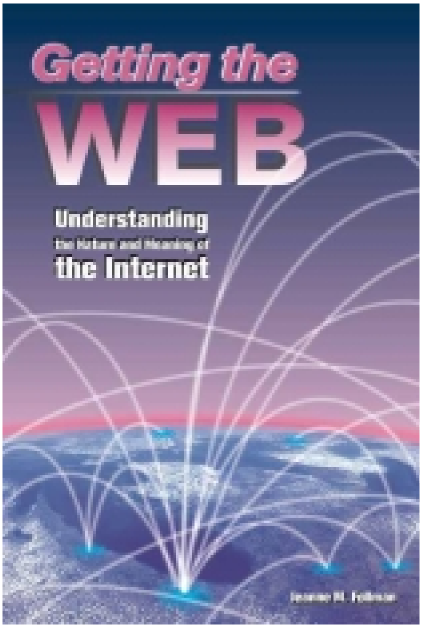
Read Me and Pass Me On
chapter excerpt & annotated Table of Contents

Getting the Web: Understanding the Nature and Meaning of the Internet



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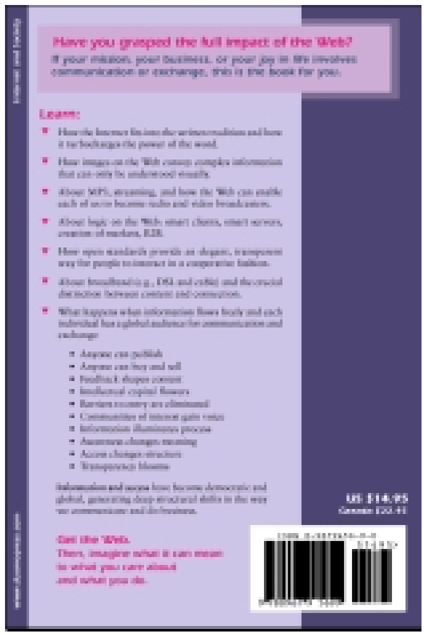

That said, Enjoy!

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an eTaste of

Getting the Web

Understanding the Nature and Meaning of the Internet

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Bandwidth and the World Wide Wait

WHEN I MAKE a telephone call from Chicago to our friend Judi in Washington, D.C., the phone company creates a connection between us. The connection starts at my telephone and continues through the wire that goes out the wall to the telephone pole. Then it goes over the wire assigned to my phone number and on to the telephone company central office for my neighborhood. The connection passes across the voice telephone network to a local central office in Washington, D.C., out the wire assigned to Judi's phone number, and on to their house and telephone. She and I can then listen and talk to one another over this connection until we both hang up.

When I send her an email, something similar happens, as the email travels through the telephone company for computers. I dial into my Internet Service Provider (ISP), write the email and click "Send." The file representing my email travels in *packets* (i.e., chunks of a file) from my computer and modem over the telephone wire to my central office. The file then zips to the ISP where it enters the Internet network proper. It is routed to Washington, D.C. to Judi's ISP, where it is stored in her email box. When she dials in to check her email, the message completes its journey to her computer via her central office, telephone wire, and modem.

When I surf, the files of words, pictures, sound, motion, and logic take a similar path. After I click on a link, my browser generates a request for the Web page that goes out via the modem, over the telephone wire to the central office, and on to the ISP, the Internet, and the Web server hosting the Web page. The server serves the files of the Web page and those files travel back to me, going from the server via the Internet to my ISP, to my central office, and over my telephone wire through the modem to my computer, where my browser displays the files.

The Local Loop

The telephone wire to my home is actually a pair of copper wires called a *local loop* that runs from the central office to my home and then back again. When we use our phones to dial into the Internet, this local loop is largely responsible for slowing down response time and turning the World Wide Web into the World Wide Wait.

The classic *dial-up* Internet communication looks like this:

Human
- ***Computer (i.e., client)***
  - ***Modem***
    - ***Local Loop (i.e., telephone wire)***
      - ***Central Office***
        - ***ISP***
          - ***Internet network***
            - ***Server***
              - ***And then back again:***
            - ***Server***
          - ***Internet network***
        - ***ISP***
      - ***Central Office***
    - ***Local Loop (i.e., telephone wire)***
  - ***Modem***
- ***Computer (i.e., client)***

Human

That's how humans use computers to send files over the Internet and that's how the Internet functions as the telephone company for computers.

The telephone network was engineered to carry the human voice, not a bunch of bits. Yet most of us access the Internet with a dial-up connection. That means our use of the Internet involves a trip via a modem across at least part of the voice telephone network – the local loop to the central office. That leg of the trip, the loop between you and the central office, is the most vexing roadblock to the creation of high-speed Internet access. Those millions of miles of local loops, in the ground and on telephone poles, are unfortunately unequal to the task of handling high-speed Internet access. Therefore, a colossal amount of work and investment is required to give us the kinds of wires we need. Communications companies will be spending enormous amounts of money in the next few years to solve this problem.

In order to illuminate and judge the solutions that such companies are proposing for the roadblock of the local loop, let's look at a few simple telephone network characteristics. Understanding these characteristics will make it easier to judge the various high-speed Internet access options that are now becoming widely available.

- ❒ All dial-up connections have to pass through at least part of the voice telephone network – the local loop between your home and the central office.
- ❒ A local loop can suffer from noise or static, crosstalk, interference, moisture, and critters chewing on the lines. Humans can usually communicate through these disturbances but computers and modems get completely bogged down.
- ❒ In a network such as the Internet, the entire download

time is at least as slow as the slowest link in the chain. A file could blaze across the country in milliseconds, but if it has to creep the last mile from the central office to you, the entire download will be just that slow.

- ❐ Much traffic on the Internet is either local or is generated by downloads from a small percentage of very popular Web sites.
- ❐ Surfing is mostly a matter of receiving information. By clicking on a link, you send a very tiny request to the server which then generates a potentially huge download of files. However, future Internet applications such as interactive sound and video may not fit this tiny-upload/huge-download profile.

The local loop presents a gigantic logistical challenge to the delivery of high-speed Internet access. Each local loop is a pair of copper wires (fondly known as the "twisted pair") going to each home via telephone poles or underground cables. In the United States alone there are over 600 million miles of these copper wires. Almost half of all American households use the Internet, most of them dialing up over their local loop. If these local loops are to be upgraded to deliver high-speed access, the wires must be identified, located, and physically manipulated by a technician who must drive to a neighborhood and climb a telephone pole or dig up a buried cable. The local loop is by far the Web's biggest bottleneck; files can move about 170,000 times faster over the Internet's speediest circuits than they can over a local loop.

The local loop is the biggest roadblock to speed but not the only one. On a network where the entire download time for a file is at least as slow as the slowest link, many factors contribute to the World Wide Wait, including slow or busy servers, the distance a file must travel, and congestion on the Internet proper.

The Internet

What does the Internet itself look like? It looks a lot like a telephone network. For most of the last century, the Bell System, in concert with hundreds of smaller, mostly rural telephone companies, wired the United States for voice. Since deregulation, the offspring of the Bell System as well as other players like Sprint and MCI have continued building a series of networks that operate together to deliver local and long distance voice telephone service to the United States and to interconnect with telephone companies in other countries. They also have created a series of private data networks for corporations, universities, and other institutions that work along with and alongside the voice network.

The Internet is a data network built to send packets between servers and clients. With the voice and data networks, it forms our telecommunications infrastructure. Major Internet National Service Providers (NSPs) including AT&T, BBN, PSI, Sprint, and UUNet/MCI, have created a series of high-speed networks called *backbones* that transfer packets representing our files. Backbones are interconnected at Network Access Points (NAPs) to government, regional, and academic networks in the United States as well as similar networks in the rest of the world (e.g., EBONE in Europe). Our ISPs hook into this network as well, which is how we get access. Once you're on the network, you can get to everyone else on the network and they can get to you. To date, the four original NAPs in the United States (Chicago, New York, San Francisco, and Washington, D.C.) have grown to twelve as facilities and traffic have increased.

Not surprisingly, the Web contains a wealth of information about itself. If you're interested in learning more about the structure and future of the Internet and the Web, check out the Internet Society (www.isoc.org) and the World Wide Web Consortium (www.w3.org). Also, you can find a great tour of the Internet at the What Is site (www.whatis.com/tour.htm). And to see terrific graphic visualizations of the various networks of which it is made, see An Atlas of Cyberspaces at www.cybergeography.org or do a search on "visualize internet topology."

The Internet Service Provider (ISP)

On the voice network, we usually deal with one local telephone company and one long distance telephone company to gain access. On the Internet, we gain access through an Internet Service Provider (ISP). However, ISPs provide much more than an Internet connection, including services such as email, Web site hosting, search features, and tech support. People with dial-up connections can easily change their ISPs so competition has improved the services that these companies offer. ISP choice, however, is something that may not survive the delivery of high-speed Internet access; more on that in the chapter on Content and Connection.

Traffic on the Internet

When we talk on the phone, it doesn't take forever for the other person's voice to reach us. When we watch TV, the shows don't broadcast in slow motion. When we listen to the radio, the songs bang out in perfect rhythm. But when we surf the Web, we wait and wait.

If you recall from our earlier discussions, text files are of reasonable size, picture files are much larger, audio files are even larger than that, and video files are the biggest of all. That translates directly to the time it takes for the files to download, making the delivery of the multimedia parts of the Web the most painful. If the Internet were all words, download times would not be an issue. But image, audio, and video files are not only quite large, such files are seeing the most explosive growth.

When the fourth *Star Wars* movie came out in 1999, Apple Computer posted a preview of the movie as a QuickTime file on its site. The file was 25 Megabytes in length and was downloaded more than 23 million times, generating more than 400 trillion bytes of Internet traffic.

Traffic on the Internet is measured in Perabytes (1,000 trillion bytes) per month. As traffic increases, the capacity of the network must increase in order to keep download times reasonable. In effect, in order to cut down travel times, we need to build not only wider highways but wider side streets for our data, which brings us to a discussion of *bandwidth*.

Bandwidth

In his book *The Race for Bandwidth*, Cary Lu defines bandwidth as "a measure of how much information can flow from one place to another in a given amount of time." (Redmond, Washington: Microsoft Press, 1998). Bandwidth, therefore, is as much a matter of capacity as it is of speed. On the Internet, it is purely a matter of capacity since speed is determined by the physics of electricity and light. Capacity, however, is up to us. A high speed line is faster because it allows our bits to march side by side, rather than in single file, so more of them reach their destination in the same amount of time. High-speed lines are fast not because they transmit more quickly but because they are wide enough to transmit more bits at one time. If you're transmitting a voice over a phone line, bandwidth doesn't matter. If you're transmitting information, it matters very much.

If cars were data and highways had bandwidth, we would measure it by the number of cars that could utilize the highway in a certain amount of time. For example, I can drive downtown on the Kennedy Expressway in Chicago at four in the morning in about 10 minutes; if I try the same trip at 5:00 P.M. on a Friday evening, it could take an hour and a half. Why? Because the number of cars making the same trip exceeds the bandwidth of the highway. So we all wait. Once bandwidth is exceeded, everything slows down. The solution is to build a highway with adequate bandwidth, maybe one that's 30 or 40 lanes wide. Odds are good that even Chicago traffic wouldn't clog up a highway that wide, but you never know. And we never will, because no one is going to build a 40-lane highway for cars. But we are for data.

On the Internet, we measure bandwidth by measuring how many bits can move from one place to another in one second. We call it bits per second, or *bps*.

Here's a refresher on words just to get you warmed up. These numbers are actually approximations since a Kilo is really 2^{10} or 1024 and so on (that happens when you count only using 0s and 1s):

Thousand = Kilo	**1,000**
Million = Mega	**1,000,000**
Billion = Giga	**1,000,000,000**
Trillion = Tera	**1,000,000,000,000**
Pera	**1,000,000,000,000,000**

A connection at a fixed width is just like a highway: the more bits you have, the more time it takes once the bandwidth limit is exceeded. The more media-rich Web sites get, the more traffic they generate and the longer they take to download.

And just like a highway, the alternative to waiting is the creation of connections with bigger bandwidths, allowing more bits to march side by side, like cars on a multilane highway. Sending 28,000 bits through a connection that has a bandwidth of 28,000 bps will take about a second; sending it through a 56,000 bps connection will take only half as long. Browsing a media-rich Web page over a 28K modem connection could take a minute or two; browsing that same page via a direct T1 connection would take only a second or two because it's a much wider road. That's a big difference and communications companies are betting that it's a difference for which people are willing to pay.

Here are the approximate bandwidths of different Internet connections:

28K modem	**28,000 bps**
56K modem	**56,000 bps**
T1 line	**1,500,000 bps (1.5 Mbps)**
T3 line	**45,000,000 bps (45 Mbps)**
OC3	**155,000,000 bps (155 Mbps)**
OC12	**622,000,000 bps (622 Mbps)**
OC48	**2,400,000,000 bps (2,400 Mbps or 2.4 Gbps)**
OC192+	**9,600,000,000+ bps (9,600 Mbps or 9.6 Gbps)**

The backbone networks of the Internet are composed of combinations of T1s, T3s, and optical carrier connections (the OCs). Of course, we could all just order T1 lines, but then our phone bills would approach a thousand dollars a month and we'd all have to become mini-ISPs to do the other tasks necessary to manage a direct connection to the Internet. The alternative is to await the high-speed solutions developed by the communications companies.

The work required to deliver universal, high-speed access to the Internet falls into two spheres: speeding up the network proper (backbones, Network Access Points, etc.) and breaking up the bottleneck of the last mile created by our use of the local loop.

Speeding up the Internet Network

The National Service Providers who manage the networks of the Internet are large corporations with access to capital markets so they can invest in new facilities to increase bandwidth. For example, they can install additional high-speed backbones or speed up the routing of traffic through the Network Access Points.

In addition, many companies are implementing a strategy called *network cashing*, which effectively cuts down traffic by bringing Web content closer to its ultimate destination. This is how it works. As we said earlier, much traffic on the Internet is either local or it is generated by a few very popular Web sites (e.g., AOL, Yahoo). If hundreds of thousands of people sign on in Chicago and they all go to Yahoo.com, the same few Web pages would download over and over again from California. On the other hand, if the network had a copy of Yahoo.com stored on a server in Chicago, it could intercept the request and serve Yahoo from the local copy rather than fetching it from California. The download would go much faster, traffic on the backbone would be reduced, and no one would know the difference. Network caching of the content of very popular sites reduces network congestion and speeds up download time.

Speeding up traffic on the Internet proper is a technically sophisticated and difficult undertaking. But it pales in comparison to the work required to break the bottleneck of the local loop.

Speeding Up the Local Loop

If you stand outside your house or apartment, you will probably see three types of wires entering the building: telephone, cable TV, and electrical. Telephone lines are already widely used to access the Internet and cable TV isn't far behind.

The Internet was able to grow as fast as it did because so much of the infrastructure was already in place. When I started surfing in 1995, I didn't need to buy a computer; I already had one. And I didn't have to order a phone line. All I needed was a modem, an ISP account, and some software. The Internet access that most of us have today is very similar. The modems and machines have gotten faster but everything else remains the same.

As we have said, the act of dialing into an ISP puts us on the voice network. Although that leg is only a small part of the path, it slows down the entire transmission. So even if well-heeled National Service Providers create the speediest backbones in the world, dial-up access will be limited by the tiny bandwidth available on the voice network. The 56K modems that are popular today make the absolute best use they can of that sliver of bandwidth, but access won't get faster until we break the voice bandwidth barrier. Or until we do something completely different, like converting our bits into color rather than sound and sending them through our cable TV cables, or converting them to radio waves and sending them through the air.

As the millennium begins, the Internet is still a network of institutions such as governments, schools, universities, corporations, and ISPs, with direct, high-speed connections to the Internet. In fact, ISPs exist mainly to get the rest of us onto this institutional network. But since our access piggybacks on the voice network, we're limited by the 56K ceiling. It took decades and a massive monopoly to get the country wired for voice; wiring for data isn't going to happen overnight.

In the Interim

In the meantime, the industry is moving ahead with interim solutions that make things better but not ideal. These solutions can all be described as *broadband* – broad bandwidth connections that accommodate high-speed data transmission. They are meant to provide to homes and small enterprises the high-speed Internet access that large institutions already enjoy. Broadband access provides not only high speeds, it provides access that is "always on." No more dialing into your ISP, sitting through the busies, and waiting for the connect. If you want to surf, you just launch the browser and off you go. As Tim Berners-Lee says, it makes using the Internet less like using a lawn mower and more like using a pen.

Because implementing broadband access is such a huge logistical undertaking, the costs will vary for each of these solutions.

So will the way in which corporations make and recover their investments. When I dial into the Internet using my 56K modem, the telephone company doesn't have to do anything. But if I want to break the voice bandwidth barrier on my local loop, not only do I need a new modem, the telephone company needs a new modem in the central office that can hear more than voice frequencies. It also has to make sure that the copper wires in the local loop are of high quality. If not, a technician will have to climb a pole or dig up a cable. And that will have to happen not just for me but for the millions of other people who eventually will want broadband access.

Speed in Both Directions

The quest for high-speed, broadband access is currently driven by the World Wide Web and its rich multimedia components of images, sound and motion. The broadband solutions seen today reflect that drive. The two front runners, Asymmetric Digital Subscriber Line (ADSL) and cable TV access, both facilitate speedy downloading but not equally speedy uploading. That's not a problem for surfing because it's all on demand and a matter of a tiny request generating a huge download. Email and instant messaging applications upload files to the ISP but they are text-based and small. However, once we get the bandwidth to receive decent sound and video, someone will invent an instant messaging application (imagine it – Barbie WebCam!) whereby kids can not only send each other text but also live sound and video. Then they will be able to see each other making faces and hear each other talk, and once again the local loop could be a bottleneck, only this time a bottleneck of uploading rather than downloading.

The point is, the interim broadband solutions we see today are just that: ways to squeak additional bandwidth out of the existing infrastructure of local loops and cable TV. The Internet is still in its infancy and still very much shaped by the telephone network. Dial-up access allows the Internet to crawl; interim broadband solutions allow it to toddle along on its training wheels. But the ultimate in access is not even close to implementation. All we can hope for (and demand as consumers and stockholders) is that these interim solutions improve the situation today without compromising a better solution for tomorrow, and without compromising the integrity of the network itself (more on that topic in the Content and Connection chapter).

ADSL and cable TV access are the two most popular interim broadband solutions; some combination of either with fiber optics is probably the optimum wired configuration. But there are other alternatives which don't involve wires at all: wireless and satellite. Let's now look at all of these broadband solutions in more detail.

BROADBAND SOLUTIONS

Asymmetric Digital Subscriber Line (ADSL) and the Poor, Deaf Phone Company

When you dial into your ISP, the telephone company can handle your call and get it to the right place because your modem creates sounds within the frequency range of the human voice. If you hit the A above Middle C on a piano, the piano strings would vibrate 440 times in one second (440 cps). The telephone network can transmit and reproduce sounds between 300 and 3,300 cps, a bit above Middle C to a little higher than three octaves above Middle C. When your modem squawks, it squawks within that range and the phone company can transmit those squawks to your ISP. But if the modem generates any sounds above or below that range, they would be lost in the transmission.

However, this voice frequency range takes up less than half of one percent of the frequency range that the copper wires of your local loop can transmit. Even though the voice network wouldn't know what to do with it, the copper wire itself can transmit frequencies up to around one million cps (1 Mhertz). So if you tried to use that other 99 percent without special equipment, the signal (e.g., file) would be lost; it is beyond the range of what the voice telephone network can transmit. Humans can't hear much above 30,000 cps; the voice telephone network can't hear much above 3,300 cps. Using the other 99 percent means using frequencies so high-pitched that they can't be heard and transmitted by the voice network.

ADSL is the most popular entry in a family of DSL technologies that take advantage of the other 99 percent of the frequency range of the local loop. ADSL is implemented via a pair of modems that can hear the full bandwidth of the wire, one at the telephone company central office and the other at your end. The ADSL modem is smart enough to send both voice and data. It sends the voice signal through the traditional 1 percent frequency range of the local loop and sends data through the other 99 percent. Downloads travel at very high speeds, up to around 6 Mbps; uploads however, travel slower, around 640 Kbps.

The ADSL connection is asymmetric – it is structured to allow a much greater bandwidth for downloading than for uploading. That works great for surfing, since very little goes up but a whole lot comes down. However, when we start sending sound and video interactively to each other, the upload constraint could become an issue. The other problem with ADSL is the limited length of the local loop. It doesn't work if you are more than two or three miles away from the central office. It also doesn't work if your local loop is noisy or has been chewed by critters. However, one version of ADSL (G.lite) is designed to run on noisier lines, albeit at slower speeds (1.5 Mbps). But if you are close to a central office, ADSL provides a great way to get high-speed, always-on access.

Cable TV

The other leading broadband solution uses your cable TV line rather than your phone line. It takes the colorful approach of converting your bits into colors rather than sound and sending them as one of the channels in the cable feed to your home.

With cable TV, you access the Internet via a cable ISP that has its own direct connection to the Internet. The cable ISP takes bits and converts them into colors (i.e., analog video signals) and sends them to you on a cable channel. The cable coming in through your wall goes to a splitter rather than to the cable box. There the data channel is split from the regular cable feed; the cable feed goes on to the cable box and TV and the data goes on to the cable modem. The cable modem turns the colors in the video signal back into bits and sends the bits on to your computer.

Like ADSL, cable access is faster on the download than it is on the upload. Likewise, it provides an Internet connection that is always on. One of the problems with cable access is that the download time you actually experience is a function not only of the bandwidth of the connection but of how much everyone else in the neighborhood is downloading. Internet cable access is delivered by bringing into each neighborhood a fiber-enhanced cable feed, to which the cable from your home is connected. All the people connected to that one feed share its 10 Mbps bandwidth. If you share the feed with 50 other people who love to read books in the evening, your downloads will probably be speedy. If you share it with 500 or 1,000 or 2,000 other people who love to download video, you may be better off with your old dial-up connection. Additionally many cable companies don't offer dial-up service to your account usable while traveling. Furthermore, they don't yet offer a choice of ISPs or modems. You use what they give you. This is an issue of some concern and we discuss it in the chapter on Content and Connection. But cable TV access is a way to high-speed, always-on access that is gaining in popularity.

Fiber Optics

The last wired broadband option is fiber optics. Fiber can carry millions of megabits a second; high speed Internet backbones are all fiber optic carriers. Rather than using a modem to wiggle electricity in a copper wire or colors in a cable, fiber optic lines use lasers to wiggle light, turning the light on and off billions of times a second in a pattern that maps to the bits in the file being transmitted. The problem, of course, is that most of us have copper local loops. To replace more than 600 million miles of copper with fiber is a job communications companies may not be willing to take on. Furthermore, light-wiggling devices are needed as well – the optical equivalent of a modem. Fiber is great for new buildings and developments which have to be wired from scratch. If it happens for the rest of us, it will probably happen as fiber to the neighborhood with a connection to existing facilities to the home.

So far, we've seen our bits encoded as sound, color, and light. Why not radio waves?

Wireless Options

That's exactly what Local Multipoint Distribution Services (LMDS) does. It is a wireless system designed to deliver data through the air at millions of bits per second. A receiver is placed on your rooftop in a fixed location that has a good line of sight to a base station antenna; the antenna sends bits encoded as radio waves to your receiver and then to your computer. LMDS is unfortunately limited by noise caused by walls, hills, and water.

Another wireless option uses transmissions from satellites to send radio waves to small receivers on housetops. Satellite systems have huge bandwidth capabilities but they also involve massive deployment costs and are still considered experimental.

Finally, the cell phone has possibilities for evolving into a broadband medium. It faces the same hurdle as the voice telephone network, since it was engineered to carry the human voice, not data. Nevertheless, considering the huge infrastructure investment needed in wired broadband, it remains an interesting alternative.

Accessibility Issues

We think of the telephone as being ubiquitous – everyone has one. But that's not the case, especially in rural areas. Also, the local loop may be too noisy, making it unusable for data transmission. These days, in rural areas, the cost of telephone service resembles the price of providing it. If it costs tens of thousands of dollars to lay wire to your house, you may just have to pay that much if you want a phone. If you're already wired, it's not a big deal. If you're not, it is a big deal.

In the old days, when the Bell System and the independent telephone companies originally wired the country, they used a cost structure that enabled urban areas to subsidize rural areas and business services to subsidize residence services. As a result, the phone companies made money yet everyone was able to afford a telephone, even if the phone company had to run a wire hundreds of miles just for one house. That's not the way things are today. Cost structures in a competitive environment are usually based on the cost of providing the service, so companies tend to invest in services with big paybacks, leaving some customers with either no service or with a service they can't afford. The cost structures used by the communications companies delivering broadband services will determine in large part how widely such services are offered. How granular is the service from which a company must make a profit? What subsidizes what? These questions are all opportunities for civic debate and the answers that materialize will help determine the extent and quality of our broadband access to the Internet.

Cost and Convergence

Cost structures, and more generally, the business models used by communications companies, will determine the nature and quality of the services they provide as well as their accessibility. Let's say a phone company offers always-on, high-speed Internet access, data services, and voice telephone service (most of which is digitized anyway once it leaves the central office). And let's say that both myself and my friend Judi in Washington, D.C. have some software, a microphone, and a speaker that allows us to send interactive sound files through the Internet. We can then use this setup to talk back and forth. If we do this, will we still need telephones? And what about the phone company? I'm using one of their services to supplant another. How should they bill me? In what services should they be investing their capital?

A similar convergence is occurring in cable TV, with cable Internet access giving us the ability to download video on the Internet through the data cable feed as well as video through the traditional cable feed. Does that mean that the cable ISP becomes an entertainment company? Some cable TV companies also offer telephone service. Does that mean they are turning into telephone companies? And what effect will the emergence of digital high-definition TV have? Being able to turn print, images, audio, video, telephone service, TV and movies into bits has great potential for making us and our communications and entertainment industries fairly crazed for some time to come.

Why Bandwidth Matters

Cars have been around for almost a century and we still have huge daily traffic jams. On the other hand, it's a lot easier to lay a fiber optic cable than it is to build a highway. But why is bandwidth important? Why can't we all just be more patient with the Web and sit through the wait? For a few reasons.

Thomas Friedman, in his book *The Lexus and the Olive Tree*, says that the first of the "Eight Habits of Highly Effective Countries" is being wired. "Bandwidth in the late 1990s is important for commerce in the same way that railroads were important in the 1890s and seaports were in the 1790s. It's the way you sell your product." (New York: Farrar Straus Giroux, 1999).

Bandwidth also enables new ways to communicate. Current bandwidth on the Internet handles words quite well but the same cannot be said for images, sound and motion. For us to fully enjoy the riches of the Web, we'll need faster connections. Streaming video is a perfect example. It exists, but its poor resolution and small footprint inhibit it from many important uses. It may be fine for a talking-head news program but would not be adequate as a way to put a lecture online. While we could see the head of the teacher, we might not be able to make out printed words, visual aids or other demonstrations. An entire class of products, the "university on demand," is just one that awaits the arrival of broadband.

We also need faster connections so that new methods of communication and exchange can flower. Fast and always-on connections enable a different level of interaction. For example, voice telephone service on the Internet only works if you have a connection that is always on. And products that deliver interactive video will not take off until a critical number of us have high-speed, always-on access with upload speeds as fast as download speeds. When that happens, we'll all be able to talk to one another like they do on *Star Trek*, looking at a monitor and seeing the person to whom we're talking.

When paper and movable type were invented, book shops sprang up everywhere, creating a marketplace in which ideas could travel by being swapped, bought and sold. Commerce led; culture followed. With broadband access, we bring image, sound and motion into a similar arena and put at least some of the power of broadcast into the hands of the individual. And since this revolution is taking place in the information age, we as consumers, shareholders, and citizens have at least some chance to affect how broadband content and connection are delivered.

Getting the Web

Annotated Table of Contents

A quick look at the other chapters in the book.

The Big Picture

The pictures taken by the Apollo 8 astronauts were the first to show us Earth, floating alone and majestic in space; these pictures forever changed the way we think about ourselves. Likewise, the Internet is now forever changing the way in which we interact. It is launching us into the new millennium by giving to each individual the powers of communication and exchange that in the past were held only by governments and corporations. This book explores what the Internet is, how computers and telephones shape the internet, and how the Internet shapes communication and exchange and ultimately, us. Technically, it's all quite complex and sophisticated. Conceptually it's a simple matter of moving files back and forth between servers and clients to engage people in communication and exchange. Chapter topics: Looking at What, Not How — Structure of the Book

Part I

In Part I, we see what happens when individuals exchange words, pictures, sound, motion, and logic by putting them in files and moving them back and forth on the Internet – the telephone company for computers.

The Telephone Company for Computers

How the telephone network and computers, as either clients or servers, make up the fabric of the Internet and create the basic mechanism for communication. Chapter topics: *Computers — The Telephone Network — Clients and Servers — Summary: The Telephone Company for Computers*

Files

Traffic on the Internet is no more or no less than billions of requests and files, flying back and forth all over the world, between clients that have requested the files and servers that have served them. Chapter topics: *Signals — Suck It and See*

Files of Words

How the Internet fits into the written tradition and how it turbocharges the power of the word, visualizing discourse and giving each individual the power to create complex repositories of thought and to enter into a conversation on that thought with anyone else on the planet. Chapter topics: *Visualizing Discourse — A Changing Relationship with Text — Mesopotamia dot COM — The Solitary Reader — The Logic of the Book — The Flavor of Text on the Internet — Hypertext - Connection Made Manifest — Breaking Down Barriers — What We Were After All Along?*

Files of Pictures

How images on the Web can be used to convey complex information that can only be fully done pictorially. Chapter topics: *Image File Guts - Pictures as 0s and 1s — Pictures are Cool — Visual Knowledge — Photographs — Art*

Files of Sound and Motion

How the Web can enable each one of us to become radio and video broadcasters. Chapter topics: *Sound as 0s and 1s — Streaming Audio — MP3 — Internet Radio — Broadcasting Internet Radio — Video on the Web*

Files of Logic

Smart clients, smart servers, B2B: what happens when we start creating Web clients and servers that not only do "show and tell" (i.e., transmit files of words and pictures), but do the million other things that software is known for. Chapter topics: *Smart Servers — Smart Servers - Business to Business — Smart Clients — Downloading Programs — The Telephone Company for Computers*

Part II

Part II explores why the Internet is the way it is: how computers and telephone networks shape the nature of the Internet. We see how open standards successfully orchestrate the daily movement of millions of files, we look at search engines, we see why bandwidth is an issue, and we explore the crucial difference in a public network between content and connection.

Open Standards

Open standards are the power that fuels phenomenal growth, providing the clarity and stability necessary to create new forms of communication and exchange. They provide an elegant, transparent way for people to interact in a cooperative fashion. As Tim Berners-Lee says, "As long as we accept the rules of sending packets around, we can send packets containing anything to anyone." Chapter topics: *Standards and Communication — File Types — File Standards — Standards and the Birth of the Web — Standards Today — Open Standards — Open vs. Proprietary Standards — Open Standards and Growth — The Power of Cooperation*

Searching the Web

Push vs. Pull, metadata, and why it's so hard to *find what you're looking for on the Web. Chapter topics: *Push vs. Pull — Catalogs, Search Engines, and Portals — Mechanizing Meaning — Metadata — Sort of Meta — Real Metadata*

Bandwidth and the World Wide Wait

A quick tour of the Internet, why squeezing bits through the voice telephone network is such a slow process and what forthcoming "broadband" solutions, especially ADSL and cable, can do to help the situation. Chapter topics: *The Local Loop — The Internet — The Internet Service Provider (ISP) — Traffic on the Internet — Bandwidth — Speeding up the Internet Network — Speeding Up the Local Loop — In the Interim — Speed in Both Directions — Broadband Solutions — Asymmetric Digital Subscriber Line (ADSL) and the Poor, Deaf Telephone Company — Cable TV — Fiber — Wireless Options — Accessibility Issues — Cost and Convergence — Why Bandwidth Matters*

Content and Connection

What happens when a number of centralized, private networks such as TV broadcast and cable networks crunch into the distributed, decentralized public network that is the Internet. Chapter topics: *Bundling — Bundling in a Broadband World — Bundling Access and ISPs — Public Networks Connect — Content, Connection and Convergence — History Repeats Itself — The Pricing Issue — The Infrastructure Challenge*

Part III

In Part III, we discuss the ways in which the Internet shapes communication and exchange and ultimately, us. The Internet gives us a splendid mechanism to hold an enriched conversation or to do business with anyone on the planet. And when people start talking on the Internet, information flows freely, anyone can publish, barriers to entry for many businesses are virtually eliminated, intellectual capital increases, feedback shapes content, communities of interest gain voice, local communities thrive, and complex and differentiated entities form and emerge, like the open source movement and the Internet itself. Information illuminates. The Internet will make obvious new ways of doing things and create new ways of looking at life. With it, we can more easily see ourselves in the full context of who we really are and ensure that our institutions truly function the way they should.

Individuals in Conversation

On the Internet, the vast complexity and storage capacity of computers fuses with the reach of the telephone network, dramatically enriching our conversations. If your interests, your business, or your mission in life lay within the realm of communication or exchange, the Internet is the tool for you. Are you ready? Chapter topics: *Communication and Exchange — The Power of Publishing — The Power To Exchange — The Creator's Tool of Choice — Using Files for Communication and Exchange — Visualizing Discourse — Internet Time — Discourse and the Shaping of Content — Sharing and Amplifying Intellectual Capital*

Formation of Community

On the Internet, it's not unusual for people who would otherwise be complete strangers to do cool stuff as a community for no other reason than their love of doing cool stuff. Far from being a force for social isolation, for people of like minds or similar interests, the Internet is a wellspring of community formation, and is itself the product of such a community. The Internet dissolves barriers, the main but not the only one being distance, and provides a forum for conversation, debate, and interaction. Chapter topics: *Conveying Presence — Reaching the Niche Audience — A Small Corner of Cyberspace — Victorian Email — Enhancing Physical Communities — The Virtual Corporation — The Community that Created the Internet — Doing Good and Showing Off — Open Source — Transparency and Complexity — Cyberspace is Earth*

Conversations Driving Change

The Internet doesn't cause change but the people using it certainly do. If there are conversations between people and within communities that the Internet can bring about, it is from these conversations that change will come. Information and access have become both democratic and global, generating deep structural changes in the way we communicate and do business. Chapter topics: *The Free Flow of Information — Access Changes Structure — Everyone's an Operator — The Price in the Marketplace — The Marketplace Itself — A Market of One*

An Outbreak of Sanity

Information illuminates. With it, we can see ourselves in the full context of who we really are and insure through transparency that our organizations function the way they should. Using the Internet, each individual, alone or in communities of interest and knowledge, finally has the power to trump the agenda of the institution and shape it to serve those who give it meaning. It may be just the thing we need to permanently nail into place the mother of all paradigm shifts: the idea that the person gives meaning to the institution, not the other way around. Chapter topics: *Illumination and Formalization — Transparency — Epiphanies of Context — Welcome to the Renaissance*

Glossary, Bibliography, Index

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