Broadband, DSL, SDSL, ADSL and ADSL 2+

What are broadband, DSL, ADSL and ADSL 2+?

'Broadband', 'DSL', 'SDSL', 'ADSL' and 'ADSL2+' are all types of line connection to a public telecommunications network for high speed internet access.

The term '**broadband'** is generally applied to any type of high speed internet access line. Thus all types of 'DSL', 'ADSL' and 'ADSL2+' lines are also 'broadband connections'. 'Broadband' might also be used to describe high speed Internet acess via Cable TV network (in this case not using 'DSL' technology).

DSL

'DSL' stands for 'digital subscriber line'. The term is a general term applied to a variety of different technologies used to achieve 'broadband' or high speed digital transmission over 2-wire or 4-wire 'standard copper' public telephone network access lines – usually for the purpose of high speed Internet connection. All DSL technology can be subdivided into one of two types:

  ▸ **SDSL** (symmetric digital subscriber line) and
  ▸ **ADSL** (asymmetric digital subsriber line)

The prime difference between 'SDSL' and 'ADSL' is the speed of transmission in the *'downstream'* direction (the direction from the network towards the user) – relative to the speed of transmission in the '*upstream*' direction (te direction from the user towards the network). In SDSL the transmission rate in *downstream* and *upstream* directions is the same (i.e. *symmetric*). In ADSL, the *downstream* rate of transmission is greater than the *upstream* bitrate (i.e. *asymmetric*). The commonest form of DSL is ADSL.
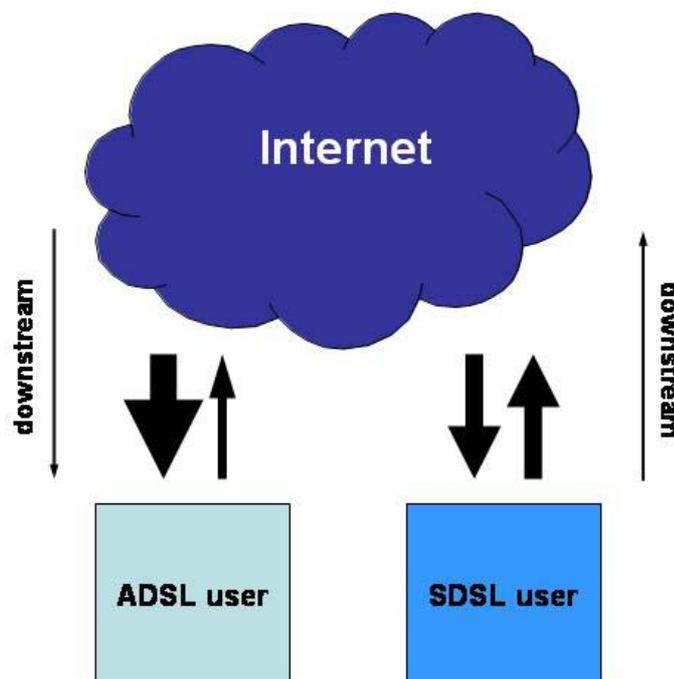
upstream and downstream flows: the difference between ADSL and SDSL

Other types of DSL

As well as SDSL and ADSL, a number of other DSL abbreviations and 'types of DSL' have been invented over time. These include: HDSL, XDSL, VDSL. In reality, these are all variants of the basic SDSL and ADSL types of DSL or simply alternative terminology:

  ‣ **HDSL** (high speed digital subscriber line) is a particular type of SDSL – usually providing 2 Mbit/s transmission in both downstream and upstream directions
  ‣ **VDSL** (very high speed digital subscriber line) is able to operate at very high speed (e.g. up to 50 Mbit/s) over copper cable – but only over short distances. Typically VDSL is used in 'hybrid' networks, comprising short copper cable connections from VDSL customer premises to locally placed street cabinets and then by means of glass fibre to the network operator's exchange building site (this type of hybrid network is sometimes referred to as 'fibre-to-the-curb' (FTTC)).
  ‣ **XDSL** is sometimes used as a generic term to mean 'any type of DSL'. The 'X' stands in place of a letter making up a recognised DSL abbreviation. Thus XDSL may be used as a shortform to mean 'any of: ADSL, HDSL, SDSL, VDSL etc.)

SDSL

'***SDSL***' stands for 'symmetric digital subscriber line'. An SDSL line provides for transport of digital data simultaneously in both directions across the line – the same bitrate being available in both directions (thus 'symmetric'). SDSL connections typically allow transmission of up to 6 Mbit/s in both directions, but usually require a 4-wire connection (equivalent to two standard telephone lines). SDSL service is typically more expensive than ADSL and is usually provided by telephone companies as a 'business service' – either as a private 'leaseline' connection between two different company locations or as a high speed Internet access line at a site which sends as much data to the Internet as it receives (e.g. the company's web server is located at the site: so a high volume of data is sent *upstream* to the network. Meanwhile, Internet 'surfing' activity of company employees at the site demand that a high *downstream* data rate is also available – so that Internet pages appear quickly).

ADSL

In ***ADSL*** ('asymmetric digital subscriber line' - the most common form of DSL), the total available capacity of the high speed digital subscriber line is split asymmetrically between *downstream* and *upstream* directions of transmission – there is a much higher bitrate made available for *downstream* transmission – at the expense of the *upstream* transmission rate. The advantage of this is that information transferred *downstream* (e.g. delivery of webpages, software downloads etc. out of the Internet to the user's PC) can be delivered much more quickly. Since little information is sent *upstream* by the typical Internet surfer (e.g. only the odd 'click' message or short email), the asymmetry of ADSL benefits the user.

ADSL is a particular type of DSL: indeed ADSL is often referred to simply as 'DSL', since ADSL is the commonest form of DSL. (**Note**: All ADSL lines are 'DSL' lines – and many ADSL services are simply marketed as 'DSL'. E.g. T-DSL, Deutsche Telekom's german version of DSL is actually an ADSL service. But remember that not all DSL is ADSL). ADSL is a technology used to provide a digital highspeed internet access line over a 'normal 2-wire telephone line'. Over an <u>established telephone or IDSN (digital telephone) line</u>, the public telephone company uses ADSL technology to provide the high speed ADSL internet access line <u>sharing</u> the same 2-wire connection to the public network.

The fact that the ADSL line can <u>share</u> the same 2-wire connection as the user's (analogue) telephone or ISDN (integrated services digital network) telephone line is important, since it affects the equipment which must be provided for the ADSL service (DSL splitter/filter and DSL modem) and the economics (price to the user).

Operation of ADSL – what equipment do I need?

When ADSL is operated on a 2-wire analogue telephone (standard telephone) or ISDN line (e.g. BRI or ISDN2), the telephone service operates normally in the 'baseband' of the connection. The high speed data connection provided by ADSL uses only the high frequency signal transmission capabilities of the connection. To keep the the telephone/ISDN and ADSL services apart, high frequency *filters* or *splitters* are used at both ends of the user's connection. At the customer's premises, the splitting device is called simply a *DSL splitter* or *DSL filter*. This may take a number of different forms, but is generally a small device:
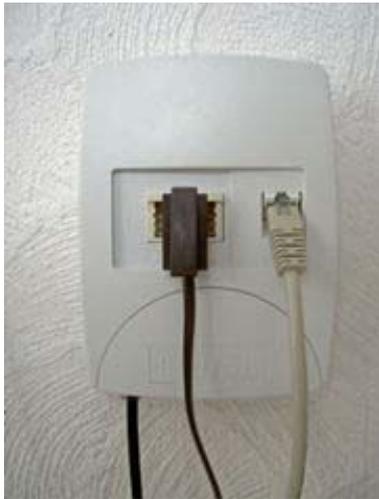

DSL splitter　　　　　　　　　　　　　　**DSL filter**

A DSL splitter or DSL filter must be provided at the ADSL customer's premises in order for the service to work. Sometimes this device (e.g. DSL splitter) is despatched in the post to the customer by the service provider at the time when the customer signs up for ADSL service. The customer need only plug the device in according to the installation instructions. Alternatively, in some countries, it is the responsibility of the customer to purchase his own filter or splitter. In these countries, the splitter may be provided as an 'in-cable device' (like that illustrated on the right above) and be provided with a DSL modem, when purchased from a computer store.

In addition to the DSL splitter or DSL filter, the ADSL customer must provide a DSL modem (most devices sold as DSL modems are actually a combination of DSL modem, router and firewall) to plug into the DSL spliter or filter. Typically, national telecommunications law requires that the DSL modem be owned by the customer, who may purchase such devices either from the DSL service provider or from a computer store. The customer's computer or LAN (local area network) is then connected to the DSL modem using either standard ethernet (10/100baseT with an 8-pin RJ-45 connector) or using WLAN (wireless LAN). DSL modems are available with a wide range of different capabilities. The ADSL user needs to consider carefully which features are necessary. more on DSL modem choice...

DSL modem (simple)

Meanwhile, at the public network operator's 'exchange premises' the equivalent splitting device is called a **DSLAM** (digital subscriber line access multiplexor). This is a much larger, rack mounted device shared by several hundred of the operator's DSL customers. The overall ADSL network connection is something like:

Typical ADSL line configuration
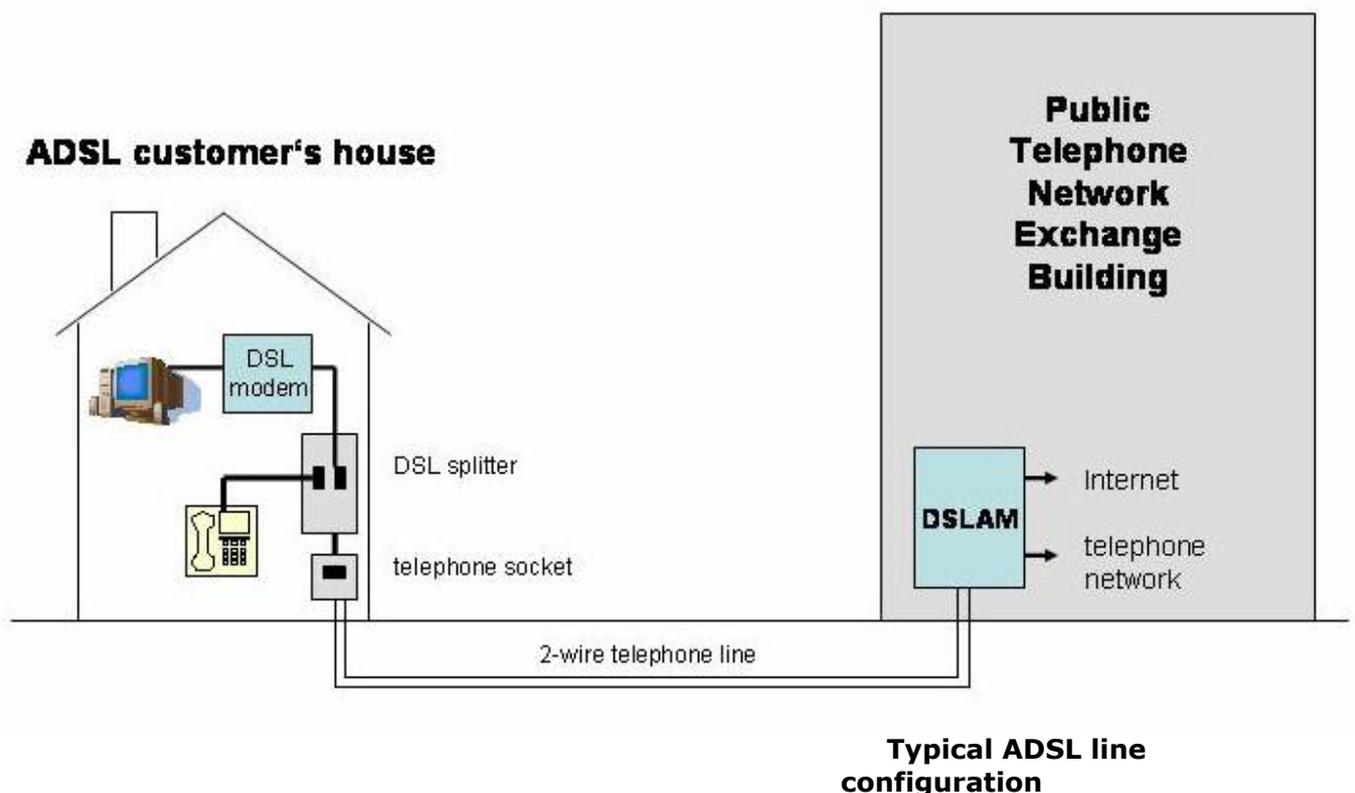
The fact that an ADSL service typically shares the telephone line with an analogue telephone (standard telephone) or ISDN telephone line connection makes for better overall economics in cases where the ADSL customer also requires a telephone line. Indeed, most ADSL service providers offer relatively cheap ADSL line subscription tariffs because they assume that a telephone service will be provided over the same line to the same customer. Indeed: it is usually a commercial pre-condition of ADSL service, that the customer also subscribes to a telephone or ISDN line service as well: even if this telephone or ISDN service is provided by a different service provider. The maximum bitrate of a standard ADSL line is 8 Mbit/s. ADSL is defined in ITU-T recommendations G.992.1 and G.992.2.

What are ADSL2 and ADSL 2+?
ADSL2 and ADSL2+ are further developments of the ADSL standard (defined in ITU-T recommendations G.992.1 and G.992.2). In particular, the developments increase the bitrates and line lengths possible with ADSL. The higher bitrates are intended to allow new applications over DSL, such as HDTV (high definition television).

The maximum bitrate of an ADSL2 line (defined by ITU-T recommendation G.992.3) is 12 Mbit/s. The maximum bitrate of ADSL2+ (defined in ITU-T recommendation G.992.5) is 25 Mbit/s. In addition, there is a variation of ADSL2/2+ which allows an upstream bitrate of up to 3.5 Mbit/s

Can I really have telephone service from one provider and ADSL (or ADSL 2+) service from another – both using the same line?
The simple answer is 'yes' – however this depends upon the country you are located in, the current telecommunications laws and regulations of your country, and upon the commercial conditions of the available telephone line and ADSL service providers in your country/region.

In most 'deregulated' countries, it is possible (using a single shared 2-wire telephone line) to receive telephone or ISDN service from one operator (typically the old phone company – the ex-monopoly operator (also called the 'incumbent operator') and an ADSL service from another operator (typically a newer, start-up – an Internet service provider or ISP)). Put simply, the telecommunications regulators in the affected countries have decreed that the incumbent operators must be willing to operate 'line sharing' and/or line 'unbundling' with their competitors.

What is line sharing?
In a technological sense, ADSL service may be provided over the same 2-wire line as a standard telephone or ISDN public network connection. More...

This opens the commercial possibility of simltaneous telephone and ADSL over a single 2-wire telephone line ('line sharing') – but provided by two distinctly separate service providers. Typically this works as follows:

The old telephone company (ex-monopoly or 'incumbent' operator) provides the 2-wire line from the customer's premises to his nearest telephone exchange building (typically within 3-5 km) and usually provides the basic telephone and/or ISDN service across this connection. Meanwhile, the ADSL service provider makes use of 'line sharing' of this line by providing his ADSL customer with a DSL splitter and/or modem. Meanwhile, the ADSL service provider also shares the use of the incumbent operator's DSLAM. The onward connection from the DSLAM to the public Internet is then arranged by the ADSL service provider.

The ADSL service provider usually pays a monthly fee to the incumbent operator for 'line sharing'. In addition, he may be required to pay a one-off installation fee, a one-off cancellation fee and service or fault repair charges.

Why should an incumbent operator provide line sharing? The answer is usually "because the national telecommunications regulator has forced him to do so – in an attempt to increase competition in provision of telecommunications services".

Under line sharing, the customer will usually receive two separate monthly invoices:

▸ One from the 'incumbent' operator for telephone line service (monthly subscription) and calls made, and

▸ One from the ADSL service provider or ISP (Internet Service Provider) for monthly connection fee and data volume charges (or data flatrate).

The level of service you receive, and the overall performance of your Internet access line as an ADSL customer will depend not only upon how well the ADSL service provider's Internet access network operates, but also upon the level of service of the incumbent operator in maintaining the DSLAM. In cases where the incumbent operator is only a grudging provider of the 'line sharing' capability, the ADSL service level may be adversely affected.

What is unbundling?
'Unbundling' is a term used by telecommunications lawmakers and regulators to describe the case in which incumbent telephone companies (ex-monopoly national phone companies) are forced by law or regulations to rent the 'bare wires' of their network to their competitors. 'Unbundling' allows a competitor of the incumbent operator to use existing telephone cables to connect potential customers to the competing network, without otherwise using (and thus being dependent upon or restricted by) the network technology and/or manpower services of the incumbent operator. In deregulated countries, 'unbundling' is intended to increase competition in telecommunications services – with the benefits of lower prices and a wider range of customer offerings.

In the case where an ADSL service provider chooses to use an 'unbundled' line to realise his ADSL line to a customer, he has full decision power over the use of the line. An operator using an 'unbundled' line provided by the incumbent is not usually mandated to provide for 'line sharing' with a third operator. Whether the ADSL operator chooses to provide a telephone or ISDN service over the same connection is up to him. Typically, operators try to persuade or force their customers to buy a complete package of 'ISDN line and ADSL', since this provides them with the highest revenue income from the line. But maybe: with the emergence of VOIP (voice-over-IP) as an increasingly popular means of telephone service using the Internet, ADSL service providers will increasingly be forced by the market to provide 'ADSL only' connections (without parallel telephone or ISDN service).

As with line sharing, the ADSL service provider usually pays a monthly fee to the incumbent operator for an 'unbundled' line. In addition, he may be required to pay a one-off installation fee, a one-off cancellation fee and service or fault repair charges. The charges are usually much higher than the equivalent charges for 'line sharing'.

The prime benefit of 'unbundling' is the independence from the incumbent operator. The technology which may be used and its capabilities could therefore be exploited to provide a more powerful service than that offered by the incumbent operator. In addition, the service level is unconstrained by the skills and responsiveness (or lack of) of the incumbent.

How is DSL realised by Service Providers? (DSL Resale, DSL Wholesale and Bitstream)
Some ADSL providers simply 'resell' DSL services actually provided by other operators (typically incumbent operators). In this case, the ADSL customer usually receives two invoices: one from the ADSL provider for the ADSL connection and the data volume carried (or a data 'flatrate') and one invoice from the incumbent operator for telephone line service. This is sometimes called '**DSL Resale**' and sometimes '**DSL Wholesale**'.

There are two main types of DSL Resale/DSL Wholesale: regulated DSL Resale and voluntary DSL Resale/DSL Wholesale.

In cases where the incumbent operator offers the regulated form of DSL Resale (e.g. in Germany), this is usually because the national operator has forced him to do so. In this case the terms of the technical realisation and the prices chargeable by the incumbent operator to the DSL reseller are all closely controlled by the telecommunications regulator.

In some countries (e.g. UK), the incumbent operator introduced a DSL Wholesale (or DSL Resale) service on a 'voluntary' basis either entirely on its own commercial initiative or else before the decree of the national regulator. In these cases, the terms of the resale (technical conditions and prices) are set directly between the incumbent operator and the reseller (i.e. there is more flexibility).

The 'bitstream' service is a variation on 'DSL Resale' or 'DSL Wholesale' service. 'Bitstream' service is under discussion in European telecommunications regulatory circles as a means of improving competition in DSL line provision services. It gives the competitive ADSL service provider the economic benefits of DSL Resale (economic ADSL service offering without major investment in a nationwide DSL network infrastructure), but with slightly more technical scope than DSL Resale offers. In effect, 'bitstream' is 'halfway between line sharing and unbundling solution for ADSL'.

How does the realisation of my ADSL line (line sharing, unbundling, DSL Resale) affect me?
The basic technical realisation of an ADSL connection is the same, independent of the commercial arrangement for provision of the telephone/ADSL cable and related equipment (provided either by: own-cable infrastructure, line sharing, unbundling or DSL Resale) on which the service is based. See figure...

However, the ownership, control and commercial conditions for the use and service support of the various equipment components making up the connection may have a significant impact on the service a customer receives.

The more equipment components and service personnel are under the direct control of your ADSL service provider, so the greater degree of control your ADSL service provider has over the level of service and responsiveness you receive. The more equipment components are owned by your ADSL provider, so the greater control your provider has over the technical capabilities of the service and the early introduction of new features (e.g. ADSL 2+). A long term commitment to DSL Resale, for example, might prevent an ADSL service provider and all his customers from using the recently introduced, and higher speed ADSL 2+ service.

Conversely, by using an 'unbundled' line or his own cable infrastructure, a service provider can gain nearly total control of the ADSL capabilities and service level of his ADSL offering.

Greatest degree of control: **ADSL provider uses own cable infrasructure**

ADSL provider uses unbundled lines
ADSL provider uses bitstream service
ADSL provider uses line sharing
ADSL provider uses DSL resale (regulated)
Least degree of control: **ADSL provider uses unregulated DSL wholesale**

Which operators use their own cable infrastructure, line sharing, unbundling and/or DSL Resale?

It is not always easy to determine which cable connection method (own infrastructure, unbundling, DSL resale etc.) an ADSL service provider is using to provide his service, although the following generalisations are true in most European countries:

▸ **Ex-monopolist incumbent telecom operators:** The ex-monopoly players (incumbents: e.g. British Telecom in UK, France Télécom in France, Deutsche Telekom in Germany, Telefónica in Spain etc.) use their own cable infrastructure to provide DSL/ADSL service under their own Internet brandnames (BT Internet, wanadoo, T-Online, Telefónica Net)

▸ **ADSL Resellers / ISPs:** Most of the new players offering ADSL are ISPs (Internet Service Providers: e.g. AOL, Pipex, Tiscali, United Internet (1&1, GMX) etc.) who are offering ADSL service based on a DSL Resale arrangement – usually provided by the incumbent operator. DSL Resale is a relatively easy way for a new market entrant to offer ADSL service economically, while still being able to offer nationwide service coverage. When a new service provider appears and is instantly able to offer nationwide coverage then more than likely: this service is based on DSL Resale of another operator's (wholesaler's) service. In the longer term, the capabilities and price of the offering will depend upon the wholesaler as much as upon the ADSL reseller.

▸ **Network Infrastructure Builders:** A small number of players are concentrating on trying to build their own large scale network infrastructure – combined with 'unbundled' and 'line sharing' lines of the incumbent. (e.g. Neufcom/Cegetel in France; Arcor, QSC and Telefónica in Germany). The investment required for such an undertaking is enormous – reflecting the financial substance behind these service providers. But as a means of achieving earliest possible return on their large invesments, these players also typically offer 'Wholesale DSL' services to other ADSL service providers – as an alternative to the incumbent's DSL Resale service. Service providers in this category can be distinguished by their limited geographical service coverage (target main cities only, but with an ever expanding list of cities) and by promotional offers which nearly always combine an ISDN telephone line together with ADSL service.

Which Internet access line is best for me? (dial-up, ISDN, ADSL, ADSL2+, SDSL)
Which of the following access lines is best for me?

▸ **Dial-up (using analogue modem and normal telephone line)**
▸ **Dial-up (ISDN)**
▸ **ADSL**
▸ **ADSL2 or ADSL2+**
▸ **SDSL**

Dial Up (telephone line and modem): If you are not already an Internet user and are unsure of the benefits that access to the Internet will bring, or alternatively if you only have infrequent or minimal requirement for Internet access or your requirement is for nomadic access from different geographical locations, then probably the cheapest method of access is a 'pay-as-you-use' dial-up Internet access service. A number of providers offer such services: there is no subscription charge, but instead simply an online registration. Service is charged directly by means of the telephone bill at a rate per minute – for the duration of each call.

▸ **Call charges** for accessing such services typically lie around 0.5 – 2.0 Eurocent/minute (£ 0.003-0.01).

▸ **Maximum speed** of dial-up connections is limited by the modem installed in your PC and is 56 kbit/s, although the actual data throughput is typically much lower

than this: it is limited by the total capacity made available by the provider in connecting the 'dial-in-point' to the Internet itself. This capacity must be shared between many users. Typically only 1/50 of the registered users may use the capacity at any one time. In addition, the data throughput rate of dial-up lines using modems is also restricted by a high incidence of data errors (poor quality lines and noise on the line require that errored data be re-transmitted)

▸ **Limitations**: it is sometimes necessary to make several calls to the dial-up number before a connection can be established. Particularly in the evening it may be necessary to wait until a quieter time before a connection can be established. And once a connection is established, website page download times may be quite lengthy. Many modern websites are no longer designed with dial-up users in mind.

Dial Up (ISDN): If your usage of the Internet is only occasional, but you find the speed of analogue dial-up access with a modem a little too slow, then the right solution for you may be an ISDN dial-up connection. For this you will need an ISDN network card installed in your PC. Access and charges are very similar to dial-up modem access (indeed in most cases you will call the same dial-up access point).

▸ **Call charges** for accessing such services typically lie around 0.5 – 2.0 Eurocent/minute (£ 0.003-0.01).

▸ **Maximum speed** of ISDN (digital) dial-up connections is 128 kbit/s when the modem and provider support channel bundling (2 x 64 kbit/s channels operating together as a single connection). Otherwise the maximum bitrate is 64 kbit/s. The 64 kbit/s rate may appear only slightly faster than the 56 kbit/s of analogue dial-up modems, but in reality the performance is much better, since ISDN lines are not prone to high rates of data errors as is the case with analogue modems. But as with dial-up using an analogue modem, the actual data rate is limited by the total capacity made available by the provider in connecting the 'dial-in-point' to the Internet itself. This capacity must be shared between many users. Typically only 1/50 of the registered users may use the capacity at any one time.

▸ **Limitations**: it is sometimes necessary to make several calls to the dial-up number before a connection can be established. Particularly in the evening it may be necessary to wait until a quieter time before a connection can be established. And once a connection is established, website page download times may be quite lengthy. Many modern websites are no longer designed with dial-up users in mind.

ADSL/broadband: If you are a frequent user of the Internet, 'surf' for long periods of time or have a need for large scale data transfer, an 'always on' connection or high bandwidth applications (such as gaming, software downloading, music or video-on-demand, Internet telephony (VOIP) etc.) then the right solution for you is ADSL or an equivalent broadband service. For this you will need an ethernet network card (10/100baseT) installed in your PC.

▸ **Charges** are typically around €15-25 monthly for line connection and €5-€10 in data transfer charges (dependent on volume, or based on a flatrate charge) [total charges €20 (£15) to €35 (£28) per month]. For serious Internet users, the predictable and limited charges offered by a DSL volume flatrate charge may be the prime motivation for changing to ADSL.

▸ **Maximum speed** of standard ADSL connections is 8 Mbit/s in the downstream direction (from Internet to ADSL user) and up to 1 Mbit/s upstream (from ADSL user to network)

▸ **Limitations**: The prime limitation is that ADSL is not available to everyone – not all exchange areas are equipped for ADSL. In addition, for very heavy users or for bandwidth-hungry applications (such as live video or TV-streaming, large scale software downloading, video-on-demand, high speed 3D gaming etc.) the downstream bitrate may be a limitation. The upstream limitation of 1 Mbit/s may also be a limitation for users requiring to send a lot of data ('peering' applications, large file transfer, back-up applications, web server connection at the site etc.). In this case, ADSL2, ADSL2+ or SDSL may be better suited.

ADSL2/ADSL2+/broadband: If you are a frequent user of the Internet, 'surf' for long periods of time or have a need for largescale data transfer or high bandwidth applications (such as gaming, software downloading, music or video-on-demand, and the 8 Mbit/s downstream bitrate of standard ADSL is a limitation, then ADSL2 or ADSL2+ is the right solution for you. Alternatively, given that ADSL2+ is fast becoming the 'standard' type of ADSL offered by ADSL service providers, you may elect for ADSL2+ directly anyway. By equipping yourself from the start with an ADSL 2+ compatible DSL modem, you avoid the possible need for a new modem later. To use ADSL2 or ADSL2+ you will need an ethernet network card (10/100baseT) installed in your PC.

▸ **Charges** are typically around €30 monthly for line connection and €5-€10 in data transfer charges (dependent on volume, or based on a flatrate charge) [total charges €40 per month]

▸ **Maximum speed** of ADSL2 connections is 12 Mbit/s in the downstream direction (from Internet to ADSL user) and of ADSL2+ connections is 25 Mbit/s. Maximum upstream rate is 3.5 Mbit/s (from ADSL user to network)

▸ **Limitations**: As with ADSL, not all telephone exchange areas are equipped for ADSL2 and ADSL2+. In addition, the upstream limitation of 3.5 Mbit/s may also be a limitation for users requiring to send a lot of data ('peering' applications, large file transfer, back-up applications, web server connection at the site etc.). In this case, SDSL may be better suited.

SDSL: For small businesses, an ADSL connection may be the perfect solution for Internet access and inter-site datanetworking. However, for many businesses – particularly those with large email or file servers, databases, website servers, peer applications or data back-up arrangements, it is just as important to have a high *upstream* data rate (data transfer from customer site to network) as it is to have a high *downstream* bitrate (data transferred from the network or Internet to the local site). In this case, an SDSL connection may be the best solution

▸ **Charges** are typically around €90 monthly for line connection and flatrate data transfer charges

▸ **Maximum speed** of SDSL connections is typically 6 Mbit/s in both *upstream* and *downstream* directions

▸ **Limitations**: As with ADSL, not all telephone exchange areas are equipped for SDSL. Where the data rate of 6 Mbit/s is not sufficient then you may need to request a high speed leaseline (e.g. ethernet, 34 Mbit/s, 155 Mbit/s or Gigabit ethernet – 1000 Mbit/s) as your means of connection to the Internet.

Reasons for buying ADSL – Applications of ADSL
The prime applications of ADSL are for:

▸ Surfing the Internet
▸ Electronic mail (email)

‣ Webmail
‣ 'chatting'
‣ 'blogging'
‣ software downloading
‣ creating and managing a website
‣ gaming or network gaming with others
‣ mp3 and music downloading
‣ podcasting and itunes
‣ Internet telephony and VOIP (voice-over-IP)
‣ Webcams
‣ Netmeetings and videoconferencing
‣ video-on-demand
‣ IP TV (IP television)
‣ HDTV (high definition television) via the Internet

ADSL Connection types and Provider offerings

Internet service providers and broadband operators now offer a wide range of broadband and DSL/ADSL/ADSL2+ offerings:

DSL type	downstream bitrate	upstream bitrate (typical)	upstream bitrate (typical upgrade)
DSL 1000	1.024 Mbit/s	128 kbit/s	256 kbit/s
DSL 2000	2.048 Mbit/s	192 kbit/s	384 kbit/s
DSL 3000	3.072 Mbit/s		
DSL 6000	6.144 Mbit/s	512 kbit/s	576 kbit/s
DSL 8000	8.192 Mbit/s		
(ADSL2) DSL 12000	12 Mbit/s		
(ADSL2+) DSL 16000	16 Mbit/s	800 kbit/s	1024 kbit/s
(ADSL2+) DSL 20000	20 Mbit/s	1024 kbit/s	
(ADSL2+) DSL 24000	24 Mbit/s		3500 kbit/s

Reasons for buying the highest speed DSL line available?

You may have a number of requirements for buying the highest speed line available:

‣ **To be able to download more data** (e.g. for largescale software or file download, data file transfer or data backup applications). In a 60 minute 'busy hour' window each day you are able to transfer a maximum of 450 Mbytes for each 1 Mbit/s of linespeed

‣ **To support bandwidth-hungry applications** (e.g. as you may require in order to enjoy higher speed or higher quality/higher resolution live video streaming – e.g. for IPTV and HDTV – high definition television downloads across the Internet). Without a high speed line, you will have to make do with poorer quality, poorer resolution pictures and videos.

‣ **For faster response of interactive applications:** where you are running interactive applications (such as games) it may be critical to ensure fastest possible delivery of data and messages in both directions. A faster bitrate reduces the elapsed time until full receipt of a given length of message at the receiving end. Note however, that a line with double the bitrate does not deliver the message in half the time. The length of the line (propagation distance) is also critical to the overall elapsed time for message conveyance. In the example below a 20x increase in ADSL connection bitrate reduces the message propagation to a half of its previous value.

Message transfer time example:

Let us compare the time for message transfer of a message of 64 byte (64 x 8 bits = 512 bits) length

Let us assume that the total distance the message will be carried is 100km. Therefore the propagation time across the connection of a single 'bit' of data is ≈ 100 km /(¾ x 3 x10^5 km/s*)

Propagation time of single bit of data (due to length of connection) is 0.444 ms

[*Note: 3 x 10^5 km/s is the speed of light through space. Digital signals in a telecommunications network travel at about ¾ of this speed]

Connection 1:	Connection 2:
1.024 Mbit/s download rate	20.480 Mbit/s download rate (20x speed)
time to transmit 512 bits = 0.5 ms	time to transmit 512 bits = 0.025 ms
total time elapsed to message receipt = *latency* = 0.444 ms + 0.5 ms = 0.944 ms	total time elapsed to message receipt = *latency* = 0.444 ms + 0.025 ms = 0.469 ms
	delivery in half the time, but requiring 20x bitrate

If you are a software application designer:
The most significant improvement in the speed at which your application runs may be achieved by reducing the 'conversational' exchange of the user's client software with the server. In particular, eliminating the need to wait for 'acknowledgement (ACK)' messages as confirmation of particular actions will considerably reduce the time required for process execution. (In the example above, each 'acknowledgement' required from the distant end will 'cost' at least double the time which elapses during a simple message receipt – since a message transmission and an ACK reply must be conducted – a minimum PING response time of 2 x 0.469 ≈ 1 ms delay or *latency*)

▸ **As an insurance against future needs ('future-proofing'):** Given that most modern equipment (e.g. DSL modems) already supports the latest ADSL2+ standard, it is easy to predict the development of future applications and services exploiting the higher bitrates (up to 25 Mbit/s) which it makes possible. It may simply be prudent to avoid the costs of a later equipment and line connection bitrate upgrade by contracting to the higher bitrate from the start.

In order that you can make most benefit from the highest speed of ADSL connection, you may need new or more equipment to deal with the increased speed and data (e.g. DSL modem compatible with the ADSL2+ standard, or 'always on' home entertainment server to capture the large volumes of data associated with video downloads).

The Differences between ADSL service providers ("the options and pitfalls in your choice of provider")

When choosing your ADSL supplier, I recommend that you consider the following factors which differentiate provider offerings:

Factor for consideration	Remarks
Downstream bitrate	▶ Various bitrates are available from 1 Mbit/s to 25 Mbit/s (ADSL2+). ▶ Make sure that you can get the bitrate you require for your current needs, but that there is also scope to upgrade to a higher bitrate later. ▶ Check the terms for an upgrade.
Upstream bitrate	▶ Make sure that the upstream bitrate is sufficient to meet your needs ▶ There may be an option to upgrade the upstream bitrate
FastPath	▶ Usually an option – maybe at extra charge ▶ May be required be gamers and others requiring rapid PING time response (i.e. low latency)
ADSL2+ standard supported?	▶ The ADSL2+ or ADSL2 standard is required for speeds above 8 Mbit/s – up to 25 Mbit/s ▶ It is advisable to purchase one of the most modern DSL modems – one supporting the ADSL2+ standard as well as straight-forward ADSL ▶ If your provider supports ADSL2+ then the door is open for an easy upgrade at a later date speeds up to 24 Mbit/s as may be required for video-on-demand, IP-TV and HDTV (high definition television)
Geographical service coverage	▶ Very few ADSL service providers are able to provide nationwide coverage ▶ Check that you are within the coverage area of your preferred supplier (this 'pre-qualification' is typically carried out by the supplier as part of his order process)
Monthly charges for connection	▶ Check that you understand the supplier's tariffs and commercial conditions. ▶ Sometimes the monthly subscription includes a flatrate charge for unlimited data volume, sometimes data volume charges are extra.
Data volume charges – flatrate?	▶ Data volume charges might be per MB (Megabyte) ▶ There may be a fixed charge for all volume up to a given GB (Gigabyte) volume per month ▶ There may be a 'flatrate' charge for unlimited data volume ▶ Some providers also make charges related to the time duration during which the line was connected – though increasingly these charges are disappearing in favour of 'always on' connections and flatrate tariffs.
Quality of Service (QOS)	▶ The quality of service (QOS) provided by different ADSL providers can vary greatly. ▶ It is difficult to assess the quality you will receive in advance or from their website.

	▶ Of course, all providers promise high quality ▶ But they differ greatly in the network capacity they provide in their backhaul/backbone networks – the part of their network linking your local ADSL connection to the public Internet itself ▶ It is common for Internet Service Providers (ISPs) and ADSL providers to provide their backhaul capacity according to an average peak hour kbit/s data rate per customer connection (e.g. 20 kbit/s per customer). This is equivalent to an 'overbooking' factor on 1 Mbit/s lines of 50 – there is only 1 Mbit/s of 'backhaul' capacity to the Internet for every 50 customer 1 Mbit/s ADSL connections. ▶ The higher the 'overbooking factor' applied by the ADSL service provider, the slower your Internet connection will respond at times of peak traffic loading. ▶ To get some idea of a provider's QOS level before you order his service, you may like to consult the published statistics of your national telecommunications regulator. ▶ Most national regulators force ADSL service providers (as well as all other telecommunications service providers) to publish statistics on QOS – including waiting time to installation, service QOS and responsiveness to fault handling
Forced release every 24 hours?	▶ Many ADSL service providers conduct a 'forced release' of each ADSL connection every 24 hours ▶ If an application is running at the time of the forced release it may be temporarily disturbed as the connection is re-established ▶ To mitigate the problem you may choose to manually set up the first 'always on' connection sometime in the very early morning – or at another period of very low usage
DSL modem choice and price	▶ The range of DSL modems and the prices offered may vary greatly from one provider to another ▶ Equipment developed by companies in the country of operation may be better optimised for local network conditions than the offerings of international equipment and router providers such as Cisco ▶ More below on features you might need...
Fixed IP address	▶ Most ADSL providers allocate IP addresses on a 'dynamic' basis. This means that your IP address is assigned to you each time you re-establish the connection. For the duration of your connection your IP address is unique and only available for your use, although from time to time, your IP address assignment may change

	▶ A fixed IP (Internet protocol) address may be beneficial when distributed servers or roaming users at other locations have to access your site ▶ A fixed IP address may also be beneficial as a reliable means of identifying your site to other locations, servers or applications for security purposes (though the fixed IP address is not a 'guarantee of identity')
Port restrictions	▶ In order to restrict certain types of usage of your ADSL connection (this can have performance and security benefits in some cases), your ADSL service provider may restrict the use of certain *port numbers*. ▶ If you require to use any exotic data protocols or applications, check that the relevant port numbers are permitted.
Peer-to-peer usage restrictions	▶ Although many ADSL service providers claim 'flatrate' tariffs, some are not keen on customers who use their connections at their maximum bitrates for prolonged periods of time (e.g. for permanent peer-to-peer data exchanges or data distribution). ▶ Some operators reserve the right (in their terms and conditions) to cancel your service and remove your ADSL connection or migrate you to a different tariff or service. ▶ If you intend heavy 'peer-to-peer' usage it may be prudent to check this with the service provider upfront.
Hosting package/email included?	▶ Many ADSL service porviders include a web hosting package including your own Internet domain name (e.g. www.yourname.com) as part of your ADSL subscription. ▶ This often includes software tools, email accounts and an anti-virus software subscription. ▶ But do not pay extra for this if you don't need it. ▶ Always compare the direct cost of an anti-virus subscription with the annual charges quoted on the websites of the major providers (e.g. Norton Antivirus).
Installation and other one-time charges	▶ Installation and one-off charges (including postage costs for sending you the splitter and/or DSL modem) can be significant.
Contract lock-in period	▶ Many ADSL service providers offer terms including no installation charge – but at the cost of a 12 month or 24 month minimum contract commitment.
Upgrades	▶ Do the commercial terms allow an upgrade or downgrade of your bitrate at no charge?
Installation assistance and service	▶ Does your provider have a 24 hour telephone hotline to assist you when you can't get things to work? ▶ Is the hotline free or what are the charges for this assistance?

Choice and Configuration of your DSL Modem
Consider your requirements carefully when selecting your DSL modem. The 'free' modem offered as part of your set-up package by your new ADSL service provider may not meet all your needs. Likewise, the most expensive one may provide capabilities you don't need and thereby generate unnecessary expense. Remember: even if the DSL modem is provided for free: under most countries' telecommunications laws, the DSL modem (as CPE = customer premises equipment) to be owned by you the customer: it's yours, and if you change ADSL service provider you can 'take it with you'! Since the modems are standard equipment, they will generally work on other providers networks.

When choosing a DSL modem, look out for:

DSL Modem feature	things to look out for
Basic DSL modem requirements	▶ The modem should support standard ADSL (ITU-T recommendations G.992.1 and G.992.2) ▶ Standard ADSL provides a downstream bitrate up to 8 Mbit/s and upstream up to at least 576 kbit/s ▶ The modem you choose should support the bitrates you require now and the bitrates you foresee that you might require in future ▶ ADSL2+: Since ADSL2+ is fast becoming the 'standard' method of providing ADSL amongst the ADSL service providers, I recommend that you ensure that any new modem you purchase is ADSL2+ compatible
Mandatory Connections – Every DSL modem should have at least three connections	▶ Power connection ▶ DSL network connection to DSL splitter or DSL filter and thus to ADSL network. This is usually a rectangular 8-pin RJ-45 socket ▶ Ethernet 10/100baseT LAN connection for connecting your PC or LAN (RJ-45 socket also. [Ensure that your modem has at least one LAN cable connection, even if it also offers WLAN (IEEE 802.11)]
Essential Capabilities – you should ensure that your DSL modem has the following capabilities built in:	▶ **Router function** ▶ **PPPoE** (PPP over Ethernet) – this is essential in order your PC can establish the ADSL connection to your ADSL provider ▶ **DHCP** server function (dynamic host control protocol) this may not be explicitly stated on the box, but is mostly included when a router is included) ▶ **NAT** (network address translation) is an essential requirement of the router if you intend to connect more than one PC via a LAN to your ADSL connection. The NAT function converts the 'private IP address' used in the local LAN to the 'public IP address' issued by your ISP which you need when accessing the Internet. ▶ **Firewall function** – your DSL modem should have at least a simple firewall function for preventing access to the files on your PC or

	LAN by unauthorised external Internet users ▸ **Web management interface** – this allows you to access your DSL modem easily using an Internet browser software (e.g. Internet Explorer or Firefox) to configure your ADSL conection for service and change settings (e.g. firewall settings) if required
Optional features – you may consider the following features to be advantageous	▸ **WLAN hub** built-in ▸ **LAN switch** built-in ▸ **Internet telephony function** built-in
WLAN **(Wireless LAN – otherwise known as WiFi or IEEE 802.11)**	▸ **WLAN** allows for wireless connection and networking of your PC and various computer peripherals (e.g. scanner, printer, external harddrive etc.) ▸ **Multiple 802.11 standards** – be careful when purchasing your DSL modem/WLAN hub and WLAN cards for your computer equipment – to ensure that you purchase the same 802.11 WLAN standard for each device – either 802.11a, 802.11b or 802.11g ▸ **WLAN security** – make sure not only that your DSL modem/WLAN hub can support WLAN security, but also that you remember to set it up. This ensures that only devices authorised and correctly configured by you with the appropriate passwords are able to access the Internet via your ADSL connection. You would be amazed how many people operate WLANs without proper security! (possible security standards: WEP – wireless equivalent privacy or WPA – WiFi protected access)
Internet telephony **VOIP (voice-over-IP)**	▸ **SIP** (session initiation protocol) is the protocol required for setting up (usually cheap) telephone calls across the Internet. Some DSL modems include a **SIP client** able to set up such calls. In order that the system works, your ADSL service provider or other third-party Internet Service Provider as VOIP operator must provide the corresponding **SIP server** ▸ **SIP soft client** – it is possible to conduct VOIP (voice-over-IP) "Internet telephony" from any PC connected to the Internet and equipped with a "SIP soft client" (e.g. Skype client). However, the voice quality of such calls may be inadequate – particularly when you simultaneously 'surf' the Internet ▸ **DSL Modems offering SIP clients** can typically be split into three classes: **I.** DSL modems offering an solution which fully integrates VOIP with your existing analogue or ISDN exchange line and which allow continued use of your existing telephone handsets. In this arrangement outgoing calls from your 'normal' phone benefit from the cheap rates of VOIP, while incoming calls to

<table>
<tr><td></td><td>your existing known telephone number ring the same phone.

II. DSL modems offering a new VOIP telephone line in addition to your existing telephone line. A new (but standard) telephone handset may be required to make use of this extra line. In particular, the new line is likely to be attractive for cheap outgoing calls. Incoming calls to the new line are also possible – provided the caller knows your new VOIP telephone number. Solutions in this category do not always support adequate QOS (voice signal prioritisation in the upstream direction) to give good speech quality.

III. DSL modems offering VOIP but requiring the purchase of new special VOIP telephones. The quality of speech using such solutions is not usually very high.

▸ **Recommended: Solution I** above when you wish to benefit from VOIP. The best DSL modem manufacturers for such a solution are typically national manufacturers (e.g. AVM FritzBoxFon in Germany).

▸ **Cisco/Linksys** has not so far produced DSL modems with the best integrated VOIP solutions</td></tr>
</table>

When installing your DSL modem, I would recommend that you make provision for lightning protection (surge protection) on both the power supply connection (power surge protection) and the ADSL connection (telephone surge connection) to your network service provider. Without protection, you may find yourself having to buy a new DSL modem everytime a thunderstorm comes your way! Experience has told me that this is a real risk!

Affect of line length – why can I not get the bitrate and/or DSL service that I want?
Since the modulation technique used to carry the high bitrate ADSL signal over your "local loop" telephone line makes heavy use of high frequency signals, the line has to be of a given minimum quality before ADSL can be expected to work properly.

Where the minimum quality required for the maximum bitrate is not available, operation at a lower bitrate may be possible. The bitrate which is possible depends on a number of factors:

▸ **The length of your telephone line** from your house to the nearest telephone exchange. The length must typically be less than 5.5 km. Longer lines usually mean that the following parameters are not met...

▸ **Signal loss** across your telephone line should typically be less than 45 dB.

▸ **The noise level** on your telephone line (poor connections ("fried egg noise") or crosstalk (humming or overhead conversation or other signals) disturb the ADSL signal. Line noise must typically be less than 55 dB.

▸ **Line capacitance** of your telephone line acts as a filter for the higher frequencies. The value must be less than 180 nF.

▸ **The cable guage** (i.e. the diameter of the copper core) of your telephone line - narrower guage wires cause higher signal attenuation (loss of signal strength) but may have lower capacitance.

A check is usually carried out when you order your DSL line, to check whether your exchange is equipped for ADSL and to test the quality of your individual line – in order to determine what bitrate can be offered and/or guaranteed. In cases where the line fails the test, your order may be rejected. In this case you have two options if you are determined to get service: to request a re-check of your line (if it was borderline), or to indicate that you are willing to accept a lower bitrate and/or forego the bitrate guarantee.

ADSL Economics

Experience shows that the pricing of ADSL services can be very confusing. Maybe some service providers are determined to make their services appear at first glance (and without appropriate analysis) to be much cheaper than their competition, when the reality is that their 'hidden charges make them more expensive. You should make sure to check ALL the charges that will be due...

Cost Element	Check the following:
Monthly connection fee	▸ This is likely to be the most important element of your overall costs – especially if your line is likely to be in service for a long time
Monthly usage charges for data volume or flatrate	▸ Sometimes a flatrate (unlimited usage) is included in the quoted monthly connection charge, sometimes it is extra. ▸ Sometimes the volume is charged per GB (gigabyte) or flatrate up to a given number of GB per month and per GB thereafter. ▸ Check that you have estimated your likely data volume and have chosen the best volume tariff to minimise your costs. ▸ Even though you may not have the volume to justify a flatrate, you may choose this tariff in order that you have a predictable constant monthly invoice
Internet Access (ISP) charges	▸ Check whether you need to pay an extra subscription for Internet access (ISP) service – this usually includes an email address etc. ▸ Check whether these charges include hosting services (e.g. website, own domain name, virus subscription services etc.) which are of value to you ▸ Select a different ISP and/or different Internet access tariff if relevant ▸ Cancel other ISPs (e.g. AOL) if this is no longer essential
Telephone line costs	▸ You are usually obliged to have a standard analogue telephone line or ISDN line service (ISDN2 or BRI), which the ADSL service may share

	▶ Check the price of this line and the usage charges (even if it is provided by a different public provider) ▶ Ask if there is an alternative and compare the costs (line connection fee and usage charges) of the alternative
Cost of DSL modem	▶ Consider the purchase cost of your DSL modem ▶ Consider the cost of an alternative purchase (e.g. from a computer discount store) ▶ Consider re-using the DSL modem you already have (e.g. provided by a previous ADSL service provider)
ADSL installation charges	▶ There is usually a one-off charge applied when you first order the service ▶ The lower the one-off charge, the longer the duration of the contract commitment you are likely to have to make ▶ If you are changing ADSL provider, will you experience a break in service? If so, for how long?
Cost of installation assistance and helpdesk/service	▶ Will the provider make a charge for 'pre-configuring' your DSL modem and/or other equipment or for assistance on-site when delivering and connecting the various equipment, or will you do all of this yourself? ▶ What charges apply when you call the hotline?
Additional usage charges	▶ Are there any other usage or support charges that will be chargeable?
Hidden charges	▶ Your DSL modem may be 'free' but how much does the smallprint reveal that you will have to pay for 'postage'?
Length of contract	▶ What is the minimum commitment period? ▶ What notice will you have to give to cancel the contract thereafter? ▶ Is a smooth transition to an alternative ADSL provider (without break in service) assured at the end of the contract?

Make sure you calculate the total costs which will be due over the entire lifetime of your likely usage of the connection. Alternatively, compare the total costs for the first 24 months (including DSL modem, installation etc.) and compare additionally the direct monthly costs which will persist thereafter.

Setting up DSL: DSL access methodology and security
Once your ADSL service provider has accepted your order, your DSL splitter/DSL filter and DSL modem will be despatched to you. In addition, you need to receive an ADSL/Internet access service username and password. This may be provided by your ADSL service provider or by your Internet access provider or ISP (Internet Service Provider). This may or may not be the same company. For example, there was a time in Germany when the connection provider of Deutsche Telekom was T-Com. Meanwhile, the username and password were provided by T-Online.

Your ADSL service username usually has a form similar to an email address, something like:

1234567@yourADSLprovider.com

or

yourname.xxx@yourADSLprovider.com

Your ADSL username and password you should keep confidential. They need to be configured into your DSL modem (recommended) and/or your computer. Typically, your DSL modem configuration panel will allow you to choose between an 'always on' and a 'connect when necessary' configuration. Unless your ADSL service provider charges extra for the service, I recommend that you select the 'always on' option.

Your username and password are registered by your DSL modem with the BRAS (broadband remote access server) and/or RADIUS server of your provider, where they are authenticated and authorised before your ADSL connection is established.

Once plugged in and configured, any computer with a normal ethernet LAN connection can be connected to your DSL modem for Internet access service.

Enjoy your ADSL service!

Popular search and research sites
Google
Wikipedia
Del.icio.us

Popular software downloads
Mozilla: Firefox & Thunderbird
Microsoft
Apple iTunes
Adobe and Macromedia
Java
Linux
NVU
Blog software

Popular music and podcasting sites
iTunes
BBC Radio

Popular gaming sites
IGN
Mousebreaker

Line performance problems? – what might make the line appear slow
If you find that the Internet page download speed is rather slow, despite your new high speed ADSL interconnection connection, this may be down to any one of a number of reasons:

▶ Overloaded (overbooked) backhaul capacity connecting your local exchange to the public Internet

▶ Capacity limitations or traffic overload in the networks and *peering points* between the networks making up the Internet itself

▶ Limited streaming capacity of the remote server (e.g. web server)

▶ Limited *upstream* bitrate from the remote server to the Internet (Some web servers are connected by means of DSL connections – in this case they may not be able to deliver data faster than 128 kbit/s).

▶ Poor application design – computer applications which are unduly 'interactive' or demand repeated 'acknowledgement (ACK)' messages are likely to be preceived by users as reacting very slowly. ADSL line configuration parameters (in particular, by having your ADSL service provider activate the 'FastPath' feature) may help in some cases. Gamers can benefit from the 'FastPath' feature. Otherwise the software may require re-design to improve the speed of performance.

▶ A fault on your DSL connection or at your service providers DSLAM. However: the normal effect of a fault on you connection is not simply to reduce the data transfer speed but to cause complete loss of service.

To trace the exact location of the problem within the network, it may be useful to employ a PING-tool to detect the network connection or node which is the main source of the packet delay (latency). Typically you input the Internet address or web-style address of the server or other device you are trying to communicate with and the PING-tool then sends and receives repeated messages to the device in order to measure the overall *round-trip-time (RTT)* to each of the network nodes along the entire length of the connection – displaying the results in a table or graphic.

Recommended PING-tools:
For Windows users: WinMTR
For LINUX users: SmokePING

Internet telephony (broadband telephony) and VOIP
Since Internet telephony (also called broadband telephony or VOIP – voice-over-IP) is increasingly being offered as an integral part of many ADSL providers service offerings (as a cheaper alternative to 'normal' telephony), it seems relevant to provide a brief overview of the typical VOIP services, what you will need and where the pitfalls are:

Factor to be considered	Remarks
Basic Requirements for VOIP	▶ In order that a VOIP (Internet telephony) service can work at all, at least three elements are required as described below: ▶ The VOIP service provider must provide a VOIP server (usually nowadays a SIP server) ▶ The VOIP user must be equipped with a suitable VOIP telephone or other VOIP client device (e.g. SIP client) ▶ An Internet or other IP-network path must exist between VOIP caller and called destination

Calling from VOIP to the 'normal' or 'legacy' telephone network	▶ This is technically possible, provided that the VOIP service provider/network operator has installed a *media gateway (MGW)*, as well as the appropriate network interconnection ▶ For certain types of network interconnection to the public telephone network, the VOIP network operator may need to be registered as a public telecommunications operator
The SIP Server **(alternatively H.323 or MGCP server)**	▶ The SIP server is the VOIP equivalent of a telephone exchange. This arranges for the establishment of call connections between VOIP caller and the called party (destination address) ▶ Alternatively, an H.323 or MGCP server could be provided instead of a SIP server. This are alternative protocols to SIP. However, SIP is becoming the predominant protocol
VOIP telephone handset or softclient	▶ In order to make a VOIP call, the VOIP user must be in possession either of a VOIP telephone or a VOIP-software-client running on his or her PC ▶ Alternatively, a telephone-to-VOIP adaptor (correctly called an IAD – integrated access device) may be used (such a device may be built-in to your DSL modem) ▶ In order to avoid speech quality problems (in particular bad echo heard by your VOIP counterpart), it is advisable when using a VOIP softclient to use a headset and microphone (rather than the speakers of your computer)
Telephone addresses used for VOIP	▶ Different VOIP service providers use different types of addresses for making VOIP calls ▶ Skype, for example, uses a special Skype user name. All well and good if only other Skype users are to call you, but not so good if you wish to be generally reachable under this 'name-like' address ▶ Increasingly common is the allocation by VOIP service providers of standard telephone numbers (so-called E.164 numbers). Such a number allows a VOIP user to be called from any public telephone ▶ Remember that the format and area code of the number you are allocated will affect the charge which callers incur when telephoning you.
Advantages of VOIP	▶ The main advantage is the reduced cost of making calls (often free calls to other VOIP users and very cheap calls to normal telephone numbers) ▶ Increasingly, VOIP service providers are offering flat rate monthly usage charges for unlimited numbers of VOIP calls ▶ Another advantage is the ability to use your VOIP telephone account as a 'nomadic' telephone line: anywhere you can connect to the Internet you can be reached under the

	same VOIP telephone number and make calls on your own account.
VOIP voice quality	▶ This can vary dramatically from one VOIP provider to another ▶ Ask your VOIP service provider about the average service quality he achieves. Ask for his MOS (mean opinion score). MOS is rated on a scale of 1-5. The public fixed telephone network gets a score around 3 to 4, while mobile networks score a little lower. An MOS of 3 or more for a VOIP network means that the voice quality is at least as good as the telephone network ▶ If your VOIP provider can't tell you his MOS, then he probably hasn't bothered to set up a proper QOS monitoring and management framework yet ▶ The best VOIP connection quality is achieved with a DSL connection, when the DSL modem prioritises voice ahead of data – particularly on the bandwidth-limited *upstream* direction. ▶ The best quality is thus achieved on DSL (rather than dial-up connections) by DSL modems with built-in VOIP integrated access devices (IADs) ▶ Soft-client solutions and peer-to-peer solutions (e.g. Skype) may achieve reasonable quality but are inadequate when any data (e.g. from Internet surfing) has to share the same Internet access line, since they are unable to prioritise the voice for better QOS (quality of service)
VOIP quality: delay and echo	▶ Because the Internet imposes variable and sometimes relatively long delays on the messages it carries, VOIP calls can be subjected to longer delays than we are used to on normal telephone connections ▶ The delay itself can be disturbing, since your correspondent may appear to take an unusually long time to answer questions. Your may think he hasn't heard and start talking again, only to find you're talking over his reply. ▶ The delay can lead to unusually long times to establish calls and unreliable establishment of calls. ▶ Furthermore, the delay can lead to echo (hearing your own voice again – somewhat time delayed) ▶ Special measures may be necessary to eliminate echo. One such measure is to use a headset rather than the speakers of your computer. This avoids the possibility of the loudspeaker noise being returned via your microphone and thus causing echo. The delay itself cannot easily be eliminated.
Security and Fraud risks of VOIP	▶ Much is made by some operators (e.g. Skype) about the benefits of signal

	encryption when using VOIP. Maybe you feel this is important when choosing your VOIP service provider and VOIP devices ▸ But for most purposes the chances of overhearing are pretty remote and the dangers probably not that great. (There has never been encryption in the fixed telephone network, and the encryption in mobile networks is primarily to prevent the chance of radio overhearing). ▸ I personally reckon there is a far greater need to be concerned about fraud. If someone steals your VOIP username and password, they can make calls from anywhere and run up your account. Ask your VOIP provider what precautions are in place to minimise this risk.
Telephone numbers which are difficult to reach or unavailable from VOIP phones	▸ Many VOIP operators are unable to provide access from VOIP callers to various categories of telephone numbers: ▸ Calls to emergency services (fire, police ambulance) are rarely available ▸ Calls to service numbers (e.g. 800, 900) and operator services may be unavailable ▸ Calls to mobile phones may not be possible, be of poor quality and/or expensive ▸ Calls to VOIP users of other service providers may not be possible if there is not a 'peering' agreement
Other things you should be aware of	▸ **Calling Line Identity (CLI):** is offered on both outgoing and incoming calls by some VOIP operators, but is not always 100% reliable ▸ **ENUM:** this is a database of VOIP users. By participating in the ENUM service, your VOIP operator is able to ensure the widest possible access to VOIP users worldwide – using the most efficient connection path. ▸ **Lawful Interception:** Currently, many VOIP operators do not yet conform to telecom laws requiring them to enable 'lawful interception' of telephone calls by public enforcement agencies such as the police. However, this situation can be expected to change shortly. But assuming you're not a criminal, you have nothing to fear. ▸ **Number portability:** while you are now able to 'take your telephone number with you' should you change from one public fixed telephone network operator to another, you may have difficulty porting your existing fixed network number to a VOIP service and in number portability of a VOIP number from one provider to another.

What are the alternatives to DSL, or the options when DSL is not available?

If DSL is not available in your area, or your order is rejected because of the inadequate quality of your line, what can you do?

▸ Request your line be re-tested if it was a 'borderline' case (i.e. nearly met the quality standard)

▸ Indicate to your chosen ADSL provider that you are willing to accept a lower bitrate service and/or to forego a service/bitrate guarantee

▸ Check to determine if there are any "wireless dsl" (WiFi, Hotspot or WIMAX operators) offering service in your area

▸ Consider satellite ('sky dsl') service

▸ Consider a 'leaseline' connection for Internet access service (likely to be expensive and only appropriate for business users)

▸ Consult your national telecom regulator about your options

▸ Revert to dial-up telephone or ISDN access to the Internet

Complaining to or about your provider
Your national telecommunications regulator will handle your complaints if your service provider doesn't:

Country	Regulator	Website	Incumbent Operator
Austria	RTR	www.rtr.at	Telekom Austria
Belgium	IBPT	www.ibpt.be	Belgacom
Czech	Ministry of Transport	www.mdcr.cz	České telecomy
Denmark	TST	www.tst.dk	TDC (Tele Danmark)
Estonia	TSM	www.tsm.ee	Eesti Telekom
Finland	THK	www.thk.fi	Telia Sonera
France	ARCEP	www.arcep.fr	France Télécom
Germany	Bundesnetzagentur	www.bundesnetzagentur.de	Duetsche Telekom
Greece	EETT	www.eett.gr	OTE
Hungary	IHM	www.ihm.gov.hu	MATAV
Ireland	ODTR	www.odtr.ie	Eircom
Italy	AGCOM	www.agcom.it	Telecom Italia
Latvia	Delna	www.delna.lv	Lattelekom
Lithuania	RIM	www.rim.lt	AB Lietuvos telekomas
Luxembourg	ILR	www.ilr.etat.lu	P&T Luxembourg
Netherlands	OPTA	www.opta.nl	KPN Telecom
Norway	NPT	www.npt.no	Telenor
Portugal	ANACOM	www.icp.pt	Portugal Telecom
Slovenia	Ministry of the economy	www.mg.gov.si	Slovenia Telecom
Spain	CMT	www.cmt.es	Telefónica
Sweden	PTS	www.pts.se	Telia Sonera
Switzerland	OFCOM/BAKOM	www.bakom.admin.ch	Swisscom
UK	OFCOM	www.ofcom.org.uk	British Telecom

Glossary of Broadband Terms

ADSL	asymmetric digital subscriber line (up to 8 Mbit/s)
ADSL2	asymmetric digital subscriber line (up to 12 Mbit/s)
ADSL2+	asymmetric digital subscriber line (up to 25 Mbit/s)
BRAS	broadband remote access server
BRI	basic rate ISDN
CLI	calling line identity
Downstream	data transfer from the public network/Internet to the user
DSL	digital subscriber line
DSLAM	digital subscriber line access multiplexor
FastPath	a technique for reducing latency (PING times) on ADSL connections
HDSL	high speed digital subscriber line
IAD	integrated access device (VOIP)
IP	Internet protocol
ISDN	integrated services digital network
ISP	Internet service provider
ITU-T recommendation G.992.1	standard for ADSL
ITU-T recommendation G.992.2	standard for ADSL
ITU-T recommendation G.992.3	standard for ADSL2
ITU-T recommendation G.992.5	standard for ADSL2+
PING	packet internet groper
QOS	quality of service
SAN	storage area network
SDSL	symmetric digital subscriber line
U-R2	German national interface standard for ADSL lines
Upstream	data transfer from the user to the public network/Internet
VDSL	very high speed digital subscriber line
VOIP	voice-over-IP
WEP	wireless equivalent privacy
WiFi	wireless LAN (IEEE 802.11)
WLAN	wireless LAN (IEEE 802.11)
WPA	wireless protected access
XDSL	generic term for any type of DSL