

private network management. The architecture of a GAN is illustrated in Figure 3-5.

INTERNET LAYER

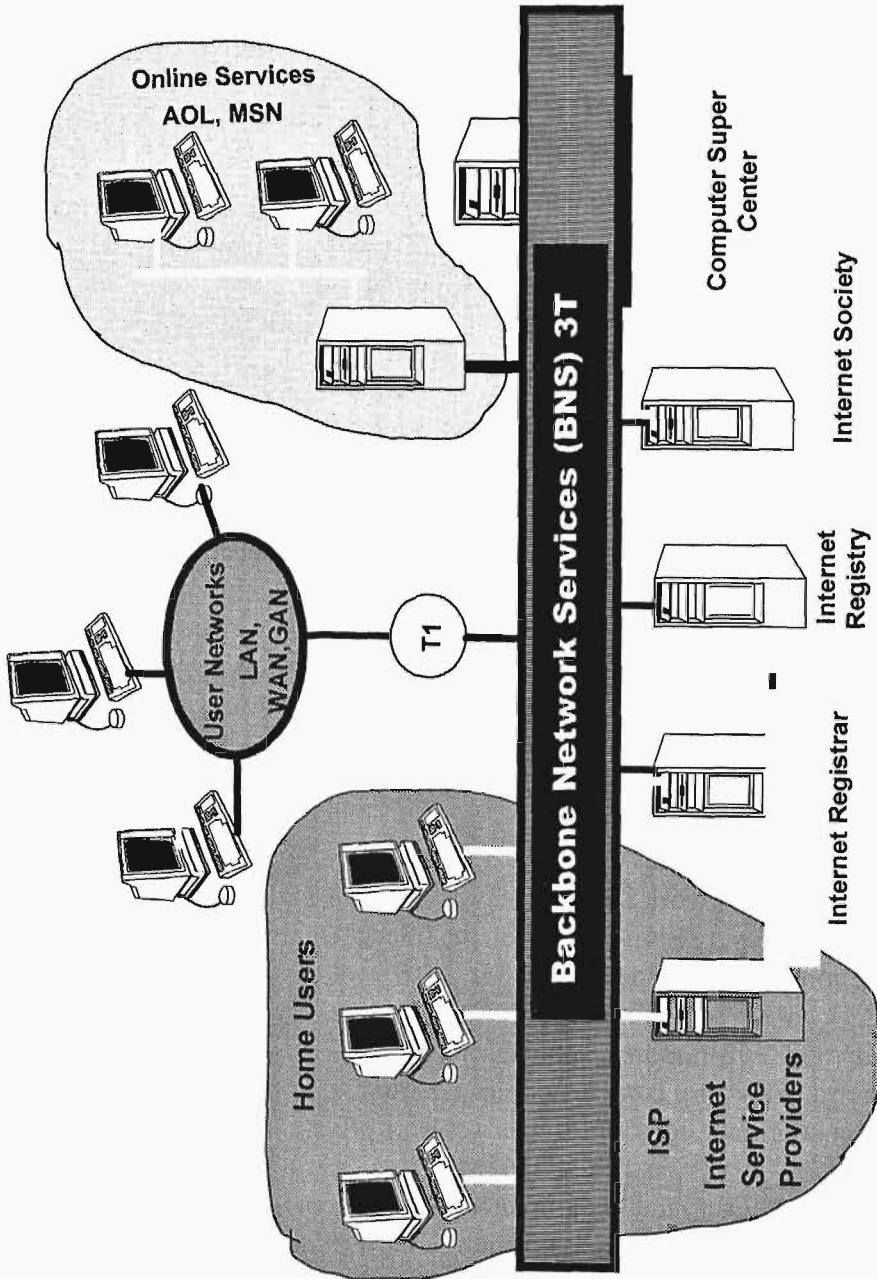
Internet

The Internet is a public, global network of web-driven computers (servers) that provide free access to the majority of info-communication services for individual and organizational users. The Internet is an international computer network of networks that connect government, academic, and business institutions as well as individual users. In the 1960's the Department of Defense developed the Internet. Its first Wide Area Network was called the ARPANET after the name of the Advance Research Project Agency. Then in 1983 ARPA opened the ARPANET for public applications, and since then this network has been called the Internet. It is an open system since the technical specification needed to build Transmission Control Protocol and Internet Protocol (TCP/IP) is open for everyone who wants to develop network tools and applications. By the year 2000, the Internet was used by several million servers and over 100 million individuals. The Internet as a whole reaches around the globe, connects computers from personal computers to supercomputers, and is not administered by a single authority.

The Internet architecture is shown in Figure 3-6, which is composed of the following components:

- Backbone Network Services at the speed of 3 TB (Tera Bits per second = 1000 GB per second) between the Internet main nodes composed by the computer super centers;
- Internet Registrars are responsible for registering Internet domain names, such as *www.cnn.com*, to people and organizations. They are overseen by boards made up of representatives from private and public institutions;
- Internet Registry tracks the connections between Internet addresses such as 125.34.24.21 and domain such as *www.zdnet.com*;
- Internet Society steers the direction of the Internet and its development in the scope of its technological and architectural issues, e.g., how TCP/IP and other Internet protocols should work.

Figure 3-6: How the Internet Runs



- Internet Service Providers (ISP) provide a paid access to the Internet for home users and small organizations;
- Corporate Networks – provide an access for their users;
- Online Services such as America Online or MSN provide a paid access to extended information services and the Internet.

Names and Addresses. Each server connected to the Internet has its own net IP-address, and an organization's domain name, which contains data about the type of the organization (Table 3-1) as well as a country code (Table 3-2), with the exception of the U.S. Since users from the United States are the largest users' group of the Internet, they do not have to write the country code in domains and e-mail addresses.

Table 3-1: Domain Types on the Internet

Code of Domain Type	Type of Organization	Example	Organization
edu	educational organization	tiger.wmich.edu	"tiger" server of Western Michigan University
gov	government organization	whitehouse.gov	White House
mil	military organization	airforce.mil	Air Force
net	network organization	archie.sura.net	net indexing tool applied at the University of Maryland
org	Other organizations	telecity.org	Kalamazoo teleCITY
com	commercial organization	americaonline.com	America on Line

Table 3-2: Country Codes Used on the Internet

Code	Country	Code	Country	Code	Country
AQ	Antarctica	FR	France	NZ	New Zealand
AR	Argentina	GR	Greece	PR	Puerto Rico
AT	Austria	HK	Hong Kong	PT	Portugal
AU	Australia	HU	Hungary	PL	Poland
BE	Belgium	IE	Ireland	SE	Sweden
BR	Brazil	IL	Israel	SG	Singapore
CA	Canada	IN	India	TW	Taiwan
CH	Switzerland	IT	Italy	UK	United Kingdom
CL	Chile	JP	Japan	US	United States
DE	Germany	KR	Korea	VE	Venezuela
DK	Denmark	MX	Mexico	ZA	South Africa
ES	Spain	NL	The Netherlands		
FI	Finland	NO	Norway		

Each domain is unique and provided to an organization after consulting the Domain Name System (DNS), which is a worldwide distributed database of names and addresses. An organization can register for a domain name, selecting a unique name and using the above provided codes: for example, the Digital Kalamazoo County in the U.S. selected a name *telecity.org*. The DNS database will assign the IP address of this organization server. The IP address is a set of four groups of numbers separated by periods, such as 123.567.55.2, which is the IP address for a connection of a given organization.

In the e-mail systems, user ID is composed of a first and last name, @ character, and organization domain, for example: *ian.smith@wmich.edu*. In addition to the user ID, a password is required in e-mail systems.

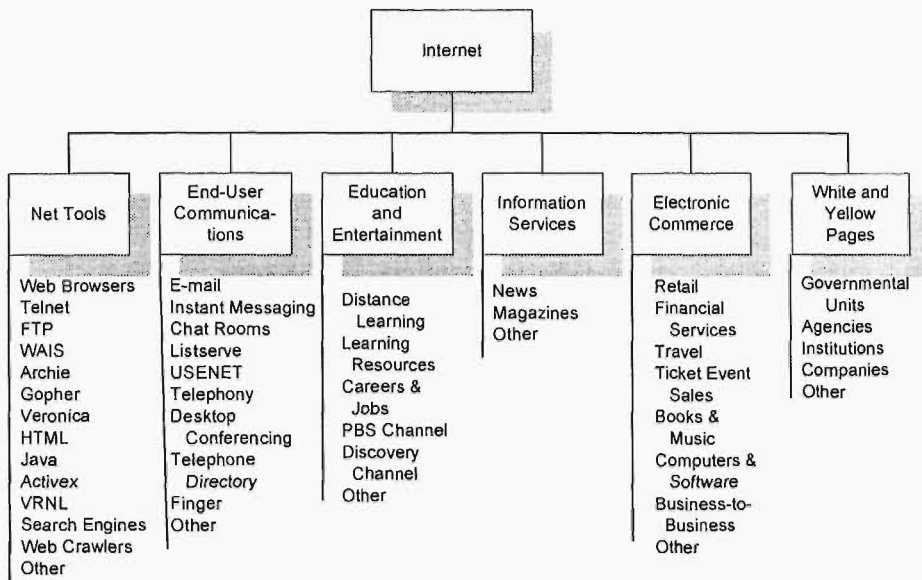
Most Internet service providers (ISP's) and many large organizations maintain DNS servers that serve as the source of information about DNS entries for a specific set of domains. The servers also cache used domain names and their IP addresses in a local lookup table. When a request to resolve a domain name arrives, the resolver parses the components of the domain name right to left, starting with the top-level domain (such as .com or .edu) and queries the DNS server for that domain, which redirects it to a DNS server for the second-level domain (such as *telecityglobal.com*); this process proceeds until the address is resolved or an error is encountered. In practice, recently used DNS entries are cached by the local resolver for possible reuse. If a website is hosted on servers belonging to an ISP, the IP address belongs to the ISP, even though the domain belongs to the customer. If the Web server operator changes ISP's, then the IP address will change as well, but the domain name will not.

The Internet Services and Systems. The classification of the Internet services is provided in Figure 3-7. They are grouped in the following manner:

- Net Tools, which allow the user either to navigate the Internet or to build its applications,
- End-User Communications, which allow communicating among people,
- E-commerce, systems that allow the pay-per-exchange transactions (Chapter 5),
- Education resources that allow students and instructors to seek help and support for their studies,

- Entertainment resources that allow the user to look for games, chat rooms,
- Information Services, such as news and magazines,
- Electronic White and Yellow Pages,
- Other.

Figure 3-7: The Classification of the Internet Services



Net Tools. Among net tools one can distinguish the following:

- *World Wide Web (WWW)* browsers for the navigation of the Internet home pages and databases. Among the most popular navigators are *Netscape* and *Internet Explorer*. The location of each Web page within WWW is given by its URL, or Uniform Resource Locator; for example, the URL for the Kalamazoo teleCITY posting home page is <http://www.telecity.org>. HTTP stands for Hyper Text Transfer Protocol, which is a communication language used by Web servers and clients.

- *Telnet*—a tool enabling you to log on to remote computer sites. You can log on to the Library of Congress in the following manner: *\$telnet>open locis.loc.gov* (where \$ is a prompt character on your server).
- *FTP—File Transfer Protocol* is a tool allowing the transfer of files from another site to your computer. For example, you may transfer a file (software) from the anonymous site, accessible to all users in the following manner: *\$ftp wuarchie.wustl.edu*, login as *anonymous*, and use your *e-mail address* as a password. You will obtain software from The Washington University Public Domain Archives.
- *Archie* is a tool allowing the search for a file on an archie server. To do this you telnet to a distance location:

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$telnet archie.rutgers.edu
login: archie
archie> "type a file name"
make a note of the file location
archie>quit
buy
apply FTP to transfer the found file to your computer

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- *WAIS – Wide Area Information Servers* for searching databases' contents.
- *GOPHER¹* is a retrieval tool applying a system of menus. Log on as *gopher* and retrieve menus from an educational institution in Australia *info.anu.edu.au*.
- *Veronica²* - a search tool which searches gopherspace only; however, you do not have to quit it and use FTP as in Archie, so it is possible to retrieve the file instantly. Type *gopher* and select other *Information Sources and Gopher Servers* menu, select *Veronica* and type your search criteria *Apollo 1*. Navigate the selected menus and find your word: *Apollo 1*.
- *Search engines*: are computers with programs that retrieve a list of websites that match some user-selected criteria such as "light cotton and

tuxedo.” The user navigates to the search engine’s sites and their URL addresses:

- Yahoo *www.yahoo.com*
 - Infoseek *www.infoseek.com*
 - Excite *www.excite.com*
 - Alta Vista *www.altavista.com*
 - Lycos *www.lycos.com*
 - Inktomi *www.inktomi.com*
 - Open Text *www.opentext.com*
 - WebCrawler *www.webcrawler.com*
 - WWW Worm *www.webcrawler.com*
 - Other
-
- *Web crawlers* – are also called spiders, ants, robots, bots, and agents because they traverse the Web automatically to collect index data about home pages’ contents.
- End-User Communications* include the following systems and services:
- E-mail.
 - Instant Messaging – a service of America Online and MSN which delivers e-mail messages to a desktop screen’s dialog box for “instant” communication.
 - Chat Rooms – participants communicate in real-time.
 - *Listserv* – gets its name from “list server” and is an automatic discussion list service. It is a program that handles all the list administrative functions such as subscribing and unsubscribing users to and from interest groups. It is an e-mail-based discussion forum. All new contents of listserv are sent to the user’s e-mail address and are shown in his/her “new mail.” Responses sent by subscribers are sent to all other subscribers.
 - *USENET* – is a service to support discussions, interest groups, and conferences. These communications are transmitted on the USENET network, which can be transmitted across the Internet. About 3 million people participate in the USENET idea exchange. USENET is a conferencing service and is not considered an e-mail system. It is an open

and uncensored environment, where people from different facets of life spend time together “reading,” “responding,” and “posting news.” USENET is divided into about 10,000 different newsgroups devoted to a special topic. Each newsgroup is made up of articles, which are similar to e-mail messages. Major news categories include: com-computer, misc-topics that do not fit anywhere else, news-groups dealing with USENET administration, recreational subjects, sci-topics on established sciences, soc-socializing and world culture topics, talk-debates, and biz-business topics. Some examples of newsgroups (entered through the browser):

- *sci.military*
 - *rec.humor.funny*
 - *soc.women*
- *Telephony*—Internet telephones let users talk across the Internet to any PC/Mac computer around the world, for the fee of the Internet connection. Of course the two communicating computers must have installed the Internet telephone software. The user can download the phone packages for free from the following websites:
 - Netscape’s CoolTalk *www.netspeak.com*
 - Intel’s Internet Phone *www.intel.com*
 - IBM’s Internet Connection Phone (IC Phone) *www.ibm.com*
 - *Desktop conferencing*—is a real-time Internet-based telephone connection with video of conferencing parties. The user needs to install a desktop camera and the supporting software of *www.compaq.com*.
 - *Telephone directory*—there is a free service in which users can look up the names, phone numbers, and addresses of friends, colleagues, and businesses:
 - *www.switchboard.com*
 - *www.bigbook.com* with 3-D pictures of business sites
 - *Finger*—is a service of finding people when we know on which computer (server) they operate. One can usually use any part of the person’s name and Finger will return essential data on all the users with that name on that computer. You need to type *\$finger@remote-host-name*. Not every server provides the Finger service for security reasons.

Education resources include mostly websites that provide tools and information for teachers, professors, pupils, students, and administrators about curricula, syllabi, textbooks, laboratories, online classes, projects, issues, and equipment. Look for:

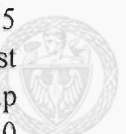
- The University of Phoenix Online Campus www.uophx.edu/online
- The Louisiana College www.lacollege.edu/lconline.html

Entertainment resources – there are plenty of resources that provide entertainment; look for:

- Discovery Channel Online www.discovery.com
- PBS Online www.pbs.org

Electronic White and Yellow Pages – are directories that contain listings of many people/organizations.

Without a doubt, the Internet is ushering in an era of sweeping change that will leave no business or industry untouched. In just the five years from 1995 to 2000, the Internet has gone from a playground for nerds into a vast communications and training center where some 300 million people swap information or deals around the world. Remember: it took radio more than 30 years and television 30 years to reach 60 million people! Never has technology caught fire so fast.



Intranet

Many companies have built internal networks using the same software standards as the Internet. Companies use intranets to distribute information and speed data exchange among offices. Intranet activities usually take place behind secure “firewalls” so that only authorized users have access. An intranet can span multiple business locations via the Internet. Recently the intranets are being implemented under the form of enterprise information portals (EIP)³.

Extranet

When a company throws open its internal network – or intranet – to selected business partners, the intranet becomes an “extranet.” Suppliers,

distributors, and other authorized users can now connect to the company's network over the Internet or through virtual private networks. Once inside, they can view data the company makes available.

Companies ranging from Mobil Corp. to NationsBank Corp. are embracing intranets to key business partners over the Internet. Extranets use open software standards to shave networking costs and open the door to innovative applications. Prudential Health care figured that out. The managed-care plan has an extranet linking its internal systems to the corporate networks of large subscribers. That permitted the benefits managers at companies to enroll new employees themselves – rather than sending paperwork or dialing Prudential's call center. It also allows people to check their eligibility and claim status, or change doctors at any hour of the day. The payoff is sweet for Prudential too: the self-service extranet cuts hundreds of calls a day to the company's 800 number.

Extranets are about more than just saving money, though. They also can be a way to forge more intimate business links among partners, allowing them to share business data, even collaborate on product design and development.

Hewlett-Packard Co. and Procter & Gamble Co., for instance, have extranet links to their advertising agencies to swap marketing plans and speed the review of ad comparing. A winemaker, Robert Mondavi Corp., which buys satellite images from NASA to spot problems in its vineyards, aims to push those images out over an extranet to its independent growers. That would improve the grapes within the Mondavi business and also improve relationships with its subcontractors.

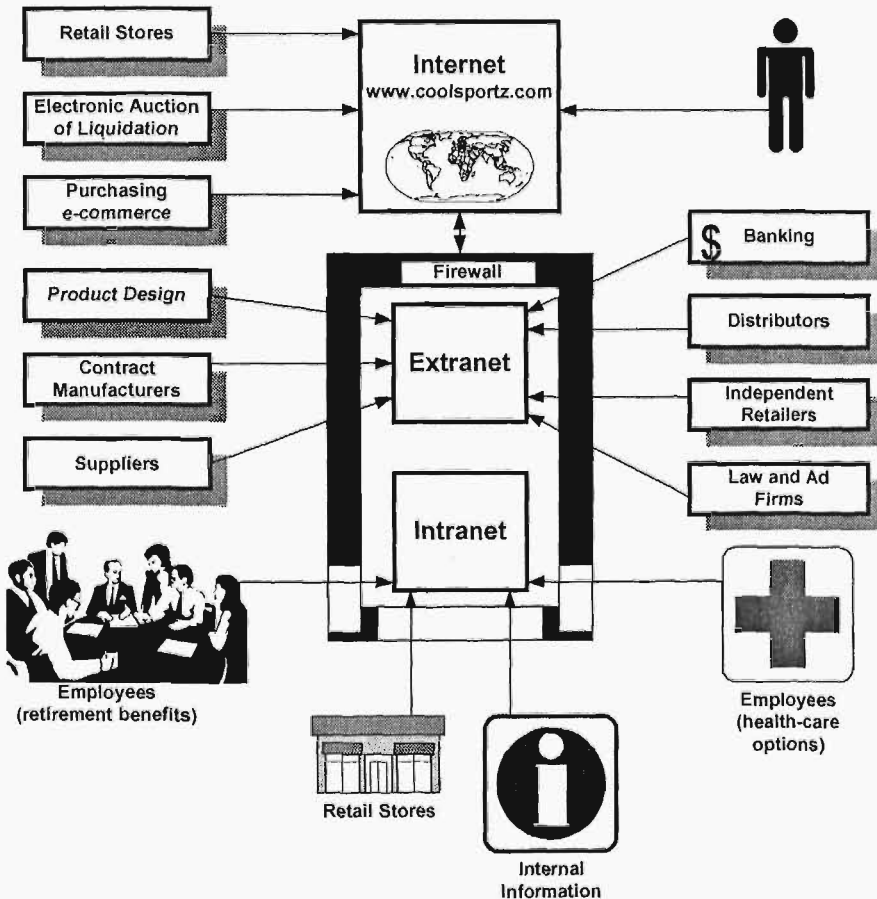
Adaptec Inc., a leading supplier of computer-storage products invested \$1 million for an extranet. Adaptec does not make the chips it uses in its products. Adaptec saves money that way. But the company cannot move as quickly, in some sense, as rivals that build their own chips. In this business you are either fast or forgotten. To speed up communications with Adaptec's Taiwanese chip suppliers, Adaptec developed the extranet to tie all the companies in a kind of virtual *keiretsu*. Now, messages from Adaptec flow in seconds from its headquarters to partners in Asia. More important, the two-way communiqués include not just parts orders but also engineering drawings and detailed manufacturing instructions. Adaptec has reaped great benefits, reducing the time between the order and delivery of its chips from as long as 112 days to 55 days – the same cycle enjoyed by companies that make their own chips. The time for processing purchasing orders fell from six days to minutes, and suppliers stopped having to manually re-enter faxed orders – eliminating

the potential for disastrous errors. Adaptec also saved \$9 million on its work-in-process pipeline.

The complexity of networking based upon the Internet, Intranet, and Extranet is shown on Figure 3-8, where a mythical merchant Cool Sportz (designed by Business Week) uses the Internet for e-business.

Cool Sportz has a private company intranet to communicate with branch stores and employees in remote offices.

Figure 3-8: The Internet-based Cool Sportz Company



The Internet.

Consumers. Cool Sportz's website is promoted in TV ads, and gets thousands of hits a day. From a survey of its site, Cool Sportz collects demographic data, and it advises registered surfers on sales and new products.

Electronic auction. When products do not sell, Cool Sportz auctions them through an online brokerage. The company posts information about the goods at minimum price. Potential buyers enter bids, and Cool Sportz ships the goods to the winning bidder.

The Extranet.

Product design. Cool Sportz enlists freelance designers to create CoolWear products. The designers exchange drawings with Cool Sportz over the extranet. Then Cool Sportz staff and designers can mark them up while talking together live over the extranet.

Manufacturing. For years, Cool Sportz has placed orders with contract manufacturers using Electronic Data Exchange (EDI), an old software standard that is neither cheap nor flexible. Now, Cool Sportz saves money by moving some of these orders over the extranet.

Suppliers. Cool Sportz used to order shoes, ski gear, and camping goods by phone and fax. Now, the company saves time and money by sending orders electronically over the extranet. Some suppliers let Cool Sportz enter their private networks to place orders.

Distributors. Cool Sportz sells its CoolWear products through 2,500 independent sporting-goods stores around the country. Distributors who supply these shops use Cool Sportz's extranet to check on their commissions and read up on new merchandise-marketing programs.

Law and ad firms. To help efficiency, Cool Sportz requires its law firm, accounting firm, and ad agency to belong to the corporate extranet. This ensures privacy and security for e-mail and electronic files. Cool's marketers brainstorm over the extranet with the ad agency.

Banking. While awaiting standards for the Net-based electronic banking, Cool Sportz sends invoices by secure e-mail, which reduces paperwork and speeds up payment. The CFO likes collecting bills faster, but is less eager to see accounts payable go electronic.

The Intranet.

Retail stores. The company collects data from its 1,200 retail stores around the country and fills hundreds of product reorders electronically. All stores are on the Cool Sportz intranet, a secure link that traverses the Internet. Cool Sportz also “pushes” information on promotions and discounts to its stores.

Employees. Instead of phoning the Human Resources department, Cool Sportz staff refer to an electronic version of the employee book on the company intranet. They use a Java-based application to change their investment and health-care options and calculate their retirement benefits. Expense reports filled via the intranet are paid within 48 hours.

COMPUTING LAYER

A computer environment supports information processing in EII through the following building blocks:

1. Computer sets, divided into the following classes:
 - Supercomputers (ex. Cray T90),
 - Mainframe (e.g.: IBM ES/9000),
 - Midrange (e.g.: IBM AS/400),
 - Server (e.g.: IBM RS/6000),
 - Desktop PC,
 - Mobile PC,
 - Network Computer, NC (IBM Network Station),
 - Internet browsers (e.g.: WebTV),
 - Hand-held computers,
 - Other.

2. Operating systems (a layer software that resides between hardware and application, which manages the execution of programs and the data flow among devices), such as:
 - Server/host operating systems (IBM MVS, VSE, VM, OS/400, DEC VMS),
 - Server operating systems (Novell NetWare, MS Window NT server, Unix),