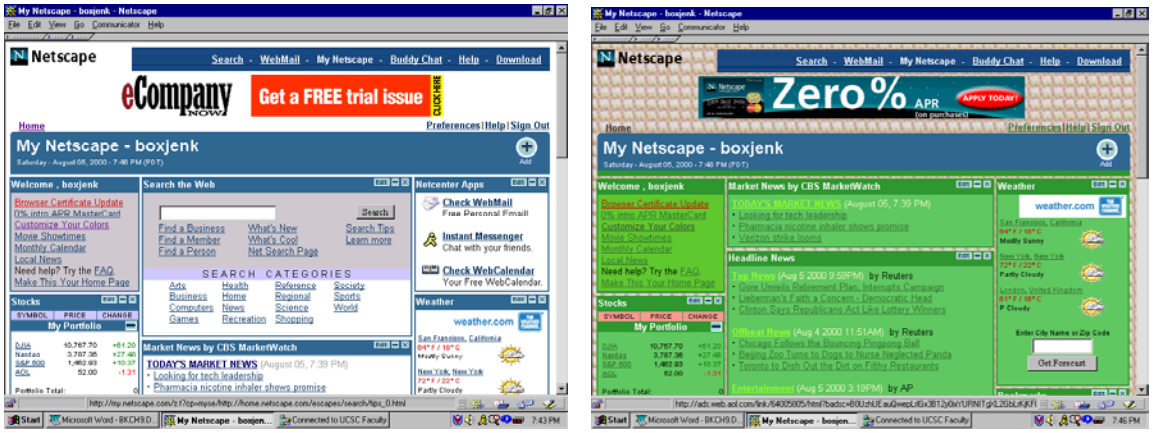
Yet another way to control certain kinds of content use is by providing it in a form that inhibits copying. We can use the example of financial information on public companies. One way in which such information can be presented is in the form of databases of documents. For example, I can go to the Securities and Exchange Commission's Edgar online database of company filings with the SEC, get a listing of all documents on a specific company, and download each of those documents one by one. This will not take me too long, and I then have this data (which is meant to be publicly available) and can organize it in any way I want. For example, I can construct charts showing the company's revenues over some period of time. However, if the data were

only presented to me in the form of a chart, in response to a specific request, I would not have access to the data itself, and could not use it in ways that required that access. In the example illustrated in Figure 9.1, I was able to get various charts of Microsoft's stock price, but could not get the raw data to use as an input into some other analysis. Nor could I get access to the formulas or programs used to do the calculations and display the charts.

While shareability and lack of excludability are the two most salient economic characteristics of digital products, there are several other characteristics of information products, and content products in general, that are economically relevant. The technological characteristic of modifiability, combined with the inherent richness of communication, together mean that information products can be incredibly varied. There are many ways of communicating the same basic information, varying the words used, the fonts, the layout, accompanying pictures, and other aspects of 'look and feel'. Individual tastes may also vary enormously, since there are so many possible dimensions to choose from. The possibilities for customization and product differentiation in general are discussed in Chapter 13. Below we provide a simple illustration.

Figure 9.2 shows two 'MyNetscape' pages. The left hand one was a default setting. In the right hand one, in a few minutes, I was able to change the colors and background (achieving ugliness with remarkable ease), eliminate some information 'channels', and give others more prominence. There are hundreds of possible permutations and combinations that I could try, to get the 'look and feel' that I want. In a different example, computer games will offer the ability to create numerous different starting scenarios. Different computer games, while belonging to the same general category (say, 'role-playing' or 'strategy'), will have so many possible points of difference that they can appeal to all kinds of tastes between them.

Figure 9.3: Customizing 'MyNetscape' – The Default and the Ugly



Another significant characteristic of content products is time-dependence. While some music, books, movies and art may be 'classics', other content may only have a short life span. Some of this obsolescence is driven by fashion. The constant production

of new content, combined with the limited time we have, also plays an important role. Finally, some kinds of content, such as news, are inherently ephemeral: 'yesterday's news' is a metaphor for anything out-of date. Of course, even yesterday's news may make a come back. After the passage of time, it forms the basis for history! Even the forecast of tomorrow's weather, which will be obsolete for its original purpose day after tomorrow, may be useful for a different purpose: as data for evaluating the accuracy of the model that generated the forecast.

Whatever the reasons for the dependence of economic value on the time of consumption, it can be an important dimension of pricing information products. When stock price quotes first became commonly available on the World Wide Web, they were free for quotes that were twenty minutes delayed, but one had to pay for 'real-time' quotes, typically by paying a subscription fee. Consumers of this particular type of news were differentiated by their willingness to pay for timely access. While charging for real-time stock quotes still occurs, they are usually charged for as a part of a bundle of other services, and real-time stock quotes are typically available without cost from many financial web sites.[4] This is simply the result of competition. The negligible marginal cost of providing the information, combined with competition, pushes the price to zero. Where the information is more specialized (e.g., options prices), competition is less fierce, and the downward price pressure is correspondingly less.

While stock price information may be valuable to anyone who invests, and its value depends on getting it as quickly as other investors do, other kinds of information may have a time-dependent value for external reasons. A project deadline for a student or employee may make some information very valuable for completing the project, and useless after the deadline has passed. However, such information may still have value to someone else with a different objective or deadline.

A characteristic related to time dependence is the intensity with which an information product is used. Some content products are used just once: news, mystery novels. Others may be enjoyed repeatedly: music, in particular. Products that control digital processes, such as games, depend greatly for the overall value on repeat use. Note that even single-use digital products are durable, and could be particularly susceptible to sharing through sequential use. Books are often read and sold to used bookstores for resale. Libraries provide another mechanism for sequential shared consumption of books. Since resale is typically legal, where the information product is valuable enough, use of it must be in the form of conditional access through a subscription, or pay-per-view, rather than outright sale. Digital databases, in particular, have this character.

The connection between time and value in the usage case is not the particular time that the information is available, but whether the information was available and used at a previous time. Reading yesterday's newspaper may still have some value for me today if I did not read it yesterday, but not if I read it yesterday already. For some information

[4] There may be a one-time nonmonetary cost of reading through and agreeing to a liability waiver. The stock exchanges require this to protect themselves from any implied promise of providing perfectly current information. For example, network congestion or crashes can delay information transmission!

products, in particular, games, the value may rise with use over time, as I learn the rules and the nuances of strategy. At some point, boredom may set in, and then the value declines with further use.

A final characteristic of information products is the dependence of their value on the consumption by others. If I have exclusive information about a company, and I am not legally barred from trading on that information, it is extremely valuable to me. On the other hand, if everyone else heard the same news at the same time, then the stock price almost certainly adjusted rapidly to the news, removing any possibility of making a killing! Other people having the information in this case creates a **negative externality** for me: the value of the information to me depends negatively on other people also knowing it.

In other cases, the value of an information product increases as more people use it. Even if the product is used singly, the ability to exchange electronic files with others may be important. Word-processing programs, spreadsheet programs, and presentation software are all more valuable if their outputs (documents, spreadsheets, presentations) can be shared or exchanged as needed. This is an example of a **network externality**, a special kind of **positive externality**. In this example, the implicit assumption is that the outputs can not be shared across products. Thus, if Corel's Word Perfect can read and convert documents produced by Microsoft's Word then users of both are in the same network. In practice, compatibility across different programs may not be perfect.

Network externalities may be more direct. Interactive services such as chat rooms, instant messaging, online auctions, and online games all benefit from having more simultaneous users being available. Information products and services with strong network externalities may encourage specific kinds of pricing and marketing strategies. Demo versions and free trials of software aim to make products with positive externalities dominant by building an installed base of customers that will find it costly to switch from a large network. We examine these issues and strategies in Chapter 16. Note that free trials may be used for different reasons, for a wide variety of products, particularly ones that provide new functions or are offered by sellers without strong reputations.

9.5 Digital Product Innovations

Much of what we have examined so far involves traditional products delivered in new ways. Online news replaces newspapers, computer games replace board games, email replaces the US Postal Service and sometimes the telephone. Often the functionality is very similar, but the product or service is delivered more quickly, is more flexible, and has lower marginal costs. The last fact may imply a greater importance of economies of scale. Rather than just old wine in new bottles, however, the Internet and World Wide Web may make completely new concoctions possible as well. We will consider three kinds of innovations that are possible due to the digital nature of some products, and the digital nature of the communication of information. First, we will examine how digital products may be packaged or bundled in new ways, including being combined with physical products. The example we will use is online grocery stores.

Second, we discuss microproducts, which are simply pure digital products that become technologically and economically possible because of the low costs of modifying and distributing digital products in general. Finally, we examine a nondigital product, consumers' time or attention, and see how it becomes an economic good that can be bought and sold, as a result of the digitization of other aspects of commerce.

The essence of e-commerce is information. How does the availability of information change what is being sold? Consider the example of buying groceries. We typically drive to the grocery store with a shopping list, get a cart and wheel it through the aisles, filling it up and checking off the list. We stand in line to pay, and then drive home. In this process, we may see additional items that we want to buy, and add them to our cart. They may be things we had forgotten, impulse items, or items discovered to be on sale. We may also inspect items, review labels for ingredients and nutritional content, and just browse. As we discussed in Chapter 4, shopping includes gathering information and using up time, as well as making purchases.

What is different in shopping online? Part of the difference is in the time cost. We no longer have to incur the costs of going to and from the store, and of wheeling through the aisles and standing in the check-out line. Thus these services are now bundled with the physical product. Yet this kind of service has existed in the past, and is not by itself what makes shopping online for groceries an innovation. What is really new is the capacity to transmit large quantities of information, store it, and analyze it. In the grocery shopping case, this information includes complete product information for easy price and ingredient comparisons, a running tally of the cost of items in the virtual cart, past purchase information, and even home inventory tracking based on past purchase patterns.

An online grocer (examples include Homegrocer, Netgrocer, Peapod and Webvan) can offer its regular customers virtual shopping carts that are already filled with items that the shopper is predicted to need or want, personalized shopping suggestions, and complementary information (recipes, stories, and so on). Certainly a physical store can do much of this, especially with 'club cards' that are like frequent flyer memberships, and that track purchases. However, the physical store can not offer the same degree of personalization and level of information processing. The customer meets the information system only at the check-out, while in online shopping, the interaction is continuous. Figure 9.4 shows the home page of Homegrocer.com.

In sum, therefore, online shopping can be thought of as offering a bundle of three different categories of goods and services: the physical products themselves, the service of time in physically assembling the order and delivering it, and an information service that is made possible by the infrastructure of the Internet and the World Wide Web. The digital information processing and communication capability of this infrastructure is what makes the bundling of the other two services economical: the service of assembling the order and delivering it would not be cost-effective without it.

Figure 9.4: An Online Grocer

The online grocer example is only an example. It is appropriate though, because groceries are a $400 billion a year business in the United States. Groceries are bought regularly, and a grocery store purchase represents a combination of a wide variety of small items. The potential for improved processing of information is enormous for those consumers who find it a tedious chore. Others may be attracted by the time savings. Other physical goods are also transformed by online shopping into bundles of products, time saving services, and information services. We can think of these as product innovations made possible by digital information. The questions for sellers will be whether they can provide these new product-service combinations at a reasonable cost, and whether enough people are willing to buy them so that sellers can cover those costs.

Information products by themselves can also be packaged in innovative ways. For example, we can think of online **portals** such as Yahoo and Netscape as being new kinds of information services. While newspapers do combine different kinds of content such as news, weather, shopping information and entertainment into daily information packages, portals use the power and reach of the World Wide Web to offer much greater variety and access, and opportunities for immediate action. I can go from an advertisement to a purchase with just a few mouse clicks. In that sense, portals represent

aggregation of content and shopping opportunities, much as a company such as Webvan does. Webvan now offers many other products besides groceries. The difference is partly in emphasis: portals offer content, and piggyback the selling of physical products on that, while businesses such as Webvan are focused primarily on the physical products, bundling information and time services with them to differentiate their offering. Also, the online grocers, in particular, must create a new delivery infrastructure to match the time-dependent nature of their products, while the portals sell products that use the specialist delivery infrastructure that is already in place (the Postal Service, FedEx and UPS, for example).

A possibility that is the opposite of aggregation of content, or bundling it with physical products, is that of dividing up digital products. To illustrate, consider a magazine such as *The Economist*. It offers numerous short articles bundled together in its weekly print magazine format. It also features longer surveys on countries, industries, or global trends. For many years, additional copies of these surveys have been available for separate purchase by traditional means of ordering by mail, phone or fax. Now that *The Economist* is available online, however, one can purchase individual short articles (typically about a page long) from the online archive, for a dollar each. This is an example of what have been called **microproducts**. Fixed transactions costs of using credit cards mean that a customer must still buy these microproducts in bundles, by purchasing 10 credits at a time. However, these credits can be used at any time, and for any combination of articles.

The low cost of creating, modifying and copying digital information mean that anyone can offer such information microproducts, not just established media companies. The cost of a Web site is low compared to its potential reach. If it has content that people are willing to pay for, no matter how small or specialized, then an economically viable product is created. Payment methods can vary. The credit card payment for a minimum number of microproducts is one possibility. Small subscription fees are a similar method. Neither captures the full potential of microproducts. A third possibility is collecting payment in kind, by getting the information buyer's attention for advertising. We discuss this separately later in this section. Finally, the seller may simply ask for cash and checks to be sent using an honor system. This is, of course, the method used by Stephen King for his latest book, The Plant, which is being published chapter-by-chapter on the Web (see the Illustration Box, next page)! Of course King has a reputation and a collaboration with Amazon.com to collect payments, plus the incentive of continuing the Web publishing only if enough people pay.

Another example of microproducts comes from the world of financial information. Hoover's Online offers some free information on companies, additional detailed information for subscribers, and also access to a set of databases for all kinds of financial, business and other information. Figure 9.5 (next page) shows the results of a search for information on Microsoft from *Moody's Corporate News*. Each article again costs a dollar, though other sources offer reports or articles that cost anywhere from $2 to several hundred dollars.

Illustration Box
Stephen King Sells Book Chapters for a Buck

What It Is

It's The Plant, an epistolary novel set in the early 1980s (before e-mail, in other words, and when even the fax was a fringe technology). It'll be presented in parts ranging from 5000 to 7000 words. The story is sort of funny and at the same time pretty gruesome (think Christine). I'm committed to publishing at least the first two segments. Whether or not I publish more depends.

Depends on What?

In the words of The Turtles, "You, baby, nobody but you." If you pay, the story rolls. If you don't, the story folds.

How Much?

Buck an episode.

How Does it Work?

Click on the Download the Plant link. On the next page you will be given the choice to pay either before or after downloading the file.

People choosing to pay before downloading will proceed to the Amazon.com Payments site. (Don't worry, they'll direct you back to this site after they take care of payment issues). You have the option to pay by Credit Card, by Check, or by Money Order. After you've taken care of the payment, they will direct you to a page back on this site with information on how to download The Plant as well as information on what you'll need in order to read The Plant. People choosing to pay after downloading The Plant file will be taken to a page with information on how to download The Plant as well as information on what you'll need in order to read The Plant. Remember, whether or not you pay has a direct impact upon whether or not installments are available after the two installments promised. To pay for the download, come back to this page, and rather than clicking on "Download The Plant", click on Returning to Pay Page. From there you will go to Amazon.com Payments, they will direct you in how to take care of payment.

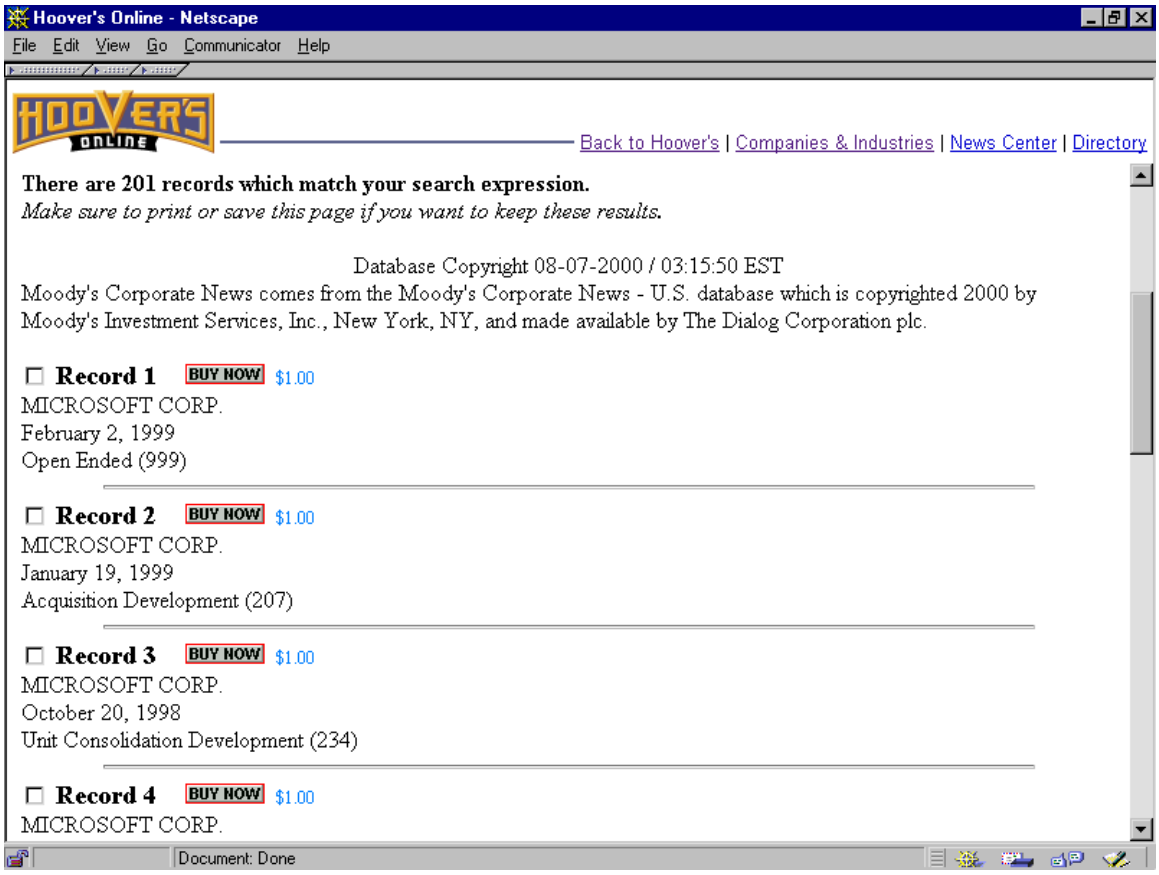
Source: www.stephenking.com/download.html

Finally, not just static documents may be offered as microproducts. Firms such as Ask Jeeves offer answers to queries in plain English. Or firms may offer music by the song. Right now such services are free, but this does not seem to be what economists would call a long-run equilibrium!

The full potential of microproducts will be realized when a system of payments has evolved that does not require minimum credit card payments, nor mailing in money orders, checks or cash. We will discuss electronic payments systems in Chapter 12. Currently, one of the most convenient and common forms of payment for microproducts is through bartering one's attention. Obtaining the microproduct may well involve

implicitly agreeing to view advertisements as a form of payment. This method goes beyond microproducts and digital information of course, and we discuss it in general, next.

Figure 9.5: Microsoft for a Buck Online



We made the point in Chapter 4 that time is valuable. That may seem obvious, but we also suggested a way of thinking about the value of time, as the opportunity cost of forgone earnings. Even if we do not value our leisure time in precisely that way, it does seem that even our leisure time is worth something to us. That time is also worth something to businesses that have something to sell. They want to have our attention. The most common example of this value of our attention is traditional broadcast television. Before the days of cable TV, and even before public television, all TV viewing was free, once you bought the set. What paid for all the programming? All the TV commercials we watched. Free content (entertainment and news) was provided in exchange for our attention.

This seems like a haphazard way of conducting such a costly economic activity. How did advertisers know they were getting their money's worth? First, almost every household had a TV (its penetration rate was much faster than any product before or

probably since). Second, there were only three networks and three channels to choose from. Third, intermediaries (the Nielsen ratings firm, for example) emerged that monitored viewing habits by having sample households keep logs of what they watched. The resulting ratings of programs determined the rates charged by networks for advertising on different shows.

To summarize, the networks produced programs, or outsourced them, bartered them for our attention, and then sold access to our attention to advertisers. This system has been modified somewhat over time. We may now pay directly for programming through subscriptions, or by voluntary contributions for public television. Radio, too, has 'public' stations in addition to the more common commercial ones. However, the system of broadcasters exchanging content for attention, and then selling the availability of that attention, has not only remained intact, but has become a significant component of the World Wide Web and e-commerce. Every site that offers content 'for free' must support itself by selling our attention, by displaying advertisements.

So how is this digital version of advertising any different from the past? The difference is that the flow of bits between computers on the Internet allows a much finer measurement of attention. Individual attention can be measured by what Web pages are viewed and when, and what advertisements the viewer clicks on. Thus attention becomes a commodity that can be exchanged in the market. An individual may receive a discount on a computer purchase or Internet service, or some other kind of restricted payment for offering this attention. As in the case of money payments, the attention is no longer linked tightly to a particular time-consuming activity. For example, banner ads may be targeted at the computer user who signs up for such a plan, based on his or her demographic characteristics and not what he or she happens to be surfing on the Web. Payments may also be made directly for clicking on banner or pop-up ads. for example, CyberGold received a patent (#5,794,210 – Attention Brokerage) for precisely such a scheme.

As in the case of online groceries, the flow of digital information is what allows a new kind of product to be offered. Only the viewing of digital ads can be monitored and paid for in this precise way. We discuss advertising and marketing in e-commerce further in Chapter 15.

9.6 Infrastructure Products and Services

While all kinds of digital products and models of online business are being tested in the marketplace, one aspect of the Internet is undisputed. An enormous new infrastructure has to be put in place to meet the demands of e-commerce. In this sense, we can never move completely from a world of atoms to a world of bits. We briefly describe some of the main categories of these products and services in this section. Some of the firms that provide these products and services are described in the next three chapters.

Communications Equipment This category includes the wires and cables that carry the huge streams of bits that now flow around the globe, and the equipment that controls and directs the traffic. A massive effort is under way to upgrade existing networks of copper wires to fiber-optic cables that can carry vastly greater amounts of data. Perhaps even more important than these cables are the switches and routers that make sure that the data gets where it is supposed to. Switches and routers are essentially special-purpose computers, whose only job is traffic control. The use of fiber optics means that a new generation of equipment has to be designed, since traffic control for light adds additional technological issues compared to traffic control for electrons. The importance of this sector can be gauged from the stock market value of the firms that are providing these products, firms like Cisco, JDS Uniphase, Lucent, Nortel, and numerous others.

Connectivity Services Providing access to the Internet, while it relies partly on providing the lines or cables, can be considered as a separate service. In particular, traditional Internet Service Providers (ISPs) for households use existing telephone lines to provide dial-up access to the Internet. The infrastructure that such ISPs need themselves is therefore at one remove from the customer. Dial-up modems do not provide connection speeds fast enough for businesses, nor for many new residential uses of the Internet, such as downloading music and playing online games. An attractive alternative that has emerged recently is Digital Subscriber Line (DSL) technology, which still uses the copper wires of existing phone lines, but is many time faster than dial-up access.

While the Regional Bell Operating Companies (RBOCs) seem to have a head start in providing DSL to residential customers, many new firms are competing for the business market. They have been aided in this by Federal Communications Commission (FCC) rulings that ease the ways in which they can access the existing telecommunications infrastructure of the RBOCs and other local voice communications carriers. New DSL providers can locate their own switching equipment at existing facilities owned by incumbent phone companies, although with some restrictions.

Television cables and cable modems provide an alternative to DSL for households, using a different set of wires that traverse the 'last mile' to our homes. Businesses also have the option of having dedicated wires laid, to obtain connections faster than DSL, and able to support more users simultaneously.

Storage Services One of the most basic advantages of digitization is the ability to store vast quantities of information in a small physical space. An entire encyclopedia, that would fill several large print volumes, can be fit on a single CD ROM. Our desktop hard drives can store as much information as several encyclopedias. Yet the amount of information stored digitally for access through the Internet dwarfs any single user's storage capacity. Even a 30 gigabyte hard drive, enormous and unaffordable for home computers a few years ago, but now easily available, can fill up quite quickly with multimedia files downloaded from the Internet.

Aside from capacity issues, making sure one's information is safe, that it is backed-up, that it is secure, all these are hassles that, again, people are willing to pay

specialists to deal with. Storage services provide extra capacity for individuals and businesses, as well as the service of managing the information that uses this capacity: protecting it, making it accessible to those who are entitled to do so, and so on. Storage services are thus yet another cog in the Internet infrastructure. They take advantage of economies of scale by using large storage devices, and provide economies of specialization in providing and maintaining this storage and related services.

E-Commerce Software This covers a broad range of products. Software of this nature has already been used for quite some time to automate and connect internal business processes, and sometimes to do the same with suppliers, over dedicated networks. Software for e-commerce extends those capabilities to include customers. This may seem like a straightforward extension, but the issues of security, usability and scalability make e-commerce software a challenging product category. While software that runs a web site displaying products and product information like a catalogue or brochure is relatively simple, capabilities for exchanging information, and for transacting require much more complexity.

A transactive web site must be integrated with the firm's inventory, financial and other information systems to avoid customer disappointments, and to allow the firm to track how purchases will affect the firm's future decisions on ordering and manufacturing. Payments must be properly collected and tracked. If possible, some level of customer service functions must be integrated into the web site: queries that can be answered automatically online can save the firm a considerable amount of money.

This category of products therefore includes some of the most notorious examples of software patenting: Amazon's 'one-click' shopping, Priceline's reverse auctions, software for group buying (where the price paid depends on the number of people ordering together online), and so on. Effective software to make the customer's online purchasing experience smooth and seamless may mean the difference between success and failure for an e-tailer, or any firm that aims to do substantial business over the World Wide Web.

Hosting Services Where does the software that drives e-commerce sit? We use browsers to access and navigate the Web, and they may allow certain pieces of information to be deposited on our desktop computers, but the engines of e-commerce are the 'business logic' and database programs that are loaded on more powerful computers, called servers. Firms can choose to maintain such computers completely by themselves, but, as in the case of any other part of the value chain, they may also choose to outsource all or part of these functions. This outsourcing gives rise to hosting services.

The most basic form of hosting, called colocation, provides secure physical space, power, and accompanying connectivity to the Internet. Here the customer is responsible for providing the hardware and software for staging its web site, and sometimes for arranging the actual connections to the Internet. The facilities, called data centers, are located near the Internet backbone, the high-speed, high bandwidth core of the physical network that underlies the Internet. Customers' servers sit in racks bolted to the floor, in cages. Exodus Communications was one of the pioneers in this area, and is one of the

largest hosting services. Colocation companies have tended to find that just this facility rental was not enough to generate attractive returns. A natural evolution has been for data center firms to offer more services.

Data centers may provide the hardware and the basic software that allows businesses to have e-commerce web sites. They provide dedicated servers for customers that are large enough, or shared servers for smaller businesses. Digex is an example of such a hosting service. Customers typically sign contracts with a set-up charge, and a three-month minimum service agreement. Thus an enormous business for renting computing infrastructure has arisen as a result of the growth of e-commerce. Rentals for short-term needs, such as cars for business trips or vacations, and various kinds of machinery for construction projects, are nothing new. In the case of hosting services, however, long-term rentals are an outsourcing driven by economies of scale and specialization. Hosting services are able to take advantage of these in ways that most businesses can not. Even large firms may choose this form of outsourcing since their scale will be much lower than that of the data centers, which may host thousands of firms simultaneously.

Even the provision of hardware and basic software has not proved to the limit of the scope of hosting services. They are now aiming to take advantage of potential economies of scope by providing additional services that are conveniently or efficiently provided along with basic hosting. These services can include management of the client's machines, managing network security, stress testing, and various kinds of consulting services.

Hosting services can also be treated as including firms that host particular software applications for businesses. The most common of these has been email. Again economies of scale and specialization have led firms to have their email managed by companies specializing in this task. Again, firms in this category try to offer a range of services beyond basic communications capabilities: security, integrated messaging (such as electronic faxes or voice mail linked to email), spam blocking, and certified delivery. Customer relationship management might also fall in the category of application hosting. In other words, a firm might outsource the task of automated customer service, rather than licensing the software and performing it in-house. Application hosting in this form is at the other end of the spectrum from colocation services, and might be included in the next category.

Application Services Application service providers (ASPs) are the newest category of service providers in the world of e-commerce. One key difference from the traditional application outsourcing model is that that model involved large-scale, complex software applications where day-to-day management was required. ASPs aim to make all kinds of business software available for rent over the Internet, from expensive applications suites down to desktop productivity tools such as Microsoft Office. In this model, software is changed from a product to a service. The selling points of such a model are reductions in up-front licensing costs, flexibility by avoiding lock-in and allowing easy upgrades, and choice from a variety of software vendors.

The model has some attractions for software firms as well. It permits greater control over use, ensures recurring revenue, and avoids the shrinking market problem that all durable goods face. The ASP category is really the implementation of the idea touted by Larry Ellison of Oracle and Scott McNealy of Sun Microsystems, that 'the network is the computer'. Software no longer has to reside on thousands of desktop computers, but is available over the Internet, just like news, entertainment and other information. Even Microsoft has accepted this idea, and is planning to make its applications available over the Internet in this way.

Of course the technical difficulties of adapting software to run over the Internet are not to be underestimated. Furthermore, the economics of the ASP approach are still not clear. Does it make sense for this particular boundary to be drawn around what the firm owns and what it rents? How does this affect control and effectiveness in decision-making? In one way, ASPs extend the web hosting idea. ASPs themselves need computing infrastructure, which they may buy and assemble themselves, or rent from hosting services. Thus ASPs can be in the hosting business, and hosting services can become ASPs. In another sense, ASPs involve extending traditional application outsourcing. Not only 'back-end' software is moved out of the firm's boundaries, but the pieces used directly by the firm's employees are also accessed on an as-needed basis.

There are as many types of ASPs as there are types of business software, so we have only give a brief overview. This category is not only heterogeneous, it is still in the very early stages of its evolution. Yet it illustrates the ultimate power of digitization, where large, complex software applications for handling all kinds of business tasks can be called up using a web browser and a few mouse clicks, whenever needed, and on a pay-per-use basis.

Online Exchanges Business-to-business and consumer-to-consumer transactions have traditionally relied heavily on face-to-face meetings, often intermediated by newspapers to provide information on possible exchanges, or by human brokers to provide a range of services. The Internet has opened up the possibility of such services being provided more systematically, as is the case with financial markets. Financial markets have developed a sophisticated set of exchange institutions because of the high value and volume of the transactions.

The technological change that has taken place with the Internet is a reduction in the cost of setting up and maintaining such exchange institutions and services. Alternatively, one can think of the change as being that far greater value (in terms of information about mutually beneficial exchange possibilities) can be provided at the same cost as before. From either perspective, formal exchanges become economically viable for goods and services that were otherwise not candidates. The best known example of this change is eBay's national market for collectibles, which were otherwise sold in flea markets, or through intermediary dealers who took a high fee for bearing the risk and the carrying cost of such items, or through hit-and-miss, relatively expensive

advertising. We will discuss online exchanges more in Chapter 12, when we look at changes in the organization of markets in general.

Other This category is really all the products and services that are finding new uses as part of the Internet's infrastructure. Server computers that once connected groups of corporate users inside 'Intranets' are now souped up for doing duty as part of the foundations of the World Wide Web. Microprocessors that are inside these computers have also adapted. Much of this innovation was happening anyway, but e-commerce has accelerated it, and increased the rewards.

One might also include handheld devices in this miscellaneous category. Cell phones and personal digital assistants (PDAs) become different kinds of devices for connecting to the Internet in a new way, without the encumbrance of wires. Each has an origin and a different use that is independent of the Internet (voice communications for cell phones, portable information management for PDAs), but each is also drawn into the new 'circle of e-life'!

Finally, software vendors, consultants, and other professional services firms have all adapted to the Internet, modifying their offerings to meet the new demand. For example, firms that might earlier have focused on advising how to build and manage internal information systems now offer services focused on e-commerce, such as how to build effective web sites for customers or suppliers.

9.7 Conclusion

In this chapter, we have begun to describe the essentials of e-commerce, beginning with the nature of digital products, and their economic characteristics. We have classified digital products and services, both the ones we consume and those that help make up the infrastructure of the Internet. We have analyzed some of the economic issues in the provision of digital products and services, and provided some examples of product and service innovation made possible by digitization. In the next three chapters, we will continue this analysis, looking in more detail at how firms and markets are changing in order to make e-commerce a reality.

Summary

- Digital products are physically characterized by being virtually indestructible, easily modifiable, and almost costless to copy.
- Digital products and services can be classified broadly as content (news and entertainment), tokens of exchange (tickets and financial tokens), or processes (interactive games, business processes).
- Key economic characteristics of information products are shareability and lack of excludability. These attributes are driven by their physical characteristics.
- The economic properties of information products may make perfectly competitive market structures (large numbers of small firms) impossible to sustain.

- The value of information products can depend on time as well as who else uses them.
- Innovations in products and services made possible by digital information include bundling of time and information services with physical goods (online groceries), microproducts (small pieces of information sold individually), and direct purchases of individual attention for advertising.
- A wide variety of new products and services are required for the infrastructure of the Internet and e-commerce, including communications equipment, connectivity and storage services, various kinds of infrastructure and application hosting and management services, and market exchange services.

Questions

1. Does 'being digital' really change things beyond just offering products and services faster and in greater variety? Are there things that were absolutely impossible earlier that are now not only possible, but economically viable?
2. Do the economic characteristics of digital products help an Amazon.com? How about a Yahoo! or an eBay? What kinds of products and services do you think were offered in industries made up of many small firms before the advent of e-commerce?
3. Give three examples of products or services that are changed as a result of digitization, and three examples of totally new products or services, made possible by 'being digital'.