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Future Telecommunications: Trends and Directions

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4.1 Introduction

Imagine for a moment how daily life would be affected if the telecommunications services and applications that we take for granted were to be removed. The daily paper would contain mainly local news and any international stories would be describing events that were weeks or months old. We would spend much of our time during the week traveling from house to house and town to town as we tried to keep in touch with our friends and business associates. We would tend to live close to where we were born and raised otherwise we would risk losing contact with friends and family. Finally, the number of envelopes, paper, and stamps sold would be constantly increasing as people wrote letters in order to have their presence felt in far-off locations without having to travel.The contrast between our everyday life and this example clearly shows just how significant the impact of today's telecommunications services has been on how we communicate. As hard as it is to imagine a day without the communications systems and services that have become such an integral part of our lives, so too will it be impossible for future generations to imagine living in our times with our "primitive" telecommunications infrastructures and applications!

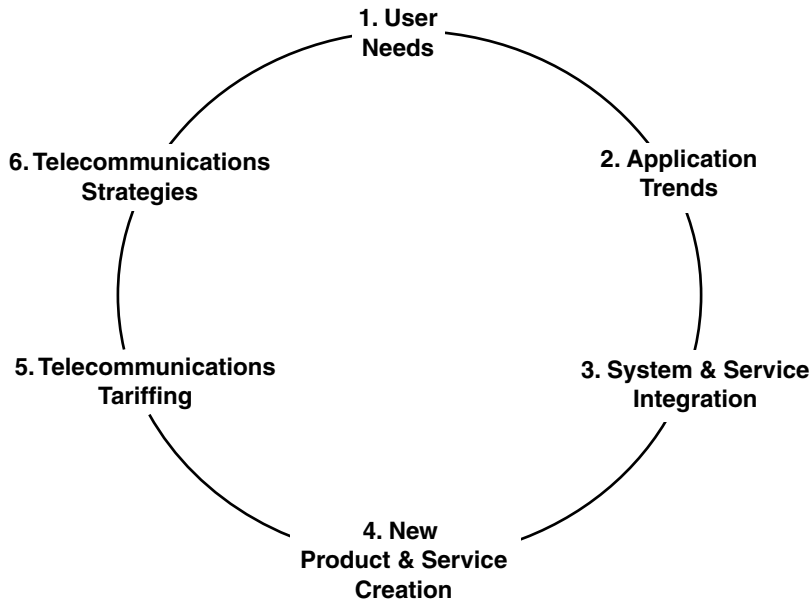

FIGURE 4.1 Telecommunications trend lifecycle model.

In this chapter we will be looking at where the field of telecommunications is evolving to. This type of prediction is not without a great deal of risk: a similar analysis done as recently as 1990 could not have hoped to accurately identify the impact that the Internet now has on the way we communicate today! However, the basic building blocks that will control the evolution of the field of telecommunications, the telecommunications DNA if you will, are reflected in the state-of-the-art services, applications, and equipment available today. We will look at the current trends along with the end-user requirements and competitive market forces that will shape the future of telecommunications.

To help focus the consideration of such a large topic as the future of telecommunications, it is helpful to have a model to frame the discussion. The model that we will use in this chapter to identify future trends in telecommunications is shown in Figure 4.1.

This telecommunications trend lifecycle model that we will be using is intended to provide a high-level view of how the effects of changes "ripple" throughout the telecommunications field. We will be discussing the model in a sequential manner, starting with an analysis of the changing needs of end users. It is important to keep in mind that innovation and change in real life is often chaotic and seems to resist following orderly models. Therefore, as long as we understand that a new telecommunications trend can potentially start at any step of the trend lifecycle model (i.e., a new equipment technology is invented in a research lab and only later is it understood well enough to be used to address end-user needs), then we will be able to correlate this chapter's analysis and the real world.

4.2 User Needs

The modern world is currently undergoing its third major communications transformation. It took 38 years for radio to garner 50 million listeners; likewise, it took 13 years for television to achieve a similar number of viewers. Incredibly, the worldwide computer communications network known as the Internet has required only 4 years to reach that milestone. In the U.S., as of this writing, there are more than 62 million Internet users and another 7 million are estimated to be joining them soon. These users will be joining a worldwide community of over 100 million Internet users. As is to be expected, when more people make use of the Internet, more information needs to be processed by the networks and computers

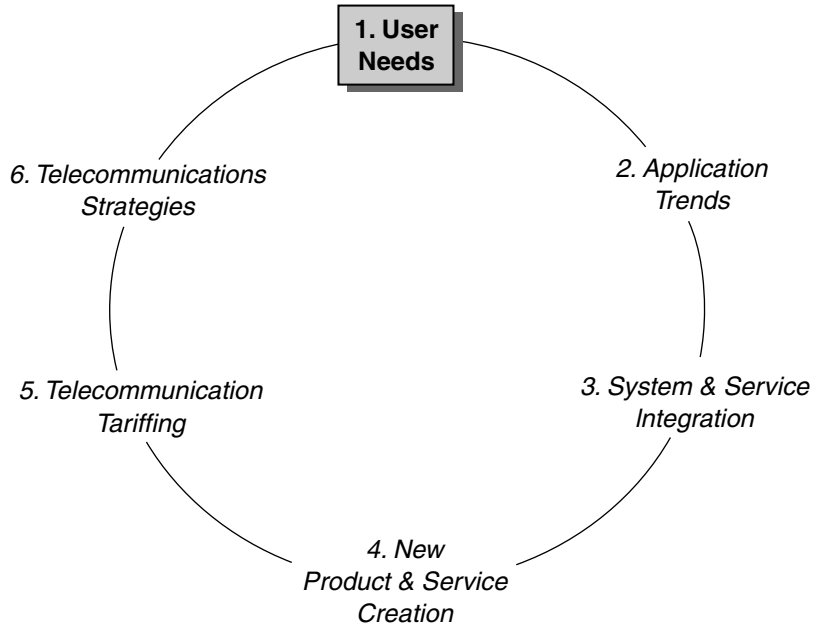

FIGURE 4.2 Trend analysis — user needs.

that make up the Internet. The U.S. Commerce Department (as of April 15, 1998) estimates that the amount of information processed over the Internet is doubling every 100 days. The needs of these users and others like them will form the drivers of telecommunication trends in the future.

In this section we will examine the user needs that will form the basis — and demands of — tomorrow's telecommunications systems and applications (Figure 4.2). We will start by determining exactly what types of users' needs we have to understand. Next, we'll explore the specific problems and challenges that each group of users is currently trying to solve. Finally, we'll identify several general trends in user needs that will have the greatest impact on future telecommunications services.

4.2.1 Types of Users

It can be argued that almost everyone in industrialized countries could be considered to be an end user of telecommunications services and applications. A recent study by the International Telecommunications Union (ITU) standards body reported that in high-income countries (per capita GDP of more than U.S. $8955) there exists a "teledensity" of more than 50 phone lines for every 100 people. This would lead one to conclude that in these countries, telecommunications services and technologies will evolve to meet the needs of the general public. However, in order to identify specific future trends in telecommunications, we need to limit our focus to only those users who either have the financial resources or sheer numbers to generate and sustain a trend in telecommunications. We will also avoid focusing on narrow vertical application segments such as healthcare and banking in order to identify trends because their influences on future applications and services can be safely generalized into broader end-user groups without losing their contribution. In this chapter, we will segment end users into four primary groups for further study. These groups can be characterized in the following ways:

- **Businesses:** This segment of telecommunications end users is defined to be a group working toward a common goal at one or more locations. As a rule, businesses need to interconnect each of their workers on a frequent basis. Depending on the size and type of business, this interconnection requirement can result in the need for large amounts of bandwidth. The business segment

is also characterized by its growing need for 7 days per week × 24 hours per day × 365 days per year connectivity in order to support globally distributed operations. Businesses are fairly price resistant — they are willing to pay more for access to applications that they feel will provide enough of a competitive advantage to recover their costs.

- **Mobile Professionals:** These end users generally interact with business segment end users. The difference between these segments is that mobile professionals generally operate either by themselves or as part of small focused teams. Mobile professionals don't have a fixed location connected to telecommunications services; rather, they need to have services find them or permit them to access the services from a wide variety of remote locations. Once again, the mobile professional segment is fairly price insensitive to the price of telecommunications services that have a direct correlation to a competitive advantage.
- **SOHO:** The small office/home office (SOHO) segment is a rapidly growing portion of the market, as larger businesses discover it is more economical to outsource many of the tasks they used to perform internally. Tax incentives from many local and federal governments designed to decrease commuting congestion and pollution have also added to the economic incentive for this segment to experience explosive growth. Telecommunications applications have been crucial to fueling the growth of this segment. Existing applications have permitted home office workers to have access to similar communications resources that centralized workers also enjoy. The SOHO segment is price sensitive; however, their large numbers can often be used to create attractive business cases for both the end users and the service providers.
- **Residential:** This segment of end users wants to have telecommunications services delivered to their homes. The telecommunications applications desired by this segment often are used to communicate with other residential end users, businesses, or for entertainment. This segment is very price sensitive; in order to pay for a telecommunications application or service, something else will have to be given up. Each application is subjected to a tradeoff evaluation by the end user.

4.2.2 Different Users Have Different Needs

Each of the different user groups we have identified is facing a different set of challenges that can be addressed in a variety of ways by telecommunications services. In this section we will explore the environmental and social drivers that have created these end-user needs. In the final section of this chapter we will identify the common drivers that apply to each segment of end users. As you read this section, it is important to keep in mind that although the specific details of how end user problems will be addressed may change over time, the core set of conditions that have created the needs will not change.

4.2.2.1 Business End-User Needs

Businesses exist to earn a profit and they do this by offering some combination of better products, lower prices, or by meeting the specific needs of a particular customer better than any other firm. For the purposes of this discussion, we group together businesses of all sizes from the very small to the very large. Although the specifics of the problems they are trying to solve may differ, all businesses face the same basic set of challenges.

The communications needs of business end users can be divided into two basic groups: internal needs and external needs. A business's internal needs relate to how it communicates the way that it wants to do business to its employees and how those employees communicate status and learned information throughout the firm. The external communication needs of a firm relate to how it exchanges information with members of its business environment. These members include other businesses (trading partners) and customers alike. We will now examine the drivers in each of these different groups of needs in detail.

In the last decade, firms have come to realize that one of their primary sources of competitive advantage can come from how well they exchange information internally. Having used the recent explosion of networking and computer storage technology to collect, store, and distribute large amounts of information,

firms are now looking to refine their operations. What businesses have realized is that they have a major challenge of providing everyone in their organization with access to the specific types of information that they require in order to perform their jobs better. A key challenge is that each employee in a firm performs a different task (or performs the same task in a different business context) and therefore needs to have access to different types of information at different times. How to provide such connectivity presents a significant challenge to businesses of all sizes.

One of a business's most valuable resources is its internal knowledge of how problems were identified and solved in the past. A key communications objective for a firm is to find a way to share problem-solving experiences throughout the firm. Meeting this challenge is critical for the firm, otherwise it will face the expense of solving the same problem for the first time over and over again. The solution involves communication solutions that not only provide access to detailed records of past projects, but also include identification and access to the employees who were involved in solving the problems. Only by finding a way to meet this challenge can firms refine their problem-solving processes and become more competitive.

The cost of producing products or services has received a great deal of attention in recent years. Businesses have implemented a wide range of control and monitoring systems that are able to evaluate the operations of different internal processes. Such systems include enterprise resource planning systems that can control the supply chain of a product's production process, quality improvement tracking systems, and just-in-time manufacturing systems. One of the primary purposes of each system is to permit a firm to more effectively use its resources and raw materials — in other words, they help a firm run a "lean operation" in which all of its assets are fully utilized. Such tightly run operations require a business to establish and maintain a wide variety of communications between its internal divisions no matter where they may be located. Additionally, there is a direct correlation between how fully the firm's assets are utilized and how rapid communications between the different parts of the firm are executed. These processes and systems force a business to walk a tightrope between operating at peak efficiency and not having to correct materials to operate at all. Firms must identify what communication is required to support such mission-critical systems and then implement and use their telecommunications solutions to gain a competitive advantage.

Finally, businesses are often thought of as a collection of employees who come together at company-owned locations to perform work. Businesses are now starting to realize that the arrival of relatively inexpensive computing resources, coupled with the availability of numerous communications services, call for rethinking about how they conduct their daily operations. Firms have already realized that many of the noncritical or nonstrategic processes they perform can be effectively outsourced to other firms that are able to perform these processes more efficiently and at a lower cost. Firms are now starting to reexamine how and where their remaining employees work and interact. The popularity of telecommuting and rotating "work from home" days shows how firms are starting to explore these uncharted waters. One of the primary keys to making a widely distributed workforce successful is to identify communications solutions that permit the firm's employees to interact as though they were together in an office, without the actual expense of the office.

Advances in transportation and communication have permitted businesses of all sizes to compete on a global scale. New businesses are able to offer their products to almost any international market, starting on their first day of operation. Existing businesses that have saturated their traditional domestic markets are able to seek new revenue streams in unexplored global markets. One side effect of operating and competing on a global scale is that all of the telecommunication systems that a business established to facilitate internal communications for its domestic operations must now be extended to become both location and distance insensitive. This requirement affects all forms of communication including voice, video, and data. As a clear confirmation of this growing need, the Federal Communications Commission's (FCC's) statistics show that since 1987 the growth of the U.S. long distance market has been propelled by a 14.5% compound annual growth rate (CAGR) in international long-distance revenues. Traditionally, such services have been very distance sensitive, thus making telecommunications expenses a significant expenditure for a globally distributed business. As the number of firms that operate internationally has

increased, so too has the number of telecommunications service providers. This increase in service providers has provided businesses with an opportunity to seek out and use those providers who are able to help them minimize their telecommunications costs. Once again, the FCC's statistics show that the composite cost of an international phone call has dropped from U.S. $1.00 in 1992 down to U.S. $0.68 in 1997.

As businesses study how they can maximize their profits, they have realized they can reduce their costs by streamlining interactions with their suppliers. This new understanding has led to the sharing of information, such as current sales results and stocking data between retailers and their many suppliers. The high volume and near real-time characteristics of this information have created a growing need for more sophisticated telecommunications services. Once again, since retailers and suppliers may be located in different areas, the telecommunications systems must be distance insensitive.

Finally, the most important interaction that a business has is with its customers. Customers are demanding that it become easier and quicker to interact with a firm. They want to see updated product lists and information; in some cases they want to be able to custom-design their own solution from a firm's product lines; and they want to be able to review and perhaps pay their bills electronically. This increased level of interaction with customers who are not physically located in a firm's place of business demands an entirely new set of sophisticated telecommunications services.

4.2.2.2 Mobile Professional End-User Needs

As business become more decentralized and at the same time more customer-focused, the ranks of the mobile professionals are swelling. This new breed of employee can no longer be thought of as being only a salesperson; rather, the mobile employee may be part of any one of a number of project teams that have been brought together to solve a specific problem. As more and more employees start to operate away from the firm's offices for longer periods of time, the ability to use communications systems and services to provide information, obtain status updates, and share learned knowledge becomes even more important. Let's take a look at some of the specific needs of this group of end users.

Arguably, the most critical need of a mobile professional end user is his need for up-to-date information. Since a mobile user is operating away from a centralized office environment, his ability to learn about changes in products or company strategy is limited to what information is sent to him — the critical real-world "water cooler" information exchange system is no longer available to him. New means of identifying important information need to be created along with an effective two-way system for distributing that information and getting end user responses and feedback.

Since the mobile end user is often away from the office and in fact may be spending much of the time with a customer, it is impractical to carry all of the product and service reference material that may be required to perform the tasks. Therefore, it's important that the mobile end user be able to quickly access all of the material that may be required to support the current task. Note that the information required may take many forms including text, pictures, animation, and video. Many firms that sell large, complex software systems have changed the way that they now perform product demonstrations. Instead of taking complex computer systems to the customer's site, they use a standard laptop and establish a communications link back to their office, where the application is running on the more complex hardware system. This is one way for the firm to better utilize its expensive resources and better support its mobile users at a lower cost. Such services are only the start of what will be required to support the growing mobile user community.

The type of data that can be accessed by mobile users is another critical issue. Current analog modem links over voice-grade phone lines limit mobile users to a bandwidth between 28.8k bps and 56k bps, which is acceptable for accessing small- to medium-sized text documents. As more and more information is stored in richer formats such as video and integrated multimedia documents, new telecommunications services will have to be created to support mobile users. The need for access to multimedia information is especially critical for mobile users whose firms design, manufacture, or sell complex products. The multimedia information for these products can help the mobile user to shorten the selling cycle by

permitting such complex products to be clearly and simply communicated. New telecommunications solutions are required to ensure that mobile users are able to access *all* of the information they require in order to perform their jobs.

A unique requirement of mobile end users is that, unlike stationary users, information must "find" its way to the mobile user. The mobile user is expected to change locations quite often and can't be expected to be reached via an addressing scheme that requires the user to always be at a given geographic location. This applies not only to voice communication but also to all forms of electronic information interchange. This issue has been partially addressed by some of today's current telecommunications solutions; however, such solutions generally work only within a limited geographical area (country or artificially determined service provider territory) and completely different solutions have been designed for voice and data services. Mobile users require solutions that provide seamless integrated voice and data solutions of ubiquitous coverage.

Although many of the needs of a mobile end user relate to ensuring reachability at all times, the opposite is also a concern. One of a mobile user's more valuable resources is time. Giving others the ability to communicate with the mobile user also gives them the ability to appropriate time. The mobile user needs to be able to limit who has what level of access. Additionally, the mobile user needs to be able to decide if and how to respond to each request for valuable time.

A mobile user's toolkit consists of several groups of information to help do the job on a daily basis. These groups of information consist of a variety of phone lists, customer names and addresses, customer lead lists, internal corporate directories, etc. As this collection of data grows in size, so too does it grow in value to both the mobile user and the company as a whole. The telecommunications challenge is how this information can be shared among the wide variety of communication devices used by the mobile user without having to retype the information each time.

The demanding lifestyle that being a mobile user requires often results in the lines between a worker's personal and professional lives being blurred. Since the mobile user may be away from home for long periods of time, it is critical that personal messages from various sources and in varying formats must be able to find their way to where the mobile professional is. Additionally, personal communications must be clearly identified as such and must be easily differentiated from work-related communications. Both mobile workers and the firms that employ them appear to be drivers for this type of requirement — both parties realize that good communications can help a mobile worker strike the correct balance between different roles and responsibilities.

Change and movement are key components of a mobile user's typical day. Because of this, there is no single best way for messages and information to reach the mobile user. Therefore, the mobile user needs to be able to access a message in any one of several different ways: e-mail via the phone, and voicemail via the laptop. It is critical that the information is able to reach the mobile end user as quickly as possible without restricting how the user chooses to retrieve the information.

The era in which groups of the same people worked together for years or even entire careers is quickly coming to a close. Mobile users are at the forefront of this change and represent the new breed of worker: they are part of dynamic teams quickly created to solve specific problems. Once the problem has been solved and a solution implemented, the team is then dissolved and its members go on to join other dynamic teams. From a communications perspective, the mobile user needs to be able to easily exchange and work on the same information with other members of the dynamic team during the time that the team exists. The security associated with such communication is a critical factor. In today's customer-focused markets, employees of the customer may be part of the same dynamic team as the mobile user. In such cases, the ability to filter and restrict a team member's access to sensitive data is required in order to ensure that the internal and external team members are able to work together smoothly.

4.2.2.3 SOHO End User Needs

In contrast to large established firms, employees of small firms have different communications needs. We include in this group those workers, who may work for firms of almost any size, operating out of

their homes. Corporate outsourcing and the increasing number of new businesses have caused this small office/home office (SOHO) group of end users to increase in size on a yearly basis. As the telecommunications service marketplace becomes more and more competitive, the SOHO segment of end-users has started to receive the attention of telecommunications service providers. The key to a provider being able to successfully serve this market will be an ability to correctly identify the needs that will motivate the SOHO end-users to purchase telecommunications services.

Unlike either the business or the mobile user, the SOHO end-user is extremely price conscious. Smaller organizations naturally tend to have smaller budgets and therefore will have less to spend on telecommunications services of any kind. However, SOHO end users are generally involved in very competitive market niches and so they feel that it's necessary to their continued survival that they arm themselves with any tools that provide a competitive advantage. The end result of these two conflicting conditions is that the SOHO end user will purchase or subscribe only to those telecommunications services that are priced within budget and which can be clearly demonstrated to give a competitive advantage.

SOHO end users do share some of the same basic needs that mobile end users have. Specifically, those SOHO end users who operate out of their homes will have the need to be able to separate personal messages from business messages. This issue is a little more complex than it was for mobile end users because all of the messages are delivered to a single location — the user's home. An extension to this need is that the at-home SOHO end user, just like the mobile end user, needs to be able to control who can communicate and when. Since all requests for time (phone calls, e-mail, etc.) will come to home, the SOHO end user needs to be supported by telecommunications services that can be told which role the end-user is currently playing — homeowner or worker.

Most SOHO establishments share a desire to one day be bigger then they are now. As a move in that direction, SOHO end users want to be able to start projecting a "big company" facade at all times when dealing with customers. This requirement manifests itself in several different ways: addresses and staffing levels. In the days prior to electronic addresses, small firms could use postal boxes to obscure their less impressive residential or strip mall addresses. As we move into the future of electronically linked businesses and electronic commerce, the importance of an impressive electronic address will take the place of the postal box. Additionally, since SOHO operations are generally staffed at very lean levels (i.e., perhaps a single employee), SOHO-end users are always on the lookout for telecommunications services that can take the place of additional nonexistent staff members and which can be used to provide superior customer contact. An example of such an application would be the "automated attendant" feature on many small business phone systems which automatically provides company information and basic directory services.

For the SOHO end user, the previous requirement can be further extended. It is once again the limited amount of staff available in the SOHO environment that generates the need for additional telecommunications services. These services are needed to permit potential customers to easily show themselves the SOHO firm's products, prequalify themselves, and then get in touch with actual employees. This use of telecommunications services to handle initial customer interest and then using valuable human resources only when the customer has demonstrated that they are a viable potential customer may be one of the most important drivers for SOHO telecommunications requirements. It certainly is one of the easiest to justify spending money!

Like the mobile end user, a SOHO end user must often work with others in order to secure large business orders, due to a SOHO's small size. This can often result in a SOHO establishment being required to *ad-hoc* partner with another business on a per-project basis. The telecommunications requirements that would be driven by this opportunistic type of limited partnering would be to support the exchange among the temporary partners of such information as schedules and project information. Once again, security would be critical; just because partnering is occurring on this project does not exclude the possibility that these partners may be competing against each other in the future.

Unlike the mobile end user, the SOHO end user has a "base of operations" — an office. It will be used to store almost all of the information related to the SOHO operation. This organizational structure

produces a telecommunications need to permit the SOHO end user to access the information while away from home. Such access requirements include the ability to retrieve voice messages, electronic data, and any other information or formats that may be required. There is also the need for notifying SOHO end users that new information has arrived at the office in their absence. Note that once again, the information can arrive in a multitude of different formats.

Finally, since a SOHO end user faces the dual dilemma of operating under a tight budget today but believing that the operation will grow larger tomorrow, whatever telecommunications decisions are made today must be able to grow and change with the business. Solutions that must be removed and replaced are unacceptable both in terms of costs and time lost.

4.2.4 Residential End-User Needs

Our final segment of end users is also arguably the largest. In the U.S. there are currently over 120 million homes; it is these residential end users to whom a wide variety of service providers hope to sell additional telecommunications services. The marketing success of standard telephone service and the mixed success of various cable and Internet-related services clearly shows that the residential end-user community is a complex and multi-faceted group. The service providers hoping to capture a significant share of this diverse group must be willing to spend the time to understand what shared needs are currently unsatisfied.

Perhaps the most important factor that must be considered when attempting to understand the needs of the residential end-user is that, unlike the other end user segments that we've studied, the residential end-user has a relatively fixed budget from year to year. The result of this is the simple fact that every purchase is a tradeoff: if a new telecommunications service is to be purchased, then something else must be passed over. In most cases, this means that any service that does not provide a clear return for the residential end-user's investment is certain to fail. A good example of this occurred when the next generation of phone services based on the Integrated Services Digital Network (ISDN) technology were introduced. Despite the technology being sound, one reason that they failed was because residential end users judged them to not provide enough of a benefit to justify their cost.

As communication systems have improved our lives, they have also permitted us to move faster throughout the day and get more done. The result of this has been that the residential end user views the ability to manage time as a critical need. Any product or service that can provide more control over how limited time resources are spent seems attractive. However, as we have previously discussed, other factors such as price and availability will still play a very significant role in determining the residential end user's final acceptance.

As more and more information arrives at a residence, a striking advantage of postal mail over telephone service starts to emerge: information that is delivered via the postal system clearly identifies its intended recipient. On the other hand, a phone call arrives with no attached address and so whoever is first to answer the phone is required to perform a crude routing function in order to ensure proper delivery. This problem will only continue to grow as Internet access requires separate e-mail addresses and cable services permit channel and scheduling selections to be customized on a per-viewer basis. Any services that seek to address these needs of the residential end user must make sure that they are able to handle information that arrives in a variety of formats and that both end-user addresses and information processing preferences are handled by the service.

People are tribal by our very nature — we accomplish our daily activities by interacting with a wide variety of other people in our community, neighborhood, and extended family. Residential end users have a need to stay in touch with their contact group which resides locally as well as their extended families who may not live locally. The specific relationship defines the frequency of this contact and the format where it needs to occur. Today, such contact is mainly limited to text (letters or e-mail) and voice (via the phone). However, the arrival of the Internet and its support for a diverse set of multimedia communication formats has started to acquaint residential users with new options for communicating.

A very important constraint on any new telecommunications service is that it must be easy for the residential end user to use. Since the educational background and technical sophistication of residential

users can vary widely, the majority of residential end users require that systems they purchase be easy and intuitive to use. One of the reasons that basic telephone service has been such a success is that the service is intuitive and simple to use. Note that the amount of end-user training time that it takes to learn to use a phone is very short! A key point for service providers to remember when introducing new services is that, in the mind of the residential end user, ease of use is a more important factor than additional bells and whistles.

Residential end users are always on the lookout for bargains whenever they are preparing to make a purchase. This mentality can be seen in the types of retail establishments that dominate the U.S. landscape: Wal-Mart, Kmart, and an almost infinite variety of strip malls. One of the greatest advantages of the Internet as it exists today is it permits skilled users to rapidly perform comparison shopping prior to going out and making a purchase. In the future, telecommunications services that standardize such comparisons and permit product offerings to be compared on multiple criteria including price, features, and availability would meet a need of the residential end user.

As we move into a new millennium, it is becoming evident that the skills required to survive and thrive in the modern world are changing. An example is found in automobile repair. The number of residential end users who service and maintain their car themselves has dropped substantially due to increased complexity in automobile design (anti-lock brakes, turbo-charged engines, etc.) and a decrease in the amount of time available to perform such basic tasks. Interestingly enough, when a car is taken to a repair shop to be worked on, one of the first steps that the mechanics perform is to attach computer input cables to various parts of the car in order to diagnose its operational health. Residential end users understand that this change in required life skills is occurring and they are eager to not be left behind. Therefore, they see access to education and information resources as a critical need and they desire telecommunications products and services that can improve, supplement, or provide greater access to such educational resources.

One of the greatest benefits of modern communications services is allowing people to interact with others who share a common interest. Without such services, perhaps these people would otherwise never know about each other. Residential end users desire services that will permit them to interact with other (potentially) remote end users who share a common interest. Examples would be collectors, fantasy-league sports players, on-line action houses, and support groups. New telecommunications services offer the possibility of permitting such interactions to occur on a global scale.

In the past, if a residential end user wished to gain access to valuable resources such as technical help, a stockbroker, etc., they had few options: schedule an appointment and then travel to meet with the resource provider face-to-face or phone them and either wait on hold or wait for them to call back. Telecommunications services that can streamline access to such valuable and limited resources are desired by all residential end users.

Access also plays a key role when it comes to a residential end user's finances. Better access to financial resources such as loan information, checking/savings account information, and stock portfolios has always been desired but not widely available. Key barriers to such services in the past have been concerns regarding both the security of transactions and the inability to validate the identity of the user, and the lack of appropriate equipment at the end user's residence to support such services. Both of these issues are being dealt with and will not continue to be barriers.

Residential end users seek ways to supplement other activities and thereby produce a richer experience for themselves. Users desire a way to gain more information or to follow up on something else that they have read about or seen. An example would be PBS's *Nova* programs, which display different Web links that point to supplemental material about the portion of the show that is currently being viewed. Additionally, residential end users would like to be able to follow up and obtain more information on advertised products that they see in different media — note that this accounts for the fact that Web addresses have become a standard part of any auto advertisement!

In a fashion similar to both mobile and SOHO end users, residential end users are very concerned about both their privacy and how they spend their valuable time. Residential end users want to be able

to control who is able to get access to them and when such access is permitted. Therefore, they are interested in finding solutions that permit them to control who is able to send them information and how they are notified when that information arrives.

Finally, the ultimate benefit of technology is that it permits residential end users to plan events around their schedule rather than the other way around. Residential end users would like to be able to pick what time they want to be entertained instead of having to arrange their lives around external entertainment schedules.

4.2.3 End User Requirements Summary

As we conclude this section, it is important that we review the needs that are facing the four main segments of end users who will be driving the evolution of telecommunications into the future: business, mobile, SOHO, and residential. It is important to note that each of these segments is attempting to accomplish a different set of goals with different sets of available resources. This simple fact becomes quite evident when one looks at the differences in how much each of the different segments is going to be willing to spend on new telecommunications applications and services.

Although there are significant differences between each of the major end-user segments, several common themes have emerged. One of the most fundamental needs that each segment is trying to address is the ability to better control how its time is spent. Telecommunications services have the unique ability to eliminate distances and to permit time to be "shifted" — that is, to allow interaction between different parties to occur when it is most convenient for all of the involved parties. This need is further supported by each segment's desire to be in control of when and how they communicate with someone. The curse of modern technology is that it severely limits our ability to make ourselves unreachable when we so desire. The ability to regain this ability is a need that has been expressed by end users in all segments. Finally, the realization that end users are working harder at their jobs and the fear that this will cause their professional and personal lives to blur into an undistinguishable mass has generated a common set of needs. Users are seeking a way to be able to clearly distinguish communication and information that is associated with one role that they play from their other roles.

The recognition of these common basic end-user needs provides a clear prioritization for the development and deployment of future telecommunications applications and services. At its core, telecommunications is a field that exists to improve lives and solve problems. Advances in telecommunications often appear to be based on the latest "gee-whiz" technologies; however, for a new service or application to be successful, it must address one or more of the basic end-user needs that we have identified.

4.3 Application Trends

Telecommunications applications provide solutions to the problems faced by people who wish to exchange information ("end users"). We define telecommunications applications as the software that provides end users with access to the functions that permit information to be exchanged. A wide variety of telecommunications applications are in use today: the software in telephone switches that provides such services as emergency 911, caller I.D., three-way calling, etc; e-mail and Internet Web browsers; distributed synchronized databases such as Lotus Notes™, etc. Each type of application was developed to solve a specific set of end-user problems. Future telecommunications applications will also be developed to meet the needs of end users.

The types of future telecommunications applications will be directly related to the end-user needs discussed in the previous section. In order to focus our investigation into telecommunications applications, we will use the same segmentation of end users from the previous section. Figure 4.3 shows the stage of the Telecommunications Trend Analysis Model that is covered by this section. Our investigation will consist of two main parts: application functionality and functionality implementation. Looking at the application functionality trends that are occurring will help us to understand how application

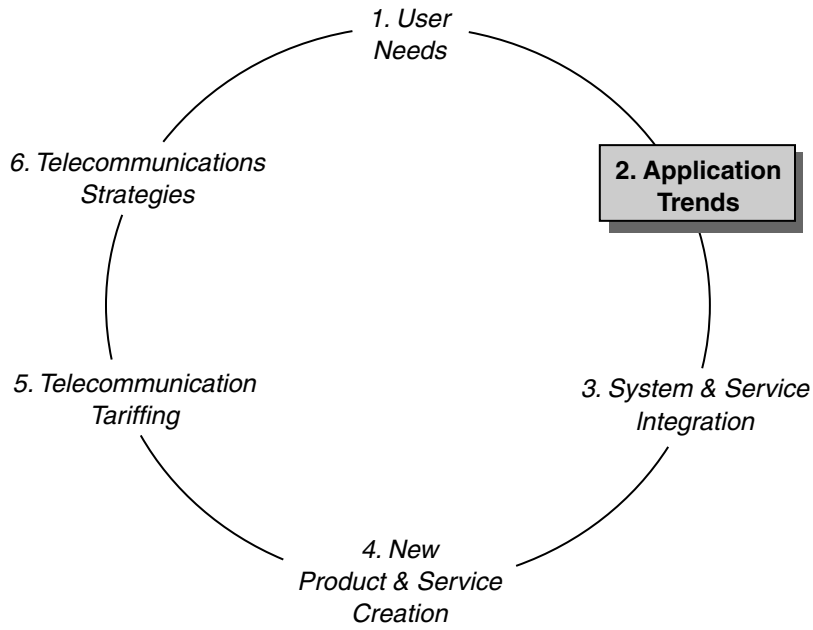

FIGURE 4.3 Trend analysis — application trends.

developers and service providers are working to address end-user communication needs. We will explore how this new functionality will be deployed in the real world when we go one step farther and look at how vendors and service providers are planning to implement the new application functionality.

4.3.1 Application Functionality

All four major categories of end users will require more functionality from their telecommunications applications. Because of the large purchasing power of each segment, competition among service providers has started to increase in the past few years. This trend is most noticeable in the U.S. and England; however, the arrival of the European Union (EU) and a unified currency (the Euro) in western Europe is also helping to make those telecommunications markets competitive.

A result of multiple competing service providers means that, at the very least, all segments of end users will shortly be presented with multiple sources for all existing services. Additionally, the number of services offered to end users will increase more rapidly than in the past due to the need for providers to distinguish their offerings from each other.

The eventual result will be that the telecommunications applications offered to all end user segments will become more customized in order to meet the specific needs of a particular segment. Since end users are best suited to determining their exact needs, the process of subscribing to a telecommunications application will change from the selection of "all-or-nothing" applications in which the end user had little or no choice to participating in a "build-your-own" functionality selection in order to create a customized application.

This ability for end users to design their own applications will be the arrival of true multimedia applications that combine voice, video, and data features into a single customized application. This customization will cause the functionality provided by applications to increase over what is available in today's applications. New functionality will be apparent in the following five areas: Internet services, e-mail, videoconferencing, wireless services, and enhancements to traditional services. We will now look at application functionality improvements we can expect in each of these areas.

4.3.1.1 Internet Applications

The recent explosion in the popularity of the Internet (an unmanaged collection of interconnected computer networks that are all able to "speak" the same communications protocols) has forever changed what telecommunications applications will be expected to do. Studies of Internet usage are difficult to do because of its rapid growth; however, in the early 90s the Internet was used by a handful of researchers and scientists, and studies eventually predicted that the Internet was expected to reach more than 200 million end users and 60 million hosts by 2000. With this kind of growth, it is very conceivable that the usage of the Internet will catch up to, and perhaps surpass, the use of the telephone in the not so distant future.

Today's Internet applications lack the functionality required for end-users to perform e-commerce transactions efficiently. Electronic commerce ("e-commerce"), the use of the Internet to facilitate the buying and selling of goods, is viewed by many as "the next big thing." The Internet offers sellers of goods the ultimate virtual storefront: without having to rent physical space, they can display and demonstrate their products for potential buyers. What is currently missing is the end-user's ability to feel confident making a purchase of the displayed goods directly over the Internet. The reasons for this lack of confidence are varied: lack of a secure environment, lack of an appropriate exchange mechanism, and privacy concerns.

Users are well aware of the fact that as they exchange information with a retailer's Internet application, it is possible for a malicious user to monitor and record their transaction. This could result in the malicious user obtaining credit card or bank account identification information that could then be used to steal funds from the unsuspecting user. Enhancements to functionality are being made to both the retailer's and the end-user's applications. Basic encryption is now available that can be used to secure the transaction information before it is transmitted in order to negate the effect of any interception of the transmission. As this type of functionality is added to end-user's browsers and Internet-aware applications, user confidence in secure Internet transactions will increase and e-commerce can be expected to grow at an explosive rate. In the short term, some service providers are offering guarantees to make good on any losses incurred while using their networks in order to "jump-start" e-commerce activities.

E-commerce is currently complicated by the lack of an agreed upon form of "digital cash." Despite gains in the past decade regarding the increasing use of credit and debit cards, the majority of retail transactions still occur using either paper money or checks. Neither of these two popular forms of exchange translate well to being used in the Internet's all-electronic environment. Once again, several different approaches to this problem are currently being investigated. Recent agreements among many of the major credit card companies have identified the required functional and exchange procedures that will be required to support electronic forms of currency for existing and new Internet applications.

Finally, as more and more of everyday life becomes computerized, consumers are starting to become concerned about how much information retailers are able to obtain regarding personal habits and buying patterns. As the use of the Internet to purchase goods increases, a retailer's ability to track the user's entire buying experience will also be increased. Such information could include a history of goods that the consumer looked at but did not purchase, how often and at what times of day the user visited a specific electronic "store," and all of the products that the customer has ever purchased. Consumers have become alarmed that retailer's applications will be able to "mine" their purchasing history to target other goods for advertising purposes or that retailers will sell their information to other retailers for their use in trying to sell goods to the consumer. As Internet e-commerce applications mature, consumers are going to insist that retailers clearly identify what consumer-related information is being tracked and post their polices regarding use or sale of that data. Internet applications will have their functionality enhanced to support and enforce such privacy policies.

Although the Internet is a worldwide phenomenon, the majority of its content has been created in the English language. The reasons for this are varied; however, the origination of the Internet in the U.S. and the high availability of both computers and Internet access in English-speaking countries has definitely played a major role. Future Internet applications will be required to be able to deal with multiple

languages. The tools to make this possible are slowly starting to emerge. Internet-based language translation products are now available that offer translation services for several languages. Whereas the amazing translation devices seen in some popular science-fiction movies may still be a long way off, the ability to translate text found on the Internet into another language or the ability to select a language for the purchasing process are just around the corner.

- Some service providers who are deploying high-speed digital access services are also establishing on-line communities built around high-speed access. These communities provide an opportunity for businesses to set up on-line shops, as well as a place for both residential and business customers to receive e-mail, purchase goods, access applications, and find out current event information for their local areas.
- Service providers are starting to explore the opportunities presented by integrated bills, accepting payment and providing customer care electronically over the Internet. Voice services and Internet services can be consolidated onto a single bill. Additional applications can electronically present the bill to customers and accept payments over the Internet. This type of application can be used with all types of telecommunications services including paging, IP voice, and long distance. An additional benefit of this approach is that it permits targeted marketing of specific customers and offers a better chance of capturing an impulse buying opportunity.
- Many vendors are looking for ways to replace today's ubiquitous fax machines. Some of the more innovative solutions are coming from companies that are trying to reduce their product support costs. One approach to directly provide a user with only specifically requested information uses Internet based "push" technology. This information delivery technique requires a user to log on to the company's server via an Internet connection. Then the company is able to "push" or force the display of specific information. The true power of this approach becomes clear when the user is able to talk with the company at the same time by using a separate line. These hybrid solutions are a cross between e-mail and fax services. Companies have found that this type of solution works best when the company has a great deal of information that the user would otherwise have to work through in order to find what is needed.
- Firms are discovering that an estimated 10% of customers sometimes need assistance when using the firm's Web site. So-called "chat" applications are being added to Web sites to provide customers with the ability to receive real-time one-on-one guidance from employees of the firm.

4.3.1.2 E-mail Applications

E-mail has become such a critical part of how so many people communicate that we choose to treat its functionality separately from that of Internet applications. A 1998 survey by Forester Research revealed that 83% of Internet users send e-mail, making it the most popular on-line activity. Surfing the Web is the second most popular and attracts 81% of users.

- Adding voice and video to e-mail represents the next step in e-mail's evolution. Some service providers are now able to deliver e-mail that contains embedded links to additional voice and video components of the message. The additional e-mail components are then sent to the user through streaming technology that uses a service provider's computers to do the majority of the required processing, and then ships only the resulting images to be displayed on the end user's Web browser application. The challenge is to avoid disappointing the end users with poor application performance that causes them to revert to standard text-only messages.
- Estimates show that up to 40% of users' time on the Internet is spent on e-mail. In 1997, America Online (AOL) had 11 million members and it processed 15 million e-mails per day, which roughly relates to 23% of its members on-line time.
- E-mail is fairly pervasive, fast, and relatively free. One of the next logical steps is to make it secure. Currently, the majority of financial and legal communications occur using either paper or the

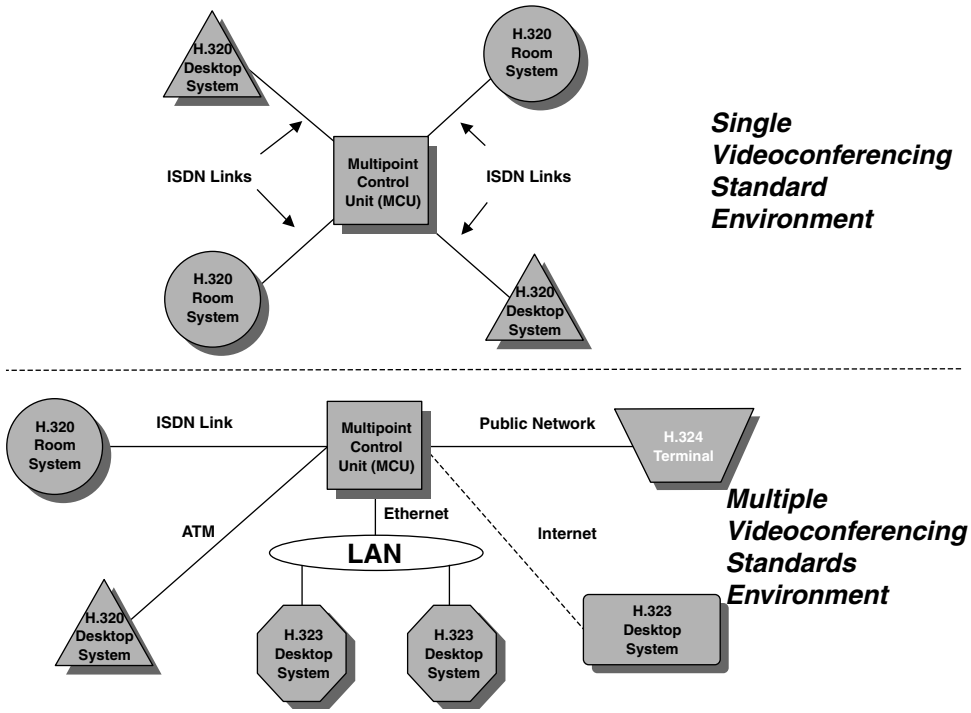

FIGURE 4.4 Videoconferencing environments.

somewhat dated electronic data interchange (EDI) systems. The problem with existing e-mail is that it can be easily faked. Internet security has five key requirements: access control, authentication, privacy, integrity, and non-repudiation.

- Current secure e-mail solutions use a public key infrastructure (PKI). PKI is a set of security services that can be used to provide security over public networks. PKI services consist of encryption, digital signatures, and digital certificates. PKI services require the use of a two-part key: a public key and a private key. Information is sent to a user after having been encrypted using their publicly advertised "public key," and can only be decrypted using the user's secret "private key." Every PKI exchange is monitored and authenticated by a company that provides digital security services.

4.3.1.3 Video Conferencing Applications

- Videoconferencing (Figure 4.4) offers many benefits, including savings in corporate travel and savings in employees' time. The U.S. market for videoconferencing service revenue is projected to top $27 billion by 2002. In 1995, videoconferencing service revenue was $2.5 billion. Important pieces must be in place for videoconferencing to happen: rising demand from multinational corporations, improvements in technology, solidification of key standards, and proliferation of standards-compliant video-enabled products from heavy hitters such as Microsoft and Intel. Key issues for service providers are reliability, quality, and ease of use. Current standards include:

Video Conferencing Standard	Purpose
H.320	Videoconferencing over ISDN
H.323	Videoconferencing over LANs, WANs, intranets, and the Internet
H.324	Videoconferencing over regular dial-up telephone lines

- According to networkMCI Conferencing, about 250,000 videoconferencing-capable devices are currently in place worldwide; by 2000, there will be over 50 million. A big user issue is service complexity: it can take 40 to 50 minutes to set up a call because all endpoints need to be configured to the same line speed, audio rate, frame speed, and resolution rate. How both vendors and service providers have interpreted standards can also affect the service: a mismatch in interpretations can result in dropped calls. Videoconferencing systems that are able to talk to different standards-compliant endpoints are now becoming available (e.g., H.323/H.320 gateways).
- IP muliticasting will be able to provide multipoint H.323 videoconferencing. IP multicasting will save users' bandwidth on packet networks because the information needs to be transmitted only once over a given link, with routers replicating information as required. One challenge associated with multicasting is that it imposes a significant communications load on the processor at each endpoint since each endpoint, must send information to every other endpoint. This means that IP multicasting is not currently scalable for large videoconferences.

4.3.1.4 Wireless Applications

- Wireless data service providers are starting to shift their focus from vertical to horizontal applications. In the past, wireless data applications have been traditionally targeted at the public safety and utility markets. Newer applications target members of the financial community, such as bankers, analysts, and traders, by providing real-time access to stock information. One of the key success factors to entering horizontal business markets will depend on the service provider's ability to create appealing service bundles.
- In the U.S., the future of the mobile data market is based on the cellular digital packet data (CDPD) technology. CDPD is TCP/IP implemented over cellular networks. CDPD is well suited for certain types of transmission, especially short file transfers. CDPD was first specified in 1992; however, it has been slow to be adopted and there are currently fewer than 500,000 data customers on all U.S. cellular networks. Although CDPD may be well suited to supporting Internet-related applications, it is currently limited by two factors. The first is the fact that CDPD-based services are only available in selected markets. The second is that CDPD's bandwidth is currently limited to 19.2k bps and actual connection throughput can drop as low as 2.4k bps when network voice traffic is high. CDPD transmission rates as high as 56k bps have been discussed; however, support for such rates is not currently provided.

4.3.1.5 Enhancements to Traditional Services

- Vendors are starting to work with service providers to create service solutions that meet end user needs. Unified messaging products are the first examples of such services. The service alerts users that they have e-mail via their service provider's Web site and their own voice/fax mailbox. This will be provided as a first step for customers who only want basic service. To be added: products that use text-to-speech technology. Good approach: everybody doesn't need everything. Future services include integrated e-mail, voice, and fax mailbox; non-subscriber voice connect — allows e-mail users to send voice messages to anyone; and consolidated wireless/wireline mailbox with improved phones that contain text display screens.
- The Universal International Freephone Number (UIFN) system allows a single toll-free number to be used around the world. Users apply to the Internatinoal Telecommunications Union (ITU) for an eight-digit number that is accessible by dialing the appropriate international access code, "800," and then the new number.
- Many new telecommunications applications are being developed for call centers. These applications are being designed to help companies gather information about their customers and make sure that the products and services that the company offers are meeting the needs of their customers. This type of application uses computer telephony integration (CTI), automatic call distributors (ACDs), and interactive voice response (IVR) systems.

- One of the primary motivations for firms to use virtual private networks (VPNs) is to avoid the costs of expensive dedicated leased lines. Vendors are now making VPN products that contain combinations of functions, including serving as IP routers, corporate firewalls, and certificate authorities, along with the required VPN functions of encryption and authentication. A key drawback to today's VPN products is that the processing power required to perform VPN functions such as encryption severely limit the throughput of the devices.

4.3.2 Functionality Implementation

The enhanced telecommunications application functionality described in the previous section requires that the way applications are designed must be radically altered. As the computing equipment available to end users continues to improve, the intelligence required to support the application is migrating from within the network to the endpoints. In new and emerging applications, much of an application's functionality may reside in the end-user's equipment. This is dramatically changing how networks are designed. We will investigate these types of changes later in this chapter.

The competitive environment that service providers are starting to operate in will no longer permit deployment of new applications at the current somewhat leisurely rate. End users will demand new applications as soon as they identify problems they need to solve. The service provider who is the first to be able to offer a solution to such end users stands the best chance of capturing the largest share of the market. Past history has clearly shown providers that it is better to be first to market and bring additional functionality later rather than wait until a new application is perfect.

The arrival of networking equipment that is able to provide exponentially larger amounts of bandwidth will aid developers of new telecommunications applications. Table 4.1 identifies several of the network bandwidths now available for use with new applications. The result of greater bandwidth availability is that less development time will have to be spent attempting to minimize the amount of data that telecommunications applications exchange. This reduced development time will result in applications that are richer in functionality, being made available to end-users more rapidly.

TABLE 4.1 Standard Transport Bandwidths

Transport Type	Bandwidth
OC-3	156M bps
OC-12	622M bps
OC-48	2.5G bps
OC-192	10G bps

Recent increases in the amount of bandwidth provided by data networking equipment, coupled with the initial availability of products that can provide voice services over a data network, have fueled a focus on Internet Protocol (IP)-based networks. As competitive service providers build new networks to provide services, they are selecting networking equipment that permits them to build IP-based networks rather than the traditional Class 5 voice switches. These new service providers believe that in the very near future all information (voice, video, and data) transported by a provider will be viewed as data and can be encapsulated in the IP data network protocol.

If current application trends continue as expected, almost all future telecommunications applications will be "Web-Aware." Simply put, this means that such applications will have the ability to obtain information from and provide information to other applications via World Wide Web (WWW) Internet protocols. Although still in its infancy and facing an unsure future, the Java programming language has popularized a highly distributed programming model that will influence the design of such future applications. In this model, the network has the responsibility for advertising what applications it supports and storing the logic required to provide the application. The end-user's customer premises equipment

(CPE) will then download the needed functionality and execute it locally, thus distributing application processing from the network's limited resources.

The use of data networks for telecommunications application interconnection will have the interesting side effect of causing what has been called the "death of distance." Because end users are currently charged for the size of the connection that they use to access the Internet, it no longer matters how far the data travels once it is transmitted. This will result in a greater use of more widely distributed applications. A more detailed discussion of the effects of changes in telecommunications application pricing is provided later in this chapter.

One of the greatest bottlenecks in deploying new telecommunications applications resides in the back office operations of the service providers themselves. After an end user selects a service and negotiates any customizations, there is often a delay (sometimes, significant delay) as the provider processes the order and reconfigures its network to deliver the requested service. The telecommunications applications introduced in a competitive environment must be deployed with minimal support costs and must start to generate revenue as quickly as possible. One of the most promising means of accomplishing both of these goals simultaneously is to automate the telecommunications application service ordering process. Assuming that the obvious security issues can be solved, interfacing the application directly to the provider's operation support systems (OSS) will reduce the support costs for the application while at the same time decreasing the delay between when the service is ordered and when the application is available to the end user.

Finally, the near-panic caused by the so-called Year 2000 (Y2K) bug, which caused some applications to be unable to distinguish between 1900 and 2000 due to historical efforts by software developers to minimize the amount of memory required to execute an application, will forever change how telecommunications applications are developed. Immediately after having experienced the expense and turmoil caused by the hunt for potential Y2K errors in hundreds if not thousands of hardware platforms, operating systems, and applications, end users can be expected to demand protection from future errors. Although complete protection from software errors can never be guaranteed, new telecommunications applications will most certainly contain enhanced testing capabilities that will permit the end user to simulate program execution in an off-line environment in order to determine how it will react to a given set of inputs.

Let's now take a close look at some of the issues surrounding how some of this enhanced application functionality will be implemented in two important segments of telecommunications applications: Internet applications and wireless applications.

4.3.2.1 Internet Functionality Implementation

- A carrier-grade IP telephony gatekeeper that complies with the emerging H.323 standard is now available in evaluation versions. This product can be used to tie together IP and public network gateway systems from other vendors. This product is significant because it represents the first phase of multivendor interoperability. Ericsson plans on using applications to differentiate its gatekeeper product — specifically for applications that are better suited to reside inside the carrier network.
- Hammer Technologies has introduced an IP test system that monitors the quality of voice on IP networks. The system automatically tests voice quality, measures audio quality, and includes a Voice over Internet (VoIP) protocol analysis tool as an IP traffic generator.
- Microsoft, Netscape/AOL, and Sun are all competing to supply commercial Web server and application platforms to public network service providers. Each of these companies has a different vision of what the next generation of telecommunications applications will look like. Microsoft sees applications being built on top of low-cost PC-based Microsoft operating systems. Netscape/AOL sees applications as being distributed and platform independent. Sun sees applications running on open, fault-tolerant systems that use the Java language.
- Some service providers are aggressively deploying advanced high-speed digital subscriber services. Many of these service providers own and operate switch-based networks and feel that a switched

network infrastructure routes packets faster and more reliably than a routed one. Such providers are offering Internet access and LAN-like services.

TABLE 4.2 Digital Subscriber Line Bandwidth

Symmetrical Service Rates	Asymmetrical Service Rates
256k bps	4M bps downstream, 1M bps upstream
512k bps	7M bps downstream, 1M bps upstream
768k bps	
1M bps	

- In order to provide access to popular Internet content to users in other countries, creative applications are being developed to distribute the information. Using a combination of satellite links, multicasting software, and local caching, service providers are using public Internet kiosks to permit users to view the most popular web pages. This eliminates long waits for dial tones and conflicts over access to what precious bandwidth exists. This new approach "pushes" content to where the user is instead of requiring the user to pull content off of North American servers.
- Dynamic HTML will allow designers to make richer, multilayered pages. Dynamic HTML will allow designers to create Web pages more efficiently so each link of information doesn't have to be downloaded from the server.

4.3.2.2 Wireless Functionality Implementation

- Microsoft has announced that it is developing a non-standard microbrowser as a part of its goal to enter the wireless data marketplace. The microbrowser will permit wireless users to browse the Web, provision services, and access billing information. The Wireless Application Protocol Forum released the open wireless mark-up language (WML) microbrowser specification.
- Researchers have been able to crack the messaging encryption algorithm used in U.S.-based CDMA and TDMA digital cellular networks. The researchers have broken the Cellular Message Encryption Algorithm (CEMA) code. The CEMA code has been designed to safeguard dialed digits that are sent over the airwaves. Different encryption algorithms are employed for user authentication and voice privacy. The reason that the researchers were able to crack the CEMA code was, in part, due to the fact that the wireless industry has watered down its security algorithms in order to appease the U.S. federal government.

4.4 Systems and Service Integration (Figure 4.5)

4.4.1 Introduction

As telecommunications technologies are able to provide end users with more and more complex services with an increasing number of interrelated features, end users have started to complain. Just as when you go to purchase a car, you don't want to be required to make decisions regarding issues that are relatively unimportant to you. An example of this would be when taking an airline flight, you do care about flight times and where you sit; however, you don't care what altitude you fly at or what movie is shown. End users simply want to be able to use telecommunications services to make their lives easier and to make themselves more productive — they don't want to be telecommunications experts in order to select and use such services.

Service providers and network equipment vendors are responding to these needs by integrating what are currently separate service offerings into new feature-rich services and by consolidating technology-specific networks into single networks that are simultaneously able to handle voice, video, and data information exchanges. In this section, we will explore some of the drivers for service and system integration and identify how these are going to affect the telecommunications services available to end

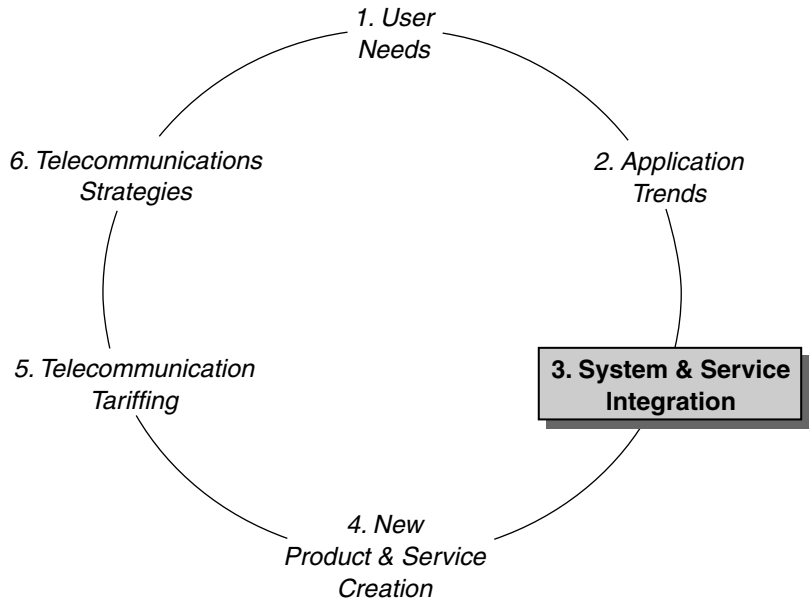

FIGURE 4.5 Trend analysis — system and service integration.

users in the future. We will then take a look at specific trends in service and system integration as they relate to each one of the four classes of end users identified earlier in this chapter.

4.4.2 Drivers for Integration

Integration of services and systems requires both considerable effort and expense. In order to make such an investment worthwhile, there needs to be a future payoff for service providers and application developers who make the integrated solutions. In fact, there are several distinctly different motivations that are in the process of creating integrated solutions. The drivers for integrated services are as follows:

- **Competitive differentiation:** As the number of service providers is increasing, the number of end users in each segment is remaining relatively constant. This means that service providers will only be able to grow by wooing end users away from their current providers. In order to accomplish this, a provider will have to be able offer the end user a compelling reason to switch. Integrated services can be such an enticement, and such tactics are starting to appear in the form of "follow me" offerings where voice, paging, and mobile services are linked to a single service. With such a service, someone trying to contact the end user dials a single number which then attempts to establish a connection with the called party via each different communication method. If the desired end user is not reachable, then a message can be left on a voice mail system that the end user can check via any of the available technologies.
- **Single provider:** Recent surveys of end users have revealed that, all other things (such as price) being equal, users desire to receive all of their services from a single provider. The reasons are simple: a single provider means a single bill and one number to call in the event of any problems with the service.
- **Technology advancements:** The integration of multiple services into a single offering to the end user has its own potential risks. An integrated application requires a significant amount of end-user customization in order to provide the maximum benefit. An example of an integrated service that has suffered from low end-user acceptance due in part to its complex configuration is the Integrated Digital Services Network (ISDN). Advances in network intelligence and equipment processing allow the configuration of new services to be simplified and have allowed much of the

configuration process to be performed automatically by the network equipment itself. Additionally, improved network element processing has permitted multiple elements in different technology domains to exchange the required information to support integrated services.

- **Improved billing systems:** Amazingly enough, one of the greatest limitations on integrating services has been the billing system used by service providers. Such large and complex billing applications were originally designed to support a specific set of services offered via a single technology network.

Likewise, there are several identifiable drivers working together to motivate service providers to create integrated systems. The drivers for integrated systems are:

- **Reduced network deployment costs:** End users are starting to demand services that have voice, video, and data components. Service providers will have the choice of building separate redundant networks to provide such services or of building a single high-speed network to handle all three forms of communication. As you may well imagine, the decision to build a single network becomes very straightforward once the economics of building a single network to deliver all services is considered.
- **Reduced operations costs:** A significant cost of delivering a service to an end user can be attributed to the operational expenses required to keep the network working correctly. The use of an integrated network reduces the number of network elements required to deliver services, simplifying operational requirements and thereby lowering the ongoing cost of offering the service.
- **Bandwidth breakthroughs:** The possibility of using an integrated system to offer services to end users could not be realized until improvements in network equipment and transport technologies occurred. Recent increases in the bandwidth that can be provided by a single network have made it possible to build a single network that can support multiple services.
- **Tariffing:** Existing tariffing of telecommunications systems was designed years ago when the primary offerings to end users were voice services. Data networks are currently free of many of the limitations that restrict what and where services can be offered via traditional voice networks. We will discuss specific tariffing-based motivations later in this chapter.

4.4.3 Integration for Service Providers

- The arrival of wavelength division multiplexing (WDM) systems has caused service providers to reevaluate their existing time division multiplexing (TDM) systems. Network planners currently believe that the two different approaches can be used together to create networks that provide the lowest bandwidth costs.
- As service providers prepare to reshape their circuit-switched networks into IP packet-routed networks, the issue arises about what type of operation support system (OSS) will be needed. Service providers have a range of functions to support: provisioning of new services, service assurance, and network management. Existing service providers will most probably address this problem by reusing part or all of their existing billing or customer care systems. The greatest challenges will come in the areas of network management and provisioning.
- Sprint Corporation announced in June 1998 that they were planning on carrying all of their voice, video, and data traffic over its asynchronous transfer mode (ATM) network. Sprint CEO William T. Esrey predicted that this approach would cut Sprint's cost of delivering a voice call by 70%. Sprint expects to achieve this level of cost reduction because of the much higher performance:cost ratio of data switches vs. conventional circuit-switched voice switches.
- Traditional circuit-switched system service providers are watching the success of facilities-based Internet service providers (ISPs) and their packet-switching and routing forwarding networks. In addition, the large circuit-switched network equipment vendors are also modifying their equipment in order to transition them to work in a packet-switched environment. Many are forgetting

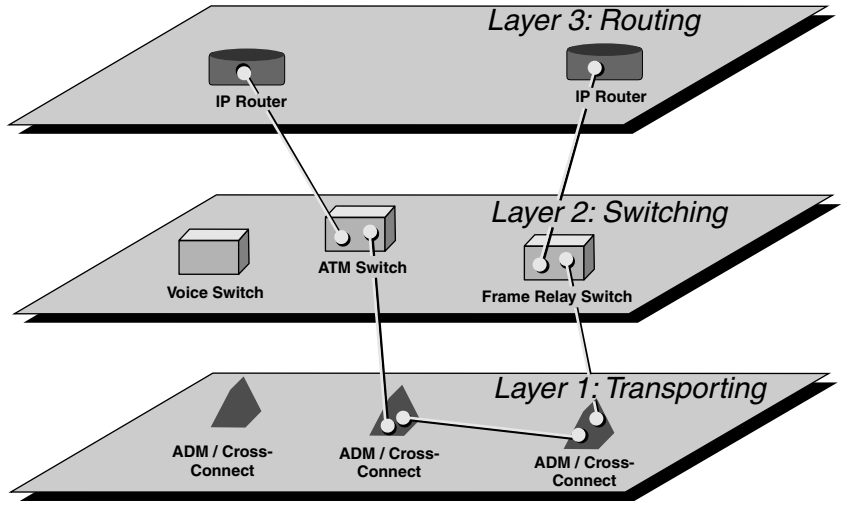

FIGURE 4.6 A new network architecture.

that the existing circuit-switched, connection-oriented public network infrastructure has been built up over decades and includes layers of resiliency and fault tolerance built in. Another key point is that time-slotting information in hardware allows for guaranteed latency and delay parameters that simply cannot be achieved in many packet-switched systems. It is possible that in the future, the circuit-switched network will serve as a mission-critical backup system for the public packet-based system and will only be used for those cases where the "call must go through." A possible casuality of the move to a packet-based public network could be the current computer-telephony integration (CTI) market.

- ISPs are now at the front line of telecommunications equipment design. Today's ISPs are building their own facilities, laying their own optical fiber and installing their own carrier-class switches in points-of-presence (POPs). Traditional circuit-switched service providers have been taking more data and even voice traffic off traditional circuit switches and putting the traffic on packet-switched networks that were formerly considered to be "data-overlay" networks.
- The current public network consists of voice switches interconnected via transport systems. New user demands are causing this network architecture to be reshaped to now support voice, video, and data services. This new network architecture (Figure 4.6) uses a transport infrastructure which supplies the required interconnectivity to create its foundation. The architecture's switching layer provides the call set up and teardown functions throughout the network that are required to deliver services using a variety of protocols. Finally, a routing layer is used to provide the final step in the process of delivering data services to end users.
- Within the telecommunications industry there is still disagreement about whether packet switching, ATM, or traditional circuit switching has the best performance:cost ratio. Peter Sevcik, a senior associate at Northeast Consulting Resources, Inc. has shown that each successful new generation of switching technology cuts the performance:cost doubling time in half. Sevcik says that traditional central office circuit-switched telephone switches double their performance:cost ratio every 80 months; ATM switches do the same every 40 months; packet switches and routers double their ratio every 20 months; frame relay switches double their ratio every 10 months.
- Hewlett-Packard (H-P) is helping ISPs develop an architecture that delivers fast, consistent, and differentiated service over the Internet. The goal is to enable individual businesses to guarantee service levels to end customers over the Internet and to offer predictable and differentiated services.

H-P's product is a bundle of special H-P hardware and software, along with add-on services from Cisco Systems, that will offer ISPs end-to-end, mission-critical service level guarantees and Internet service level agreements. Technically put, this product offering will integrate control, measurement, and management across the servers in the network in order to guarantee delivery of service levels.

- Sprint's announcement of their plan to build an integrated on-demand (IOD) ATM-based network to deliver voice, video, and data sets the standard for future public network developments.
- As service providers start to offer services that use multiple technologies, equipment vendors are modifying their existing equipment to support the providers' new needs. Traditional voice switch vendors are enhancing their wireline switching products to also support wireless services. Some switch architectures are so flexible that providers can mix and match wireline and wireless modules to permit subscribers to connect to a cell site or the public network using the same switch.
- U.S. West reports that the average voice call is approximately 5 minutes. The average data call is about 32 minutes — this is causing congestion in the central office.
- U.S. West is conducting trials with two ISPs to weed out Internet traffic from voice calls. Using distributed SS7 technology, ISP-bound data calls are identified at the user's ingress switch and immediately routed to the ISP over a parallel data network. This differs from the way traditional end-user data calls are set up. Data calls are normally routed to the ISP through the phone network via ISDN or digital switched services such as channelized T1. The data call rides the public network the whole way.
- Service providers are showing a renewed interest in video services. Vendors are demonstrating products that can push 26 Mbps over existing twisted pair wiring for up to 4000 feet. Broadband wireless equipment vendors are mainly focused on data applications; however, some have demonstrated videoconferencing and distance learning applications.

4.4.4 Integration for Business Users

- Some observers suggest that more than 60% of the costs associated with modern data networking lie in the cost of ownership.

TABLE 4.3 Application Driving Network Growth*

Application	Data Types/Sizes	Network Traffic Implication	Network Need
Scientific modeling, engineering	Data files 100s of megabytes to gigabytes	Large files increase bandwidth required	Higher bandwidth for desktops, servers, and backbones
Publications, medical data transfer	Data files 100s of megabytes to gigabytes	Large files increase bandwidth required Low transmission latency High volume of data streams	Higher bandwidth for desktops, servers, and backbones
Internet/Intranet	Data files now Audio now Video is emerging High transaction rate Large files, 1 MB to 100 MB	Large files increase bandwidth required Low transmission latency High volume of data streams	Higher bandwidth for desktops, servers and backbones Low latency
Data warehousing, network backup	Data files Gigabytes to terabytes	Large files increase bandwidth required Transmitted during fixed time period	Higher bandwidth for desktops, servers, and backbones Low latency
Desktop video conferencing, interactive whiteboarding	Constant data stream 1.5 to 3.5 Mbps at the desktop	Class of service reservation High volume of data streams	Higher bandwidth for desktops, servers, and backbones Low latency Predictable latency

*Source: Gigabit Ethernet Alliance

- Ethernet LANs typically offer 10 Mbps of shared bandwidth. As the volume of network traffic increases, however, this amount of bandwidth quickly becomes inadequate to maintain acceptable performance to support demanding applications. These traffic jams are fueling the need for higher-speed networks. Fast Ethernet, or 100BASE-T, has become the leading choice of high-speed LAN technologies. Building on the near-universal acceptance of 10BASE-T Ethernet, Fast Ethernet technology provides a smooth, nondisruptive evolution to 100 Mbps performance. The growing use of 100BASE-T connections to servers and desktops, however, is creating a clear need for an even higher-speed network technology at the backbone and server level. Ideally, this technology should also provide a smooth upgrade path, be cost effective and not require retraining. The most appropriate solution now in development is Gigabit Ethernet. Gigabit Ethernet will provide 1 Gbps bandwidth for campus networks with the simplicity of Ethernet at a lower cost then other technologies of comparable speed. Gigabit Ethernet will be an ideal backbone interconnect technology for use between 10/100BASE-T switches, as a connection to high-performance servers and as an upgrade path for future high-end desktop computers requiring more bandwidth than 100BASE-T can offer.
- Although Gigabit Ethernet is primarily an enterprise LAN technology, several service providers (most of them ISPs) have begun evaluating it for use in local and metropolitan area sections of their networks. Gigabit Ethernet can connect network equipment such as the server, routers, and switches within a service provider's POP, both inexpensively and at high speeds. One of Gigabit Ethernet's biggest selling points is that its cheaper and faster than asynchronous transfer mode (ATM) or Synchronous Optical Network (SONET), which many service providers now use to link gear in their POPs. Gigabit Ethernet's heavy data orientation and distance limitations are red flags, however, for established telcos looking for technologies that can support voice, video, and data.
- Inverse Multiplexing for ATM (IMA) is a specification for provisioning multiple ATM circuits in T1 increments. IMA was created to bridge the bandwidth gap between T1 (1.544M bps) and T3 (45M bps). Using IMA, several low-cost T1 lines can be used to aggregate the bandwidth and distribute ATM traffic across multiple physical circuits.
- Frame relay speed and capacity improvements are being designed in order to keep pace with the needs of the new public network for data services. The two major changes to frame relay are the emerging frame relay over SONET (FROSONET) and multi-link frame relay (MLFR) standards. FROSONET provides specifications for frame relay to run at OC3/STM-1 or OC12/STM-4 speeds. MLFR adds scalability to frame relay networks, thus helping service providers keep pace with growing traffic demands while providing an incremental capacity jump for users who are outgrowing T1 capacity but are not ready for the speed or expense of DS3/E3 lines. The FROSONET specification uses the same high-level data link control (HDLC) over SONET mapping that is being used for Point-To-Point Protocol (PPP) over SONET (PoS). This saves costs by allowing the same hardware to be used for both PPP and frame relay interfaces. MLFR trunks combine multiple physical links between switches in the public network into a single higher-capacity logical facility. Additionally, frame relay's existing quality of service (QoS) functionality permits it to be used by service providers to offer such capabilities as service level agreements (SLAs) and customer network management (CNM) functionality.
- Time division multiplexing (TDM) is used to combine individual connections in order to traverse longer distances. Switched circuits, such as those used in telephone networks, provide dedicated connections between two points. Switched-packet protocols, such as Ethernet, provide good utilization of the backbone but have no provisions for providing the equivalent of a switched circuit over a network. Switched-cell protocols such as ATM provide good utilization of the backbone and have provisions for providing CBR and UBR virtual circuits, but are expensive when compared to the newer switched packet systems such as Gigabit Ethernet.
- Wide area networks (WANs) tend to be rings like FDDI or various star configurations. Generally, the number of entry points into the network tend to be very limited. WANs are designed to

transmit data over long distances, tend to be focused on isochronous data, and lean toward circuit switching because they were often devised by telephone companies to carry voice.

- Five leading car and truck manufacturers have banded together to lead the Automotive Network Exchange (ANX) project. This is designed to create a specialized high-end, Internet-like VPN to link North American automakers and their suppliers. This very reliable and secure network may act as the beginnings of a parallel "Business Internet."

4.4.5 Integration for Mobile Professionals

- The CDMA Development Group (CDG) is coordinating location technology trials among member carriers and vendors. Trial focus will be on the three types of technology: global-positioning system-based, network-based, and a combination of the two. The FCC has mandated that carriers are required to be able to locate callers within 125 meters. Some carriers believe that they will ultimately implement multiple location technologies. Network-based solutions are less precise but may meet the FCC mandate. A handset-based solution may locate users more accurately and, if used with a network-based solution, may allow a carrier to offer enhanced services such as location-sensitive billing and concierge services.
- A spokesman for the CDG reports that wireless data represents only 10% of the total wireless airtime in the U.S. New CDMA products have been introduced recently that will increase data rates to 64 kbps.

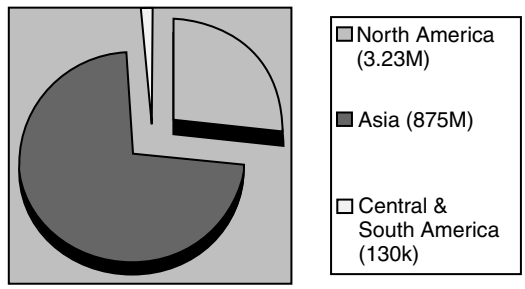

FIGURE 4.7 Worldwide CDMA subscribers (source: CDMA Development Group).

- Service providers and equipment vendors are currently working on developing standards for the third generation of wireless products: "3G." The first generation was analog, the second was digital, and the third will be wireless broadband that will be used to support high-speed mobile data services.
- What standard will be used for the next generation of wireless services is still undecided. Possibilities include W-TDMA which suffers from limitations in growth and W-CDMA which suffers from limitations in power and processing.

4.4.6 Integration for SOHO Users

- In September 1998, the ITU ratified a single standard (V.90) for 56k bps access over the Public Switched Telephone Network (PSTN). V.90 data transmission technology overcomes the theoretical limitations imposed on standard analog modems by using the digital server connections that most Internet and online service providers use at their end connection to the PSTN.
- Community area networks (CANs), as represented by cable modems, have a unique topology that is not served well by existing LAN or WAN topologies. They have a large connection count of shared wire like LANs, but have distances like those of WANs. Current CAN implementations generally utilize a single downstream CATV channel that is shared by all network participants. A separate upstream CATV channel is also shared for transmitting from the home to the cable head end.

- Low and medium earth orbit satellite systems (LEO and MEO).
- Geostationary (GEO) satellite systems are being used to deliver data broadcasts. There are two primary types of GEO services: very small aperture terminals (VSAT) and direct broadcast satellite (DBS). Two DBS services have been announced: an entertainment service and a data service. The data service will serve corporate customers with occasional and regular broadcasts, along with residential customer service. One possible use of the data service is for software distribution. Another company is offering three versions of its DBS Internet access service: direct delivery of text files at 12 Mbps, multimedia at 3 Mbps, and Internet access at 400 kbps. This service is asymmetrical: customers send information requests to the service provider via telephone lines and receive data via the customer's 24-inch antenna. VSATs are used for corporate broadcasts of data including price updates. VSATs operate at speeds between 14 kbps and 64 kbps, with high-speed bidirectional communication
- Home based LANs
- According to U.S. West, DSL services can be up to 250 times faster than a 28.8 kbps modem.
- Virtual private networks (VPNs) provide an alternative to leased-line connections. VPNs provide an inexpensive way to extend the corporate network to telecommuters, home workers, day extenders, remote offices, and business partners.
- VPNs are implemented through tunneling, in which the data to be transmitted and header information are encapsulated inside standard IP packets, usually after encryption and sometimes after compression as well.
- Three VPN tunneling protocols are currently in line to become industry standards: PPTP (Point-to-Point Tunneling Protocol), L2TP, and IPSec (IP Security).
- Security is a critical component of a VPN implementation, especially for those implemented over the public Internet. Encryption delivers the "private" in virtual private networking, but it is very process intensive. Because of this, hardware-based VPN products deliver the best performance.
- Infonetics Research estimates that service providers' share of the VPN market will grow to U.S. $8.8B by the end of 2001.
- Despite severe quality limitations, users have already started using the Internet to deliver videoconferencing. Many of these early systems use 56 kbps links to deliver video images of 160 by 160 pixels at a rate of 12 to 14 frames per second — that translates to a small video box confined to just part of the computer screen, showing a jumpy image. Existing corporate videoconferencing systems deliver full-screen images at 30 frames per second — a much higher quality image. Internet-based videoconferencing services won't be real until new QoS standards are in place such as the Resource Reservation Protocol (RSVP) and IP version 6 (IP6).

4.4.7 Integration for Residential Users

- Researchers are issuing cautions regarding unsolved problems with digital subscriber line (DSL) and cable modem services. Complexities have been identified regarding the mixing of POTS and DSL services without using a splitter. One of the biggest issues concerns what happens when a user picks up a telephone handset in a splitterless service — the result is an immediate change in load on the local loop, resulting in a loss of one to two orders of magnitude in signal amplitude. Additionally, crosstalk can occur when several POTS twisted pairs in the same bundle are used to provide DSL service.
- A new service that is being considered combines Internet and television services so that end users can simultaneously surf the Internet and watch enhanced broadcast television at home. One approach uses cable television systems to deliver downstream data to advanced set-top boxes. Other approaches are more software oriented and don't necessarily need set-top boxes.

- The FCC has mandated that broadcasters must have started offering some high-definition television (HDTV) digital programming in 1999 and complete their transition to digital by 2006.
- MSNBC, the cable broadcaster owned by Microsoft and NBC, has experimented with technology that allows broadcasters to send digital signals embedded within television signals to PCs. MTV, along with Intel, launched Intercast Jam, which broadcasts videos to PCs alongside rock artist information via a webbrowser in the broadcast signal.
- For years, TV stations have been beaming out data in small doses — in the form of closed captioning, test signals, ghost canceling, and messages to affiliates. That data is carried mainly through the vertical blanking interval (VBI). This offers a total of between 150 and 200 kbps of available bandwidth. This bandwidth is now being used by the Intercast consortium to transmit ancillary data streams to PCs via the VBI.
- Vendors are starting to create products that support videophone services. One such product puts a video camera in a set-top box and displays its image on any cable-ready TV. A touch-tone phone provides audio, dialing, and navigation of the system's on-screen controls. The system includes a built-in 10BaseT Ethernet interface to link directly to a cable modem, digital subscriber line modem, or corporate network.

4.5 New Product and Service Creation (Figure 4.8)

4.5.1 Introduction

The increasingly competitive telecommunications environment will require service providers to create and deploy new products and services faster than ever before. Providers were able to create new services at a much more leisurely rate in the past. A provider could wait until the next generation of technology had been deployed into the network before introducing the services that used the new technology.

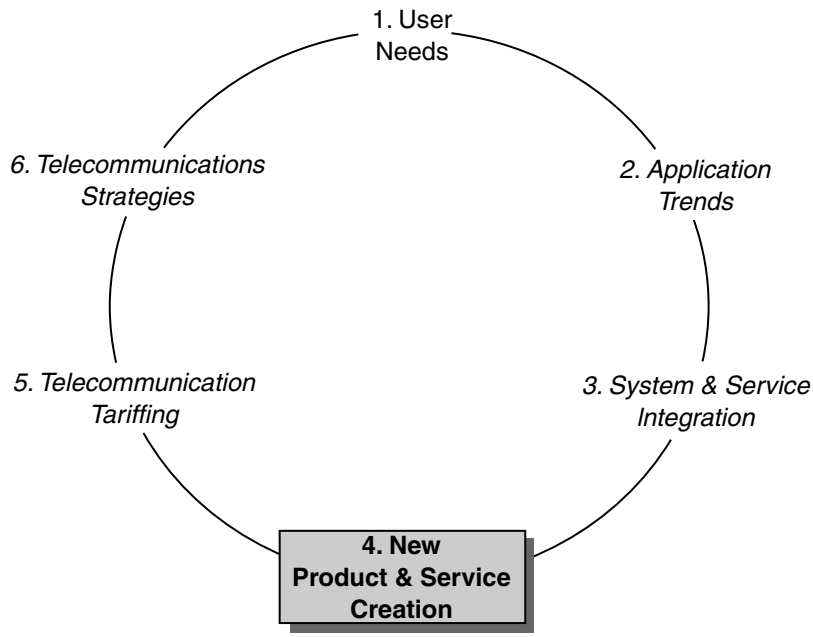

FIGURE 4.8 Trend analysis — new product and service creation.

As the number of service providers increases, it is generally agreed that the ones who will succeed are those who are able to best understand their end user's needs and deploy services that best meet those needs. In order to accomplish this, a provider will need a new approach to designing and deploying future services.

Changes in network equipment and in the types of networks that are being deployed are equipping providers with the essential tools. In this section we will first look at some of the drivers and constraints that providers are facing as they struggle to change how they create services. Next, we'll focus on how services will be created in tomorrow's network. Finally, we'll investigate how network bandwidth affects the types of services that can be created and what is being done to provide more bandwidth for new services.

4.5.2 Drivers and Constraints

- U.S. West is now offering a PCS service that includes mobile dial tone and advanced messaging and routing capabilities. The dial tone service combines a handset-generated and network-generated dial tone. The handset portion allows users to hear dial tone while dialing, and the network-generated portion allows users to hear a dial tone while they are initiating features. Customers have said that they associate dial tone with reliability and quality. The service also includes a same-number feature that routes calls made to a home, office, or PCS number to a PCS phone. It can also route all messages to a single mailbox, notifying users of messages via a light on the handset.
- Two different standards are being considered for using ATM to switch IP traffic: Multiprotocol over ATM (MPOA); ATM Forum; based on LAN emulation, seen as a campus backbone solution. Multiprotocol Label Switching (MPLS); IETF; designed with the large-scale WAN in mind
- Service providers are looking for new ways to rapidly introduce new services to meet growing customer demands. Existing circuit switches can generally only be modified by their vendors, which takes too long and costs too much. Programmable switches (Figure 4.9) consist of three main parts: a programmable switching fabric, controlling software ("host program"), and external media used to provide enhanced-services functions. New functions can be added to programmable switches by simply adding services and features to the host program. Open interfaces and APIs permit third-party developers to create vast libraries of available services.

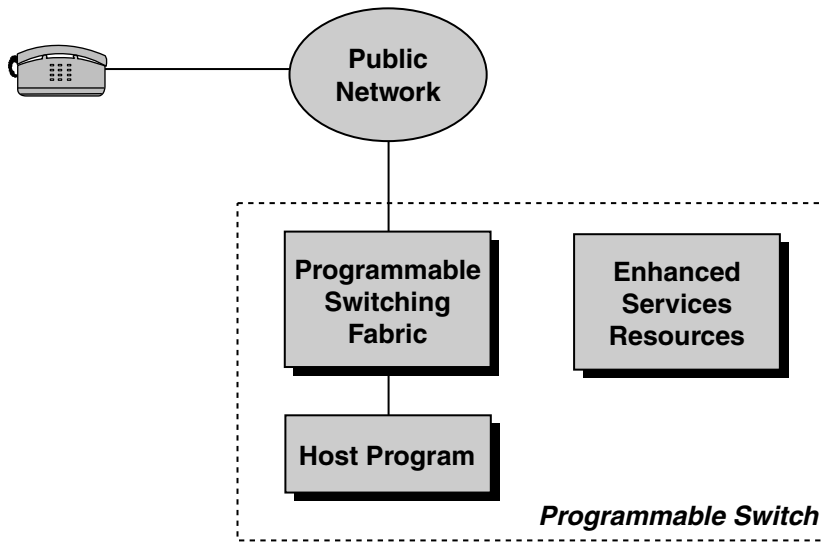

FIGURE 4.9 Programmable switch architecture.

- In order to help ISPs that are not ready to make a full-fledged investment in electronic commerce with an option to start a little smaller, e-commerce software vendors are getting creative. One vendor permits ISPs to operate small on-line stores (less than ten items to be sold) for free. As they increase the size of the "store," they then start paying the vendor for the use of the software.
- As of 1997, there were more than 1.3 billion televisions in the world, compared with 245 million PCs and 741 million telephone lines.
- Both the competing standards for digital television, one promoted by the U.S.'s Advanced Television Systems Committee and the other promoted by Europe's Digital Video Broadcasting Group, offer an almost unlimited potential to broadcast data to end users. In tests, broadcasters have been able to transmit 60 Mbytes of data during a 51-second commercial.
- Some cable operators are now able to offer traditional switched voice services using their cable networks. These services are proving to be very popular and in fact are more popular then the highly touted cable modem services.
- Joint research done by International Data Corporation, Zona Research Inc., and Literature Searches reveals that U.S. corporations spend more than U.S. $14 billion annually for their own expensive but reliable data networks.
- In order to permit Internet traffic to be prioritized, two sets of networking protocols are working their way through the IETF. The first set is called Differentiated Services (DiffServ). It provides routing mechanisms designed to manage various QoS profiles, or performance parameters. The other set of protocols is the multiprotocol label switching protocol. MPLS is a routing mechanism designed to group all packets within an IP session into a single "flow" at the networking layer (Layer 3) and "tag" each session as such for expedited passage through router hops.
- Wireless service providers who use TDM are looking for ways to differentiate their services. Their latest attempt is called Wireless Office Services. These allow users to access PBX features from their wireless phones while they are in the office and when they leave the office. This permits them to use such features as four-digit dialing and call forwarding in all environments.
- AIN platforms and capabilities are ways that new services can be introduced into the public network. However, the change to a packet-based network puts the future of AIN services in some doubt.
- Vendors' research labs are starting to produce products that implement some of the latest advances in speech recognition technology. This type of interface is seen as a major step toward the convergence of telephony and Internet applications. Call center applications are expected to be among the first to benefit from these types of products.
- Vendors are offering service development products for Internet protocol-based voice service providers. Service providers will be able to use these products to add key features such as universal messaging, follow-me services, and paging to their IP/public network gateways. All incoming messages are stored in a single mailbox and can be converted to a variety of formats that the user can then access via Web-browser, e-mail, or telephone.
- The Voice-over-IP (VoIP) Forum recently ratified an implementation agreement that defined an interoperability profile based on the H.323 standard from the ITU. H.323 was designed to be a technology for multipoint-multimedia communications over packet-based networks, which include IP-based networks, such as the Internet. It can be applied in a variety of ways — audio only (IP telephony or VoIP); audio and video (video telephony); audio and data; and audio, video, and data.
- One debate in the communications community is how to successfully deliver QoS and implement service-level agreements (SLAs). QoS, a network-wide performance characteristic, refers to the network's ability to fulfill a traffic contract — the SLA — between the WAN network provider and the subscriber for the minimum service provided by the network.

- ISPs are replicating content across multiple services in order to balance user demand loads. Vendors are now starting to offer products that allow service providers to automatically route end-user requests to the replicated server that has a low enough load to facilitate the request.
- User demand for access to multimedia Internet content has resulted in novel solutions being created by vendors. One approach uses satellite links to bypass the Internet and deliver multimedia content to local ISPs where it can be cached for access by local users. This approach can be further extended to caching of popular websites in order to speed up local access speeds.

4.5.3 New Service Creation

- The emerging consumer vehicle tracking service is called telematics. Telematics systems combine GPS and cellular networks to offer safety and concierge services to consumers in automobiles. The number of users is expected to grow from 58,000 subscribers this year to 1.2 million by 2003, according to the Strategis Group. Most U.S. telematics operate on AMPS because of its near-ubiquitous coverage.
- Smaller ISPs are using audio and video conferencing capabilities to distinguish themselves from competitors. These service providers are starting to investigate using client and server software solutions that permit videoconferencing over the Internet. Initial users include schools that have a need to provide a one-on-one tutoring experience but don't need an elaborate room-based videoconferencing system. The supporting software systems are all H.323 compliant.
- Business travelers want to be able to access the Internet even when they are traveling internationally. This is currently not possible — such travelers must reach their ISPs POP in order to access the Internet. Some service providers are attempting to build international POPs to meet this need. Other smaller ISPs are banding together to create consortia to offer Internet access to their collective customers. An additional service that is being investigated would offer roaming users access to their corporate intranets via secure tunneling.
- Bell Atlantic Mobile is offering utilities the ability to read customer's meters automatically via wireless data transmission using the cellular digital packet data (CDPD) network. The service would allow utilities automatically to read meters and monitor energy flows, among other services, from a central location, skipping the need to send personnel to customer locations. This service offers utility companies an advantage in a deregulated market because they can offer their customers a better picture of their usage patterns and then offer them a special deal to keep them from going to other utility providers.
- As of 1998, the Strategis Group reported that CDPD services had only 17,000 subscribers.
- Service providers are starting to offer enhanced fax services. These services include mailbox, which provides a secure fax mailbox accessible from any location; never-busy fax transparent service stores faxes for later delivery; fax-on-demand lets businesses create a library of faxable documents that customers can access; and fax broadcast delivers a document to as many as 10,000 locations with just one transmission.
- ISPs are starting to roll out Internet protocol voice services to corporate users. Initially, business users can connect their PBXs to the ISPs IP network, thereby cutting costs on internal long-distance calling. The next step is to combine IP voice with extranets. Businesses would then be able to call other businesses at remote locations using five-digit dialing.
- Many PC games now come with multi-player Internet options. Users first connect to the Internet, then select a specific server which "hosts" a gaming session. Then as the end-user plays the game in multi-player mode, the server allows them to exchange information with other players in real time.
- Consumers and businesses will soon have the ability to both view and pay bills via the Internet thanks to various forms of electronic bill presentation and payment (EBPP). This new service will

allow billers to cut paper processing costs and garner customer loyalty and website hits. Financial institutions, bill consolidators, Internet portals, and makers of personal financial manager (PFM) software products look forward to capturing market share.

- Studies show that 40% of U.S. homes have a PC and only 20% of those are plugged into the Internet.
- Electronic commerce is struggling with the issue of how to reach customers who are not connected. Companies that have to use both the telephone and the Internet to reach customers are looking for a way to tie the two systems together — "v-commerce." These firms want to develop new applications that will link voice and data, telephone, and PC to let Internet vendors reach customers who can't reach their Web pages. These new applications will use Motorola's VoxML markup language which simplifies embedding speech into Web pages.
- The Web provides an opportunity for delivering a new type of picture called immersive photography. This technology allows you to use your PC to navigate around a digitized 360-degree photo. This technology is targeted toward Internet retailers who want to give their customers a wrap-around view of their goods, including high-end real estate agents, travel agents, cruise lines, and destination marketers.
- Visual communication services are poised for proliferation as new advances eliminate the final technological and market obstacles. The ideal solution for multimedia services combines the organization and simplicity of the telephone system with the multimedia and open nature of the Internet.
- Telemedicine is a broad term for several facets of medical care. Collaborative videoconferences between sites, on-line access to patient records, medical libraries and databases, and continuing medical education all fall under the term. Most telemedicine programs today are either simple store-and-forward systems or ISDN videoconferencing systems adapted for use in a health care setting.
- Automobiles are being equipped with more and more electronics and telecommunications devices. Many cars now have Global Positioning System (GPS) receivers and computers to help the driver from becoming lost. The U.S. government, state governments, and a variety of industries are considering spending U.S. $200 billion on the Intelligent Transportation System (ITS) initiative. ITS will provide automated cross-border fleet services for North America, enhanced driver navigation, automated accident reporting, and toll collection. Futurists foresee a day in which a car monitors its "health" and can then use wireless communications to identify repair stations in the event that a potential part failure is detected.
- Prepaid wireless services have become a big business in the U.S. The industry may see more than U.S. $650 million in prepaid card service revenues in 2000. Customers generally must pay to have their wireless service activated, then they must purchase a prepaid denomination, often in the form of a card from a retail distributor. The next step is to initialize the prepaid service via an interactive voice response (IVR) service.

4.5.4 Increasing Bandwidth

- Wireless cable operators are starting to offer high-speed Internet access services using multichannel multipoint distribution service (MMDS). Without converting to digital, the most wireless cable operators could offer in video is 33 channels, which can't compete with average landline cable or satellite providers.
- Wavelength Division Multiplexing (WDM) technology is being added to the network in order to increase backbone capacity to handle new high-speed access technologies. Initial WDM systems were only 2 to 4 channels. Recently, 32 channels appeared in dense WDM. Now hyperdense or ultradense WDM (UDWDM) systems with channel densities of 40 and up and capacities of 400 Gbps are becoming available. Providers are upgrading a few fibers on a route and then

upgrading the others over a few years. One vendor boasts that its terabit demo could carry the Internet's entire traffic on a single fiber.

Time Period	WDM Capabilities
1980s	• 2 channel • Wideband WDM • 1310, 1550 nm
Early 1990s	• 2–4 channels • 3–5 nm spacing • Passive WDM components/parts
1996	• 16 or more channels • 0.8 nm spacing • DWDM, integrated systems

- GTE is using multichannel multipoint distribution service (MMDS) technology to deliver 68 video channels, 32 music options, and near video-on-demand with 40 channels of pay-per-view. GTE has also rolled out hybrid fiber/coax (HFC) cable-based digital video networks. These systems transmit at 750 MHz downstream and 40 MHz upstream.
- U.S. West has introduced a VDSL platform that provides subscribers with integrated digital TV and high-speed Internet access. Included in U.S. West's bundle are on-screen caller ID, voice messaging, and 120 channels of programming, including pay-per-view. The service operates at 256 kbps.
- Bell Canada now uses its HFC system with 10 Mbps downstream and 1 Mbps upstream to offer a picture-within-a-picture service that allows users to go online and watch television from the same screen simultaneously.
- Cable operators that want to start offering high-speed Internet access services to their subscribers without having to perform expensive upgrades to make their cable network two-way are getting creative. They are using their existing one-way cable networks to deliver content to end users while the end-users use their telephone to send information requests. Although this solution may be well suited for rural cable providers who will never have the funds to make their systems two-way, this one-way approach may not provide the bandwidth required by the growing SOHO market.
- Cable operators are able to offer residential subscribers Internet access at 1.5 Mbps rates using a cable modem. A report from Forester Research concedes the residential market to cable operators over telephone companies: cable operators are predicted to have 13.6 million cable modem customers by 2002, while telecos will have only 2.2 million ADSL users.
- U.S. West markets its DSL services to three types of residential users: consumer/Web browsers (want "always on"), gamers ("entertainment"), and work-at-home users ("looking for bandwidth and the user experience").
- The cable company MediaOne has found, through internal studies, that nearly all cable modem owners use their Internet connections seven to nine times more often than when they had a dial-up connection.
- MediaOne marketing cites a recent study that claimed the average Internet user wastes a total of 50 hours a year waiting to connect to the Internet and waiting for pages to download.
- Telecos, ISPs, and CLECs that are rolling out ADSL services are finding that the earliest adopters of the services are in the small business market. Telephone companies will stress the security of ADSL over cable modem's shared media to small business owners.
- In the U.S., the FCC has auctioned off 1.3 GHz of spectrum in the 28 and 31 GHz ranges for use in local multipoint distribution service (LMDS) two-way services.

- Broadband wireless networks have many benefits: they are fast and easy to deploy; they have minimal infrastructure and real estate requirements; they feature grow-as-you-go network build-out; and they can deliver voice, video, and data services from 64 kbps to 155 Mbps.
- LMDS can be used to offer many services. Business-oriented services include wire speed LAN interconnect and fractional and full T-1. Teleworking at 10 Mbps is virtually as fast as being at the office. Megabit per second Internet access is geared to residential users. Other services include 100 broadcast video channels in competition with cable, and second and third phone lines at home or the office.
- LMDS services compete with DSL and hybrid fiber/coax (HFC) services. LMDS is better than both DSL and HFC at offering high-speed symmetrical services.
- Wireless cable operators have spectrum in the 2.5 GHz range (MMDS).
- The H.323 protocol, used to provide VoIP services, defines ways in which multimedia formats such as phone calls, computer data, pictures, or video can be exchanged and managed seamlessly across packet-switched networks.
- A variety of broadband wireless providers have already introduced services that use multichannel multipoint distribution service (MMDS) and local multipoint distribution service (LMDS). MMDS service providers have been around for awhile, whereas LMDS providers have only recently bought their licenses. MMDS offers a broader coverage reach while LMDS offers greater capacity. Current service offerings use either the public network or a cable modem for the return path.

4.6 Telecommunications Tariffing (Figure 4.10)

4.6.1 Introduction

Perhaps no aspect of telecommunications is as overlooked as how services are priced. All segments of end users have differing amounts of funds available to spend on telecommunications services. Pricing a

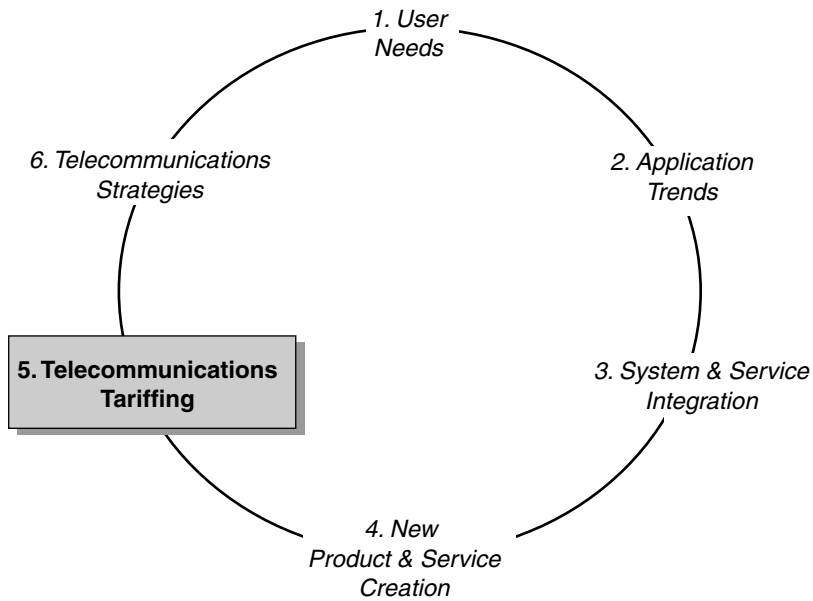

FIGURE 4.10 Trend analysis — telecommunication tariffing.

service too high will cause end users to seek lower price alternatives. Pricing a service too low will result in the service provider missing out on revenues that could have been used to fund the next service.

In the past, service providers have enjoyed monopoly status in both North America and Western Europe. Under this system, prices for services were closely regulated by governments. This is in the process of changing, and in the future service prices will be driven by market factors. This change will require existing service providers to change the metrics used to measure service and the pricing philosophies that have been used to create service rates in the past.

In this section, we will explore trends in tariffing in the leading markets of North America and Western Europe. The effect of competition on service pricing will also be examined. Finally, we'll discuss the impact that new technologies will have on the pricing of future services.

4.6.2 Regulatory Trends

- The FCC is proposing that the Bell companies be permitted to create separate subsidiaries to offer data communication services. These subsidiaries would be less regulated and could set interstate service prices without filing to the FCC. The Bell's regulated units would still be required to sell capacity to competitors but the separate subsidiaries wouldn't.

4.6.3 Service Pricing Trends

- The average long-distance call in the U.S. costs about 13 cents per minute, but the average international price is 89 cents per minute. Telco revenues per minute on international calls are predicted to fall more than 20% annually through 2001.
- Cable & Wireless USA hopes to use pricing and inexpensive long distance to draw residential customers to its Internet service. CWIX will offer customer 150 hours of on-line service, e-mail, and a free Web page for a monthly fee of U.S. $14.95. Some analysts doubt if bundling long distance with Internet access will attract new customers. They point out that the intersection of households that are on-line and use long distance heavily is not large — perhaps 15% of the total.
- In most U.S. telco service areas today, termination fees of up to U.S. $36,000 to break a tariffed service contract are still alive and kicking, despite efforts by competition to eliminate them. These contracts can prevent a customer from purchasing the services offered by a competitive provider because they still have a year or two to go on their current contracts.
- The paging industry grew by 14% in 1997 to a total of 50 million subscribers. However, in 1997 four of the top firms, which together control almost 40% of the market, reported almost a half-billion dollars in losses on combined record revenues of more than $2 billion. Many paging companies are suffering from expensive network buildouts. Paging companies seem to hold a high number of customers who refuse to upgrade beyond basic plans, according to analysts. Price wars and new technologies have driven down the costs of average basic local service from $20 a month a decade ago to less than $10 a month. In some markets, the price has shrunk to less than $5 a month.
- Although extending wireless service to the high percentage of credit-challenged users was a chief driver in the development of prepaid service, wireless carriers are discovering that prepaid strategies may be almost as critical to future growth of their overall customer bases as traditional post-paid service. BellSouth Mobility intends to have prepaid accounts for 30% of its new sign-ups.
- Traditional methods of buying and selling bandwidth are not adequate in today's competitive market. A new Internet-based service permits providers with bandwidth to sell their available bandwidth for bidding purposes. Buyers are then able to see the available bandwidth along with information regarding destination country, size (T1, OC-3, etc.), and the length of the contract. If a qualified registrant posts a bid, then the service puts the bidder in touch with the service provider to see if they can work out a deal.

- An interexchange carrier has entered into a partnership with one of Florida's tourism groups. The carrier will share its profits with hotel property owners when hotel guests make calls from their hotel rooms using the carrier's service.
- Cable operators that provide Internet access services via their cable networks are already dropping the price of their service in order to capture more of the Internet access market. Some cable operators see this as the only way to push their Internet access service beyond the early adopters. These cable providers hope to use their lower prices to attract lighter users and cut into the market share of ISPs.
- U.S. cell phone users pay for all incoming and outgoing calls that use their phone. About 80 to 85% of all cellular calls originate from a wireless phone — this means that cellular subscribers are either not giving out their phone numbers or they are turning off their phones. One way to balance traffic is to upgrade equipment to accommodate calling party pays (CPP) billing. The caller typically pays 35 to 45 cents a minute, an average rate for an outbound call from a cell phone.
- One reason that domestic long-distance services have not switched to an IP network is because circuit-switched voice is already cheap: rates are below $0.05 per minute for corporate customers and below $0.09 for residential customers. The bottom line is that to make the numbers work domestically requires 10,000 minutes a month to a single location to justify the cost of a private IP telephony network.
- The cost to complete an international voice call is much higher. Carriers charge as much as U.S. $4.00 per minute to complete a call to North Korea and other countries where it is hard to find a good termination.
- To make greater wireless penetration and increased billable minutes a reality, carriers must embrace "calling party pays" (CPP) as the prevalent billing model, rather than "wireless party pays" (WPP).
- Juan Fernandez of Frost & Sullivan reports that when CPP was implemented in Argentina, the market grew from 700,000 subscribers to 2.1 million in 11 months.
- Giving a customer the first incoming minute of a call for free is an interim way that service providers are trying to increase the number of billable minutes.
- ISPs jumped *en masse* onto the flat-rate bandwagon in 1996, only to find that "all-you-can-eat" pricing has a way of eating away at the bottom line. Some service providers have found that the flat-rate strategy delivers something that they wanted to get all along: lots and lots of customers.
- Flat-rate pricing can be a nightmare for providers, especially if their costs are largely dependent on usage and that usage is difficult to predict. Frame relay and Internet services fall into this category.
- Providers gain from using flat-rate pricing because they don't have to cover the cost of administrating usage-base pricing. That can be a significant gain considering that these expenses can run as high as 18% of the total cost of the service.
- Usage-based pricing becomes just as attractive as flat-rate pricing if the cost to deliver a service increases substantially as service usage grows.
- Wireless service providers are starting to offer prepaid services in order to address the 20 to 40% of the market that didn't qualify for service because of bad or nonexistent credit histories.
- Prepaid systems have become more attractive in recent years due to several improvements: they lacked a real-time billing engine (couldn't cut off calls in mid-conversation), and they didn't accommodate incoming calls.
- Wireless service providers can use either a switch-based or a handset-based approach to implementing prepaid services. Most providers have selected the switch-based approach because it works with any handset and it is less prone to tampering.
- The initial investment in prepaid infrastructure can be heavy, but payback periods can be quick. Along with expanding the potential customer base, prepaid wireless lowers the cost of acquiring a customer, since it eliminates the need to do a credit check.

- Despite the upfront charges (for a phone), prepaid services aren't necessarily a tough sell to credit-challenged customers. The per minute charges are comparable to those levied under low- and mid-tier pricing plans, and they include taxes and interconnection charges. Prepaid customers aren't charged monthly access fees.
- Carrier consolidation and interconnection, increased competition, service bundling, and new technology introductions all are contributing to the need for more intelligent and flexible customer care and billing systems.
- Convergent billing means using a single billing system to create all bills — it does not necessarily mean sending a customer a single bill!
- New and existing service providers competing against each other are selling telephone services that are roughly the same. Their goal is to avoid a commodity war of attrition.
- In the United Kingdom, there are 150 licensed telecommunications providers contending to supply the country's 30-odd million adults with fixed wireless, data, voice, and video communications.
- Although pricing is becoming increasingly important in telecommunications (especially voice telephony service), customer service, branding, billing, and value-added services are all keys to success.
- Types of carefully constructed rates and calling plans include bundling, demographic profiling, "loss leaders," incentive schemes, "flattened" prices, calling circles, postalized rates, and special rates.
- Service providers seek to bundle multiple telecommunications services in order to provide one-stop shopping for their customers.
- There are concerns that bundling may reduce churn for a company as a whole, but not necessarily for individual lines of business.
- When customers are asked which company they would use for bundled services, customers overwhelmingly prefer local and long-distance carriers.
- WorldCom has announced its International Business Links (IBLs) and end-to-end ATM services within Europe and to the U.S. The announcement is a culmination of its transatlantic Gemini cable project with Cable & Wireless, together with its European fiber-laying activities to link the former islands of MFS' metropolitan networks. WorldCom has made a habit of breaking the traditional telecom mold. This service announcement is no exception. Other ATM services have been slow to emerge on the commercial market. WorldCom will launch constant bit rate (CBR), variable bit rate (VBR), near-real time (NRT), and available bit rate (ABR) services, pegged favorably against existing leased circuit and frame relay tariffs.

4.6.4 Impact of New Technologies

- Networkwide QoS is needed to deliver priority service to higher-paying customers. Service providers want to use QoS as a basis for offering various classes of services to different segments of end users. By doing this, they can create different pricing tiers that correspond to QoS levels. That might be one of the best ways to offer new revenue-generating services in public data networks.
- Smaller ISPs are using centralized functionality to improve their competitive situation. Most ISPs store subscriber information on up to five different servers, thus preventing them from using data mining tools that are essential to customizing services. This opens the door to content-based billing. Software can be used to create something similar to the call detail records used with voice calls, but it will consider a subscriber's profile.
- PCS services have reduced many of the advantages of paging through longer battery life, first minute free, free/bundle voicemail, free caller I.D., prepaid plans for less creditworthy customers, and competitive pricing.

- From a connectivity perspective, the Internet is well suited for telephony because of its global reach. From an engineering perspective, it is efficient — a dedicated T1 can support as many as 130 IP voice calls vs. 24 simultaneous calls as in today's carrier networks.
- When talking about billing for IP services, the two key issues are metering and settlements. Metering is relatively straightforward. Settlements introduce trouble because the number of billing arrangements between carriers grows exponentially with the number of Internet telephony service providers.
- According to Duane Ackerman, chairman and CEO of BellSouth, 17% of new PCS customers in Louisiana recently signed up for "untethered" service as a replacement for wireline.
- Finland has the greatest wireless penetration of all markets: 42% at the end of 1997.
- Some service providers — BellSouth and Pacific Bell among them — are now betting millions of dollars that Web-based electronic billing systems are essential for hooking lucrative but finicky business customers — and eventually even some residential ones — who are interested in fast, responsive billing.
- Many service providers expect less than 5% of all telecom customers to use Internet billing in the near future.
- On-line billing, however, has its challenges. It not only requires Internet access but is also costly and complicated to set up, especially for big service providers with massive billing systems already in place.
- One of the major benefits of electronic billing is that it saves the service provider money. The more that customers opt to pay their bills through a Web site, the lower the cost of running a paper-based billing system. By some estimates, the entire paper trail from stuffing an envelope, mailing the bill, and processing the payment costs a service provider 75 cents to $1.50 per account every billing cycle. BellSouth estimates that it spends 7 cents to send every printed page.
- Initially, the IP did a poor job of tracking and generating the appropriate data to accurately measure usage for customer billing. Changes are being investigated because of the interest in using IP telephony for voice and fax.
- Many different usage-based services are currently being planned: least-cost routing, time of day routing, dynamic bandwidth allocation, volume discount rates, callback, security enhancements, Web hosting, e-mail, chat lines, whiteboards, videoconferencing, work group collaboration and multimedia sessions, software applications distribution, applications rental, and classes of service quality.
- Many technical challenges of IP-based services must be tackled. Foremost are extrapolating and scrubbing down traffic information from routers and switches and matching that against customer account data for bills. This invoices tracking packet volumes, counting bits or bytes and logging origination or destination IP addresses.

4.7 Telecommunications Strategies (Figure 4.11)

4.7.1 Introduction

The brave new world that represents the future of telecommunications will consist of a group of aggressive global service providers who are competing for the same segments of end users. How each of the service providers hopes to succeed at the expense of its competitors is a fundamental part of its long-term strategy.

A provider's strategy for increasing its market share must be in part based on its current situation. In this section we will look at the current situations that describe many of today's up-and-coming service providers as well as some of the well-established players. We will examine their business goals and how they may go about achieving them. Finally, we'll identify some of the possible events that could dramatically change existing strategies.

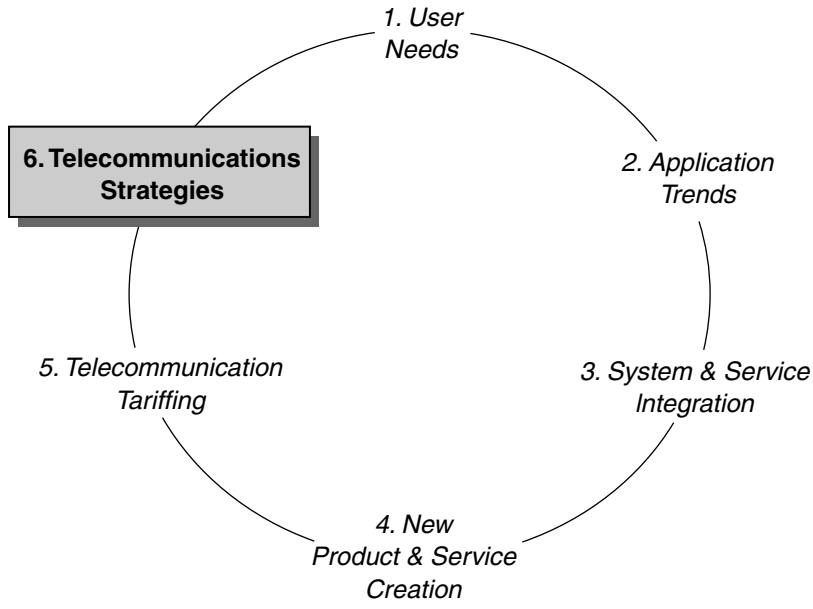

FIGURE 4.11 Trend analysis — telecommunications strategies.

4.7.2 The Players

The value chain of products and services will dictate the positioning of telecommunications service providers. The positioning process usually starts with answering a number of questions, such as:

- What is the perceived quality of my network?
- Is the network keeping pace with the growth of subscribers?
- How much should be invested?
- Where do I need to invest?
- How can I get more revenue out of existing services?
- How can I reduce operating costs?
- How do I know if a problem is just a solitary abnormality or a building problem?
- How can I reduce customer churn?
- How can I predict future capital expenditures?
- How can I get system usage information to improve marketing and sales?

The traditional value chain was very simple. The equipment suppliers — a closed market of monolithic suppliers — have provided hardware with hard- or soft-wired integrated services. This equipment was key for network and service providers who have based their service offers to their customers on the capabilities of this equipment. Change cycles and service creation were extremely long, hardly meeting the customer's expectations.

The actual value chain includes the following principal components (TERP01):

1. Infrastructure
   - IT component suppliers
   - OSS application suppliers
   - Network element suppliers
   - System integrators

2. Network Products and Services
    Network operators
    Service providers
3. Hosting and Processing
    Hosting services providers
    Processing services providers
4. Applications and Media
    Applications services providers
    Context, content packaging, and management
    Content services providers
5. Customer

The players are not yet evenly distributed. Most of them are still emerging from the traditional service providers, and can be allocated to Network Products and Services. Examples are:

- ILEC (Incumbent Local Exchange Carrier): Strong provider who owns a considerable amount of telecommunications facilities and doesn't want to give away this position easily. Most likely, number of legacy support systems with little interoperability and integration in use. The result is high operating costs.
- CLEC (Competitive Local Exchange Carrier): Smaller, flexible provider who owns little or no telecommunications facilities (facility-less). By offering excellent customer care and new services, they try to build the support structure step-by-step. Their support systems are state-of-the-art, lightweight, and less expensive to operate. In certain cases, they use service bureaus for billing and provisioning.
- IEX (Inter Exchange Carriers): Primarily responsible for long-distance services with stepwise penetration of the local exchange area. They can be both incumbent and competitive providers with the result of the need for very heterogeneous support systems.
- PTT (Post, Telegraphy, and Telephone): Strong provider who owns a considerable amount of telecommunications facilities and doesn't want to give away this position easily. Most likely, number of legacy support systems with little interoperability and integration in use. The result is high operating costs.
- CAP (Competitive Access Provider): Facilities-based or non-facilities-based; similar to the ILEC, but have carefully selected local loops for high-profit commercial customers.
- NSP (Network Service Provider): Responsible for providing a highly reliable networking infrastructure, consisting of equipment and facilities. Its responsibilities are usually limited to the physical network only, but element management systems are usually included into their offers.

However, integration is important for many customers. Thus, ISPs and ICPs will play an important role as well. The short definitions are:

- ISP (Internet Services Provider): Its main goal is to provide Internet access to business and attract customers. Major challenges include peering to each other and to other carriers, managing quality, and offering acceptable performance.
- ICP (Integration Communications Provider): Emerging provider with integrated services offer, concentrating on next generation, high-speed data and wireless services, in particular for profitable business users. Its acceptance in the marketplace is expected to be high. In terms of support systems, they buy instead of build; occasionally, they use service bureaus for billing and provisioning. They take advantage of the fact that intranet, extranet, virtual private networks, eCommerce, and multimedia applications require more bandwidth than is available over traditional circuit-switched voice networks.

Hosting and processing will be most likely dominated by traditional mainframe and server manufacturers that are flexible enough to make the necessary facelifts to their equipment to meet requirements of load distribution, load balancing, storage management, and security. IBM and Compaq may be mentioned here as examples of providing reasonable services, using server farms with high availability features.

Application and media need many new competitive players. At the beginning, ASPs and ESPs will dominate this market. The short definitions are:

- ASP (Application Services Provider): Emerging service provider, which must combine application, systems, and network management. Service level expectations are extremely high; the whole business of customers may rely on this provider.
- ESP (Enterprise Services Provider): Emerging service provider from the enterprise environment. It offers services for a limited user community with similar attributes to the provider. It uses and customizes its existing support systems that may not scale well.

Hosting and processing enable Web presence and interactivity on the Internet. They are typically provided by ISPs and NextGen service providers which are active in IP services. They mainly include hosting of Web server infrastructures and content and Web-enabled transaction software and hardware which allow the execution of online transactions. It is an infrastructure type of activity, although it is characterized by added value and significant amount of additional services. Service offer alternatives are:

- Web hosting: Keeping content on Web server farms and offering access with good performance
- Value-added Web hosting: In addition, content, and database maintenance and Webmaster services
- Data hosting by offering Storage Area Networks
- Data management services, including search machines
- Public Key Infrastructure services, including trust center functions
- Centralized Web transaction services
- Web community and Internet account management
- Transaction authentication services

The typical customers of these services are businesses. While large businesses previously deployed their own Web infrastructure in-house, they now also realize the efficiencies of lower complexity and economics of scale given by professional service providers. This customer base can easily extend to the future. The key differentiators will be the service level and complexity of services offered to customers. Hosting and value-added hosting emerge as a volume business. Large data centers with server farms, load balancers, and traffic shapers combined with high availability and excellent performance will take business away from smaller service providers with lower availability and limited Internet access capability. Most service providers are inexperienced in this area.

The continuation of the value chain is dominated by innovative services that are to a certain extent IP-based. It means that the traditional circuit-switched architectures are replaced by packet-switched architectures. For the underlying physical architecture, there are many choices, including:

1. IP + ATM + SDH/Sonet = B-ISDN	Traditional approach, which has the most supporting network elements and their element managers
2. ATM transport	Includes both SDH/Sonet-less ATM transport and ATM/SDH/Sonet hybrids
3. Switched routing	ATM/IP hybrids
4. IP over SDH/Sonet	PPP or HDLC-framed IP mapped to SDH/Sonet
5. Optical IP	Transport of PPP or HDLC-framed IP over WDM with fast photonic restoration
6. Use of enhanced frame relay	Substitution of ATM by frame relay in any of the approaches 1, 2 or 3

There is no doubt that the new area of competition is content.

Content delivery management is taking off and service providers are well positioned to earn revenues there. Content delivery management helps content owners to provide seamless and fast website access for customers by

- Large scale caching
- Distribution of Web server farms
- Complex Internet routing services on managed network segments

All these aspects help to deliver reasonable performance. Processing is an increasingly important revenue generation opportunity as traditional infrastructure business shrinks. Transaction, and therefore processing, which is the infrastructure and software enabler of transactions, is believed to grow to become the single most important revenue input of the Internet value chain. Processing by no means is related to the core business of service providers, but it is important for eCommerce service offers. Services can be created by the IT organization of service providers in collaboration with systems integrators.

The Application and Media elements of the value chain create and translate traditional and digital content into Web-ready format and creates the actual interface between the digital product and the customer. This service is targeting an end-to-end process which covers creation, manufacturing, delivery, and presentation of content to customers. This is believed to be the most promising business opportunity of the Internet. It carries the highest growth potential, but at the same time the highest risks, too. Telecommunications service providers, IT companies, media enterprises, retail chains, and several other industries are competing for revenues.

Service offers are:

- Application Services to be provided by service providers, integrating IT, software, system integration, telecommunication, and consulting skills.
- Content authoring, auditing, deployment, and maintenance combined with bandwidth management, server-load management and traffic management, supporting generic, corporate, and specialized niche portals, and B2B and B2C operations.
- Content creation targeting videos, movies, audio, photo archives, encyclopedic articles, analyst reports, financial evaluation, and many others. Music and also written material combine with broadband access to support multimedia to be delivered over the Internet.

These innovative service areas must be seriously investigated by service providers. In other traditional areas, the profit margins are narrowing; in the IP area they have to face other competition. To be successful, innovative minds are required. It means more collaboration with customers, mergers, acquisitions, investment into smaller companies that may be acquired later, and flexibility in service creation, fulfillment, and quality assurance.

Another Internet-based service is Immersive Photography, allowing customers to use PCs to navigate around a digitized 360-degree photo. This technology is targeted toward Internet retailers who want to give customers a wraparound view of their goods, such as high-end real estate agents, travel agents, cruise lines and destination marketers.

Whether retailers are between service providers and customers depends on the marketplace. No general guidelines can be given in this respect.

4.7.3 Goals

The goals are different for each cluster of service providers. Table 4.4 summarizes the most obvious goals and future targets for each cluster of service providers, referenced in segment 4.7.2 (TERP01).

References

TERP01Terplan, K.: *OSS Essentials: Support System Solutions for Service Providers,* John Wiley & Sons, New York, 2001 (in production).

TABLE 4.4 Goals and Future Business Targets for Service Provider Clusters

Service Provider Clusters	Goals	Business Targets
	Infrastructure	
IT component suppliers	Sell more software Sell professional services	Replace legacy solutions Acquire OSS application suppliers Integrate legacy and innovative systems
OSS application suppliers	Sell more software Sell more professional services	Full-line of offerings of support systems Target ILEC legacy replacement Acquire other vendors of support systems Compete with system integrators
Network element suppliers	Sell more equipment via best of breed and best of suite offers	Outsource element management systems to vendors of support systems Use of open interfaces Develop solutions for eCommerce
System integrators	Sell custom design, development, and deployment Sell custom integration Sell consulting	Acquire vendors of support systems Conduct many projects Consolidate products Compete with OSS suppliers
	Network Products and Services	
Network operators (ILECs, PTTs, IEXs, NSPs, CAPs and global carriers)	Rapid introduction of new services Cost reduction Customer retention Multi-vendor management Convergent ordering Up-to-date asset management	Less internal software development More use of systems integrators More packaged software of support systems Pervasive interconnection of support systems Customer relationship management Self-care with support systems for customers
Service providers (CLECs, ISPs, ICPs)	Build network capacity Customer acquisition Improve service quality Add facilities More carrier interconnection Support of micropayment and prepaid services	Minimal internal development Automated processes More packaged software for support systems Less service bureaus Integration of support systems Customer relationship management Self-care with support systems for customers
	Hosting and Processing	
Hosting (mainframe manufacturers, server manufacturers)	Use existing storage resources Reengineer business processes Use load balancers	Penetrate the Web market Support of eCommerce Advanced asset management Support of Storage Area Networks (SAN)
Processing (mainframe manufacturers, server manufacturers)	Use existing processing resources Reengineer business processes Use caching	Penetrate the Web market Support of eCommerce Advanced asset management
	Applications and Media	
Applications (ASPs, ESPs)	Sell service Customer acquisition Early profitability	Resource integration Good management of the infrastructure Advanced asset management Excellent service levels Use of packaged software
Context, content packaging & management (ISPs, ESPs)	Real-time rating Service creation on-the-fly Mid-range profitability	Usage-based billing Multimedia support Multicasting for distribution
Content providers (ISPs, ASPs)	Real-time rating Service creation on-the-fly Mid-range profitability	Billing for content value Web switching technology

TABLE 4.4 (continued) Goals and Future Business Targets for Service Provider Clusters

Service Provider Clusters	Goals	Business Targets
Customer	Increase service reliability Lower transport costs Faster service provider responsiveness Customer network management	Self provisioning via Web Custom quality of service reporting Flexible billing formats Electronic bill presentment and payment Usage-based accounting