ADSL HOWTO for Linux Systems

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How to setup a Linux System to work with Asymmetric Digital Subscriber Loop (ADSL), a new high−speed digital access line technology available from Telcos. ADSL is one of a family of digital subscriber line (DSL) technologies available to residential and business customers using existing copper loops, providing speeds from 384kbps to 1.5Mbps. This document provides an introduction to ADSL, and information on how to install, configuration and turn up service.

5.Ordering Service

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1.Legal Stuff

ADSL HOWTO for Linux Systems

2.Introduction

This document addresses the ordering, installation and configuration of ADSL service for use on Linux Systems.

ADSL or Asymmetric Digital Subscriber Loop is a high−speed Internet access technology that uses a commonly available telephone copper loop (same wire as your phone service). Designed to run on up to 80% of the telephone available in the United States, and utilizing line−adaptive modulation, ADSL provides data speeds from 384kbps to 1.5 Mbps, normally using different speeds for the upstream and downstream channel (hence the " Asymmetric"). ADSL provides a direct, dedicated pipe to an ISP.

ADSL was designed for SOHO applications, such as a small business with 5−30 systems, or the high−end Linux user that has wants bandwidth and has some money to spend. Applications range from low−bandwidth server interconnection to streaming video applications. ADSL is designed and priced somewhere in between ISDN and T1 service, providing near T1 speeds without the cost/complexity/availability issues of T1. Since ADSL is a dedicated service, it avoids the delays and use charges inherent in ISDN service.

This HOW−TO starts with a description of ADSL services and it many variants, and a block diagram of the components that make up the service. Next, a list of requirements for ordering ADSL are provided. Also included is guide on ADSL wiring and configuring your Linux System. I have also included an Appendix with a FAQ, a listing of interesting Links,and a Glossary.

I welcome any and all comments on this document; They can be sent to `dfannin@dnai.com` .

The latest version of this FAQ is available from http://www.sushisoft.com/adsl/.

3.ADSL Overview

3.1 What is ADSL?

Asymmetric Digital Subscriber Line (ADSL) is:

- A Telephone Loop Technology that uses existing phone lines
- Provides high−speed data and analog voice (Data over Voice)
- Dedicated digital line for an IP connection
- Data rates (North America) combinations of :
  Upstream/downstream
  256 kbps/256 kbps
  384 kbps/128 kbps
  384 kbps/384 kbps

384 kbps/1.5 Mbps
and many others

- Wide range of CPE options, including Ethernet 10baseT Interfaces.
- Dedicated ISP connection (static or dynamic addresses)
- Can support an IP subnet (from 1 to 254 IP addresses, depending on ISP)
- Priced lower than dedicated private line (T1) connections

3.2 ADSL Applications

ADSL was designed to provide a dedicated, high−speed data connection for Internet/Intranet Access, using existing copper phone lines. This allows ADSL to work on over 60−80% of the phone lines existing in the U.S. without modification. Additionally, ADSL provides speeds approaching T1 (1.5Mbps), which are much greater than analog modems (56kbps) or ISDN (128kbps) services provided over the same type of line. ADSL is usually priced to be much less other dedicated digital services, and is expected to priced somewhere between T1 and ISDN services (including the ISDN usage charges).

The Telcos see ADSL as a competitive offering to the Cable Company's Cable Modems, and as such, are expected to provide competitive pricing/configuration offerings. Although Cable Modems are advertised as having 10−30Mbps bandwidth, they use a shared transmission medium with many other users on the same line, and therefore performance varies, perhaps greatly, with the amount of traffic and other users.

ADSL is positioned for Home and Small Office (SOHO) applications that require high−speed Internet Access. Since it also provides dedicated access, It can be used for interconnecting low−bandwidth servers to the Internet, and would provide a great access solution for 5−20 PCs in an Office location. It is also a great solution for those Linux power users that just want high speed access from home:−).

3.3 What is xDSL/DSL?

Digital Subscriber Line (DSL) provides a dedicated digital circuit from your home to the Telcos central office, using analog telephone line. DSL also provides a separate channel for voice phone conversations, which means analog calls (voice, fax. etc.) can be carried at the same time high−speed data is flowing across the line. DSL uses the frequency spectrum between 0kHz−4kHz for Analog Voice, and 4kHz−2.2MHz for data. xDSL is a generic acronym for a family of dedicated services, where the " x"stands for:

- **ADSL** Asymmetric Digital Subscriber Line: 1.5 Mbps−384kbps/384−128kbps
- **HDSL** High−bit−rate Digital Subscriber Line: 1.5 Mbps/1.5 Mbps (4Wire)
- **SDSL** Single−line Digital Subscriber Line: 1.5 Mbps/1.5 Mbps (2Wire)
- **VDSL** Very high Digital Subscriber Line: 13 Mbps−52 Mbps/1.5 Mbps− 2.3 Mbps.
- **IDSL** ISDN Digital Subscriber Line: 128 Kbps/128 Kbps.
- **RADSL** Rate Adaptive Digital Subscriber Line: 384kbps/128kbps
- **UDSL** Universal Digital Subscriber Line: 1.0Mbps−384kbps/384kbps−128kbps
  also called " splitterless" DSL or DSL−Lite, as it doesn't require a splitter.

where Xbps/Ybps is X=Downstream Bit rate, Y=Upstream Bit rate

3.4 Why so many speeds?

ADSL has to work over existing phone lines, which were designed 100 years ago, and were never designed for digital services (See the FAQ answers for more information). Also, ADSL is a new service, and all the providers are trying to find the right price/feature combinations that will make it in the market.

For the average user, the basic way of thinking about it is to segment the options into three categories:

- **Low End Residential**

  Speed ranges from 384kbps−128kbps, Asymmetric
- **High End Residential or Business End User**

  Speed ranges from 1.5Mbps−384kbps, Asymmetric
- **High End Server**

  Speed ranges from +2.0Mbps−1.1kbps, Symmetric

4.How it works.

ADSL is made up of several parts (shown by Figures 1 and 2):

- ADSL Network Termination (ANT) and Network Interface Card (NIC)
- Splitter or Splitterless Design
- DSLAM and Telco Loop
- ISP connection

```
Figure 1: ADSL Block Diagram (POTS Splitter)

<-------Home/Office--------------->              <-----Telco Central Office---->
                               NID
                              -----             -----
2 wire      X-----------Voice-=| S |             | D |
phone                          | P |             | S |=----- Voice Switch
line                           | L |    2 wire   | L |
                               | I |=-----------=| A |
                               | T |  Local Loop | M |=----- ISP Connection
10baseT       ---------- Data  | T |             |   |
Ethernet  X--=|         |=----=| E |             -----
  or          ----------       | R |
ATMF            ADSL          -----
NIC             ANT
```

4.1 CPE: ADSL ANT and NIC

The Customer Premises Equipment (CPE) for ADSL consists of the ANT and/or NIC card. The ADSL Network Termination (ANT), shown in Figure 1, is located at your home or office, provides an IP connection. ANTs come in several types:

- Router ANT with 10/100baseT Interface
- Bridge ANT with 10/100baseT Interface
- ANT with ATMF Interface
- ANT with USB Interface
- Integrated ANT/NIC Card

In each case, the ANT/NIC provides the a router address to an ISP. Each Telco will specify the configurations that they will allow. The most desirable configuration for the Linux user is the ANT with a 10baseT Interface, since the cost/setup is the easiest. The other options require special drivers, which have, to date, not been made available for Linux. The bad news is that some providers allow only integrated ANT/NIC PCI cards that do not have Linux Drivers.

Warning! Make sure any third party ANT/NIC you may purchase are compatible with your Telco provider. There are two major line encodings for ADSL (CAP, DMT), and several options for IP encapsulation. Your Telco should provide you a list of allowable options.

The ANT is connected to your house's inside wire (2 wire phone line). This inside wire is connected to the data side of a POTS splitter, or, in the case of the splitterless version, directly connected to the local loop. Figure 1 shows the POTS splitter wiring, and Figure 2 shows a splitterless type.

In my case, I was provided with an Alcatel ANT, which supports a 10baseT (wired as a Crossover) RJ45 jack. I understand that a NIC card that fits directly in the PC will be available sometime in the future.

```
Figure 2: ADSL Block Diagram (Splitterless Design)


<-------Home/Office--------------->           <-----Telco Central Office---->
                             SNI
                              -               -----
2 wire    X-[RJ11]---Voice----|               | D |
phone       Filter            |               | S |=----- Voice Switch
line                          |    2 wire     | L |
                              |=-------------=| A |
                              |   Local Loop  | M |=----- ISP Connection
10baseT       ---------- Data |               |   |
Ethernet  X--=|        |=-----|               -----
  or          ----------
ATMF            ADSL
NIC             ANT
```

4.2 Splitter or Splitterless Design

Somehow, the digital and analog signals need to be separated for all of this to work. Thus, a filter needs to be placed in the signal path at some point. There are two methods for doing this: Using a POTS Splitter or using RJ11 phone jack filters.

First, in the POTS splitter method, device is located on the "side of the house" where the Telco line is connected. The splitter provides two functions. First, it is the "demarcation point" that separates the Telco wiring from the inside wiring. Second, it "splits" the DSL signal from Telco into a separated data channel and a voice channel. The voice channel is a normal analog phone line (2 wire), and the data channel is sent to the ANT. The splitter is a passive, non−powered device, which will allow the voice channel to operate even if the power fails at the home location. The Telco signal is sent to the splitter using an existing 2 wire line to the home. The Splitter is housed in the Network Interface Device (NID) on the outside of your house.

Second, in the splitterless design, shown in Figure 2, the outside local loop is connected directly to the inside wire at the Subscriber Network Interface (SNI), the same box that is used today at your house. At each extension jack where you wish to plug in an analog phone, you place a special jack that contains a filter that removes the digital signal. This is called an RJ11 filter (RJ11 is the official Telco term used for your 4/6 pin phone jack). The extension used for your ANT does NOT use a filter (otherwise it won't work). That's all there is to it! It should also be noted that some low speed ADSLs will not require RJ−11 filters.

The splitterless design is very desirable from the Telco point of view, as they won't have to roll any trucks to do the install work, and allows them to offer ADSL at a lower price. For most users, it doesn't really matter, in fact, the analog phones will still work without the RJ11 filter in place. The only thing is that you will hear a bit of a high pitched whine when you use the phone. However, this is not recommended, as later version may damage the phone or have some other nasty effect.

4.3 DSLAM

The DSLAM is the equipment at the Telco Central Office that that splits the signal and connects the user to the Voice Switch and ISP. That's all you need to know from a user perspective.

4.4 ISP connection

An ISP connects to the DSLAM via a high−speed data connection, usually ATM over a T3 (45Mbps) or OC−3 (155Mbps). The important thing here is that an ISP must "subscribe" with your Telco to provide this connection.

5.Ordering Service

The basic procedure is as follows:

- Check to see if you meet the following requirements for ADSL.
- Select a Telco and ISP, and see what configurations they offer.

- Call the Telco and order the service.

Once you have ordered the service, the Telco should provide you with a Due Date. I was able to do the entire order in one phone call through my Telco, and they coordinated with the order with my ISP. I was given a due date that was one week later, and everything was completed on time, with no problems.

5.1 Home Requirements

- An appropriate NIC card

  The system (PC, workstation, router or hub) that will be directly connected to the ADSL ANT .
- Inside Wiring

  You need inside wire (2 or 4 wire) from the Telco Demarcation Point (the side of your house) to your PC location. Your existing phone line can be used. However, this inside wire can only be used for the ANT, and no other phones or extensions can be connected to this line. The Telcos or other companies can be contracted to install a new wire for you as well.
- Installation

  Who will wire it up in your house? You can do the splitter wiring yourself (My local Telco provided a wiring kit and instructions for performing the inside wiring) or you can contract them do it for an additional fee. You can save around $ 150−250 dollars by doing it yourself, which I did, or you can save yourself the hassle and have them do it. You can decide what you want to do after reading the procedure that I have included in this document. The bottom line is if you are used to dealing with phone and/or network LAN wiring procedures, and feel comfortable with doing this, then you should consider going for it. If you haven't, and your company is going to pay for it, then have them do it.

5.2 Telco Options

- Qualified Copper Loop

  The Telco will normally test your line before you order service to see if it is can pass the ADSL signal. You must be within 2−3 miles (11−16 kilofeet) of the Central Office, and have a loop that has no loading coils, bridge taps, DAMLs, or other impediments. Most of the Loops that support ISDN can also support ADSL, but since ADSL is more restrictive, this is no guarantee of success. Your Telco will help you here.
- ADSL Available from your Telco

  Is the ADSL/DSLAM equipment is available at your Central Office? Again, the Telco will check to see if it available in your area. Every major Telco in the US, and many new dedicated ADSL providers have announced plans for ADSL. I expect wide scale deployment by 1Q99.

- Bit Rate

  ADSL is priced according to the Bit Rate − Check with your Telco. You can usually order some combination of 128k,256k,384k, or 1.5M speeds. Your loop may restrict the bit rate you can be offered. My Telco also prices the service differently if you're a Residence or Business Customer.

- POTS Service

  Some providers (usually the big Telcos) offer POTS with ASDL. If you choose this option, you will need to specify which phone number (new or existing) you want assigned to it. You will need to designation whether you want the ADSL to go over an existing POTS service, or whether you want a new phone number for the analog phone line. If you have ISDN service, and want to use the same line, the ISDN service must first be disconnected. Note that some Telcos (usually dedicated DSL providers) do not offer this option.

5.3 ISP Options

- ISP Presubscription

  Your ISP of choice must be presubscribed with the ADSL Telco provider. Check with your ISP to see if they are connected. If they are not connected then you must either move to another ISP, convince them to connect up, or decide not to use ADSL.

- IP Subnet and Address.

  First, you'll need to know whether your IP addressing will be static or dynamic. Dynamic addressing is set through the use of DHCP.

  Additionally, for static addressing, ISPs will allow anywhere from 1 to 254 IP addresses to be assigned to an ADSL line, with the corresponding Variable Length Subnet Mask (VLSM).

  My ISP charges more money as you get more hosts. I suspect that most applications will use either 1 host (32 bit mask) or 6 hosts (29 bit mask). If your confused, then read the *IP−Subnetting HOWTO*. Also remember than multi−host subnets require 1 of the hosts to be the ISP router address (meaning that the 6 host subnet is really 5 hosts to you) and you can use IP Masquerading/ (see the HOWTO) or Network Address Translation (NAT) to support a larger number of addresses behind your LAN. If you request more than 30 hosts, be prepared to fill out a justification form for your ISP.

- Gateway Address

  The default gateway address. Normally, this is the first host address in your subnet. (e.g. if your subnet range and mask is 192.168.1.240/29, then your host range is .241 through .246, with the default gateway assigned to the .241 address.

- Number of MAC addresses

  The ANTs can support a set number of MAC addresses for bridging. For example, the ADSL ANT that I use is limited to 16 MAC addresses. This should be sufficient for most applications. However, if you plan to support a large number of machines directly off the hub of the ANT, you should check first to see what your limit is.

- DNS Servers

  The ISP should provide you with one or more DNS server addresses to support Domain Name Lookups. Some ISPs also provide Domain Name Server hosting (either primary or secondary server) for you as part of the dedicated service packages. See your ISP for more details.

- User ID and Password.

  The ISP will normally assign you a login/password for shell, mail, etc. access. My ISP also provides web space, mail server, and some other goodies.

6.Wiring it up

If you have ordered the installation option from the Telco, then you can skip this section and move to " Configuring Linux" . The following procedures are meant to illustrate the wiring process. Please note that your procedures may be different at your location. Make sure you follow any warnings or safety instructions provided, and that you are familiar with Telco wiring procedures.

The first step will be to wire up the connections from your Telco. Identify the line on which service will be installed, and the locations of your splitter and DSL jacks.

6.1 Wire the Splitter/NID (at the SNI)

If you have the splitterless design, you can skip this part.

The splitter will consist of two parts, the splitter and a small outdoor housing, called the Network Interface Device. Mount the splitter and NID housing per the Telcos instructions at the Subscriber Network Interface (SNI) point, usually the side of your house where the phone line is located. The phone company will need to access the splitter for maintenance, so its advisable to locate it on the outside where they can get at it. Connect the incoming 2W Telco line to the " LINE"side of the splitter. Then wire the inside pair for your telephone to the "VOICE" , and your inside wire pair for the ANT to "DATA".

Checkstep At this point, you should be able to pull dial tone off the voice side of the splitter. If this doesn't work, then either you've wired it wrong, or the ADSL service is not yet connected on the Telco side.

6.2 Wire the DSL Jack (at the computer location)

Wire up the DSL jack (RJ11) at your computer location (connected to the DATA side of the splitter). The specifics differ greatly for each situation, but basically you will have a 2 wire pair that you will connect to the DSL jack. Make sure you read the directions, as the DSL−RJ11 wiring is different for phones and ADSL jacks. In my case, you wire the phone jack on the red/green pair (the two inside prongs of the RJ11 jack) and the ADSL jack is wired on the yellow/black pair (the two outside prongs of the RJ11 jack).

6.3 Install the ANT (at the computer location)

Connect up the ANT's power cord, and connect the phone line (category 3 cable) between the DSL jack and the ANT. This cable is usually provided.

Checkstep At this point, verify the ANT syncs up to the Telco signal. Most ANTs have an green LED that lights up when the signal is good. If it doesn't sync, then check your wiring, or make sure that the Telco signal is being sent (do this by calling your Telco and verifying they have activated the service. Note that having dial tone on the line does NOT confirm the presence of the ADSL data signal.)

If you have completed the previous steps, you are now ready to move on to connecting your Linux System.

7.Configuring Linux

After you have wired up the ANT and you're getting the sync signal, then you're ready to configure your Linux System and verify your connection to your ISP. Although I will refer to a Linux System, you can connect any type of 10baseT device to the ANT. This includes a router, hub, PC, or any other system that you wish to use.

Caution!*Before you connect to your ISP*, make sure you understand all security issues of having a direct connection to the Internet via ADSL. Depending on your ISP, most outside uses can access your systems, and you should setup any firewalls, deactivate ports/services, and setup any passwords prior to connecting your machine to the world. Read the *Security−HOWTO* if you need a good overview on this subject.

7.1 Install and Connect the NIC card

Install your NIC card in your Linux machine, configure the kernel, etc., etc. See the various Linux references for doing this. See the *Ethernet−HOWTO* for more information.

Connect the RJ45 cable between the NIC and the ANT. **Note** A gotcha here is that some ANTs are already wired as a 10baseT crossover, and require a direct Category 5 cable for a direct connection to a NIC, rather than a crossover cable. I lost around 12 hours figuring this one out, so don't make the same mistake − make sure you read the instructions first.

7.2 Configure the Ethernet Interface

Configure the IP address, Subnet Mask, Default Gateway, and DNS server information. Each Linux Distribution (RH, debian, Slackware, S.U.S.E.) has a different way of doing this, so check on your particulars. You can also do this manually using the `ifconfig` and `route` commands. See the *NET3−HOWTO* for information for more information.

Once your system is configured, see if you can ping to the your default gateway address provided by the ISP. If the ping is successful, the you should see around 20 ms roundtrip delay for this connection. Congratulations, you're connected to the Net!

7.3 Setting up a Router

Depending on your local setup, you should consider some other issues. These include a firewall setup, and any associated configurations. For my setup, shown in Figure 3, I use an old i486 machine configured as a firewall/router between the ADSL connection and the rest of my machines. I use private IP addresses on my Private LAN subnet, and have configured my router to provide IP Masquerading and Firewalling between the LAN and Internet connection. See the *IP_Masquerading−HOWTO*, and *Firewall−HOWTO* for more information. My experience is that Linux provides superior routing/firewalling performance , and is much cheap than a commercial router, if you find an old 386/486 machine that you may be using as a doorstop somewhere.

```
Figure 3: My  SOHO Network Setup


<-Private Subnet-->         <-Public Subnet->    <-ADSL Line--------->
                                      |
                                 X----|
                                      |
     X------|                    X----|      |----|
            |      |--------|         |      |ADSL|            Internet
            |      | Linux  |         |-----|ANT |----------> Service
     X------|------| System |--------|      |    |            Provider
            |    E1|(Router)|E0       |      |----|            Router
            |      |--------|         |
     X------|        IP_Masq      10baseT
                   IP_Firewall     Hub
```

What I did is setup a router (Linux RH 5.0 on a i486) with two Ethernet interfaces. One interface routes to the ISP subnet/gateway, and the other interface supports a class private network address (i.e. 192.168.2.x). Using the private network address behind your router allows some additional security because it is not directly addressable from outside your ISP. You have to explicitly masquerade your private addresses in order to connect to the Internet.

Caution Make sure your kernel is complied with IP forwarding and the IP forwarding is turned on. You can check this by

```
cat /proc/sys/net/ipv4/ip_forward
```

The value is "1" for on, and "0" for off. You can change this value by echoing the desired value into this file.

```
(e.g.) echo 1 > /proc/sys/net/ipv4/ip_forward
```
Will turn forwarding on.

7.4 Setting up a Firewall/Masquerading

If you have a direct connection to the Internet, then you want to also turn on Firewall Administration and Masquerading. Figure 4 shows a picture of this.

Caution! I also need to stress that this configuration is only part of the things that need to be performed to create a secure environment. Other considerations include turning off ftp, telnet, and other services on the Router, and ensuring all password, login, etc. configurations are correctly setup for your environment. Make sure you read the *Security−HOWTO*.

```
Figure 4: Firewall/Masquerading for ADSL

        |-------|        |-------|      |-X
======X| ADSL  |=------| Linux |-----|
ADSL   |  ANT  |      E0|       |E1   |-X   Private Network
Line   |-------|        |-------|     |     (e.g. 192.168.2.x)
               <------->              |...
             ISP Subnet or host
            (Public Net Address)
```

The kernel for the Linux router is complied for IP forwarding/masquerading, and has the "ipfwadm" (IP firewall software) installed with the following options:

file: /etc/rc.d/rc.firewall (called by rc.sysinit in RH5.0)

```
echo "Setting up the firewall"
#
# From the "Firewall−HOWTO"
#
# flushes all setting
#
ipfwadm −F −f
#
# set the firewall
#
ipfwadm −F −p deny
#
# allow any machine with address 192.168.2.x to masquerade.
#
ipfwadm −F −a accept −m −S 192.168.2.0/24 −D 0.0.0.0/0
#
# allow the domain name server to work (udp 53)
#
ipfwadm −F −a accept −b −P udp −S 0.0.0.0/0 53 −D 192.168.2.0/24
ipfwadm −F −p masquerade
#
# the rest just list out the options for your enjoyment
#
ipfwadm −F −l
ipfwadm −O −l
ipfwadm −I −l
```

You need to be careful, as some application will still not work without special modules (namely ftp, real audio, and some others). Check the ipfwadm documentation for more information. I found this pretty easy to set up.

Additionally, using the private network addressing scheme is cheap, and gives an administrator complete flexibility in setting up their local LAN. The drawback is that Masquerading has a limit on the number of private hosts that it can reasonably support, and that some IP applications that pass the host address in their data fields will not work, but this tends to be a limited number.

8.Appendix

8.1 FAQs

This is the Frequently Asked Questions (FAQ) section for ADSL.

1. Q: Are there ADSL Standards.

   A: Sort of. The U.S. Bell Operating Companies have standardized on Discrete Multi−Tone (DMT) ANTs (ANSI T1.413) in their current rollout. Most others should follow their lead in the states. There are other types of ANTs, most notably Carrier−less Amplitude Phase Modulation (CAP), which, of course, are incompatible with each other.

   A biased comparison from an DMT−based vendor on this subject can be found at the Aware. Still, it provides the best detail on this issue I have seen so far.

   A rather expensive copy of the ANSI standard can be ordered at: American National Standards Institute ANSI Home Page
   Asymmetric Digital Subscriber Line (ADSL) Metallic Interface
   ANSI TI.413−1995
   Note: ANSI TI.413 Issue 2 was released September 26, 1997
2. Q: Can I use ATM to connect to ADSL ANT?

   A: Yes, you can! Some ADSL ANT (at least the Alcatel version) has a ATM Forum 25Mbps interface, which connects to a PCI NIC card. However, I have not yet heard of any Linux drivers for such cards.
3. Q: Why the heck does ADSL have all these bit rates (384/1.5/8M/20M/etc) options?

   A: The basic problem is the 100 year old design of the copper loop. It works great for analog phone, but it presents a real challenge for a digital signal. Remember that the distance of a loop is inversely proportional to the data rate that it can carry. Rate−Adaptive technologies are great for making a digital signal work in many situations, but it can't provide a consistent bandwidth for all applications, especially for very long (over 18 kilofeet) loops. The different bandwidth that you see advertised reflect various marketing wars of vendors equipment, and the Telco struggle to finalize on a "standard" set of data rates. I think that the 384k/1.5Mbps will become the standard for now. The high bit rates will only be available for special application and/or situations, since they can only be provided on a small percentage of the available loops.

Also, check out the next question on the loop imparments that cause this to happen.

4. Q: What are all these loop imparments (bridge taps, loading coils) that could disqualify my line from using ADSL? (thanks to Bruce Ediger)

   Load coils: in−line inductances that improve voice−frequency transmission characteristics of a telephone circuit. Essentially, a "load" steals energy from high frequencies and gives it to lower frequencies. Typically only used in very long (>9,000 ft) phone lines.

   By "bridges" I assume you mean "bridged taps". In older neighborhoods, the phone wiring will have been used by more than one customer. Perhaps these customers lived at different (though near−by) addresses. The unconnected "spur" of wiring is a "bridged tab" on the currently connected circuit.

   Digital loop carriers: there's a bunch of systems for carrying more than one voice transmission on a single pair of wires. You can shift the frequencies up or down, or you can digitize the voice transmissions and divide the telephone circuit by time or code or something. The more general term is "pair gain".

   These things cause different problems for high−frequency communication.

   Loads will completely mess up things by filtering high frequencies and passing low frequencies. They probably also change the "delay envelope", allowing some frequencies to arrive before others. One byte's tones will interfere with the next byte's.

   Bridged taps act as shunt capacitances if they're long in relation to the signals wavelength, and they'll actually act as band pass filters if they're about 1/4 wavelength of the signal. That is, they'll pass particular frequencies freely. Particular tones of a DMT modem might get shunted back, rather than passed along to the receiving modem, reducing bandwidth for that telephone line.

   Pair gain, digital or analog, limit the bandwidth available to one transmission in order to multiplex several on one wire. High and low tones of a DMT transmission get filtered out by the apparatus.

   The book "Subscriber Loop Signaling and Transmission Handbook", by Whitham D. Reeve, , IEEE Press 1992, ISBN 0−87942−274−2 covers the math of how to calculate the effect of line length, bridged tap, etc on the transmission characteristics of a telephone line. It's pretty expensive, however.

5. Q: Do you have examples of ADSL ANTs?

   A: Short Answer: Yes. Real Answer: The evolution of this technology is moving too rapidly for anyone to keep up to date in a HOWTO. A good source of ADSL ANTs is the ADSL Forum Home Page . Go to the Vendors pages to see what's happening.

   However, I will provide a list of some of the current technology as of June 1998.

   ♦ Router ANT with 10/100baseT Interface

Examples: Flowpoint 2000 DSL (CAP), Netspeed Speedrunner 202 (CAP), Speedrunner 204 (CAP), 3COM Viper−DSL (CAP), StarNet Ezlink 500/100 (DMT), Westell ATU−R−Flexcap (CAP), Aware x200

♦ Bridge ANT with 10/100baseT Interface

Examples: Alcatel A1000 (DMT), Westell ATU−R−Flexcap2 (CAP)

♦ ANT with ATMF Interface

Examples: Alcatel A1000 (DMT), Netspeed Speedrunner 203 (CAP), Ariel Horizon II

♦ Bridge ANT with V.35 Serial Interface (T1, Serial Router)

Examples: Westell ATU−R

♦ ANT with USB Interface

Rumored to being pushed by Intel.

♦ Integrated ANT/NIC Card

Examples: Netspeed PCI Runner (CAP), Efficient Networks Speedstream 3020 (DMT)

These are NOT endorsements of the products listed, just provided for illustration.;−).

8.2 Links

- ADSL Forum Home Page A comprehensive web site created by the adsl vendors. Fairly complete for reference information on ADSL.
- Dan Kegels ADSL Page A good general reference on xDSL − includes vendor, service provider, and other links. This page was getting a little long in the tooth as of 2Q98. Dan also maintains a super page on ISDN.
- PacBell's ADSL Page Pacific Bell is the local Telco and my provider of ADSL service.
- Jeremie's Unofficial Ameritech ADSL FAQ
- Telechoice xDSL News Page
- ADSL Deployment 'round the World Claims to have a complete list − looked accurate for my area − gives providers, prices, speeds, etc.
- Bell Atlantic ADSL Home Page

- comp.dcom.xdsl FAQ

8.3 Credits

Thanks to all those that contributed information to this HOWTO. I have anti−spammed their email addresses for their safety (and mine!). Remove the X's from their names.

- **B Ediger** (Xbediger@csn.net) Great Description of loop impairment.
- **C Wiesner** (Xcraig@wkmn.com) List of many ADSL URLs.
- **J Leeuw** (Xjacco2@dds.nl) Many tips on ADSL, especially in Europe
- **J Kass** (Xjeremie@umich.edu) Unoffical Ameritech ASDL FAQ
- **N Silberstein** (Xnick@tpdinc.com) Info on Netrunner and his experience with US Worst.

8.4 Glossary

A dictionary of some of the jargon I use in this FAQ.

2 wire Copper Loop

The two wire twisted pair from the Telco Central Office that terminates at a customer location.

ADSL

Asymmetric Digital Subscriber Line

ANT

ADSL Network Termination (a.k.a. the ADSL modem)

ATM

Asynchronous Transfer Mode − provides high−speed packet switching from 155 Mbps to (currently) 2Gbps. Used to provide backbone switching for the Internet.

ATMF−25Mbps

ATM Forum Interface − 25Mbps speed, provided by a PCI NIC card.. One of the interfaces used between the ANT and PC.

Central Office

Usually refers to one of two meanings −1) The Telco Building that houses Telephone equipment 2) The Telco Voice Switch that provides dial tone.

CPE

Customer Premises Equipment − The Telco term for customer equipment (i.e. the stuff you are responsible for fixing). Examples are CSU/DSU, modems, ANTs, and your phone.

DHCP

Dynamic Host Configuration Protocol − The IP protocol used to set up dynamically assigned IP addresses.

DS0

The basic digital circuit for Telcos − offered at 56 kbps or 64kbps. Can support one analog voice channel.

DSLAM

Digital Subscriber Line Access Multiplexer − The Telco equipment that concentrates and multiplexes the DSL lines.

xDSL

Digital Subscriber Line − A term describing a family of DSL services, including ADSL, SDSL, VDSL, etc.

HDC

See Section 2

ISDN

Innovations Subscribers Don't Need; I Still Don't kNow or maybe Integrated Services Digital Network, a digital phone service that uses a single copper pair to run 2B (64k) + 1D(16k) channels that can be used for switched voice or data.

ISP

Internet Service Provider

NID

Network Interface Device − The housing used to protect the ADSL splitter from the elements.

NIC

Network Interface Card − A PC card (PCI/ISA) that supports the required network interface. Usually an Ethernet 10baseT or an ATMF−25Mbps Card..

POTS

Plain Old Telephone Service − The service that provides a single analog voice line. (i.e. your phone line)

Recursion

See "Recursion"

SNI

Subscriber Network Interface − The Telco term for the phone wiring housing on the side of your house. It designates the point between the Telco side and the Inside Wire. This is also called the Demarcation Point.

Splitter

The passive device (low−bandpass filter) at the SNI that splits the ADSL signal into separate voice and data channels.

Splitterless

An ADSL installation that does not require the Splitter. For higher speeds, a RJ11 filter is placed on every extension phone jack where an analog phone is used, thus providing the filtering at the jack, rather than at the NID. For lower speeds, no filter is required.

SOHO

Small Office HOme

T1

a.k.a DS1 − A digital dedicated line at 1.544 Mbps, used for both Voice (24 DS0s) or Data.

T3

a.k.a DS3 − A digital dedicated line at 44.736 Mbps, provides for both Voice (672 DS0s or 28 DS1s) or Data

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