Endnotes

[1] Broadband is defined in this report as data access or bandwidth speeds greater than 256 kbps. See Appendix 1 for further discussion of broadband speed and bandwidth.

[2] CivicNet will likely include some wireless solutions to reach remote facilities. These wireless facilities will also be connected to fiber-based services.

[3] In addition to city facilities, the CivicNet proposal includes services to the Chicago Park District, Chicago Transit Authority, Chicago Housing Authority, police/fire/911 service agencies, Chicago Public Schools, and Chicago Public Libraries.

[4] MPC has been advising the City of Chicago on the development of CivicNet through its role on the Mayor's Council of Technology Advisors (MCTA), and helped conceive of the idea as co-chair of the MCTA Infrastructure Committee. Currently, the City is determining ways to move forward to save taxpayers' dollars, meet government infrastructure needs, and anchor efforts for economic development in unserved areas. Due to changes in the economy and the complexity of the project, the City is likely to break the scope into several discreet phases starting with aggregating voice and data traffic.

[5] This research only examines existing businesses; our demand forecast does not include induced demand in areas where there is little or no business activity. Therefore, any areas of the city that display lack of demand typically indicate the lack of any businesses in general.

[6] T1 is part of the T-carrier system (T2, T3). The T1 carrier is the most commonly used digital line, over copper medium, in the U.S. It carries 24 pulse code modulation (PCM) signals using time-division multiplexing (TDM) at an overall rate of 1.5 Mbps.

[7] The results of the survey are similar to nationally recognized estimates of demand by industry and firm size. The nature of many of the applications and the market channels that are opened via the Internet are creating opportunities for firms regardless of geographic location. While regional economies may be more conducive to adapting technologies — for instance, labor-intensive manufacturing plants may relocate to areas where wages are lower, as long as the firm remains in constant communication with its customers — there are many reasons to believe that access to technology and broadband allows more freedom to determine where to locate a business.

[8] As an example: Assume a financial SMB has 10 employees. Currently, a typical financial firm requires on average 35 kbps per employee. This firm is then estimated to require 350 kbps of bandwidth. (10 • 35 k = 350 k). Future demand (five years) for financial firms is projected to be 330 kbps per employee. The same firm is then projected to need approximately 3,300 kbps (10 • 330 k = 3,300 k) by 2007, equivalent to a need for Level 3 bandwidth. The growth in demand, while based on current employee size, reflects various growth factors such as number of employees.

[9] For the purposes of this report, multiple T1 refers to a bandwidth greater than T1. This bandwidth can be realized by combining circuits until the desired speed is reached. In this case, speeds greater than 3.0 mbps.

[10] See Appendix 1 for further discussion of types of service and bandwidth capacities.

[11] Tierd facilities defined. Tier 1 locations are City facilities with 100 or more voice lines (City colleges, high schools, and larger grammar schools). Tier 2 locations are City facilities with 10 to 99 voice lines. Tier 3 locations are all other city facilities.

[12] Long Haul fiber that exists between larger metropolitan areas (e.g., long haul routes between Washington, D.C. and Atlanta) is not the same type of fiber used for intercity networks and cannot be broken for access to provide local service. The existing excess dark fiber therefore cannot be lit for use within cities.

[13] Ames, Sam, "Cities, 'Bring us Your Bandwidth'," News.com, June 2001. Although some parts of the country have more communications network capacity than can be used, cities are yearning for more bandwidth. See also McGarvey, Joe, "Deflating Bandwidth Glut Predictions," *Interactive Week*, February 2000, Vol. 7, No. 7, p. 6.

Appendix 1: Broadband Access Technologies

Technology (How the data is transferred)	Description	Bandwidth	Major Chicago providers	Advantages	Disadvantages	Connection type	Media transmission type	Carrier speed equivalent
Public Switched Telephone Network (PSTN)	Commonly referred to as POTS (Plain old telephone system). Not a viable broadband solution. Only one voice transmission can occur at a time.	64K	SBC, AT&T, RCN	• Ubiquitous coverage and availability • Inexpensive	• Slow access • Not a broadband solution	Dial up	Existing copper lines	DS-0
Integrated Services Digital Network (ISDN)	Offered in two versions: Primary Rate Interface (PRI) and Basic Rate Interface (BRI).	PRI: 128 K BRI: 1.5 mbps	SBC	• Ubiquitous coverage & availability •Dedicated circuit	• Cost increases with bandwidth • Dial up connection	Dial up	Existing copper lines	DS-0 to DS-1/T1
Digital Subscriber Line (xDSL)	xDSL represents the family of digital subscriber line technologies including ADSL, R-ADSL, HDSL, SDSL, VDSL. ADSL is the most common technology.	1 Mbps download 384 Kbps upload (ADSL)	SBC, Sprint, XO Comm.	• Affordable • Secure • Uses existing infrastructure • T1 speed available	• Distance limitations lead to inconsistent availability.	Always on	Existing copper lines	DS-1/T1 depending on orientation
Cable Modem	Similar to xDSL in that performance is asymmetric – upload and download speeds are different. Primarily for home access where security is not the top priority.	30 Mbps download and 10 Mbps upload (although unlikely)	RCN, ComCast	• Affordable • T1 speed available	• Shared bandwidth could be a security concern • Inconsistent performance Not widely available	Always on	Existing copper coaxial cable. Signals travel the same medium as cable television transmissions.	< DS-1/T1
Power Line	Last mile technology similar in theory to cable and xDSL. Not widely deployed in North America, however. Power lines can provide broadband access to any power outlet and is therefore ubiquitous.	2.5 Mbps	N/A	• Ubiquitous coverage • Uses existing infrastructure	• Unproven technology • Low deployment • Shared bandwidth Security risks	Always on	Existing and new power lines	< DS-1/T1
x.25	Analog system used for low-end devices like cash stations and terminals.	2 Mbps	SBC	• Reliable data delivery • Used with low end devices like terminals/kiosks	Analog technology	Always on	Existing copper lines	< DS-1

Technology (How the data is transferred)	Description	Bandwidth	Major Chicago providers	Advantages	Disadvantages	Connection type	Media transmission type	Carrier speed equivalent
Frame Relay	Digital upgrade of x.25. Data packets are mixed together (multiplexed) for transmission, which maximizes bandwidth.	50 Mbps	SBC	No dial up	• Shared bandwidth • Doesn't carry video well • Security risks	Fixed line Always on	Pre-existing copper lines	< DS-3
Asynchronous Transfer Mode (ATM)	Typically the technology of choice for delivering a mix of voice, data, and video. ATM easily bridges with an existing network.	622 Mbps (with Fiber)	MCI	• Best at combining voice, data, and video • Very robust	• Performance varies with media choice • Expensive	Fixed line Always on	Copper, fiber	< D-3
T1 & Fractional T1	Leased Line Service. T1 service is part of the family of telecom lines that are rented for private use. It conforms to DS-1 standards and is equivalent to 24 phone lines (24 channels @64 kbps each). Fractional T1 refers to any combination above or below the available 24 channels T1 offers.	1.5 Mbps (common implementation)	SBC	• Highly scalable • Ubiquitous coverage & availability • Dedicated line for high security	• More expensive as bandwidth increases • Market saturation • Additional equipment required for high capital costs	Fixed line Always on	Pre-existing copper	DS-1
T3	Leased Line Service. T3 service is part of the family of telecommunication lines that are rented for private use. T3 conforms to DS-3 standards and is equivalent to 672 phone lines.	45 Mbps	SBC	• Highly scalable • Dedicated line for high security	• Market is saturated • Additional equipment required for high capital costs	Fixed line Always on	Pre-existing copper	DS-3
Fiber Distributed Data Interface (FDDI)	Leased Line Service. Defines 100 Mbps service over fiber. Usually implemented in LAN capacity.	100 Mbps	SBC	• Provides solid connection on its own or for other technologies • Fiber may never need to be replaced	• Very high capital costs • Largely inaccessible	Fixed line Always on	Fiber optic cable	< DS-1 <OC-1

Technology (How the data is transferred)	Description	Bandwidth	Major Chicago providers	Advantages	Disadvantages	Connection type	Media transmission type	Carrier speed equivalent
Synchronous Optical Network (SONet)	Leased Line Service. Used primarily for metropolitan area networks (MANs), SONet is the standard for digital transmission over fiber optic cable. Its carrier speed is represented by OC-x (Optical Carrier level).	40 gbps	SBC	• Primarily for MAN and WAN backbones • Supports wireless and other last mile technologies	• Very expensive • Copper media not supported	Fixed line Always on	Fiber optic cable	OC-768
Fixed Terrestrial Wireless (FTW)	Point-to-point wireless. It uses line-of-sight fixed antennas to transmit and receive high frequency radio waves. A wireless bridge and antenna are required for each site. A radio line of sight (more than just visibility) must be realized to work correctly.	10-100 Mbps	Winstar, Teligent	• Instant infrastructure • No FCC licenses required • No line charges incurred (it bypasses the local loop) makes FTW relatively inexpensive	• Transmissions are subject to environmental conditions • Limited coverage areas • Relatively new and unproven technology	Fixed line Always on	Radio waves	N/A
Wi-Fi (802.11 family)	Includes 802.11g, 802.11 a and 802.11 b standards. This wireless technology operates in various frequencies. This unlicensed 802.11 b spectrum is shared and can be used by anyone.	1-24 Mbps	Various vendors of all sizes	• Ease of deployment • Instant infrastructure • Low cost	• Limited range • Appliance interference at like frequencies • Security risks • Subject to environmental conditions		Always on	Radio waves
Satellite	Popular for Internet access where alternatives are sparse. A regular modem uplinks over PSTN or ISDN lines. Data is beamed back via satellite. Performance is asymmetric (uploads are slower than downloads).	400 kbps	DirectWay (formerly DirecPC), Starband	Accessible anywhere with the right hardware	• Subject to environmental conditions • Normal download speeds are slower than cable or DSL	Always on	Radio waves	N/A

APPENDIX 2: Digital Capacity and Transmission Table

Digital Signal Designator	T-Carrier	DS-0 Multiple (phone lines*)	Transmission Rate
DS-0	X	1	64 kbps
DS-1	T1	24	1.500 mbps
DS-3	T3	672	45.000 mbps
DS-4	X	4032	274.176

* In order to fully describe the high-speed capabilities of broadband services, DS-x multiples are listed. The DS-x (Digital Signal) standard is the base designator for measuring digital transmission. DS-0 is the designator for the transmission rate equal to that of one standard telephone line. DS-1 (T1) is the equivalent to 24 phone lines or 1.5 Mbps. Each phone line or channel carries bandwidth of 64 kbps.

Optical Fiber Capacity and Transmission Table			
Optical Fiber Designator	DS-0 Multiple (phone lines)	Transmission Rate (Mbps)	Transmission Rate (GB)
OC-1	672	51.84	X
OC-3	2,016	155.52	X
OC-12	8,064	622.08	X
OC-24	16,128	1244.16	1.244
OC-48	32,256	2,488.32	2.49
OC-192	129,024	9,953.28	9.95
OC-256	172,032	X	13.27
OC-768	516,096	X	39.81

Synchronous Optical Network (SONet) is the standard for data transmission over optical fiber. The ability to carry data, voice, and video makes SONet very popular for telecommunication and wide area network implementations. Most traffic delivered over a metropolitan area network's last mile (e.g., PSTN, ISDN, T1, Wi-Fi) is likely to arrive at its final destination via a SONet pathway.

Broadband Pricing in the Chicago Market

Service Type	Company	SBC	Allegiance	AT&T	CoreComm	Covad	DIRECTV	DSL.net	Focal
Cable Modem	Installation	N/A	N/A	$ -	N/A	N/A	N/A	N/A	N/A
	Monthly	N/A	N/A	$ 39.95	N/A	N/A	N/A	N/A	N/A
ISDN (128kbps)	Installation				$ 25.00	N/A	N/A	N/A	
	Monthly				$ 40.00	N/A	N/A	N/A	
DSL (Bandwidth varies based on type of service)	Installation	$ -	$ 50.00	$ -	N/A	$ -	$ -		
	Monthly	$30 to $180 ADSL to 1.5M	$50 to $405 ADSL to 1.5M	$150 to $400 SDSL 144k to 1.5M	N/A	$70 to $370 $70 ADSL 1.5M/386k $150-370 SDSL 144k-1.5M	$ 49.99		
T1 (1.5Mbps)	Installation	$ 896.00		$ 740.00	N/A	$ -	N/A		
	Monthly	$ 240.80		$ 372.33	N/A	$500 to $750 384k-1.5M	N/A		
T3 (approx. 45Mbps)	Installation	$ 1,358.00			N/A	N/A	N/A		
	Monthly	$ 2,598.80			N/A	N/A	N/A		
GigE	Installation				N/A	N/A	N/A		
	Monthly				N/A	N/A	N/A		
OCN	Installation				N/A	N/A	N/A		
	Monthly				N/A	N/A	N/A		

Service Type	MCI	McCleod	RCN	Sprint	Teligent	XO Communications, Inc.	Z-tel	GiantLoop Networks
Cable Modem	N/A	N/A	$ -	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	$ 39.95	N/A	N/A	N/A	N/A	N/A
ISDN (128kbps)		N/A N/A	N/A N/A		N/A N/A			
DSL (Bandwidth varies based on type of service)		$ - $80 to $200 386-1.0 SDSL IDSL is $120		$ - $ 50.00 786,1.5M, 2.0M SDSL	N/A N/A	$ 600.00 $109 to $350		
T1 (1.5Mbps)	$ 740.00 $ 337.00	$ 1,200.00 $ 450.00		$ 1,165.00 $ 367.00				
T3 (approx. 45Mbps)		$ 5,426.38 $ 7,315.98						
GIgE		N/A N/A	N/A N/A		N/A N/A		N/A N/A	
OCN		N/A N/A	N/A N/A		Up to OC3 but only for point-to-point - not Internet Access		N/A N/A	

APPENDIX 4: Economics of Supply

A detailed study of the specific costs associated with deploying a fiber optic network in Chicago is beyond the scope of this study. However, it is important to have a basic understanding of the economics involved with providing broadband services. To this end, the following data illustrate some of the financial and investment considerations that impact the decision to provide service to a given market territory.

A service provider typically weighs a number of strategic factors when examining a business case for serving a market. Demand studies are modified by an assessment of the number of competitors and their relative strengths and weaknesses. Engineering studies determine the most cost efficient routes and construction schedules. Financial analysis determine a risk sensitive assessment of potential returns from investment.

Example 1: DSL

From an investment perspective, there are several key elements to providing DSL services: telephone central office (CO) equipment; customer premises equipment; wire-line connectivity between the CO and the customer; data transport service from the CO to the service provider's network; and the Internet. Additionally, the operational, administrative, and marketing overhead must be factored into the analysis.

	Fixed	Monthly
Central Office Costs		
Telco charges		
Collocation Expenses	$ 18,000	$ 350
T1 Transport	$ 450	$ 150
DS3 (Backhaul to Internet)	$ 1,000	$ 6,500
Port & router (DSLAM)	$ 45,000	$ -
Total	$ 64,450	$ 7,000
Per Customer Costs		
Local Loop Charge	$ 40	$ 6
Installation	$ 150	$ -
Premises Equipment	$ 250	$ -
Total	$ 440	$ 6
Overhead Expenses (As percentage of revenue)		22%
Revenue per customer		$ 75.00

The following table shows the basic fixed and variable costs of providing these elements. The potential provider would then perform a breakeven analysis based on these costs and revenue to determine the minimum number of customers required to serve an area.

Breakeven analysis		178
Fixed CO	$	64,450
Fixed customer	$	440
Monthly CO	$	7,000
Monthly customer	$	6
Monthly overhead per customer	$	16.50
Monthly revenue per customer		75.00
Average lifetime of customer (months)	$	60
Minimum number of customers needed		

The breakeven formula assumes an average customer "lifetime" of 60 months, then determines the lifetime revenues ($75 • 60 = $4,500). Lifetime customer costs are determined next ($440 +($6 + $16.50) • 60 = $1,790). The net profit per customer ($4,500—$1,790 = $2,750) is then used to estimate the number of customers needed to pay for the fixed investment ($64,450 + $7,000 • 60 = $484,450). The minimum number of customers for breakeven in this example is therefore 178 (484,450/2750 ~ 178).

By applying this specific analysis, a service provider would look at a market such as Bronzeville to gauge the viability of investment. This study shows that Bronzeville has at least 200 SMBs that have demand for DSL — enough to justify at least a single competitor a profitable market. Obviously, this analysis must consider additional economic and strategic factors such as available CO space, line conditions in the market, and so forth. Yet, this analysis should provide a basic justification for at least one DSL provider serving every CO in Chicago.

Example 2: Fiber Optic Metro Network

The capital investment needed to build and maintain a fiber optic network is substantial. The table below shows a menu of costs to be considered and estimated when planning such a network.

Initial Fiber Build

Item		Cost	Note
Materials			
	Cable	$ 0.036	per fiber foot
	Fiber Count	$ 144	
	4" Conduit	$ 1	per foot
	Interduct Conduit	$ 0.75	per foot (3 interduct per duct)
	Splice Box	$ 200	each
	Initial Optic Equipment (OC-48)	$ 200,000	per node (equip + labor)
	Additional 8 Channles (OC-48)	$ 33,333	per node (equip + labor)
Labor			
	Trenching/Boring	$ 15	per foot
	Install Conduit	$ 1	per foot
	Pull Cable	$ 150	per foot
	Splicing	$ 35	per splice
Misc.			
	Engineering Cost	$ 3	per foot
	Splice Spacing	$ 20,000	feet
	Fiber Count Spliced	$ 48	fibers
	Average Miles per Node	$ 4.95	miles
	Purchase of Existing Conduit	$ 0.41	per foot
	Manhole Spacing	$ 3	per mile
	Manhole Cost	$ 4,000	per structure
Dark Fiber			
	Install Charge	$ N/A	per strand
	Mileage Charge	$ 9,437.99	per strand per mile
	Number of Strands	$ 48	fibers
	Total Installation Cost per mile	**$ 31.96**	
	Total Installation Cost	**$ 168,749**	

Many of these costs are contingent on the type of terrain and ease of access to buildings and other facilities. The estimate above is for a new, average, urban, trenched network. Some congested urban environments can range as high as $1,000,000 per mile for such construction.

These costs can be reduced considerably where existing facilities such as open conduit, accessible sewer lines for below ground installation, and utility poles for aerial stringing of fiber are available (all of which have been identified as possible resources in the CivicNet RFP). For instance, the above estimate is reduced to $68,335 per mile (a 60 percent savings) for a similar construction where open conduit is available.

The breakeven analysis is, as might be expected, complicated for a metro network. One can see that the construction cost figures can significantly impact the investment decision. The other capital expense that most impacts the analysis is that of the routers that transmit signals on the network and at the customer's premises. From the perspective of serving an individual building or customer, the main variable is the routing device that converts the optical data to electronic information that is used by consumer computing and communication equipment. For a typical SMB, this device may cost as little as $1,500 to deliver multi-megabit data to users. A more advanced router that allows for the splitting of optical signals for transmission to a number of other locations can cost about $75,000. Use of the higher end router at a city facility or neighborhood node in conjunction with stringing aerial fiber along nearby utility poles may present a very cost effective solution to deploying fiber to the city's neighborhoods.

The point of this analysis is to demonstrate the significant change in the financial dynamics that are created when alternative assets are made available to a network provider. This is precisely the strategy behind the CivicNet proposal, as it allows the potential vendor access to many of the city's telecommunications facilities, buildings, sewer systems, utility poles, and other rights of way. And, CivicNet guarantees the level of demand of City and sister agencies that will considerably minimize the risk for a carrier to invest in infrastructure upgrades. An inventory of these assets relative to areas of broadband demand described in this study is a next step to building the business case for CivicNet.

APPENDIX 5: Industry Best Practices

Shifts in consumer demand, the need for more efficient processes, and competitive pressures drive business leaders to seek new means for adapting and growing their organizations. Often, solutions are found in new information technologies and advanced communications systems. The combination of complex software solutions and high-speed data transmission, storage, and retrieval has revolutionized both the pace of organizational change and the range of new opportunities.

A multitude of applications and systems — once available to only the largest enterprises, due to development costs and operational resources needed — have now become accessible to small and medium-sized organizations (SMBs). These applications generally are divided into a number of core functions that address specific operational needs:

1. Supply chain Management;
2. Customer relations;
3. Accounting and compliance;
4. Knowledge management; and
5. Distribution planning and e-commerce

Supply chain management relates to the myriad of ways firms connect with vendors and suppliers of materials and services to support production. Whether providing raw materials or managing the logistics of shipping, warehousing, and replenishing inventories, firms are continually seeking to improve costs, communications, response times, and risk exposure by streamlining their relationships with key suppliers.

Customer relations management focuses organizations on optimizing customer satisfaction via customized marketing and support services, faster and easier information dissemination, and enhanced billing and collection functions.

Accounting and compliance functions are time-consuming aspects of most businesses. Accuracy in reporting and improved controls over information gathering and analysis impel firms to adapt the most comprehensive and effective solutions to meet their needs.

Knowledge management is a broad functional area that encompasses everything from sharing processes and information across an organization to scheduling and monitoring projects to streamlining specific data regarding work rules, benefits, and job duties.

Distribution planning manages the network of channels firms use to market, sell, and deliver their services and products. The Internet has created enormous opportunities for firms to grow by offering economical means for communicating with prospective and existing customers worldwide.

While an ongoing "chicken and egg" debate continues regarding whether advances in applications or communications technology drive change, it is clear that affordable broadband access has, in many instances, been the catalyst for new business practices. Whole technologies such as e-commerce, telemedicine, video conferencing, and remote file sharing/data collaboration would be under developed or non-existent without the high-speed networks to connect users, suppliers, and customers.

As affordable broadband access has become more widely available, and applications more commonly distributed, a number of industry-leading best practices have emerged to guide various segments of the economy. This section examines several key industry sectors and

the most successful ways organizations have used technology and broadband to expand their market reach, enhance efficiency, develop new services and products, communicate more effectively with customers and suppliers, respond to competitive challenges, and improve work conditions for employees.

Manufacturing

Manufacturing has undergone significant changes through technological improvements. In fact, technology has so integrated itself into manufacturing that one cannot talk about manufacturing operations without, in some way, discussing technology and the improvements that come from advances in computer systems and telecommunications. From taking a customer's order, to procuring raw materials, to shipping the finished goods, to billing and collections, each step has been streamlined by an assortment of technological solutions. Though this evolution has been occurring for many years, companies are still working toward the ultimate goal of system integration.

Sales The traditional way that manufacturers receive orders is from contracts for larger orders. However, smaller orders — those that generally require the most operational complexity and flexibility and, consequently, have higher operating costs, typically come from either a sales visit, by phone, or by fax. In all three of the examples below, an order has to be sent to the plant floor for production by an individual. Even if production has been computerized, someone must key the order into the system. This process, by its nature, is prone to human error. These errors cost the company money and lead to customer dissatisfaction. As a result, systems that reduce the number of times the order has to be fed into the computer decrease the likelihood of errors.

In the case of a salesperson visiting a customer and taking an order, the streamlining of the ordering process is increasingly done with simple tools. Manufacturing firms are equipping their sales forces with tools such as laptop computers and handheld PCs that have the ability to tie into the computer system either at the time the order is placed or soon after. After sales people directly enter a customer's order into a computer, the computer can link to the main system and automatically transfer the order to the production line. In some cases, the sales force may have the ability to access the system remotely, via an Internet connection (either land-line based or wireless), which gives the sales person real-time information about certain products. This tool is very powerful for giving the sales person the ability to provide the customer with immediate information about how long an order will actually take or provide the customer with the most current information about the products in question. Additionally, with the order being entered only once, the company has improved its ability to provide the customer exactly what was promised at the time the order was made.

For manufacturers whose sales process orders are received via either phone or fax, an individual must transfer the order to a computer system. At a minimum, companies are trending toward offering their clients the ability to order over the Web. Though many companies have had online ordering for some time, these systems have generally not been tied into the production system until recently.

If customers are sophisticated buyers, they may have their own procurement systems in place. In this situation, the Web ordering system can be further improved upon by the development of solutions that integrate the two company's systems by allowing them to talk to each other and transfer order instructions and status automatically. Many larger companies have been doing this for many years using Electronic Data Interchange (EDI). Until recently, smaller companies were unable to use this form of communication due of the cost of developing the interface and the limited availability (and high cost) of the network to

connect to the vendor. With the evolution of software, and its ability to utilize the Internet, there are new ways for small firms to take advantage of the same streamlining process that larger companies have enjoyed for many years. The software industry has developed standards that give most software packages the off-the-shelf ability to interconnect. Additionally, these systems can use the Internet to connect with each other very inexpensively, giving smaller firms new tools to cut costs and improve customer relations.

Manufacturing process The actual manufacturing process has benefited immensely from advances in technology and communications. In the past, though certain machines were computer operated, the information available at the computer was not always available to those who needed it. In many cases, information such as quality control measures and production rates had to be manually retrieved from the computer and forwarded to other people in the company, like the engineers and managers, who had to make decisions based on the information. This was a time-consuming process, with the decision maker often receiving stale information too late to take action. Additionally, if production was spread over multiple sites, the collection and collation of information required many man-hours, and investment in expensive communication pipeline between sites, to get the information to a central point.

Now, systems are being developed that allow the monitoring of the entire production floor and collection of information needed by decision-makers. An example of a process that benefits from this integration is the design change process. With integrated computerized systems, a company is able to streamline the change process, allowing those involved to check the status of a changed order. This also opens the door for true accountability, and gives plant floor staff the ability to plan for requested changes. Also, the change can be communicated to different sites at the same time, improving product consistency.

This increase in information sharing forces manufacturers to rely on networks more, but the costs are justified by the benefits of having real-time information. As a result, network needs have increased almost exponentially, and even smaller facilities with multiple sites need access to facilities like fiber optic networks.

Billing and Accounting Once a product comes off the production floor, a company not only needs to ship the product, but also to expedite billing to ensure that it collects money for what it just produced. Enterprise Resource Planning (ERP) software has been the breakthrough product integrating sales, production, and accounting systems. Larger companies have had the advantage of these systems, to streamline the entire product process from ordering to bill collection. SMBs have not been able to benefit from these systems due to the large financial investment required. As a result, they have developed small individual systems for each part of the process. This in-house development has been cost effective, but was intended to fix immediate needs and was not designed for total integration. Software developers are creating solutions that will make the migrating and integrating of these systems viable for even smaller companies.

One solution has come from the development of the Application Service Provider (ASP). ASPs provide network applications to other companies via the Internet. These providers can deliver large applications like ERPs to smaller firms at affordable rates by offering the systems to many different companies at the same time. By sharing the applications, the companies can utilize expensive software they previously could not afford. Additionally, the ASP can provide the software in a secure environment, so that the customers they serve can be confident their data cannot be seen by others using the software. This also allows the

manufacturer to pick and choose which parts of the ERP package to use, and which in-house solutions to continue using. The result is a customizable transition plan, making the migration process realizable for a small, capital-restricted company. The overall benefit is that smaller companies can utilize the same streamlining tools that large enterprises have had access to, at rates the smaller companies can afford.

All of the software that is needed to provide this type of functionality requires infrastructure that allows the flow of traffic from one facility to another. This can come from private facilities between plants or via the Internet. Either way, the need for high-speed network connectivity is increasingly necessary as smaller companies begin accessing these new tools.

Retail

Technology's influence on retail is evidenced every single day, from transactions made locally at the corner store to the international transactions of big business.

Sales To expand the reach of a retail operation, many companies use the Internet. For companies that are traditionally restricted by geographic limitations, the Internet allows them to reach beyond those boundaries. A local bakery can now sell its specialty goods to people all over the country. A clothing designer with a national presence now has a less expensive way to expand internationally. The Internet increases the revenue potential of the company, but it also makes the sales process more complex. In the case of multi-national promotions, companies may end up posting/hosting multiple Web sites designed for different markets and countries. This makes it difficult to manage inventories and keep the brand image of the company consistent between all of the sites. To address this issue, companies now use content management systems that centralize the content of every site. By centralizing, changes to product lines and image can be easily managed in one place, eliminating inconsistencies.

Another issue that comes from online ordering is the ability to provide reliable and updated information about the product of interest, including availability. The success of a company selling its products on the Internet is driven by similar factors that are faced if a customer is at the physical store. If an item is advertised, the customer expects the item to be in stock. Though online the customer may not have the same expectation of immediate availability, the expectation is shaped by what is present on the Web site. So, inventory accuracy is very important.

To ensure that inventory information is accurate, the Web servers have to link to the inventory system and have real-time information available for the customer. Some companies that have refined this feature have taken the process one step further and merged the physical store with the online store. This is accomplished by centralizing inventory and making it available to the Web site. Now, the customer can find out if a product is in stock and if it is available at a particular store. Furthermore, companies now allow the customer to pay for a product online, and then go to the store to pick it up. Though mostly larger chain stores have this capability, the technology is available for small stores to provide this service.

Inventory/warehousing As stated previously, ties to inventory are incredibly important to a retail operation, and the accuracy of inventory data is critical. Without inventory controls, a company's financial stability can be undermined if it becomes overstocked, and revenue streams can be damaged if inventory is allowed to run out. For retailers seeking to keep inventories at a minimum, systems that are connected directly to suppliers reduce the chance for order mistakes, and can improve delivery times. Many warehouses now have

sophisticated inventory systems that are continuously updated using bar code technology. As a product goes onto or is taken off the shelf, its bar code is scanned, and in many cases, its whereabouts are tracked all the way to the customer's premises. This improves inventory tracking and controls that are necessary for retail operations.

Customer service Prices for products can only drop to a particular economic point. After that, customer service becomes the differentiating factor that can make or break a company. For customer service to be effective, the ability to access the status of orders and show customer profiles is paramount. Customer Relationship Management (CRM) systems provide staff with these tools. There are two main ways a customer contacts a company's customer service personnel; in person or by phone. Either way, the staff person needs to be able to identify the customer in the system and have a full history available. This technology even provides the staff with the ability to do things like address the caller by name without the customer entering information on the phone, or being able to provide a refund on a customer's credit card without the customer having to produce the card. These techniques exceed the customer's expectation of service, and can lead to increased customer loyalty.

Back Office Tying all of this functionality back into the accounting system is vital. Accounting, commissioned payroll, and accounts payable are time-consuming and error prone processes if done by hand. With the correct feeds and well-defined business rules, information from the Internet and storefront sales can make the accounting process easier and virtually error free. Similar to manufacturing, ERP (Enterprise Resource Planning) applications help tie these systems together. For smaller retail shops, outsourcing is available, but with Internet connectivity, even companies with two or three retail stores can effectively link all stores to a centralized system that allows them the ability to use similar streamlining tools that larger chains have used for many years.

Health Care

Health care has been and will continue to be a knowledge-intensive and information-driven industry. The demands of managed care, HMOs, and government regulations, along with fast emerging advances in medical research, have transformed the industry. These changes have impacted hospitals, clinics, pharmaceutical firms, insurers, and individual health care workers. Coping with change has led to the development and adoption of new technologies.

The health industry, though a huge part of the U.S. economy (14 percent of GDP), is still starved for broadband connectivity. Transactions between doctors and drug companies, insurers, suppliers, and health-conscious consumers are continuing to escalate the need for high-speed communications.

Telemedicine Telemedicine offers the ability to interactively monitor patients and communicate information to medical practitioners remotely. Streaming media in the form of large data and imaging files, as well as live video and audio feeds, is indispensable for telemedicine to succeed. From assessment and diagnosis using radiological data (teleradiology), to video house calls (remote consultation), to Web-enabled call centers, to physician continuing education, to consumer learning, telecommunications is integral to the development of health care technology.

Broadband and technology have combined to impact health care in the use of enterprise portals to transmit information between hospitals and attending physicians. As a conduit for assessing and updating patient records securely, transmitting information regarding the

most effective clinical practices, and as a means of reducing medication and diagnostic errors, these systems have been introduced throughout the country. A powerful demonstration of the transformative nature of broadband is the use of remote monitoring of intensive care units (known as eICU). Though only recently introduced in select markets, early results show dramatic reductions in intensive care mortality and reduced system costs for hospitals. Sentara Healthcare, a six-hospital system in Virginia, has documented declines in mortality rates of 25 percent and cost savings of 17 percent (achieved through shorter hospital stays) with eICU. The system allows specialists, known as intensivists, to receive continuous reports of patient vital sign data plus live video feeds from a number of facilities at a single, centralized location — often the intensivists' home offices. The continuous monitoring by an expert allows for quick response to subtle, yet critical, changes in a patient's condition. The hospital benefits by adding a level of specialization and expertise previously unavailable; the intensivists gain the ability to more effectively use their knowledge; patients gain the superior treatment the experts deliver.

New efficiencies Broadband services streamline the health care process and introduce previously unrealized efficiencies. QT Medical Services, for instance, is a medical transcription service that uses broadband access to deliver its services to doctors. After a doctor meets with a patient, she dictates her findings into a computer voice file that is sent to QT Medical. A transcriptionist, working at home, writes up a report and sends it back to the hospital to be placed in the patient's files. A process that took days now takes a few hours.

Virtual Private Network (VPN) services have been implemented by a number of facilities and providers to better manage record keeping, file sharing, and general communications. The Cystic Fibrosis Foundation uses VPN to integrate its 80 offices and 600 employees nationwide. The fundraising organization uses VPN to save money on travel via teleconferenced staff meetings, and to update benefits and financial and policy information through its intranet. The Foundation has achieved significant cost savings by shifting time consuming, day-to-day functions from the local level to a regional level. The result is that staff members have been freed to focus more on their fundraising activities rather than back office and reporting functions.

Broadband also drives the drugstore of the 21st century. Pharmacists have always on, instant access to patient profiles and important drug interaction information. Credit and debit card authorization is seamlessly executed, while in-store video programming meets the needs of health-conscious shoppers. Automated cash registers provide price scanning and sales tracking to improve customer service, reduce errors, and ensure store shelves remain optimally stocked.

And, the Web has had a major impact on the way physicians practice medicine. More than 78 percent of physicians surf the Web for information on the latest drug uses, diagnostics, and treatments. Three of 10 physicians have their own Web site used to promote their practices, providing patient education, scheduling appointments, and offering answers to basic patient questions. The vanguard of doctors are using their Web sites to interface with pharmacies and drug manufacturers to fill prescriptions online. Doctors who have adopted electronic medical records, electronic prescribing, online communication with patients, and remote disease monitoring say such tools have boosted their efficiency and the quality of care they provide. As of early 2002, 26 percent of doctors reported communicating with patients online, 22 percent were relying on electronic medical records to store and track information about their patients, 11 percent were prescribing drugs online, and five percent were monitoring patients' health electronically. These figures are expected to triple by 2004.

Key information portals such as WebMD, Medscape, and Physician's Online have emerged as the busiest information dissemination sources for health care on the Internet.

Supply chain management Procurement of equipment and supplies is a significant undertaking for health care organizations. E-commerce and broadband connectivity have shown substantial benefits for the industry. A recent study by Accenture claims that e-commerce could bring two to 10 percent benefits, or up to $6 billion in value, to participants across the supply chain. The biggest potential benefit of e-commerce for providers involves eliminating overpayments and reducing rework and manual processes. The benefit for suppliers lies in freeing sales representatives from administrative tasks, enabling them more time to sell, providing access to real-time sales information, allowing for better management of fill-rates and operational processes, and reducing the level of effort for labor-intensive administrative processes including contracts, rebates, and eligibility.

Chicago's Rush-Presbyterian Hospital recently replaced its paper-based back-office system with an Internet solution. With more than 70,000 purchase orders per year and the need to integrate electronically with a multitude of vendor catalogs, the hospital developed a 'composite application' platform that integrates its ordering system and accounts payable system with the Web site catalogs of its major suppliers. Once entered, the application processes and tracks the orders through a single interface that has automated a once tedious and error-prone process. Vendors that have linked with the system anticipate a stronger bond with the hospital and a more cost-effective relationship.

Regulatory compliance Healthcare providers must manage nationally dispersed workforces while providing reliable access to central systems and data from remote offices. The passage and implementation of the Health Insurance Portability and Accountability Act (HIPAA) in 1996 pushed healthcare beyond nuclear energy as the most regulated business in the United States, and compounded the need for security. This regulation set the strictest security level for the flow of patient data between healthcare offices. Forward thinking firms have sought technology solutions to meet the needs of physicians for accessing and sharing data and the requirements of HIPAA. This was Sun Healthcare Group's challenge with 36,000 employees nationally, 1,200 who need secure remote network access at the same time. Because patient care and treatment depend on access to their health information from anywhere at anytime, network mobility, service, and reliability were top priorities of Sun Healthcare Group's IT department. With the passage of HIPAA, Sun Healthcare's ability to protect patient health information in a cost-efficient manner became absolutely critical to its success. Information security joined mobility, service, and reliability as a key requirement. Today, secure mobile access provides an effective solution for Sun Healthcare staff who travel between facilities or work from their homes. Without the speed and reliability that broadband offers, health care workers would face severe (and sometimes life-threatening) constraints on their ability to gather information and dispense adequate treatment for their patients.

APPENDIX 6: Sample Bandwidth Demand Questionnaire

The following is the survey that Tangent conducted in December 2002. A random sample of 130 businesses were selected from approximately 15,700 SMBs meeting certain criteria for this study. Tangent focused on the following areas:
-Current and future bandwidth needs of an organization
-Current broadband access technology in use (if any)
-Opinions regarding current and future broadband applications
-Monthly expenditures for services.

1. How many employees work at this facility? _____

2. How do you currently connect to the Internet or other off-site networks?
None/not applicable _____
Dial-up (regular phone lines)_____
ISDN _____
DSL _____
T1 _____
Other (specify type) _____

3. What is the maximum bandwidth speed that you use?
Please give your answer in terms of Mbps (Megabits per second).
_____

4. How much do you believe your bandwidth speed will increase in the next TWO years? IF NO INCREASE, ASK "WHY NOT?"[Answer may be in Mbps or multiple of current rate.]
_____

5. ...FIVE years?
_____

6. What factors influence your organization's current bandwidth needs?
_____
_____

7. What factors do you think will influence your organization's future bandwidth needs?
_____
_____

8. What is your current data communications expense per month? $_____

9. How much do you expect your expense to increase/decrease in the next TWO years?
_____ percent

10. ....FIVE Years? _____ percent

11. What is your current phone (local and long distance) expense per month?
_____

12. How much do you expect your expense to increase/decrease in the next TWO years?
_____ percent

13. ....FIVE years? $_____ percent

14. Which company provides your data services? _____

15. Which company provides your telephone (local & long distance services?

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16. Of the following list, which applications does your company currently use over your Internet or off-site network connection?
a. Relations with vendors or suppliers
b. Customer relations (example: call center)
c. E-mail
d. Corporate Intranet (employee Internet access)
e. Corporate Web site
f. E-commerce
g. Human resource tools (circle all examples: training, payroll, benefits; add any other volunteered applications)
h. Other business functions (circle all examples: accounting, competitive research, compliance reporting; add any other volunteered applications)
i. VPN (Virtual private network, virtual office/telecommuting)

17. Of the following list, which applications does your company PLAN to use in the next TWO YEARS over your Internet or off-site network connection?
a. Relations with vendors or suppliers
b. Customer relations (example: call center)
c. E-mail
d. Corporate Intranet (employee Internet access)
e. Corporate Web site
f. E-commerce
g. Human resource tools (circle all examples: training, payroll, benefits; add any other volunteered applications)
h. Other business functions (circle all examples: accounting, competitive research, compliance reporting; add any other volunteered responses)
i. VPN (Virtual private network, virtual office/telecommuting)

18.We've finished the questions. Would you like to receive a copy of the survey results?
YES (list e-mail or regular mail address)
NO
Thank you for your help today.

Appendix 7: Competitive Profiles

The Competitive Telecommunications Market in Chicago

Company	Internet Access/Data Service Offerings	Web
SBC Communications Inc.	ATM*, ISDN, Frame Relay*, DSL*, SONet, DS-1, DS-3 *SBC Advanced Solutions, Inc.	http://www.sbc.com/ISP
AllegianceTelecom	DS-1, DS-3, SONet	http://www.allegianceinternet.com/internet/ai_internet.jsp
AT&T	ATM, DSL, Frame Relay, SONet, Gigabit, Ethernet	http://www.business.att.com/
Comcast	Cable Internet	http://online.comcast.net/products/comcastbusiness/overview.asp
CoreComm Limited	T-1, Fractional T-1, T-3, ISDN, OC-3	http://www.core.com/web/business/internet/index.html
Covad Communications	DSL, T-1, DS-3	http://www.covad.com/business/
DirectTV (DirectWay)	Satellite Broadband internet	http://directv.direcway.com/
DSL.net	DSL, T-1internet	http://www.dsl.net/
Focal Communications	T-1, ISDN-PRI data; T-1,T-3,OC-3 internet	http://www.focal.com/
Level 3 Communications	ATM, Frame Relay, Gigabit Ethernet, DS-1, DS-3, SONet	http:www.level3.com/
Looking Glass	DS-1, SONet, Gigabit Ethernet	http://www.lglass.net/
Metromedia Fiber Network	SONet, Gigabit Ethernet, ATM	http://www.mfn.com/
RCN Communications	SONet, Gigabit Ethernet, Fast Ethernet	http://www.rcn.com/business/products_services.php
Teligent	T-1, DS-3, OC-3 level wireless	http://www.teligent.com/
Williams Communications Inc.	Frame Relay, ATM	http://www.wiltelcommunications.com/
XO Communications Inc.	SONet, T-1, T-3, OC-3, Ethernet data services, DSL, T-1,T-3,OC-3, Ethernet internet services	http://www.xo.com/

*Access the company Web site for a detailed summary of the company, its services and offerings

All information on this page was compiled from the company Web sites and other published sources.

Appendix 8: Glossary of telecommunications terms

ADSL (Asymmetric Digital Subscriber Line)	A fully digital, dedicated connection. Asymmetric refers to the transmission speeds of the upload and download for this technology. The upload speeds are typically slower than the download speeds. ADSL is the most common of the xDSL family. See also: xDSL
ASP (Application Service Provider)	An organization that hosts software applications on its own servers within its own facilities. Customers access the application via private lines or the Internet. Also called a "commercial service provider." With the advent of the Web browser as the universal client interface, the ASP market is expected to grow rapidly.
ATM	A dedicated-connection switching technology. Data sent across the network is divided into packets, which are units of a certain number of bytes. ATM is distinguished from other technologies in that it uses a fixed-size data packet (ATM cell) that is only 53 bytes total (48 of which are data, with the other five holding the destination and sender addresses).
Backbone	On the Internet or other wide area network, it is a set of paths that local or regional networks connect to for long-distance interconnection. The connection points are known as network nodes or telecommunication data switching exchanges (DSEs).
Bandwidth	Throughput usually measured in a fixed amount of data sent through media per second. The range of frequencies that can be transmitted through a medium, such as glass fibers, without distortion. The greater the bandwidth, the greater the information-carrying capacity of the medium.
BLEC (Building Local Exchange Company)	These companies install fiber-optic networks in office buildings at no charge to the owners and deliver broadband Internet, video, and voice services to the tenants (small and midsize businesses). They focus primarily on selling data services and creating applications for their customers.
BOC (also ILEC and RBOC)	A traditional local telephone company such as one of the regional Bell companies (RBOCs). See also: ILEC (Incumbent Local Exchange Carrier)
Broadband	Telecommunication that provides multiple channels of data over a single communications medium, typically using some form of frequency or wave division multiplexing. Examples include DS-3 fiber optic systems, which can transmit 672 simultaneous voice conversations, or a broadcast television station signal that transmits high-resolution audio and video signals into the home. Broadband connectivity is also an essential element for interactive multimedia and next generation applications (e-commerce, telemedicine, etc).
Cable Modem	A modem used to connect a computer to a cable TV service that provides Internet access. Cable modems can dramatically increase the bandwidth between the user's computer and the Internet service provider. Cable modems link to the computer via Ethernet, which makes the service online all the time.

	However, Ethernet is a shared medium, and the speed will vary depending on how many customers on that cable segment are using the Web at the same time.
Carrier Hotel	A building where space is leased to competitive telecommunications providers, allowing them to interconnect with each other and with the incumbent provider. Carrier hotels provide an alternative to co-locating in the ILEC central office.
Carrier	Company that provides telecommunications transmission services.
Central Office (CO)	A local telephone company switching center. There are two types. The first is called an "end office" (EO) or "local exchange" (LE) and connects directly to the outside plant, which is the feeder and distribution system to homes and offices. The end office (often called a "Class 5 office") provides customer services such as call waiting and call forwarding. The second type is the tandem office (also toll office or tandem/toll office), which is a central office that does not connect directly to the customer. Toll call record generation and accounting used to be handled in the tandem offices. Today, the billing is mostly done in the end offices. There are more than 25,000 central offices in the United States.
CLEC (Competitive Local Exchange Carrier)	An organization offering local telephone services. Although most CLECs are established as a telecommunications service organization, any large company, university, or city government has the option of becoming a CLEC and supplying its own staff with dial tone at reduced costs. It must have a telephone switch, satisfy state regulations, pay significant filing fees, and make its services available to outside customers. This was sanctioned by the Telecommunications Act of 1996.
Client	A computer or device that initiates a query, usually from a server in a client-server environment.
Co-location	When a carrier locates some of its facilities in another carrier's property or a carrier hotel.
Dark/Lit fiber	Bulk, raw fiber. Dark fiber is existing optical fiber that spans a geographic area and is sold to carriers and large businesses without any optical or electronic signaling in its path. The customer is responsible for adding the transmission equipment at both ends. Lit fiber is optical fiber that is being used to transmit data.
DLECs (Also DCLECs)	Data-centric local exchange companies whose focus is on providing data services as opposed to voice and other services.

DS-x	Standard telecommunications industry digital signal formats, which are distinguishable by bit rate (the number of binary digits transmitted per second). DS-0 service has a bit rate of 64 kilobits per second or a single phone line. DS-1 service has a bit rate of 1.544 Mbps or 24 phone lines. DS-3 service has a bit rate of 45 Mbps or 672 phone lines. Used interchangeably with T1 and T3 services (e.g., DS-1/T1, DS-3/T3).
DSL (Digital Subscriber Line)	A technology for bringing high-bandwidth information to homes and small businesses over existing copper telephone lines at speeds ranging from 1 Mbps to 42 Mbps . xDSL refers to the family of DSL variations, such as ADSL, HDSL, RADSL and VDSL. See also: xDSL.
DWDM (Dense Wavelength Division Multiplexing)	See WDM
Ethernet	Developed by Xerox corporation in 1973, Ethernet describes a local area networking technology where all of the networked devices are connected via a single cable. Data is sent across the cable using a system called Carrier Sense, Multiple Access/Collision Detection (CSMA/CD), where nodes listen to the cable before sending data packets. The nodes wait until the cable is free before sending their data across the network. If two nodes send data simultaneously a collision occurs. Once detected, the nodes wait a short, random period before re-sending data.
Facilities-Based Carrier	Carriers that own transmission facilities.
Fiber Node	In communications, a node is a network junction or connection point. For example, a personal computer in a local area networks (LAN) is a node. A terminal connected to a minicomputer or mainframe is a node.
Fiber Ring	A fiber optic transport network where the ends of the network come together to form a closed topology or ring.
Frame Relay	A telecommunication technology designed for cost-efficient data transmission between LANs and end points in a wide area network. Data is put in a variable-size unit called a frame and leaves any necessary error correction (retransmission of data) up to the end points, which speeds up overall data transmission. Frame relay is an updated, digital version of x.25, an older analog technology.

Gigabit	One billion bits of information. The information-carrying capacity (i.e., bandwidth) of a circuit may be measured in gigabits per second.
Gigabit Ethernet	An Ethernet technology that raises transmission speed to 1 Gbps. Used primarily for backbones. The first IEEE standard (802.3z) for Gigabit Ethernet defined its use over multimode optical fiber (see Multimode Fiber below) and provides full-duplex operation from switch to end station or to another switch and half-duplex using CSMA/CD in a shared environment. The 802.3ab standard (1000 Base TX) provides for Gigabit Ethernet over copper cable.
Greenfield Carrier	A carrier that does not have any traditional telephone equipment in its network. This type of carrier is "starting from scratch" with brand new IP telephony gear.
Hub	Collection center located centrally in an area where telecommunications traffic can be aggregated for transport and distribution.
ILEC (Incumbent Local Exchange Carrier)	A traditional local telephone company such as one of the Regional Bell companies (RBOCs). See also: BOC and RBOC.
Interexchange Carrier (IXC)	A company providing inter-LATA or long distance services between LATAs on an intrastate or interstate basis.
Inter-LATA	InterLATA calls are those that pass from one LATA to another. Typically, these calls are referred to as long distance calls.
Intra-LATA	IntraLATA calls are those local calls that originate and terminate within the same LATA.
IPTEL (Internet Protocol Telephony)	See Voice over Internet Protocol (VoIP).
ISDN (Integrated Services Digital Network)	Telecommunications technology that provides low-end bandwidth network connections and telephony. Includes PRI and BRI (primary rate and basic rate interface), with the former built for more high-end, high bandwidth WAN connections.
ISP (Internet Service Provider)	An organization that provides access to the Internet.
Kilobit	One thousand bits of information. Usually expressed in terms of kbps (Kilobits Per Second).
LAN (Local Area Network)	A communications network that serves users within a confined geographical area. It is made up of servers, workstations, a network operating system, and a communications link.

LATAs (Local access and transport area)	The approximately 200 geographic areas that define the areas between which the RBOCs were prohibited from providing long distance services prior to the Telecommunications Act of 1996.
LEC (Local exchange carrier)	A company providing local telephone services.
Local loop	A circuit within a LATA.
Long-Haul Circuit	A private, dedicated telecommunications circuit between locations in different LATAs.
Megabit	One million bits of information. Usually expressed in terms of Mbps (Megabits Per Second).
Multi mode Fiber	In optical fiber technology, multimode fiber is optical fiber that is designed to carry multiple light rays or modes concurrently, each at a slightly different reflection angle within the optical fiber core. Multimode fiber transmission is used for relatively short distances because the modes tend to disperse over longer lengths (this is called modal dispersion). For longer distances, single mode fiber (sometimes called monomode) fiber is used. Multimode fiber has a larger core than single mode.
Off-net	Refers to circuits on transmission facilities not owned by the carrier.
On-net	Refers to circuits on transmission facilities owned by the carrier.
Optical Transport	The transmission of data using optical fiber signified by the OC (Optical Carrier) unit.
Optronic	A combination of optical and electronic equipment.
Overbuild	Building a new network where one or more similar networks exist. 21st Century's cable infrastructure was considered an overbuild, for example.
POP (Point of Presence)	The point at which a line from a long distance carrier (IXC) connects to the line of the telephone company or the user if the telephone company is not involved. For online services and Internet providers, the POP is the local exchange users dial into via modem.
PSTN (Public Switched Telephone Network)	The traditional circuit-switched telephone network that operates worldwide for basic telephony services. Also known as Global Switched Telephone Network (GSTN) or POTS (Plain Old Telephone System). See also ISDN.
RBOCs (Regional Bell Operating Companies)	The seven regional telephone companies (formerly part of AT&T) established by court decree in 1982.
Single Mode Fiber	In optical fiber technology, single mode fiber is optical fiber that is designed for the transmission of a single ray or mode of light as a carrier and is used for long-distance signal transmission. For short distances, multimode fiber is used. Single mode fiber has a much smaller core than multimode fiber.

SONet (Synchronous Optical Network)	A fiber-optic transmission system for high-speed digital traffic. Employed by telecoms and common carriers, SONet speeds range from 51 mbps to 40 gbps. It uses a self-healing ring architecture that is able to reroute traffic if a line goes down. SONet backbones are widely used to aggregate lower-speed T1 and T3 lines.
Switch	A device that opens or closes circuits to be used for transmission of information. It is a process of interconnecting circuits to form a transmission path between users.
VoIP (Voice over Internet Protocol)	Used in IP telephony, VoIP is voice delivered using Internet protocol. It avoids the tolls charged from ordinary phone use.
VPN (Virtual Private Network)	A private network that is configured within a public network such as the Internet. VPNs enjoy the security of a private network while taking advantage of the economies of scale and built-in management facilities of large public networks. Built over x.25, Switched 56, frame relay, and ATM technologies, today's networks generate tremendous interest in VPNs.
WAN (Wide Area Network)	A communications network that covers a wide geographic area. Typically made up of several LANs contained within several buildings or campuses.
WDM (Wavelength Division Multiplexing)	A technology that uses multiple lasers and transmits several wavelengths of light (lambdas) simultaneously over a single optical fiber. Each signal travels within its unique color band, which is modulated by the data (text, voice, video, etc.). WDM enables the existing fiber infrastructure of the telephone companies and other carriers to be dramatically increased. Vendors have announced WDM or DWDM (Dense Wavelength Division Multiplexing) systems, as they are also called, that can support more than 150 wavelengths, each carrying up to 10 Gbps. Such systems provide more than a terabit per second of data transmission on one optical strand, thinner than a human hair.
Wire Center	A location where a large number of network cables terminate.
XDSL (Digital Subscriber Line)	Refers to the family of DSL technologies, including ADSL, HDSL, SDSL, and VDSL. See also: DSL.