I.

The Machine

Consider that German Konrad Zuse built the first programmable digital computer only a generation ago. The Z3 was designed to solve complex engineering equations and was controlled by perforated strips of discarded movie film. It was the first machine to work on the binary system. Zuse went on to found the first manufacturer that sold computers. See http://howstuffworks.com under Personal Computer.

The brain of a computer, the microprocessor, is currently a flat silicon chip. Silicon is an inorganic substance that allows minute amounts of electricity to pass through its circuitry, which is laid out like streets on a roadmap. The type of transistor most widely used in computing is a microscopic switch in which current flows from a power source to a power drain when voltage is applied to a raised feature between them called a gate. These electrical pulses activate rules through a series of OR, NOR, AND, NOT logic gates, switches at which specific conditions have to be satisfied before the computer can act.

Let's look at the basic parts of the computer – the machine usually used to access the Internet.
CPU: the central processing unit is a microprocessor - the brains of your PC, the CPU is designed to take software instructions and do something with them. By combining lots of these instructions very quickly the CPU can execute complex applications such as word processing and game playing
Memory: This is where software applications reside while they're running. Adding more memory to a computer lets it run even faster. While many CPUs have some memory built in, it's usually too small to do much work. For that reason, PCs always have some sort of random access memory (RAM). The RAM is measured in Megabytes (MB). The memory acts as the holding cell between your hard drive and your CPU.

Interestingly, results testing computers from various manufacturers with varying degrees of memory show improvements to system speeds were negligible after adding RAM chips. Compared with a 1981 PC, a modern one is 500 times faster, has 2,000 times as many transistors, and can store 8,000 times as much data.

Hard Drive: If all you had was your system's RAM, you would not be able to store many applications and they'd disappear every time you turned off your system. Hard drives can store huge amounts of data – many gigabytes – on rapidly spinning (100 MPH!) magnetic disks. When the CPU needs a certain piece of a program, it sends a request to the hard drive and then stores the relevant info in RAM. Hard drives keep data safe, even when you turn off your computer.
PC Card slot – this slot provides an easy way to expand the capabilities of a laptop. By inserting a credit-card size device in the slot, you can add things such as more memory, network adaptors, and video capture cards
CD or DVD drive: these drives use optical media that reflects a data-reading laser beam. Special drives let you 'burn' data including music into discs.
USB Port: a fast standard way to connect peripherals such as a mouse that doesn't require you to turn off the computer to plug in a new device.

PC Factoid: Did you know that what goes into building one PC is roughly the same as what goes into making a midsize car. Approximately 1.8 tons of material are required to manufacture the average desktop PC and monitor. According to this study, it requires at least 529 pounds of fossil fuels, 48.5 pounds of chemicals, and 3,307 pounds of water.

Now that we've examined the hardware, let's look at the 'Internet.'

What is the Internet?
See http://zakon.org and click on Hobbe's Internet Timeline.

1945 Vannevar Bush writes essay for Atlantic Monthly positing a photo-electrical-mechanical system called Memex that links research books via microfilm.

1958 ARPA formed in response to Sputnik launch the previous year.

1960s: Team led by Douglas Engelbart (or Englebart) develops NLS (oNline System) for storage and retrieval of e-documents using hyperlinks. To navigate, he invents the mouse. Ted Nelson coins term hypertext for Project Xanadu. Lawrence Roberts develops plan for ARPANet as system of interconnected computers using packet-switched network.

1968: ARPA approved plans for a 'resource-sharing computer network" to be called ARPAnet. BBN was awarded the contract to build the interface message processors – the first routers – for the packet-switched network.

In 1969, ARPAnet lauches – a network for exchanging information among a few government agencies and the large research universities working on DoD projects. First nodes at UCLA, SRI, UCSB, U of Utah. UCLA was the first host to connect to ARPANET on Sept. 2, 1969, the day the Internet took its first breath.

On that date, developers gathered to watch the first test of the new network as a new, state-of-the-art Honeywell DDP 516 (about the size of a telephone booth was connected to a Scientific Data Systems computer by a 50 foot cable.

On Oct. 29, 1969, the first message was sent from UCLA to a node at Stanford Research Institute, the day the Internet said its first words. UCLA computer science professor Leonard Kleinrock attempted to write 'login' but it got cut off at 'lo.'

This network is the backbone of today's **Internet.** ARPA itself had been created as a response to the successful launch of the world's first artificial satellite Sputnik 1 by the Soviets.

While developing contingency plans for nuclear war, scientists at RAND, a private think-tank in California, were charged with developing a communications infrastructure that could withstand a nuclear attack. RAND designed this network so that no single computer or communication line would be needed for total system survival.. Each computer would routinely look for all the other computers on the network and if one went down, it would bypass the malfunction. Likewise, if it came back up, it would recognize it again.

Stanford Research Institute, U.C. Santa Barbara, and the University of Utah were connecting within the next two months, forming the first network. Because no reliable **protocol** existed to govern network exchanges, these machines would occasionally crash, causing ARPA to seek the development of better protocols with resulted in **TCP** in 1975. As the network continued to grow, when **in 1983, ARPA switch over to TCP/IP**, so did everyone else – corporations and state agencies as well as colleges and universities. A large number of previously private networks began using this standard to gain interorganizational communication, creating an inter-network. As this grew during the 1980s, the new system became known as the Internet. To protect the research and development community from being overwhelmed by Internet 'noise', ARPA developed a dedicated access-only network called **MILNET in 1985** and abandoned ARPANET/Internet to the public.

The National Science Foundation (NSF) picked up the baton to create a better Internet. With the financial backing of Congress and the White House, the Office of Advanced Scientific Computing created NSFNET in 1988, with five supercomputing centers that would provide high-speed computing access in 1986, and upgraded dedicated fiber optic lines running between these systems to T1 status (moving from 56K bps to 1.5 Mbps. In 1991, this was upgraded again to T3 (44.7 Mbps). This became the modern Internet's 'Backbone.' NSFNET prohibited the use of the network by commercial traffic, forcing the development of commercial ISPs. These ISPs quickly outstripped, then dwarfed NSFNET in capacity and connections.

Interestingly, at the same time, every other entity with a network – in government, education, and business – was increasing the robustness of this network. Also, **in 1991, restrictions were lifted** by Congress on the use of the Internet by business. As NSFNET continued to grow, the US Dept. of Commerce began assignment of **domain** name prefixes and suffixes. NSFNET eventually shut down, less than nine years after its upgrade. At its start, there were maybe 10,000 hosts on the 'net; by the end, there were 6 million and NSFNET was only a small part of what made the system so strong. It proved that TCP/IP could be used in large networks without any sort of central manager. Finally, 1991 was the year Timothy Berners-Lee created the structure that became the **World Wide Web**.

The National Science Foundation, Department of Defense and other US government departments funded the original Internet and commercial use was not allowed. In 1995, Congress stopped funding the Internet infrastructure and it was taken over by business interests.

Currently, despite more people dishing up video and other bandwidth-hogging applications, Internet traffic growth rates are slowing down – search for *Minnesota Internet Traffic Studies* – growth seems to have settled in to 50-60% vs doubling every 100 days in the '90s.

Today, the Internet is the largest computer system in the world, with hundreds of millions people connected electronically. The Internet consists of thousands of computer networks connected together around the world. A network is a group of connected computers that exchange information and share equipment. Each government, company and organization is responsible for maintaining its own network. The Internet links together universities, colleges, organizations, individuals, businesses and government agencies using phone lines, fiber optic cables, satellite dishes and other communication and computer equipment. This allows data to travel around the globe in seconds. If part of the Internet fails, information finds a way around the disabled computers.

There are several different components to the Internet: email, real-time chat or messaging, and the World Wide Web, for example. No one organization owns or controls the US Internet. There is no government regulation and no one censors or checks the information made available online. You can find info about just about any topic imaginable. Who pays for all this? The companies, government agencies, colleges, universities around the world pay to operate and maintain their part of the Internet. Once you pay for your connection you can exchange info free of charge online.

A Brief History of The World Wide Web
The WWW is a graphical (visual) easy-to-use system on the 'net that offers vast amount of info. You need a software program know as a browser to connect to web pages. We will be using the *Internet Explorer* browser that is built into Windows in our class.

In the late 1980s, a laboratory for particle physics research in Geneva, Switzerland called CERN created a World Wide Web-like system that provided an address for other computers to access certain data via the Internet network. Timothy Berners-Lee was the researcher with this idea. He created a format to communicate called HTTP. However, the data provided was only text and had to be accessed on using complex UNIX commands. First web server launched in **1990 now at http://info.cern.ch**

In **1993, the first graphical web browser** called Mosaic was developed at the National Center for Supercomputing at U of I. by graduate computer science students. It was Windows-based, offered for free, and displayed a graphic and text format. It also made clicking on links possible. Still available for downloading at archive.org or the National Center website.

In 1994, former U of I graduate student Marc Andreessen and seven members of the Mosaic team created **Netscape** Communications, Inc. It released Netscape Navigator 1.0 for free to educators, students and non-profit organizations and as a sales product to the general public. It was the dominant web browser until Microsoft bundled their Internet Explorer with Windows '95. Internet Explorer now has most of the browser market, and Netscape was purchased by AOL. Andreessen is a very wealthy venture capitalist; he's served on Facebook's board and founded all sorts of things, including http://ning.com

Today, the Web can be described as having three parts or phases – the first Web is a **tool of research** – it puts facts as well as harmless nonsense and malicious deception at our fingertips along. The first lesson learned from this web is quality matters as much as convenience. The second Web was the dot.com boom and bust - with the lesson that **sound business models** create the opportunity to use new tools – not the other way around. The emerging third Web is a storehouse of **business logic** as well as data. Proven disciplines and business models are finding new mechanisms through the growth of Web services.

While search tools such as Google claim to have indexed more than 30 billion web pages, the 'deep Web' of data stored in password-protected databases contains more than a trillion pages of content (of English or European characters only)

Important Web Terms & Concepts

Browsers – See http://browsehappy.com
The most common browser used to be Microsoft's Internet Explorer (IE) because it came embedded with Microsoft Office – which came with most PCs. Microsoft has tried IE integrating ever more deeply into Office instead of investing in it as a stand-alone product. The next version of IE is called Edge.

One of the most popular browsers out there is Google's **Chrome**; it's a basic, fast engine to run web apps though it has gotten bloated on mobile devices.

FireFox has also grown very popular – originally based on an open-source code that can trace its lineage back to Netscape Navigator. Another free browser that is small and speedy is called **Opera** Apple's browser, which has experienced a renaissance with the iPhone and iPad is **Safari**.   Your computer comes with a browser bundled into its operating system (this is one of the things that got Microsoft into legal trouble - insisting computer manufacturers bundle just IE if they wanted to provide Windows 95.) Microsoft sees the browser as a threat to the desktop. The less it improves, the easier the argument to integrate. This would be bad for the future of the Web, tending to make it more limiting and proprietary.

How does a browser work?

A browser calls out to a server when users click on words or a picture to pull data, perform a computation or show an image. The latest webpages using Ajax coding allow the browser to load an engine that draws the user interface and performs requests for information in the background – making it faster without lag-time.

URL: uniform resource locator (some pronounce this as: "Earl"). Each web page has a unique address that enables it to be stored anywhere around the world. Upper and lower case in this address must be exact to find it. A URL consists of several parts: http://: (all pages start with this.) This is the ***protocol*** or method browsers use to access or read the page.

Then the computer's ***domain*** name (or address) that is the server for the information follows. ex. www.depaul.edu/   Further parts specify the names of ***files***, the connecting computer port or the online textual database. URLs are always written as a single unbroken line with no spaces. The URL identifies the site or publishing location of specific information on the Internet (similar to the title of a book).

http://
(This is an instruction to the browser to use this particular type of communications protocol.)
condor.edu/
(Connect to this host computer - Site name conventions: edu, gov, org, com, net)
~dmurphy/
(Look in this folder)
notes.htm
(Get this document).

Domain: a structured alphabetic unique name for a computer on a network that describes the network and organization supporting it. Domain names always have two or more parts, separated by dots. The part on the extreme left is the most specific and the part on the extreme right is the most general – sometimes called also the top level. Generic Top level domains (gTLDs) are identified by abbreviations: edu, com, gov, mil, org, net, aero, biz, coop, info, museum, name, pro., etc. These identify Internet space like Zip codes identify real space. Like street addresses, lower level domains like google.com pinpoint a specific cyberspace location within a gTLD like .com. New gTLDs will include brand-specific domain extensions such as .mycompanyname, geographic-specific domains like .texas and generic extensions like .software.

Some domain names also use a geographic hierarchy: il, us, uk, hk. There are 242 country codes, 21 generic TLDs like .com and three industry-specific domains like .coop and aero, and one infrastructure domain: .arpa. New ones are now regularly rolled out, like .mobi (for websites specially designed to work with the limitations of cell phones and .jobs for HR use. Others proposed include .travel, .mail, .tel, .post, .cat (Catalan), and .xxx (rejected for 2nd time). None of the most recent ones have been terribly successful.

Snapshot Primary US business domains (60 million):

Domain	Number Sold	In Use	Renewal Rate
.com	24,320,00	77%	55%
.net	6,080,000	77%	55%
.org	3,000,000	70%	70%
.info	1,250,000	66%	n/a
.biz	1,000,000	34%	59%
.us	750,000	28%	67%
.name	150,000	70%	70%
.coop	8,200	50%	81%
.aero	4,000	33.5	n/a
.museum	646	50%	n/a
.pro	not for sale yet.		

Other domains including 242 country codes besides .us = 23.2 million

You can buy / reserve domain names for a relatively nominal fee from companies called Registrars. The Internet Corp for Assigned Names & Numbers (ICANN) at http://icann.org , a non-profit group provides a registry of Registrars. See http://www.internic.net Nominally independent, ICANN is now now quite officially under the oversight of the Dept. of Commerce. ICANN has a new agreement giving more countries oversight and access to reports. ICANN's performance is reviewed by this mixed group every three years.The US govt. still oversees the Internet's 13 root servers. Registrations for new domains average between 3 – 5 million per quarter. Record numbers of .com and other addresses are coming up for renewal and about half are expected not be renewed. Search 'domain kiting' for a current problem with the registrar process. See http://dougmurphy.com

Cybersquatting is becoming huge issue again: speculators auto-registering expired domain names – this can be immensely lucrative: fb.com went for $8.5 million diamond.com recently went for $7.5 million; vodka.com: $3 million. – legit speculators draw a distinction between registering generic names and those that closely resemble legit domains like microsotf.com.

Hottest: snapping up .co domains to take advantage of its shorthand for company, corporation or commerce. Sony.co

The economics are compelling: Everyone gets a cut of the registration fees: the registrar – the registry that manages the TLD and ICANN – many domains are parked at advertising services or portal sites that automatically populate pages with links to ads.

With more than 100 companies now able to register Web addresses; domain names now sell for about $25 per year vs. $35 in mid'99 when Network Solutions, a government-run monopoly controlled all registrations for .com, .net, and org. Most require just a name, billing address and credit card number. Contracts range from 1 –10 years. Different registrars vary tremendously in quality – some retain control of the domain name, others are bad at updating info about billing addresses. The amount of business the registrars do is a good indicator of reliability: A look at the contribution of each to ICANN shows that only a few do most business; overall, about 50 million domain names are registered worldwide – about 5 million in foreign languages.

Domain names and email addresses have always been based on English-language ASCII characters. Internet users overseas are clamoring to use their native languages. After years of testing, ICANN has approved applications for non-English domain name which will impact more than half of the 1.6 billion Internet users who use such languages as Arabic, Korean, Japanese, Greek, Hindi, Cyrillic… ICANN recently approved opening up TLDs in the coming years – anything could become one for the right price.

Protocols: specifications or standards or procedures computers use to recognize and communicate with each other. Rules computers follow to exchange messages. They are usually programmed into standard software. Examples: ***HTTP*** (hypertext transfer protocol – the way hypertext files move across the Internet. Created by Tim Berners-Lee; this simple protocol was built on TCP/IP and provided the connection layer for the Web. HTTP is the common language that lets web browser and servers communicate. HTTP requires a client computer on one end and a server computer on the other; ***TCP/IP***: Transmission control protocol/ Internet protocol: allows computers to speak to each other regardless of the underlying networking technology (cable modem, T1, dial-up, etc); ftp: file transfer protocol) TCP breaks up messages to send them and reassembles them at their destination and IP gets individual packets from sender to receiver. It was the development of this durable protocol by ARPA that led to the growth of the Internet.

Bandwidth: the capacity of a medium to transmit a signal. More informally, the ability of certain Internet connections to carry the files and messages.

Cyberspace: William Gibson, in his SF book, Neuromancer, introduced this word – in his vision, people could literally plug a cable into their heads to 'jack into' the net.

Graphics: Pictures are some of the largest types of transferable files. You can view graphics (pictures) Most common graphics file formats: GIF (graphics interchange format) JPEG (joint photographics expert group). They can take quite a while to download: depending on your connection and the speed of your computer's processor.

Home page: first page you see when you start your browser. Can choose any page in the world.

HTML: hypertext markup language: basic web language that specifies where elements (pictures, text) go on a page and what they should look like. Tim Berners-Lee made some common sense decisions about linking that made this popular.

Hyperlink: text or images that contains links to other documents. Usually underlined or colored.

SSL: By making it possible to encrypt and secure Web connections, Secure Sockets Layer made it mostly safe to send credit card info over the Web.

XML: while HTML was the core of the original Web, XML is a programming language that is the present and future.

Those Mysterious Browser Error Messages Defined

If your screen says: 401 Unauthorized . It means you need a password to get into the site

You should try retyping your password if you are supposed to have access to the site.

If your screen says: 404 Error: Page is no longer available
It means the part of the page you're looking for is no longer there or the URL is wrong.
First, check the URL, if it's right, it's possible the content was moved to another part of the site without a redirect. Try deleting the end part of the URL to see if you get a workable page. Or see if the site has an internal search engine.

If you screen says: 503 Service unavailable. It means you have just a temporary problem - the server you're trying to access is down. Try again in a few minutes.

How Info Transfers on the 'Net
All computers on the Internet work together to transfer info back and forth around the world. These computers are referred to as Hosts: any computer that is directly connected to the 'net. When you send info through the Internet, the info is broken down into smaller pieces called packets. Each packet travels independently through the 'net and may take a different path to get at the intended destination. ARPA created the original packet for data which became the Internet Standard Protocol (common language). It is known as TCP/IP: Transmission Control Protocol/Internet Protocol. This communications protocol allows computers to speak to each other regardless of the underlying networking technology (cable modem, T1 line, dial-up line, etc.) TCP/IP packages and addressed info and then ensures it arrives safely at the intended destination, like a moving company. Routers are specialized computers that regulate the net traffic. A packet may pass through many routers before reaching its destination. Like a good travel agent, the router picks the most efficient route, based on traffic and the number of stopovers. When info arrives at its destination, the packets are reassembled. A software subset of TCP/IP known as PPP (point to point protocol) checks that the info arrives error-free. If a packet arrives damaged, the host computer that sent it is asked to send a new copy. Some other software subsets of TCP/IP allow connections: SLIP (serial line Internet protocol) or CSLIP (compressed – squeezes info together) – but neither checks for errors and they are slower than PPP.

The Internet Today
From its beginnings as a collection of small, government funded packet-switching projects in the 60s and 70s, the Internet has quickly become the world's largest distributed computing system. Engineered for redundancy and resiliency, today's Net is a planet-wide mesh of loosely associated networks, all interconnected using a common protocol - TCP/IP - via more than 9,300 public and private ISP and more than 50 top-tier providers that make up the Net's backbone.

The Internet succeeded largely because no-one in the traditional telecom industry believed in its underlying technology or its design philosophy. Executives from AT&T were present at the first major demonstration of ARPANet in 1972 and were said to be pleased when it crashed. Two years later, AT&T turned down the offer to run the same ARPANet A few years later, the standards organization for traditional telecom turned down a formal offer to adopt TCP/IP as a basis for future telecom. AT&T was happy to sell wires to those building the new network but didn't see any future in such technology. That let the Internet alone from regulators to develop. The Internet was largely just a collection of wires, bought from the telcos by ISPs who paid what the telcos thought was reasonable for use of the wires. ISP customers paid phone co. for the wires and ISPs for Internet service based on the size of the wire they were using. But some telcos want to change this. They want to charge ISPs who want to send packets…

Another More Technical Way of Looking at How the Internet Works
Topologically speaking, the Net (in a schematic sense) is a fluffy white cloud - packets of info sent from point A to B enter the cloud at one end and emerge at the other. But there isn't a clear picture of the path taken from start to finish.

Instead, think of the Net was a five-layer pyramid - at the top of the pyramid are NAPs (network access points) - public network exchange facilities that act as conduits between NSPs (national service providers) and ISPs all around the world. NAPs are critical Net components because the connections within them determine how IP traffic is routed. Consequently, they are the points where traffic gets most congested. There are multiple primary NAPs around the world and at least six in the US - these include facilities operated by Sprint in Pennsauken, NJ, AT&T in Los Angeles and San Fran, and Verizon in San Jose and Wash DC.

The second layer consists of NSPs (also known as peering centers) which are the primary users of NAPs and operate over what is known as the 'public Net backbone'. Each primary NSP consists of one or more large scale relay-based *Wide Area Networks*. NSPs exchange packets of info through NAPs and offer local ISPs a high speed access point to the Net backbone. Today's primary NSPs include UUNet, Verizon (MCI) and Sprint. To maintain primary NSP status, the network provider must adhere to certain standards - for ex, reliability must meet or exceed 99.9% uptime = cumulative total of seven hours per year for service interruptions. UUNet is one of the Internet's backbone providers. It controls the wires that Internet service providers use as superhighways to carry Internet traffic between cities and across continents. UUNet handles more than 50 percent of U.S. Internet traffic, including about 70 percent of all e-mails sent within the United States and half of e-mails sent in the world. With KPNQwest in Europe, it handles over half of European traffic as well.

Below NSPs in the hierarchy (third tier) are organizations managing regional networks and backbones. These include ISPs operating over a limited geographical area as well as ISPs that connect to one or more of the primary NSPs - ex of a US regional provider: Digex, Conxion.

The fourth tier are individual ISPs not operating their own networks or backbones - these typically offer users similar services as national providers but lease their bandwidth from national or regional carriers. All access providers pay backbone providers via *peering agreements* (fees for exchanging data) but they don’t cover the true cost of providing backbone services. The backbone is being subsidized by business voice and data - - problem: voice, and to an extent, data margins for the telcos are collapsing

The lowest or fifth level are consumer and business clients that secure service and connections from local, regional or national ISPs on a monthly or annual basis – about $25 billion market in US and growing in high single digits.

1) NAPs
2) NSPs
3) Regional Networks & Backbones
4) Individual ISPs not operating their own network
5) Consumer and business clients - you and me

Chicago has 41 major Internet backbone providers. This is largely because it was one of the first network access points where Internet service providers interconnect and exchange data flows.

Traffic on the Net reflects its distributed & decentralized nature. Info flowing from A to B travels through a chain of ISPs, NSPs, NAPs until reaching its final destination. Along the way, info may pass through fiber-optic cables, wireless links, underground cabling, and satellite networks. This journey is completely transparent to the user. Much of the routing is handled dynamically and automatically, compensating for power outages, congestion, and equipment failure. But some rerouting is not automatic. Major network failures at the largest ISPs (or NSPs or NAPs) are done manually because they affect such a large number of users.

The Evolving Internet

The Internet has become a peculiar creature with its vast infrastructure far less random and haphazard than assumed; looking at more than 200,000 central physical connections, the links form complex geometric patterns with some crucial hubs connected to hundreds of other sites. Some biologists hope the study helps them find clues to living cells- as systems The Internet has a 'scale free' geometric pattern that looks the same regardless of its level, for example, whole country vs. region. While most Internet nodes or routers are connected to only a few other sites – and losing them doesn't affect the network; there are only a few large central hubs. The largest is in downtown Chicago, run by AT&T with 125 major connections to other sites.

Internet Demand Outstripping Supply

Statistical modeling over the past few years shows capacity being exceeded around 2012. Already YouTube discontinued video delivery to certain areas because of lack of access capacity. Telcos and cable cos. are implementing usage 'caps'. IP itself is nearing end-of-life, IPv4 addresses are running out. IPv6 deployments are a tiny fraction of what is needed to fill the gap. Due in part to increased multi-homing, routing table sizes are increasing dramatically to the point they'll exceed Moore's Laws ability to keep up. It gets worse. There's no clear fix. Though there are enough bright minds concentrated on the problem, and at least one potential architecture exists.

Internet Traffic Flows

Take a look at Internet traffic and capacity: http://www.internettrafficreport.com

Net traffic has grown exponentially - 130 web sites in '93 to more than 17 million in 2000. Traffic expected to top 15 million terabytes (A terabyte is a unit of measure for Data Storage. 1 terabyte is equivalent to 1,024 Gigabytes (billion) or 1,048,576 Megabytes (million)) per month requiring networks to constantly deploy more hardware and systems with higher capacity & throughput. (World generates 161 exabytes of digital info last year – same as 3 million times the info in all books ever written.

Interestingly, about 32% of adult Americans remain unconnected to the Internet – about a third by choice, about a third cite lack of access. Those unconnected tend to be older – 78% of 70+ are offline; compared with less than half of age 60-69 and less than 25% of all adults under 70.

One fourth of Chicagoans never use the Internet - Fuller Park (28%), South Lawndale (44%) compare with Lincoln Park (98%), Loop, Near North and Lake View (96%)

Internet Countries

Chinese Internet users now surpass the number of US users (currently 220 vs. 216 million)

The US has between 80 and 100 million broadband users – China is either slightly ahead or behind.

Broadband use is slowing but growing faster than much of the world. Interestingly, while the US as a whole is outranked by many other countries in broadband penetration (Netherlands, Japan, Korea, etc.), individual states such as California, Massachusetts and Illinois if separated would rank ahead.

Broadband penetration among G7 nations: Germany (40%); Canada (35%); France (34%), UK (30%), US (29%), Japan (28%), Italy (22%)

You may be surprised at the top five countries for Internet use. Expected to be more than 2 billion users worldwide by end of year. In terms of percentage (per capita)

1. Sweden: 73.6% of population
2. Denmark: 68.7%
3. Norway: 68.3%
4. U.S: 67.8%
5. Australia: 66.4%
6. Netherlands: 66.2%
7. Iceland: 66.1%
8. Canada: 63.8%
9. S. Korea: 63.3%
10. Switzerland: 62.9%

How Can I Connect to the Internet?
Find a list of all service providers for your area code at internet.com's ISP buyers guide

Illinois ranks 8th in broadband connectivity with 553,000 households hooked to cable modems or DSL. Nationally, the number of broadband lines surged 42%: cable-based connections account for 58% of the market (16.4 million lines) and DSL is 34% of the market (9.5 million lines).

The number of people using broadband connection doubled from 2001 – but remains low among rural and minority households. 1 in 7 African-Americans and 1 in 8 Latinos and 1 in 4 whites live in a household with broadband access. 40.4% of urban households vs. 24.7% of connected homes in rural areas. 20% of connected US households have high-speed connections.

Broadband adoption in the US has slowed dramatically of late – with the number of users growing only 6% so far this year vs. 20% in previous years. The Pew study which reports this data theorizes older, less educated, lower income users just don't want it badly enough.

Globally, more than 355 million have broadband connections. After China and the US, the rest of the broadband market includes Japan, Germany, the UK, France, Korea, Italy, Canada and Spain.

Phone Modem: Most basic type of connection. Most computers come up an internal modem. Sign up with an ISP. Plug it from the back of your computer into a phone jack. This is the slowest way to get onto the 'net. In fact, even the fastest phone modem (56K bps) is slower than any other option. Be sure your ISP offers a local phone number within 8 miles of your house – see http://www.broadbandreports.com (an advocacy site) to be sure. Even with the broadband explosion, dial-up modems are improving. Some dial-up ISPs offer web accelerators – special software that speeds up the delivery of web pages by storing highly compressed versions of frequently accessed pages on their own servers.

Cable Modem: Most US homes receive video cable; of those, with phone service over the same pipe and broadband Internet access. Uses a special modem and software provided by cable company - connect through cable TV line. It can deliver fast speeds. Is available in most urban and suburban environments – more local subscribers slow down access. By far the most widely used broadband (high-speed) method. Positives: Always on, good connection speed. Negatives: Bandwidth decreases as enrollment increases.

DSL (Digital Subscriber Line): Uses existing phone lines. As fast as cable modems - offers multiple data rates and multiple connection prices. Won't slow down with other subscribers. There are distance limitations - must be within 3 miles of a central office. Always "On", thus, hackable - needs good firewall/router to stop attacks. Usually reliable. Speed depends on what you pay for... Most popular is Asymmetric DSL where download rates exceed upload. DSL employs sophisticated modulation schemes to pack data through phone wires. Positives: very secure, very reliable. Negatives: 3 mile limit. Signal can become degraded

The largest DSL service providers in our area is AT&T - you get a DSL modem, software, and line filters (that act to dampen interference and assure as fast a connection as possible) which you can set up yourself in about an hour.

Check out the performance of your broadband connection at http://performance.toast.net

Wireless Broadband – Uses Wi-Fi. Priced accordingly. Degrades with multiple devices.

High-speed wireless cell phone- Seeing major adoption.

Fixed wireless: municipality-run, uncommon, reliable, requires LOS or ubiquitous Wi-Fi

Satellite-based wireless - requires a satellite disk, a modem and separate internet account. Relatively quick connection. Like with satellite TV, possible storm interference. Upstream connections require a land line. Expensive.

Broadband over Power Lines – a growing number of utilities are exploring offering broadband over power lines. It is inexpensive and doesn't require new delivery equipment. However, standards in equipment is somewhat lacking and there are some interference issues with 'ham' radios. See http://homeplug.org

Betting on Broadband
Broadband still means DSL in most of the world – 65% of the 410.9 million subscriber connections at the end of last year. Fiber and wireless are the fastest growing connectivity options though still rare – only present at 1% or more in 11 countries. Only 3% in US; 45% in Japan. There are 210.5 million mobile wireless broadband subscribers at the end of last year. Growing three-times as fast, especially in emerging markets. (The US market is 6 million subscribers)

High speed just for high speed doesn't have value because lots of applications do not require it. In 'networked readiness' surveys, the US ranks 3rd in market environment, infrastructure and low in political and regulatory environment. Some states like New Hampshire have nearly 80% broadband penetration.

ISPs want you to pay a premium for it to get audio, video, animation and other services to take full advantage of your high speed link. The cable industry has more than 60% of the broadband market. DSL, the phone company's version of broadband, is working madly to catch up.

How did the phone company's muff their original chance? Cable jumped into the broadband market because of their fear of satellite TV. Cable was searching for services TV viewers didn't get from satellite. Meanwhile the Bells had a profitable way of serving Internet users – by renting them second phone lines. Regulatory requirements to share their systems with rivals further discouraged investment in DSL – cable companies do not have to do so. (though IL is soon to deregulate this – and absolve AT&T from this requirement – a move that will devastate non-AT&T DSL providers like Covad Communications. So it didn't roll out until very recently, giving cable a huge head start. As the Bells re-converged into ATT again, they were squeezed as people went cellular…There are about 155 million phone lines with a lot of variation between them – which creates technical problems for DSL. It has to be tweaked unlike cable. And the expense per user of installing DSL is pretty high – up to $200 more than cable. DSL does have advantages of not slowing down at peak hours because each user has their own private link to the 'net. DSL customers also have a wider choice of ISPs – most cable operators charge extra for using an ISP other than themselves.

Broadband use now exceeds dial-up use as measured by the amount of time people spent online. In the United States, more people used a broadband connection to access the Internet than dial-up for the first time in mid-2004. Broadband market penetration in the U.S. is still in the lows 60s as a percentage. More than 10 million of the world's high-speed users are in South Korea alone, a rate of 21.3 broadband subscribers per 100 inhabitants. Hong Kong was in second place with 14.9 percent and Canada was third at 11.2 percent.

Japan is currently in 10th place, with 7.1 percent of its inhabitants on broadband. The United States is in 11th place, with a subscription rate of 6.9 percent. However, the country has the largest number of broadband subscribers -- 40.9 million (34.6% DSL, 5.3% wireless, 1.3% satellite.).

The median Internet speed in the US is 1.97 mbps. In Japan, it is 61 mbps

Japan:	61 mbps
South Korea:	45.6 mbps
Finland:	21.7 mbps
Sweden:	18.2 mbps
Canada:	7.6 mbps
US	1.97 mbps