Humboldt County Telecommunications Analysis

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Map courtesy of www.redwoodvisitor.org

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INTRODUCTION

This report is intended to provide information on telecommunications options available (and pending) to Humboldt County businesses. It will give service information by community, including costs provided by the telecommunications vendors. The report will also discuss pros and cons and recommendations for various options based on business requirements. A section of the report will also talk about residential options for Internet access.

Franchised Telecommunications And 1996 Telecommunications Act

Traditionally, telecommunications has been a highly regulated sector. The thinking in the early days of the nineteenth century was that telecommunications is a natural monopoly, and regulations were imposed to protect consumers from the abuses that may come about with monopolies.

The 1996 Act was to reduce regulatory barriers and to spur competition in the telecommunications market. The Act mandates interconnection of telecommunications networks, as well as unbundling, non-discrimination, and cost-based pricing of leased parts of the network, so that competitors can enter easily and compete on services.

Currently, the "last mile" of the telecommunications network that is closest to the consumer (the "local loop") is controlled by a regional phone company, also called an ILEC (incumbent local exchange carrier), which is franchised to provide dial tone in an area.

HUMBOLDT COUNTY FRANCHISED TELECOMMUNICATIONS VENDORS

Humboldt County has three franchised providers of telecommunications: Citizens, Pacific Bell, and Verizon. Cable providers are Cox Communications, Mallard Cablevision, and Starstream Cable.

Citizens

According to their web page, www.czn.net, Citizens Communications is a telecommunications-focused company providing wireline communications services to 2.5 million access lines in 24 states. Citizens is the seventh largest local access wireline telephone provider in the United States. Its stock trades on the New York Stock Exchange (CZN).

In Humboldt County, Citizens covers the Ferndale, Petrolia, and Honeydew areas.

Pacific Bell

According to Pacific Bell's parent company's web page, www.sbc.com, SBC Communications Inc. is one of the world's leading data, voice and Internet services providers. Through its world-class network and its subsidiaries' trusted brands - SBC Southwestern Bell, SBC Ameritech, SBC Pacific Bell, SBC Nevada Bell, SBC SNET and Sterling Commerce - SBC companies provide a full range of voice, data, networking and e-business services, as well as directory advertising and publishing. A Fortune 27 company, America's leading provider of high-speed DSL Internet Access services, and one of the nation's leading Internet Service Providers, SBC companies currently serve nearly 60 million access lines nationwide. In addition, SBC owns 60 percent of America's second largest wireless company -- Cingular Wireless -- which serves more than 21 million wireless customers. Internationally, SBC has telecommunications investments in 28 countries.

Pacific Bell services the majority of the Humboldt County population. It covers Arcata, Big Lagoon, Blue Lake, Bridgeville, Carlotta, Eureka, Fieldbrook, Fields Landing, Fortuna, Freshwater, Hydesville, King Salmon, Kneeland, Korbel, Loleta, McKinleyville, Myers Flat, Rio Dell, Scotia, Trinidad, and Weott, as well as other smaller communities in the area.

Verizon

According to their web page, www.verizon.com, Verizon Communications, (NYSE:VZ), formed by the merger of Bell Atlantic and GTE, is one of the world's leading providers of high-growth communications services. Verizon companies are the largest providers of wireline and wireless communications in the United States, with nearly 134 million access line equivalents and over 29 million wireless customers.

Verizon is also the world's largest provider of print and online directory information. A Fortune 10 company with more than 247,000 employees and $67

billion in 2001 revenues, Verizon's global presence extends to 45 countries in the Americas, Europe, Asia and the Pacific.

In Humboldt County, Verizon covers the southern communities of Benbow, Briceland, Garberville, Redway, and Shelter Cove, and the northern/eastern communities of Hoopa, Orick, Orleans, Weitchpec, and Willow Creek.

Cox Communications
Cox (www.cox.com) provides cable modem services to a wide territory. They rolled out their High Speed Internet services to Humboldt County in 2001. Cox has access to 49,000 households in Humboldt County, about 80% of the population, all within about a 20 mile radius. Their territory's outer boundaries are north to Big Lagoon, east to Blue Lake, and south to Ferndale, Carlotta and Scotia. With the exception of Fairhaven, if you have cable TV, you can get cable modem service.

Other Cable Companies
The cable companies in Willow Creek (Mallard Cablevision) and Garberville (Starstream Cable) do not offer cable modem Internet service.

Non-Franchised Territory
Humboldt County has an area which is not served by a telecommunications company. This is the Yurok reservation, running northwest along the Klamath River about 30 miles from Weitchpec. There is little electrical service to this area as well. Emergency communications are by hand-held radio, which is less than effective in the mountains-and-river-valley terrain.

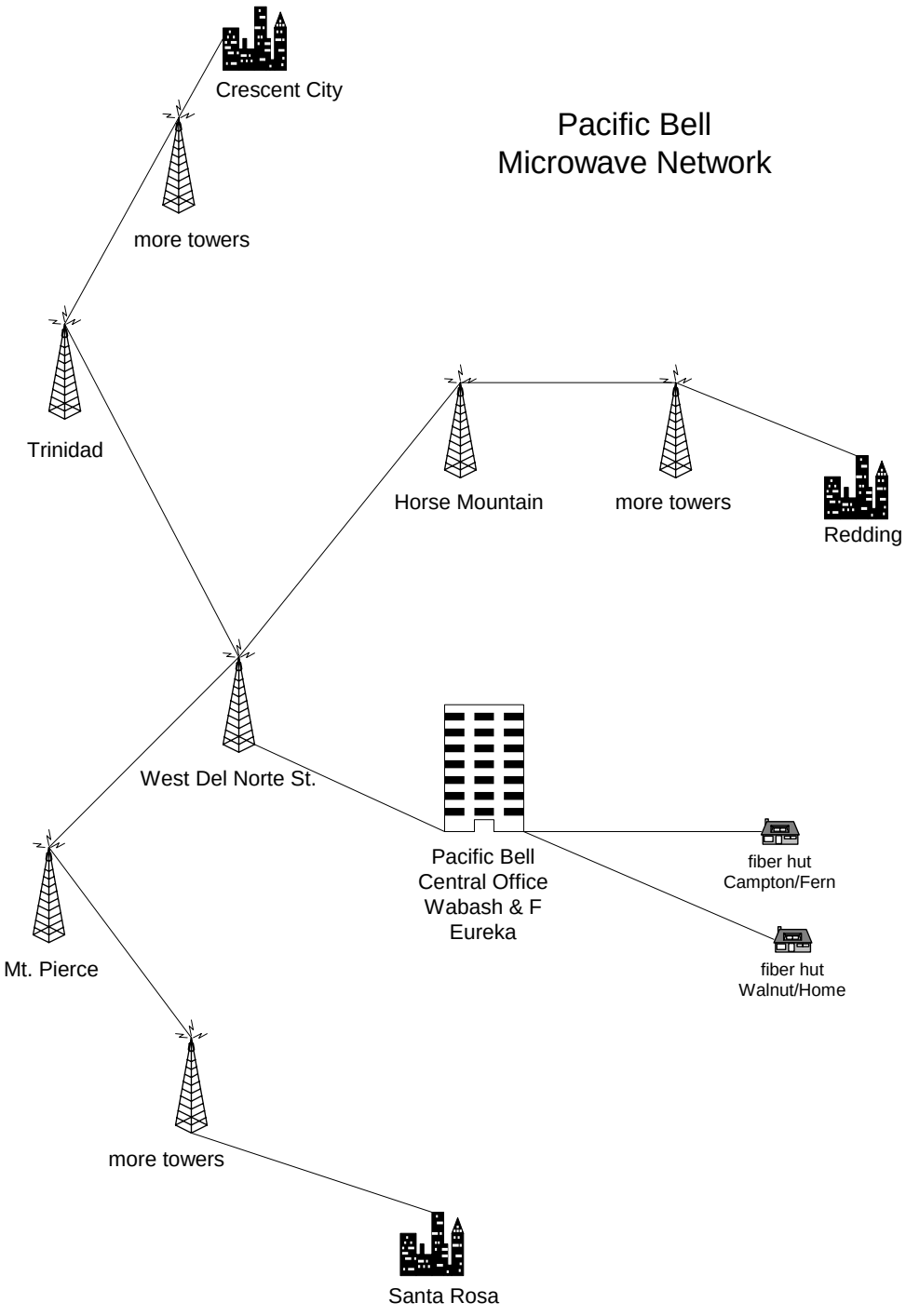
TELECOMMUNICATIONS LIMITATIONS UNIQUE TO HUMBOLDT COUNTY

The Telecommunications Act of 1996 states:
ACCESS IN RURAL AND HIGH COST AREAS- Consumers in all regions of the Nation, including low-income consumers and those in rural, insular, and high cost areas, should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services, that are reasonably comparable to those services provided in urban areas and that are available at rates that are reasonably comparable to rates charged for similar services in urban areas.

Humboldt County residents find this statement laudable, but it is not reality in terms of availability of advanced services other than in central Eureka and central Arcata. The Act may have had impact on a national scale, particularly in urban/suburban areas, but the local loops in rural, remote areas are not competitive and consumers have few choices for advanced services, such as high speed Internet access.

As of this writing, all telecommunications from Humboldt County to the "outside world" and the Internet must travel through the Pacific Bell network of 16ghz microwaves (see diagram next page). This network has two links outside the North Coast: to Redding and to Santa Rosa. In addition, all Del Norte telecommunication are via the Pacific Bell microwave from Eureka to Crescent City. These microwave systems are at capacity and starting to get "bleed through" noise, driving the project to install fiber

Any newcomers to Humboldt County who plan to set up a residence and/or a business are advised to thoroughly investigate their telecommunications options prior to purchasing or renting. Unlike urban/suburban areas, services are limited in Humboldt County. Sparseness of population, remoteness from urban areas, and limited incoming/outgoing bandwidth have not made it cost effective for telecommunications companies to invest in infrastructure. One cannot assume that a "business park" in Humboldt County has adequate telecommunications .


Pacific Bell
Microwave Network
Crescent City
more towers
Trinidad
Horse Mountain
more towers
Redding
West Del Norte St.
Pacific Bell
Central Office
Wabash & F
Eureka
fiber hut
Campton/Fern
fiber hut
Walnut/Home
Mt. Pierce
more towers
Santa Rosa

PACIFIC BELL FIBER OPTICS PROJECT

Since the microwave systems are at capacity, PacBell is working on a fiber optic project to bring 432 fiber strands from Calpella, north of Santa Rosa, to Eureka, a total of 168 miles. This project is considered to be the highest priority PacBell project in California. The work has been in progress for some time.

Engineering is complete, and contractors are working on various portions. The route is a combination of buried cable and overhead (see diagram on next 2 pages). Final test after fiber installation will be done by PacBell.

Installation is via county roads and private rights-of-way in many instances. However, three of Caltrans' bridges and a segment of Highway 101 are included in the project's scope. The project has been delayed for the past 9 months by Caltrans. They want compensation before issuing rights-of-way permits for encroachment on 21 miles of various segments north of Redway.

As of this writing, months of negotiations in the Governor's office are at an end with no resolution. Caltrans and PacBell are now bound for court. PacBell has filed an official complaint that encroachment fees are illegal for a franchised phone company. In addition, there is a preliminary injunction meeting in July, 2002, to ask for permission to continue with the project without waiting for resolution on encroachment compensation.

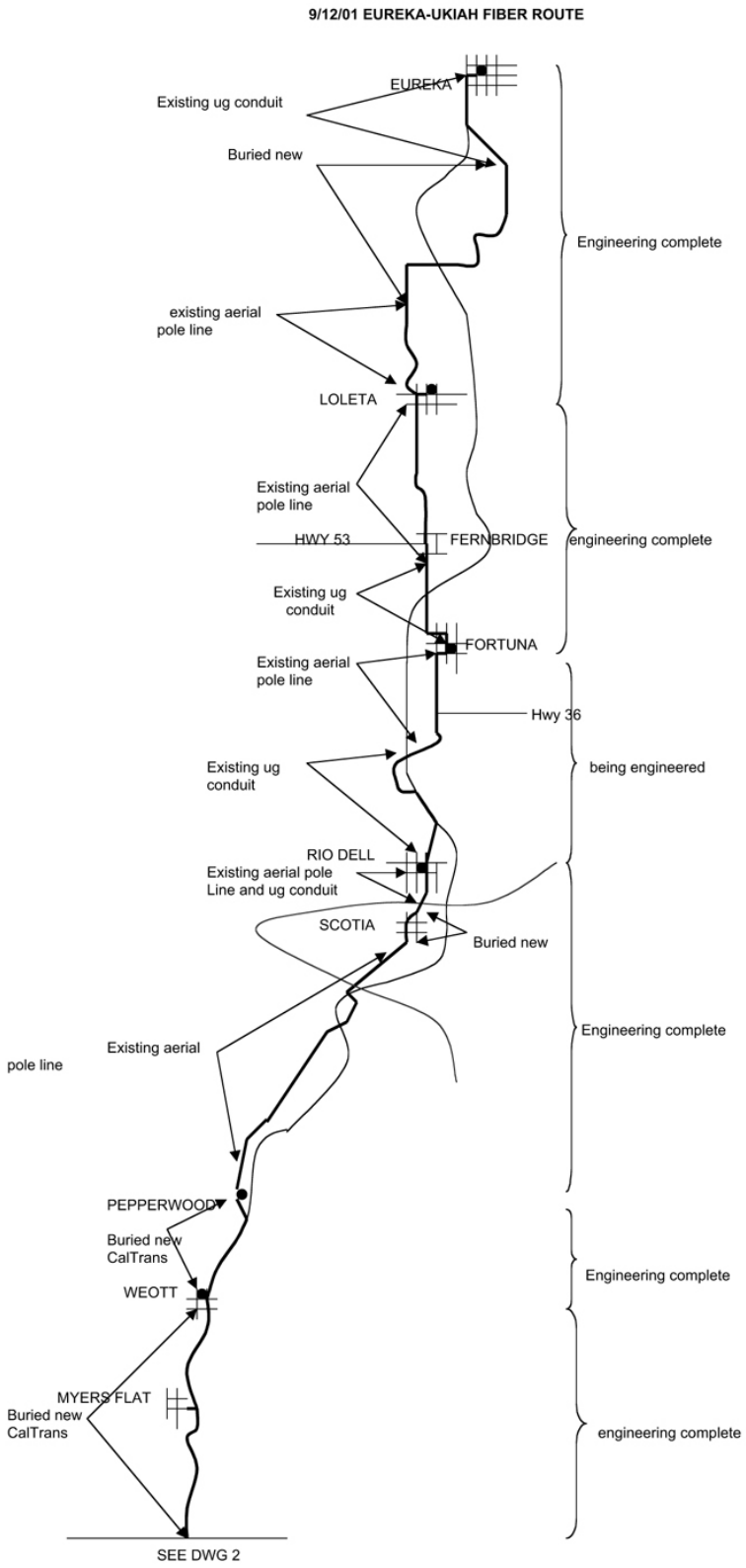
After the fiber optics project is completed, PacBell has plans to extend fiber optics from Eureka to Arcata, Arcata to Blue Lake, Arcata to McKinleyville, and Fortuna to Hydesville.

Local groups, such as the Redwood Technology Consortium, North Coast Leadership Roundtable, and private businesses are monitoring progress and advocating completion of the project, which will bring the needed bandwidth to enable additional services to the North Coast.

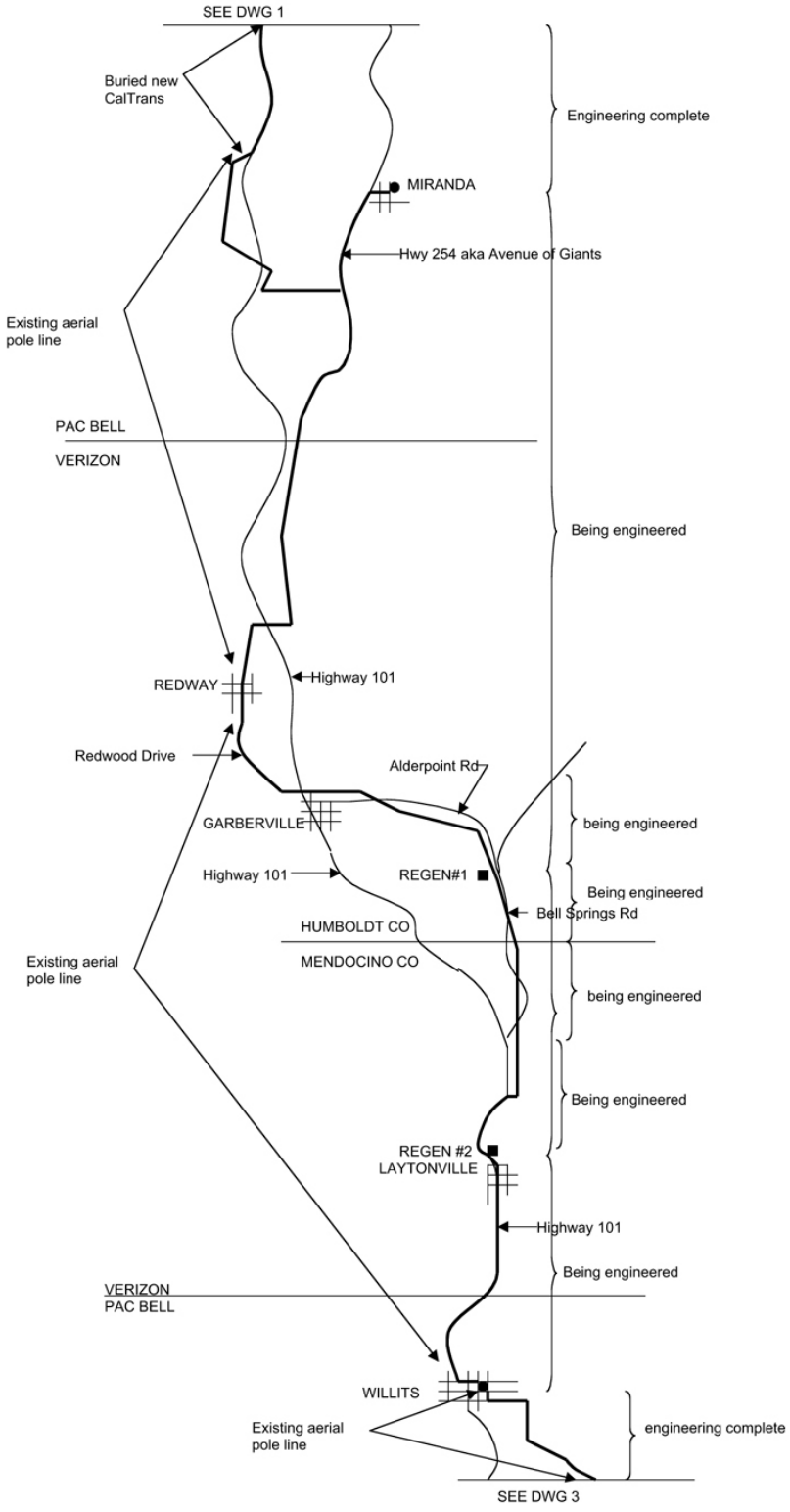
Project Pronto

DSL is being implemented PacBell-wide in *Project Pronto*. This project extends fiber to neighborhood "fiber huts". Without the fiber huts, DSL has a limitation of 18,000 wire feet from the PacBell Central Office (CO). Two of these "fiber huts" are in Cutten, at Walnut & Home and Campton & Fern. However, PacBell will not market DSL in these areas until the fiber project is completed, providing adequate bandwidth out of the area.

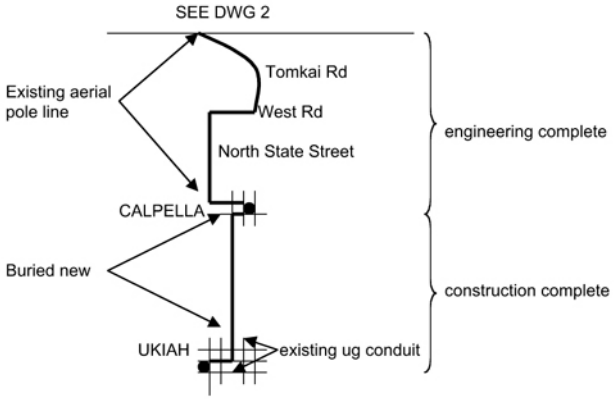
Fiber map, page 1:



Fiber map, page 2:



Fiber map, page 3:



BUSINESS TELECOMMUNICATIONS USAGE

There are several important questions to ask about your business in order to determine what your telecommunications needs are.

- Number of computers?
- What applications will be run across network, if any?
- Type of Internet usage?
- Where will my web site be hosted?
- Will I provide my own e-mail server or will e-mail be hosted at ISP?
- What are my security issues?
- How many business locations to be interconnected?
- If multiple locations, are they in same city or region?
- If multiple locations, is voice and video over network required?
- What are your up-time requirements?
- Do you need a fixed IP address?
- How will your business grow (more sites, bigger single site, online sales, etc)?

Why are these factors important?

Availability of Options.
You can evaluate options better if you know number of computers, number of business sites, and where you host your e-mail, web site, and applications. You may still need to get professional advice, but any professional will ask you the above questions as well as what your future growth will be. You do not want to install one design, then have to go to the expense of changing it soon after as you grow.

Functionality and Cost. The more complexity and functionality – business sites, computers, applications - the higher the cost to get adequate bandwidth, equipment to support it, and on-going support. Fixed IP addresses will cost you more, if they are available from your ISP. You may need fixed IP addresses for some of your applications. With convergence of voice, data, and video all on one network, the complexity goes up as does the cost.

Risk. With Wide Area Networks come uptime issues. If you need nearly 100% uptime, you will need to build redundancy into your network, and that costs more. Internet access points require attention to security with firewalls and virus scanning – no business needs a high risk of viruses or hackers in your network.

Bandwidth/Speed of Various Technologies

Technology	Max Speed (Mbps)
56K Modem	0.056
DSL	Varies (see section/tables/glossary on DSL) See Cable Modem vs DSL comments
Cable Modem	Varies (see section on Cable Modem) See Cable Modem vs DSL comments
T1	1.544
DS3	44.736
Ethernet	10/100/1000 10BaseT/100BaseT or fast ethernet/ gigabit
	These speeds are the maximum the technology allows. Actual speed will be affected by supplier-imposed limits and other factors.

DIAL-UP

Many ISP's provide low-cost dial-up service to the internet. This option requires having a modem installed on your computer and being hooked to a phone line. The computer is configured to dial the ISP, then the user logs on with a username and password to browse and get e-mail.

Why dial-up may not be appropriate in a business environment

If you have a small business with only a few computers needing e-mail and occasional browsing, you may think dial-up will work for you. Before you make that decision, you should consider what costs are associated with giving several people dial-up Internet access. The costs may actually be higher per month than cable modem or DSL with slower performance.

- Every business call will cost you, and even pennies add up over time.
- Every computer will need to have a modem.
- Modems are security risks and people could potentially dial in to your computers.
- If your voice line is used to dial up, your customers can't call you nor can you use the telephone to dial a customer or get technical support while you are online.
- If you use only one modem telephone line shared among several computers, only one person at a time can be online.
- If you have multiple modem lines, add up your monthly charges to see if DSL or cable modem might be more cost-effective.
- ISP's offer a limited number of e-mail usernames on a single subscription. If you exceed that, you may need multiple subscriptions.
- You may need to have one subscription per computer.
- Can they host your web site?

Considering the above factors and adding up costs should tell you whether dial-up is right for your small business.

CABLE MODEM

Cable modem is a cost effective option for Internet access for small businesses with a single office with perhaps 5-8 computers. It costs significantly less to use cable modem than to lease a T1 line. However, cable modems may not be able to handle the traffic loads of larger businesses and businesses who have busy web sites at their sites.

Humboldt County Cable Modem Providers

Cox Communications provides service to much of the county. The other providers, Mallard Cablevision in Willow Creek and Starstream Cable in Garberville, do not provide cable modem service.

Cox Communications

Cox provides business service, which is mostly the same as their residential service – 256K upstream and up to 3M downstream. The Cox High Speed Internet™ services use Pacific Bell DS3 circuits to reach the Internet.

The difference business service has over residential service is in the support that Cox provides and fixed IP addresses. Business accounts are given support priority over residential. There are various levels of installation costs as well, and these are detailed at the end of this report.

The cable modem itself is Cox proprietary technology, so it must be rented from Cox on a monthly basis.

Cable Modems and Security

Cables modems are ordered from a service provider, but there are other important aspects to the installation. Because cables modems are an "always on" technology, you will need to install a firewall for security and a switch or hub to hook up all your computers so they can communicate together and with the Internet. The firewall is not provided by Cox. Sometimes the hardware firewall and switch are built into the same device. Firewalls can be hardware and/or software.

You also need to make sure that all your computers have virus protection installed. Virus protection is not a one-time installation; it requires periodic updates, at least once a week, to combat viruses that are constantly emerging.

DSL (DIGITAL SUBSCRIBER LINE)

DSL is a cost effective option for Internet access for small businesses with a single office with perhaps 5-8 computers. There are several types of DSL, and they are explained best in tables on the following pages and in the glossary at the end of this report. It costs significantly less to use DSL than to lease a T1 line. However, DSL cannot handle the traffic loads of larger businesses and businesses who have busy web sites.

Humboldt County DSL Providers

PacBell provides service in Eureka and Arcata. Call for availability.

There are numerous companies providing DSL. The best way to get a current list of vendors and products is to go to www.dslreports.com. This web site also rates providers' services in terms of "smooth ride, mixed, and horror story". Internet On-Site is a local reseller for several DSL vendors (www.yeolde.com/on-site).

DSL and Security

DSL is ordered from a service provider, but there are other important aspects to the installation. Because DSL is an "always on" technology, you will need to install a firewall for security and a switch or hub to hook up all your computers so they can communicate together and with the Internet. Your service provider does not provide a firewall. Sometimes the hardware firewall and switch are built into the same device. Firewalls can be hardware and/or software.

You also need to make sure that all your computers have virus protection installed. Virus protection is not a one-time installation; it requires periodic updates, at least once a week, to combat viruses that are constantly emerging.

DSL Specifications (from www.thebandwidthplace.com)

DSL	Digital Subscriber Line	Downstream bits/sec	Upstream bits/sec	Notes
ADSL	Asymmetric DSL	Up to 8M	Up to 1 M	The most common DSL technology. Downstream speed is higher than upstream speed.
RADSL	Rate adaptive Asymmetric DSL	Up to 7M	Up to 1 M	ADSL that adjusts dynamically to varying lengths and quality of access lines.
UADSL	Universal Asymmetric DSL	Up to 1.5M	Up to 512K	ADSL with no need for a phone line splitter.
SDSL	Symmetric DSL	Up to 2M	Up to 2M	Same upstream and downstream speed. Can't share the line with voice communication.
HDSL	High bit rate DSL	1.544M	1.544M	Used for years as the basis for T1 lines. Requires 2 pairs of wires.
VDSL	Very High Bit Rate DSL	Up to 51.64M	Up to 19.2M	Still in development. Can be asymmetric or symmetric. Highest speeds at short distance only.
IDSL	ISDN DSL	128K	128K	Can reach farther distances than ADSL or SDSL. Unlike true ISDN, it's used only for data.

Distance is important with DSL. At 5,000 feet, you will have no problem getting all speeds. From there on out, speed capability will lessen accordingly and only certain DSL services will work. Pricing varies with speed.

Cable length	Max Downstream
To 9,000 feet	8.5M
To 12,000 feet	6.3M
To 16,000 feet	2M
To 18,000 feet	1.5M
To 22,000 feet	RADSL or IDSL only
22,000+ feet	IDSL only

TWO VIEWS ON CABLE MODEM VS DSL

Cable modem vs DSL, according to www.dslreports.com/faq/129

Cable modems are typically faster for downloads than most if not all DSL lines, when the cable infrastructure is new or well maintained. However, cable has a few disadvantages to DSL.

The first disadvantage is that cable is an RF (radio frequency) network -- this means that it is vulnerable to transient problems "within the network" from RF interference. Since cable is a shared media, there is a possibility that performance may degrade over time as additional households plug in, connect additional devices (videos, game machines) to the TV lines.

A cable company may react slowly to decreases in performance, as they never sell access by speed, or promise consistent speed or latency.

One of the largest disadvantages of cable over DSL is the upstream (return path). Cable companies are using a very narrow band for return signaling, below all the space allocated for TV channels. This band is prone to RF interference and is very limited in capacity. Upstream transmissions may therefore compete with others in the area, get delayed (suffer high latency) due to noise fighting techniques, and cable Terms Of Service typically prohibit any kind of constant upstream use. Internet use is shifting away from central servers broadcasting to many individuals and some interesting peer to peer applications are appearing (games, voice and video applications, communal libraries). These applications need a strong upstream channel.

In summary, cable modems are currently good value and strong competition for residential casual use, often available more cheaply and far faster than their ADSL competition. However, DSL is probably the more future-proof system, offering digital direct from the internet infrastructure. If your DSL ISP is on the ball, your performance in either direction will not be different from peak hour to early morning, and DSL lines are available for a wide variety of purposes, both business and residential.

Cable Modem vs DSL, according to www.thebandwidthplace.com/tech/?v=dslvcable

This is the hottest topic in our discussion forums and is certainly a question asked by most people looking for high speed home Internet connections. Depending on who you ask, you will get very different stories. There is no shortage of both horror stories and praise for both technologies. And that, unfortunately, is the answer - neither Cable nor DSL is better all the time. It depends completely on your local provider.

Despite what some companies would like you to believe, DSL connections are shared Internet connections. With cable connections you share the connection to your ISP with your neighbors. It is true that with DSL you do not share with your

neighbors and so have your own private connection to your ISP. At the ISP all their users share the ISP's connection to the Internet. This applies to cable, DSL, satellite, dial-up… everything.

As a consumer shopping for a connection your best bet is to talk to people in your area who own the connections you're considering. Cable is highly dependant on the neighborhood and DSL is highly dependant on the physical distance from your house to the nearest ISP CO (central office). This means that experiences vary not only from city to city but even inside the city and inside the same provider. In addition to transmission speed you have to consider price, installation time, and customer support, all factors that depend on the ISPs, not the technology.

THINGS TO CONSIDER: DSL, CABLE MODEM, OR A WAN

When your business has two or more offices, you need to evaluate your business processes and software applications. If the offices are essentially standalone, DSL at both locations may work for you. If they are not standalone from a business perspective, for instance, you need to share files or access a company accounting application or distribution software, you have to consider other options.

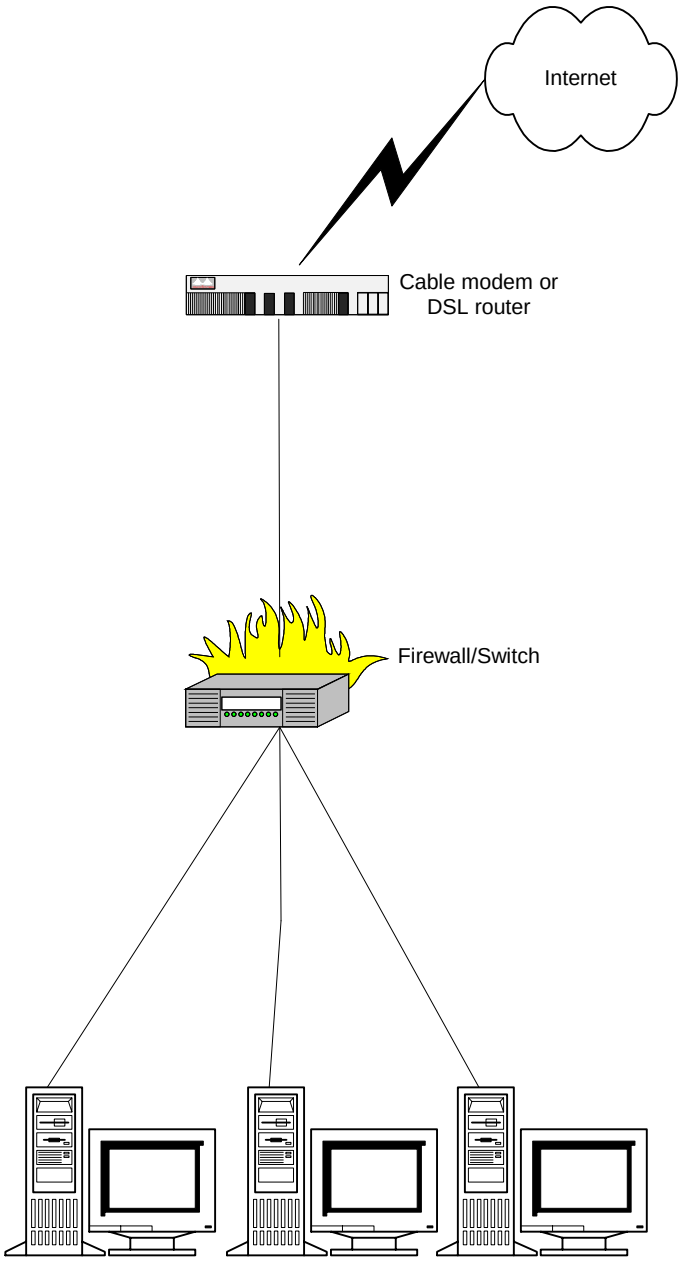
Here are two options to consider.

1. Use DSL or cable modem and Virtual Private Network (VPN) technology to communicate and share data/applications between offices. This adds complexity and support issues, but provides secure communication at a lesser cost between offices by using the Internet. This means you do not have to install a Wide Area Network (WAN). If you have more than two offices, this may not be practical. This option works best for small offices without very many computers.

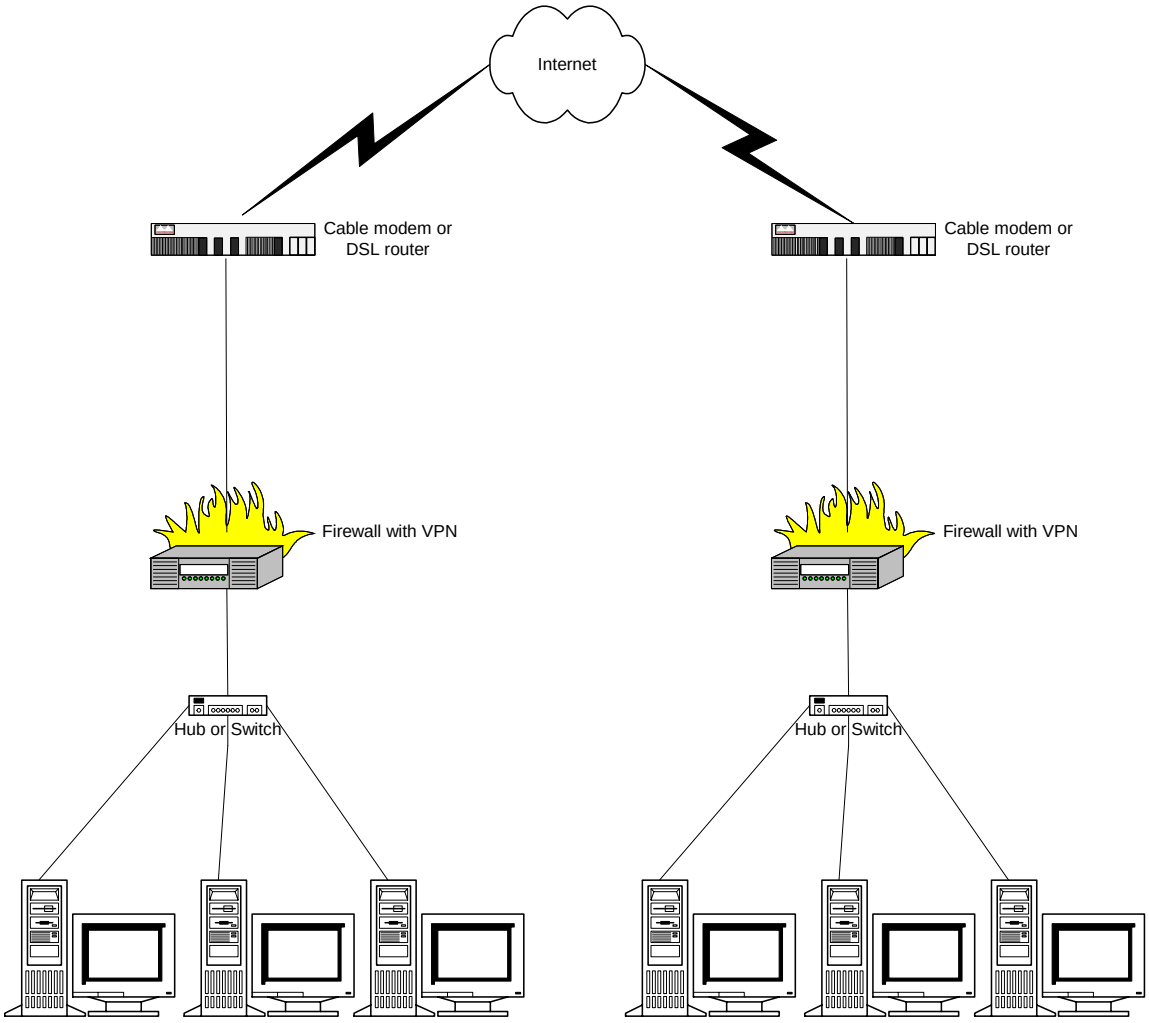
2. Build a WAN to provide private, secure communications, especially when there are more than two offices and many applications that need to be shared. Building a WAN entails leasing lines (T1 or fractional T1, perhaps frame relay) between offices and purchasing/installing routers. You would also have to purchase another leased line to the Internet via an ISP. The costs will be higher, but multiple locations and business complexity require this model. This option works best for more computers and more intensive communications between the offices and to the Internet.

For both these scenarios, you will want to get professional help in design, implementation, and ongoing support. Take a look at the sample network diagrams on the following pages – they include a DSL/cable modem office/home network, DSL/cable modem with VPN between sites, and two types of WAN having three offices. Note the difference between frame relay and T1 WAN's – frame relay does not have point to point lines coming into home office – it has lines going into the telco's "cloud" and only one home office line which aggregates the traffic from the remote offices.

SAMPLE DSL/CABLE MODEM NETWORK



SAMPLE DSL/CABLE MODEM NETWORK WITH 2 OFFICES AND VPN



WIDE AREA NETWORKS (WAN's)

T1

T1 leased lines provide 128K to 1.544M bandwidth on your Wide Area Network (WAN). These are higher cost lines than DSL and equipment but give you secure, dedicated bandwidth between sites or to your ISP. The price is dependent upon bandwidth purchased.

T1 lines, often called point to point T1 lines, are most cost-effective when they are located in about a 15 mile radius. Because they are billed per mile outside of your local phone company Central Office (CO), the cost can rise significantly.

When T1's are needed to another part of the state, often you will need to use another telecommunications carrier to provide the circuit out of the Local Access and Transport Area (LATA) to other regions.

Frame Relay

Frame relay is a cost-effective way of getting T1 or fractional T1 bandwidth, especially for the longer distances or out of the region.

T1 Point to Point vs Frame Relay, according to www.thebandwidthplace.com

A T1 line and an SDSL line use the same underlying technology - HDSL. The differences between them are not in performance, they are in ease of provisioning and speed of repair.

In the US, lines for T1 data are normally treated as higher importance by telcos than DSL lines, so time to repair and provisioning can be considerably faster. A T1 fault may be repaired within hours, or a day, whereas a DSL line fault could be a 5 day turnaround time.

The other important difference is that T1 lines are more easily repeated to cover longer distances, something that has not yet happened for SDSL lines.

T1 lines are significantly more expensive than DSL lines, a monthly T1 lease, with internet bandwidth, can amount to $1000 or more, compare that with SDSL prices of a few hundred dollars for the same speed.

DS3

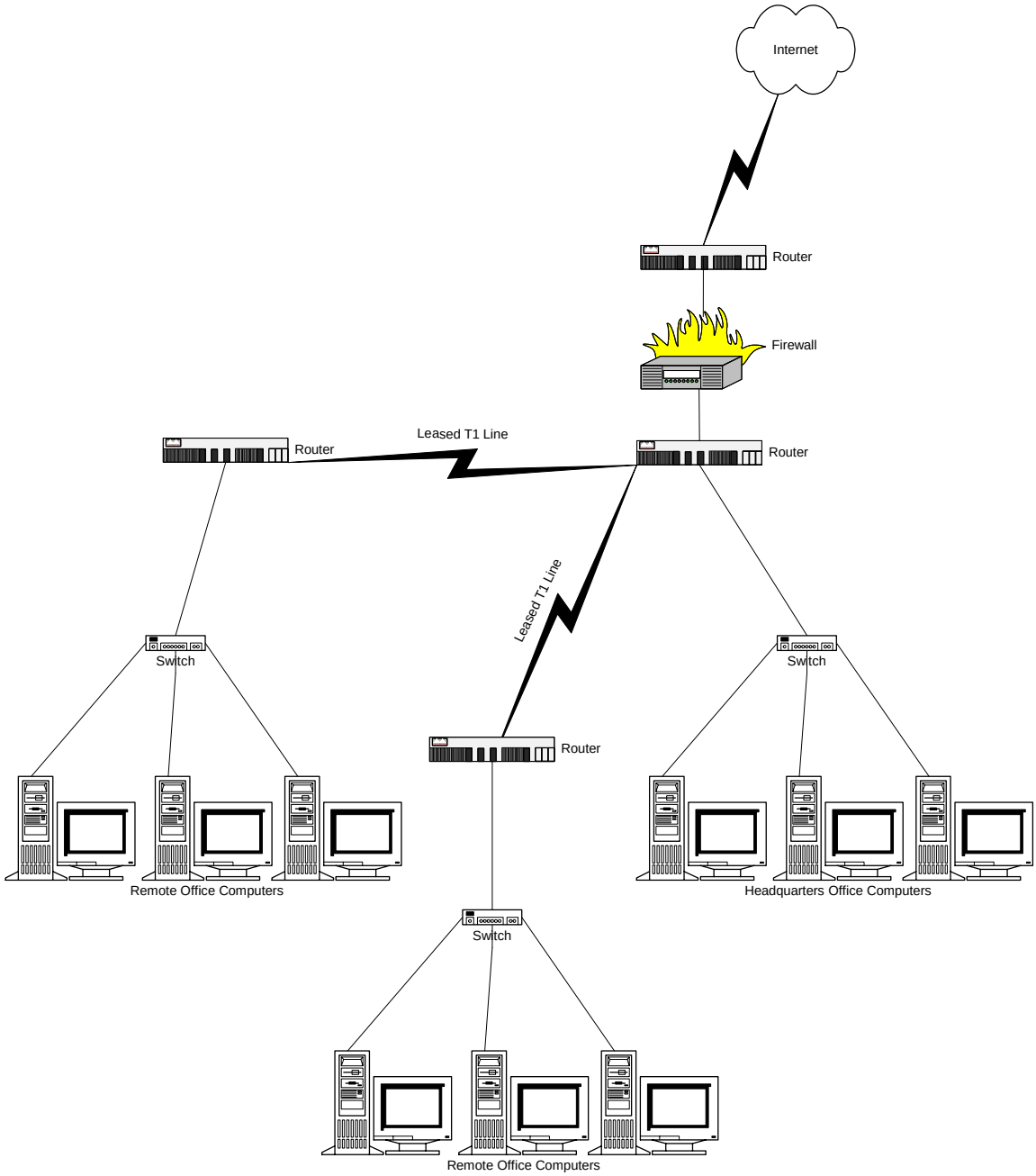
DS3, sometimes called T3, is used for very large bandwidth applications. ISP's often use DS3's to the Internet. Large companies with many offices use DS3. Currently, DS3 service is available in Eureka, but only within the area, not to the "outside world". When the fiber optics project is completed, DS3 services will be available outside the area.

ATM

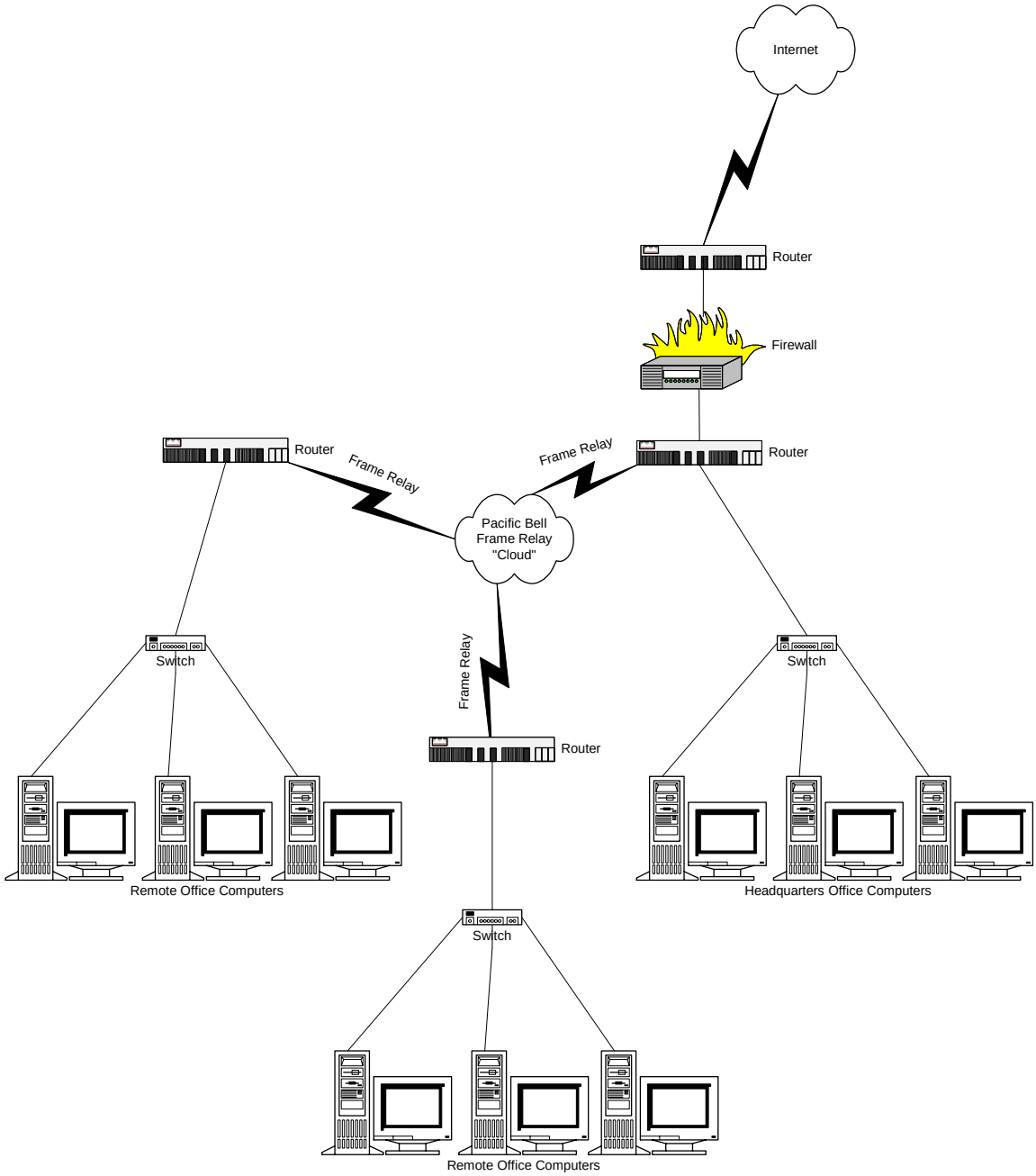
ATM is a newer technology that many people think is the answer to Internet bandwidth problems. It transfers data in packets of small, fixed size over a fixed channel. This means that different types of data over the same network, whether video, audio, or data, all take the same path and no one type of packet can hog the line.

This service is generally used by large companies. ATM service is not available out of the Humboldt County area.

SAMPLE T1 WAN DIAGRAM (3 offices)



SAMPLE FRAME RELAY WAN DIAGRAM (3 Offices)



ISDN

With the advent of DSL and cable modem, ISDN Basic Rate Interface (BRI) usage is not generally considered as useful as it once was for data connections. Several years ago, it was seen as a way to get double the bandwidth of dial-up. With the advent of DSL, cable modems, and frame relay, and their greater bandwidth, ISDN is used less.

ISDN Primary Rate Interface (PRI) is used widely for telephony applications or by ISP's for dial-in usage. PRI lines can come into a business via a T1 and this single line provides 23 phone lines in a single wire.

Now ISDN BRI is generally used for two purposes:

1. Videoconferencing. Many videoconferencing technologies use ISDN to dial to remote locations to provide bandwidth. To get best performance, many people use 3 lines to get 384K bandwidth.
2. Backup lines for Wide Area Networks. Often ISDN BRI lines are used to provide a backup or failover path when T1 lines on a WAN go down. They are slower, offering only 128K. However, they can help keep critical business functions alive until the T1 lines are back in service.

In these two instances, ISDN can work well. ISDN service depends upon the telephone company quality of facilities and service in each region. I have lived in areas outside Humboldt County where ISDN services were unstable at best, and I do not have any hard data on how good the services are in Humboldt County, though I have heard anecdotal information, both good and bad. It would be best to ask for and check references of other customers if you are considering these services.

WIRELESS

Wireless usually refers to Microwave or Spread Spectrum. These technologies can be very desirable where "land-line" communications are not possible or not cost-effective.

Microwave operates at a frequency over 150MHz and requires line-of-sight. There are assignments of frequency to military and common carrier. Microwave communications are often used for WAN's or to extend service to a remote building that have geographical challenges for installation of cabling. Microwave communications are point to point, a specific frequency, and can go up to 60 miles. The bandwidth is 1.5-622 Mbps, and must be licensed by the FCC. Cost is $25,000 on up.

Spread spectrum is a form of wireless communications in which the frequency of the transmitted signal is deliberately varied. This results in a much greater bandwidth than the signal would have if its frequency were not varied. Spread spectrum communications can be point to multipoint and can go up to 6 miles. The bandwidth is less than 10Mbps and does not have to be licensed by the FCC. Cost is much lower than microwave (<$20,000).

Wireless issues
There are at least three problems with conventional wireless communications that can occur under certain circumstances:

1. Weather conditions, especially rain/fog, can affect signal.
2. Interference is possible when another signal is transmitted on or near the frequency.
3. Signals can be intercepted, so it is not optimal for secure applications or data.

SATELLITE

Satellite system, other than in very large companies with commercial-grade satellites, usually refer to systems such as Starband or DirectPC, which are more oriented toward residential use. These systems would be more appropriate in very small businesses with only a few computers.

VIDEOCONFERENCING

With our remoteness on the North Coast, videoconferencing is a way to have virtual meetings with people outside the area without having to travel far. There are different types of videoconferencing:

1. A point to point system involves either two computers (or specialized videoconferencing equipment) outfitted with special camera, microphone, and speakers and the two participants speak to each other over the network. This can be accomplished over the Internet, Wide Area Network, or by dialing with ISDN lines to the remote site.
2. Multipoint videoconferencing allows several participants to have a virtual meeting. This requires specialized equipment and ISDN lines (usually).

Doing your own videoconferencing is not a trivial or inexpensive effort if you need high quality. There are often "glitches" with phone lines, software, or equipment. If you do not have adequate bandwidth, you will get the "talking heads" effect. Many business people would rather have a high quality audio conference, especially when there is no "show and tell" and you are well acquainted with those at the other end of the line.

Videoconferencing is especially nice in situations where you might have a product to show, where each site can be looking at plans or schematics and then point to the product to clarify critical dimensions. Videoconferencing can also be a way to "meet" people for the first time. Travel costs and time are greatly diminished by successful videoconferences.

There are videoconferencing facilities in Humboldt County where one can pay to go and have professionals coordinate, set up, and execute your conference. Their facilities have room for groups. Costs vary. These organizations include Cox Communications in Eureka, Internews Network in Arcata, Humboldt State University, and College of the Redwoods.

BUSINESS TELECOMMUNICATIONS OPTIONS

Usage	Type of Internet Access	Company	Speed	Monthly Approximate Cost	Installation Cost
Single office, small number of computers, e-mail with few "attachments", minimal browsing	Dial-Up	Various	56K maximum	$10-25, often based upon number of hours used per month	Setup cost varies, but usually $15-25
Single office, small number of computers, e-mail, extensive browsing, large file transfers	Cable Modem	Cox	256K upload, up to 3M download	$109	$99-149 depending upon having NIC card/ self install/ complete install plus firewall equipment
Single office, small number of computers, e-mail, extensive browsing, large file transfers	DSL	PacBell, various	128-384K upload, 1.5M download	$49-179	$99-200, plus service order fee and equipment fee
Small number of offices, need to share some data in between offices	DSL or Cable Modem with VPN	Cox, PacBell, various	See above	$49-179 per office	$99-200, plus DSL equipment fee and service order fee
Technology-based company with high-traffic web site or many computers using Internet	T1 (also with WAN if multiple offices)	PacBell if in same region, various if several regions	56K-DS3	$300-2000+ depending upon design	$600-1000+ per line depending upon services; additional for hardware
Multiple offices, many computers	Wide Area Network (WAN) of T1 or frame relay	PacBell if in same region, various if several regions	56K-DS3	See vendor pricing for your design	See vendor pricing for your design

RESIDENTIAL TELECOMMUNICATIONS USAGE

There are several options in Humboldt County for residential use of the Internet. For residential use, one of these options should suffice. Don't confuse home usage of these products with business usage – the needs are usually very different. Pricing is detailed in a separate section of this report.

Evaluate Your Options

Depending upon your Internet usage, you may need only dial-up connectivity. You may need more bandwidth/speed, such as cable modem or DSL, for gaming, vidoconferencing, extensive browsing, or transferring large files to web sites. You may also need to have out of town web access to your e-mail. Because of the investment and monthly expense, it's best to look into all available options before deciding.

Dial Up

Dial up Internet access uses a phone line, known as "POTS" – plain old telephone service. It rarely supplies the full 56K bandwidth of the line, which can be too slow for some functions, such as video or on-line gaming. Dial-up options are available from a number of companies, ranging from local Internet Service Providers (ISPs) to large companies such as AOL and Earthlink.

Before you sign up with an ISP, check in your phone book or with your phone company that the ISP has a local number to dial or you will incur expensive long distance charges. There are places in Humboldt County where ALL calls are long distance (Orick is an example of that).

Cable Modem

Cox Communications provides their High Speed Internet services to Humboldt County residences. Their service uses a cable modem to provide 256K upload speed and up to 3MB download speed. For home use this works well, since downloads generally, but not always, require higher speed, or bandwidth.

The cable companies in Willow Creek (Mallard Cablevision) and Garberville (Starstream Cable) do not offer cable modem Internet service.

Digital Subscriber Lines (DSL)

There are several types of DSL services, which will be detailed in a later section on DSL for business use.

According to www.webopedia.com, DSL technologies use sophisticated modulation schemes to pack data onto copper wires. DSL is sometimes referred to as "last-mile technologies" because they are used only for connections from a telephone company switching station to a home or office, not between telephone company switching stations. Usually, your residence must be less than 18,000 feet (wire feet, not as the crow flies) from the phone company's central office.

PacBell offers DSL service in Eureka and Arcata, and they have plans to offer service elsewhere when the fiber optics project from Santa Rosa to Eureka is completed. Until the fiber optics project is complete, residences in Humboldt County will continue to have difficulty ordering DSL from PacBell.

Other companies also offer DSL services in Humboldt County. Generally, DSL download speeds are 1.5M and the upload speed may be 128K or 384K depending upon the product.

An excellent web site for DSL information is www.dslreports.com. This site has great features, particularly frequently asked questions (FAQ's), definitions, and the ability to enter your zip code to find service providers.

Satellite

One-way and two-way satellite broadband is available through such various companies, such as Starband and DirectPC. These companies usually have higher installation costs due to the dish and equipment required.

One-way systems use a phone line via dial-up for the upstream traffic.

Weather conditions may affect reception and your house must have *line of sight*, with no obstructions, to receive signals. Download speeds are in the range of 500K, making it up to 10 times faster than dial-up. Satellite is very useful in areas where no other service is available.

Security

At our businesses, we rely on an IT department to take care of many security issues, but at home, precautions need to be taken as well. ISP's do not provide virus scanning or firewalling. Virus scanning should be resident on every computer and updated on a frequent basis, usually weekly. If you choose DSL or cable modem, you need to make sure you install a firewall to protect your computers, since the vendors do not provide this important service. Linksys broadband router/firewall/switch can provide a hardware firewall that several computers can hook up to for around $100.

RESIDENTIAL INTERNET OPTIONS

Usage	Type of Internet Access	Company	Speed	Monthly Approximate Cost	Installation Cost
e-mail with few "attachments", minimal browsing	Dial-Up	Various	56K maximum	$10-25, often based upon number of hours used per month	Setup cost varies, but usually $15-25
e-mail, extensive browsing, on-line gaming, video, large file transfers	Cable Modem	Cox	256K upload, up to 3M download	$45	$49-149 depending upon having NIC card, self install, complete install
e-mail, extensive browsing, on-line gaming, video, large file transfers	DSL	PacBell, various	128-384K upload, 1.5M download	$50-150	$99-200 depending upon install level, add $198 for equipment
Remote areas, faster than dial-up	Satellite	Various	500K	$60	$800+

THE INTERNET

The Internet is a world-wide distributed system. It is not a single company or a single network, nor is it controlled by a single organization. It is a mesh of many thousands of networks. There is redundancy so that it can recover from localized failures. Your ISP can be considered your “onramp” to the Internet. There are many thousands of ISP’s world-wide. If your ISP is down, it may look to you like the Internet is down, but it is not. Your ISP routes your packets requesting a remote web server or routes your e-mail to its destination. The biggest ISP’s are often called “backbones”, and they carry large amounts of the Internet’s data.

Internet Bandwidth Basics, according to www.thebandwidthplace.com
The backbone of the Internet is connected networks of high capacity communication lines. A dedicated connection to the Internet backbone that operates all the time, at the full capacity of the connection technology, is extremely expensive. Since end users rarely require 100% of the available bandwidth all the time, ISPs will purchase these expensive dedicated connections and use them to run multiple connections of various sizes to their end users. This is called "over-subscribing", and is a technique used by the Internet Service Provider Industry to realize a profit margin when providing dedicated connectivity to consumer users. Over-subscription is usually based on a bandwidth ratio and typically ranges from 4:1 to 20:1 depending on the service being provided. Over-subscription may actually occur several times before it reaches the end user.

Internet providers are measured in "Tiers". A Tier 1 provider maintains their own national network and provides their customers a 1:1 bandwidth ratio. The major Tier 1 service providers are in a "peer" relationship allowing traffic from users on separate networks to communicate seamlessly. As you move down in Tier levels of providers you encounter over-subscription rates at a higher degree as the ISP's resell the bandwidth from a higher Tier. The lower tiered ISP's have to have some sort of limit in place for their non-committed or consumer dedicated product or there would be no economical way they could provide service to thousands of end users.

Some companies require a guaranteed minimum bandwidth and pay for that at a premium. For instance a 2mb/s (Megabits per second) DSL connection may cost $500 a month while a Fractional T3 with a committed bandwidth of 2mb/s will likely cost over $2000 a month. While that 2mb/s DSL line is capable of operating at 2mb/s, if all the DSL users of that ISP were downloading at once everyone's connection would slow down. This is often observed with residential connections at "peak hours" like the early evening, also referred to as the "Internet rush hour".

Your ISP isn't selling you a connection to the Internet per se, they are selling you a connection to their network that is connected to the network of their provider and so on. This continues up to the top Tier 1 networks that are connected to each other. All these networks and servers and end users' computers together make up the Internet.

CITIZENS PRICING

POTS	
residential install	$37.25
mo.measured rate	$9.60
mo. flat rate	$17.85
business install	$60.00
monthly flat	$43.70
monthly measured	$25.25
DSL	Not available
T1 pt/pt	
installation	$1,400.00
monthly charge	$475.00
mileage	$25.00
Frame Relay	Not available
DS3	Not available
Internet Service	Not available

Communities:
Ferndale, Honeydew, Petrolia

COX HIGH SPEED INTERNET PRICING

Residential	Monthly Service	Cable Modem Monthly Rental	Total Monthly
Monthly Cost	$34.95	$10	$44.95
Self-Assisted Install	$49.95		
Professional Install with NIC	$119.95		
Professional Install without NIC	$149.95		

Business	Monthly Service	Cable Modem Monthly Rental	Total Monthly
Monthly Cost	$99	$10	$109
Self-Assisted Install	$99		
Professional Install with NIC	$119		
Professional Install without NIC	$149		

Notes:

- Check web site www.cox.com for minimum computer requirements.
- Self-assisted install customers load system software themselves and must supply and install their own Network Interface Card (NIC).
- Cable modem rental is required (proprietary hardware).
- Non-Cox Cable TV customers pay a higher monthly fee.
- Business service receives priority support 24 hours.

PACBELL PRICING

POTS				
residential install	$33.01			
mo.measured rate	$6.55			
mo. flat rate	$11.54			
business install	$67.21			
monthly	$13.04			
DSL	(charges can vary based on promotions)			
Monthly charge	$49-179			
Basic install	$99	(splitter work not included)		
Full install	$200			
Service order fee	$50			
Equipment charges	$198			
56K pt/pt				
nonrecurring charge	$597.37			
monthly charges	$47.41	Per channel, requires 2 channels		
T1 pt/pt (full T1)				
installation	$600.69			
monthly charges	$164.96	(per channel)		
Fixed Mile Cost	$125.00			
Miles ea.	$25.00	(multiply by no of miles)		
Frame Relay		1yr	3yr	5yr
	128k	$308	$291	$279
	Install	$956	0	0
Frame Relay		1yr	3yr	5yr
	384k	$440	$422	$405
	Install	$956	0	0

Pacific Bell (continued)

DS3	1yr	3yr	5yr
installation	$ 2,370.53	$ -	$ -
monthly charges	$ 2,560.17	$ 1,706.78	$ 1,327.49
Internet Service (T1)	Price offerings vary month to month, call for information		

VERIZON PRICING

POTS*	
residential install	$23.00
mo.measured rate	$10.00
mo. flat rate	$16.85
business install	$49.57
monthly	$19.22
DSL	Not available
56K pt/pt***	
access line install	$1,022.59
nonrecurring charge	$264.87
service order charge	$81.39
transport	$3.28/mile
termination	$50.00
special access line (monthly charge)	$270.00
T1 pt/pt***	
installation	$650.00
digital access	$3.34/mile
transport	$25.00
special access line (monthly charge)	$68.00
Frame Relay	Not available
DS3	Not available
Internet Service	Not available

Notes:

* Even if a customer is in service territory, facilities are not available at all locations. The service office can verify with a specific address.

** The custom calling services in these area and their monthly rates follow:

Flexible call forwarding	$2.50
Fixed call forwarding	$1.25
Call waiting	$3.50
Speed dialing	$2.50-3.50
Three-way calling	$3.50
Distinctive ring	$6.00
Remote call forwarding	$16.00

*** Per system charges. Does not include supplemental features.

Communities:

Benbow, Briceland, Garberville, Hoopa, Orick, Orleans, Redway, Shelter Cove, Weitchpec, Willow Creek

FUTURES/ADVOCACY

Congress and the FCC need to continue to enforce the law to ensure that more competition comes about across the country, not just in urban/suburban areas. The public is urged to support competition since it will lead to more choices and better pricing. Because Humboldt County is a rural, remote region, change is slower to come. There is little competition and many services required by larger companies are not available.

Future services that we know of now are:

- PacBell will offer DS3 services when fiber optics project is completed.
- PacBell is ready to offer DSL services in Cutten after completion of the fiber optics project.
- PacBell has discussed offering different levels of DSL service after completion of the fiber optics project.
- Starstream Cable in Garberville would like to offer cable modem service after they upgrade their infrastructure.
- Cox is looking at using non-proprietary hardware for their cable modem, which will reduce the monthly cost by $10. Customers can then buy their own, saving money after less than a year.
- Cox will discuss custom services with businesses.

Rumors are abounding recently about cable modem providers putting a cap on bandwidth and charging for higher bandwidth use. This article discusses recent events: http://zdnet.com.com/2100-1105-885608.html

RESOURCES

Small Business Development Center 707-443-5057
Redwood Region Economic Development Commission 707-445-9651
520 E Street
Eureka CA 95501
(both are located in same building)

Internet Service Providers
Local Yellow Pages
www.findanisp.com

Redwood Technology Consortium (Humboldt -Del Norte industry cluster group)
www.redwoodtech.org
Members include a DSL reseller, web site hosting companies, hardware support services, marketing services, ISP's, software consulting services, web development, technology integrators, and much more.

Web site for DSL availability from vendors other than PacBell
www.dslreports.com
Internet On-Site (reseller) - www.yeolde.com/on-site (Covad, MegaPath, TransEdge)

Web sites for information and definitions
www.thebandwidthplace.com
www.webopedia.com
www.whatis.com

Videoconferencing
College of the Redwoods
Humboldt State University
Cox Communications
Internews Network www.internews.org

Your Local Phone Company
Pacific Bell – www.sbc.com
Citizens – www.czn.net
Verizon – www.verizon.com

Cable modem vendor
Cox Communications – www.cox.com

GLOSSARY OF TERMS
Many of the explanations of these terms came from www.webopedia.com and www.whatis.com.

ATM - Short for Asynchronous Transfer Mode, a network technology based on transferring data in cells or packets of a fixed size. The cell used with ATM is relatively small compared to units used with older technologies. The small, constant cell size allows ATM equipment to transmit video, audio, and computer data over the same network, and assure that no single type of data hogs the line.

Some people think that ATM holds the answer to the Internet bandwidth problem, but others are skeptical. ATM creates a fixed channel, or route, between two points whenever data transfer begins. This differs from TCP/IP, in which messages are divided into packets and each packet can take a different route from source to destination. This difference makes it easier to track and bill data usage across an ATM network, but it makes it less adaptable to sudden surges in network traffic.

When purchasing ATM service, you generally have a choice of four different types of service:

- **Constant Bit Rate (CBR)** specifies a fixed bit rate so that data is sent in a steady stream. This is analogous to a leased line.
- **Variable Bit Rate (VBR)** provides a specified throughput capacity but data is not sent evenly. This is a popular choice for voice and videoconferencing data.
- **Unspecified Bit Rate (UBR)** does not guarantee any throughput levels. This is used for applications, such as file transfer, that can tolerate delays.
- **Available Bit Rate (ABR)** provides a guaranteed minimum capacity but allows data to be *bursted* at higher capacities when the network is free.

Bandwidth - The amount of data that can be transmitted in a fixed amount of time. For digital devices, the bandwidth is usually expressed in bits per second (bps).

BRI - Short for Basic-Rate Interface, the basic ISDN configuration, which consists of two B-channels that can carry voice or data at rate of 64K, and one D-channel, which carries call-control information. Another type of ISDN configuration is called Primary-Rate Interface (PRI), which consists of 23 B-channels (30 in Europe) and one D-channel. Broadband

Broadband - A type of data transmission in which a single medium (wire) can carry several channels at once. Cable TV, for example, uses broadband transmission. In contrast, baseband transmission allows only one signal at a time. Most communications between computers, including the majority of local area networks, use baseband communications.

CLEC - Pronounced *see-lek*. A Competitive Local Exchange Carrier is a telephone company that competes with an Incumbent Local Exchange Carrier (ILEC) such PacBell, Verizon, etc.

CO - Short for Central Office. In telephony, a CO is a telecommunications office centralized in a specific locality to handle the telephone service for that locality. Telephone lines are connected to the CO on a local loop. The CO switches calls between local service and long-distance service. ISDN and DSL signals also channel through the CO.

DS3 - A dedicated phone connection supporting data rates of about 43Mbps. Also called a T-3, the line actually consists of 672 individual channels, each of which supports 64Kbps.

DS3 lines are used mainly by Internet Service Providers (ISP's) connecting to the Internet backbone. Large businesses also use DS3 lines when they have large sites to interconnect.

DSL - Refers collectively to all types of Digital Subscriber Lines. DSL technologies use sophisticated modulation schemes to pack data onto copper wires. They are sometimes referred to as last-mile technologies because they are used only for connections from a telephone switching station to a home or office, not between switching stations. The most common forms of DSL are:

- ADSL - The variation called ADSL (Asymmetric Digital Subscriber Line) is the form of DSL that is most familiar to home and small business users. ADSL is called "asymmetric" because most of its two-way bandwidth is devoted to the downstream direction, sending data to the user. Only a small portion of bandwidth is available for upstream or user-interaction messages.
- SDSL (Symmetric DSL) can carry up to 1.544 Mbps (U.S. and Canada) each direction on a duplex line. It's symmetric because the data rate is the same in both directions.
- IDSL (ISDN DSL) is somewhat of a misnomer since it's really closer to ISDN data rates and service at 128 Kbps than to the much higher rates of ADSL.

Ethernet - A Local Area Network (LAN) architecture developed by Xerox Corporation in cooperation with DEC and Intel in 1976. Ethernet uses a bus or star topology and supports data transfer rates of 10Mbps. It is one of the most widely implemented LAN standards. A newer version of Ethernet, called 100 baseT (or Fast Ethernet), supports data transfer rates of 100 Mbps. And the newest version, Gigabit Ethernet supports data rates of 1 gigabit(1,000 megabits) per second.

Firewall - A system designed to prevent unauthorized access to or from a private network. Firewalls can be implemented in both hardware or software, or a combination of both. Firewalls are frequently used to prevent unauthorized Internet users from accessing private networks connected to the Internet. All messages entering or leaving the private network pass through the firewall, which examines each message and locks those that do not meet the specified security criteria.

Frame Relay – A packet-switching protocol for connecting devices on a Wide Area Network (WAN). Frame Relay networks in the U.S. support data transfer rates at T-1 (1.544Mbps) and DS3 (45 Mbps) speeds. In fact, you can think of Frame Relay as a way of utilizing existing T1 and DS3 lines owned by a service provider. Most telephone companies now provide Frame Relay service for customers who want connections at 56 Kbps to T-1 speeds.

In the U.S., Frame Relay is quite popular because it is relatively inexpensive. However, it is being replaced in some areas by faster technologies, such as ATM.

Hub - A common connection point for devices, such as computers and printers, in a network.

ILEC - Short for Incumbent Local Exchange carrier. An ILEC is a telephone company that was providing local service when the Telecommunications Act of 1996 was enacted. Compare with CLEC, a company that competes with the already established local telephone business.

ISDN - Abbreviation of Integrated Services Digital Network, an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. ISDN supports data transfer rates of 64 Kbps. Most ISDN lines offered by telephone companies give you two lines at once, called B channels. You can use one line for voice and the other for data, or you can use both lines for data to give you data rates of 128 Kbps, a faster rate than provided by modems.

ISP - Short for Internet Service Provider, a company that provides access to the Internet. For a monthly fee, the service provider gives you a software package, username/password, and access phone number. Equipped with a modem/cable modem/DSL router, you can then logon to the Internet and browse the World Wide Web, and send and receive e-mail. In addition to serving individuals, ISPs also serve large companies, providing a direct connection from the company's networks to the Internet.

LAN – Short for Local Area Network. A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. LANs connected in this way are called a Wide Area Network (WAN).

LATA - Local Access and Transport Area is a U.S. term that refers to a geographic region assigned to one or more telephone companies for providing communication services. A connection between two telephone companies within the same region is referred to as intraLATA. A connection between two local exchange carriers in different regions is called interLATA, which is the same as long-distance service. Provisions guiding the use of LATAs are outlined in the Telecommunications Act of 1996.

Last mile - The portion of the cable or telephone company that is wired directly into the customer's home.

Local loop - In telephony, a local loop refers to the connection between a telecommunication company's CO to the lines in the service subscriber's home or office. Originally, local loop service carried only telephone service to subscribers. But today, with the use of modems, ISDN, and DSL, signals are transmitted to subscribers as well through the local loop.

NIC – Network Interface Card, a board you insert into a computer so the computer can be connected to a network.

Packet/Packet Switching - Refers to protocols in which messages are divided into packets before they are sent. Each packet is then transmitted individually and can even follow different routes to its destination. Once all the packets forming a message arrive at the destination, they are recompiled into the original message.

POP - Short for Point of Presence, a telephone number that gives you dial-up access. Internet Service Providers (ISP's) generally provide many POPs so that users can make a local call to gain Internet access.

POTS - Short for Plain Old Telephone Service, which refers to the standard telephone service that most homes use. In contrast, telephone services based on high-speed, digital communications lines, such as ISDN, are not POTS. The main distinctions between POTS and non-POTS services are speed and bandwidth. POTS speed is generally restricted to about 52K.

PRI - Short for Primary Rate Interface, a type of ISDN service designed for larger organizations. PRI includes 23 B-channels and one D-Channel. In contrast, BRI (Basic Rate Interface), which is designed for individuals and small businesses, contains just two B-channels and one D-channel. PRI service is generally transmitted through a T-1 line.

Router - A device that connects any number of LAN's. Routers use headers and a forwarding table to determine where packets go. Very little filtering of data is done through routers. Routers do not care about the type of data they handle.

Switch - A device that filters and forwards packets between LAN segments. Switches are preferable to hubs for bandwidth throughput.

T1 - A dedicated phone connection supporting data rates of 1.544Mbits per second. A T-1 line actually consists of 24 individual channels, each of which supports 64Kbits per second. Each 64Kbit/second channel can be configured to carry voice or data traffic. Most telephone companies allow you to buy just some of these individual channels, known as *fractional T1* access.

T1 lines are a popular leased line option for businesses connecting to the Internet and for Internet Service Providers (ISP's) connecting to the Internet backbone. The Internet backbone itself consists of faster DS3 connections.

TCP/IP - Abbreviation of Transmission Control Protocol/Internet Protocol, and pronounced as separate letters. TCP enables two computers to establish a connection and exchange streams of data. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent. The IP protocol deals only with packets, specifying the format of packets and the addressing scheme.

Telco – An abbreviation for Telephone Company.

Telecommunications - Refers to all types of data transmission, from voice to video.

Videoconferencing – Conducting a conference between two or more participants at different sites by using computer networks to transmit audio and video data.

VOIP - A category of hardware and software that enables people to use the Internet or Wide Area Network (WAN) as the transmission medium for telephone calls. Internet telephony products are sometimes called IP telephony, Voice over the Internet (VOI) or Voice over IP (VOIP) products.

VPN - A virtual private network (VPN) is a private data network that makes use of the public telecommunication infrastructure, maintaining privacy through the use of a tunneling protocol and security procedures. A virtual private network can be contrasted with a system of owned or leased lines that can only be used by one company. The idea of the VPN is to give the company the same capabilities at much lower cost by using the shared public infrastructure rather than a private one. Phone companies have provided secure shared resources for voice messages. A virtual private network makes it possible to have the same secure sharing of public resources for data.

Using a virtual private network involves encrypting data before sending it through the public network and decrypting it at the receiving end. An additional level of security involves encrypting not only the data but also the originating and receiving network addresses. VPN software is typically installed as part of a company's firewall.

WAN – Short for Wide Area Network. A computer network that spans a relatively large geographical area. Typically, a WAN consists of two or more Local Area Networks (LAN's). Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the Internet.