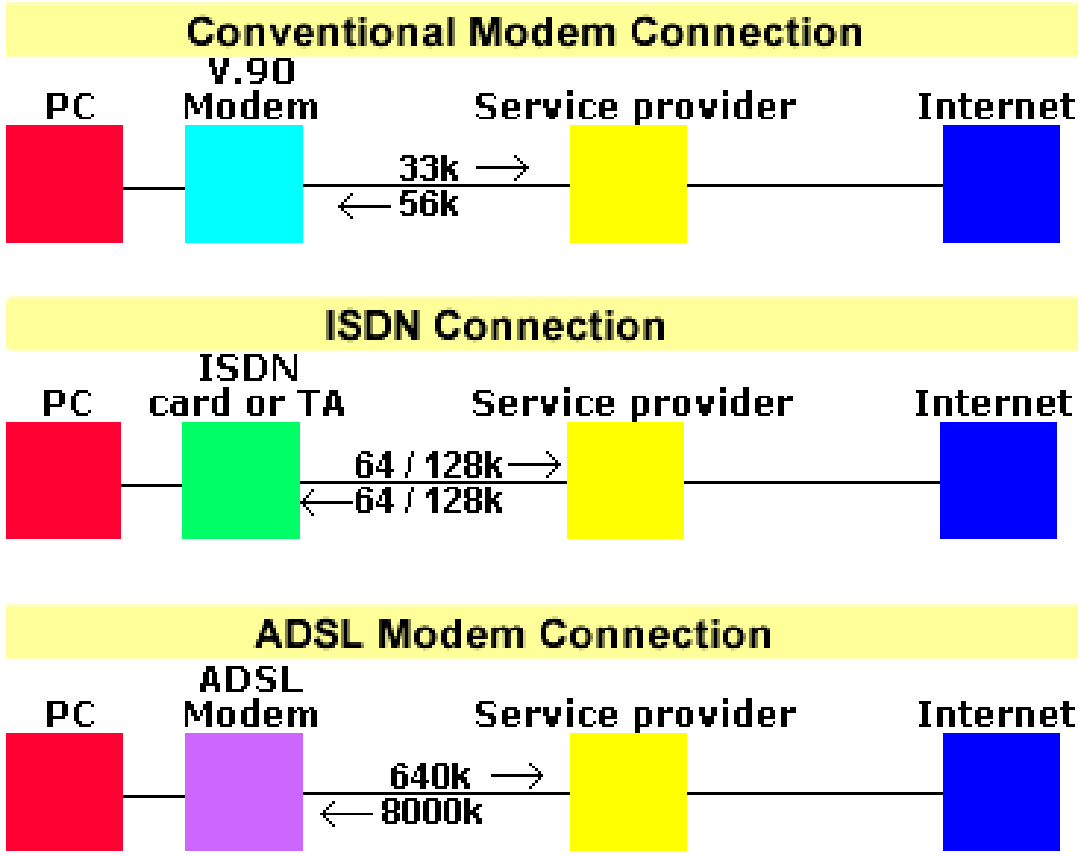
WHAT IS ADSL?

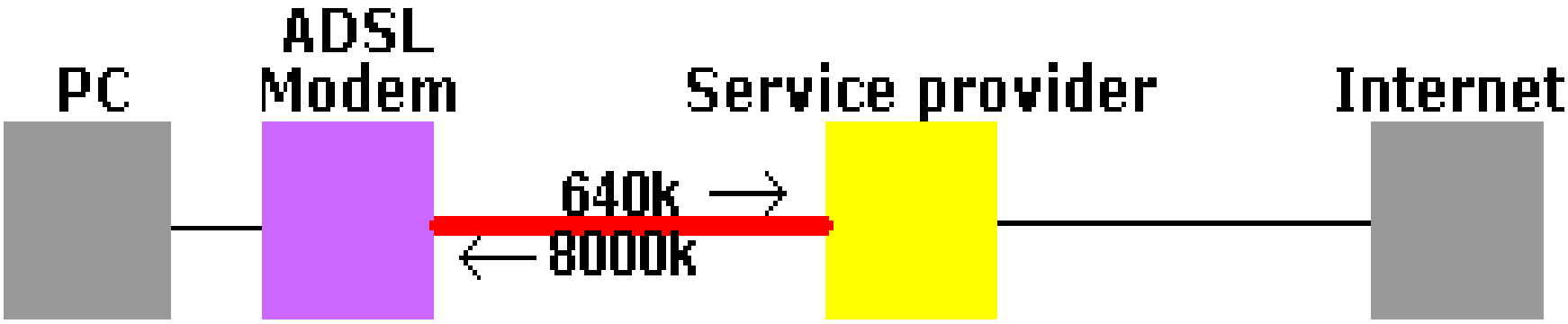
At the simplest level, ADSL is a high-speed replacement for your modem or ISDN adapter that allows you to access the Internet faster. The following diagram shows the maximum speeds attainable.



What does ADSL mean?

ADSL stands for **Asymmetrical Digital Subscriber Line** - it is the transmission technique used on the line from your modem to your service provider.

Asymmetrical: The speed of transmission is not the same in both directions. The downstream (from network to consumer) speed can be more than ten times as fast as upstream (from consumer to network). This coincides nicely with the requirements for Internet access where a single mouse click (therefore a small amount of data sent by the consumer) can result in the receipt of a large amount of data from the Internet.



Digital: ADSL modems operate on a bit stream, and are intended for carrying digital information between digital equipment such as PCs. In this respect they are no different from conventional modems.

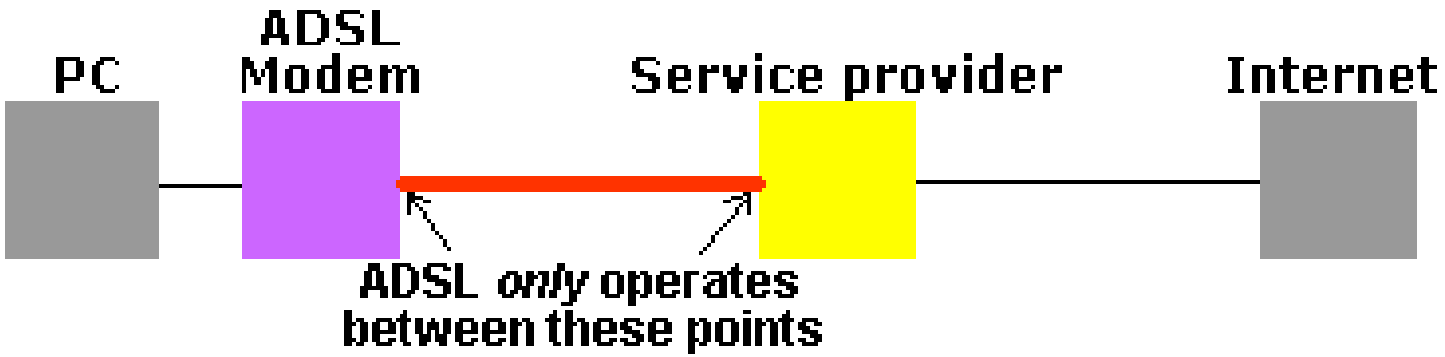
Subscriber Line: ADSL itself only operates over the subscriber's normal telephone line to the local exchange. The telephone line can continue to be used for voice calls through the use of devices called 'splitters' that separate the data and voice on the line.

Beyond the point at which the subscriber's line is terminated in the exchange, other technologies are responsible for the data transmission.

What does ADSL do?

ADSL defines how data can be transmitted between a user's premises (home or office) and the local telephone exchange over the normal telephone wiring. The telephone companies call this telephone wiring 'the local loop'.

Getting data to and from the local telephone exchange is not in itself of much use. The purpose of ADSL services is to enable high-speed access to the Internet, so discussions of ADSL (including this one) generally include how the data connection is extended to an Internet Service Provider, and therefore, to the Internet.

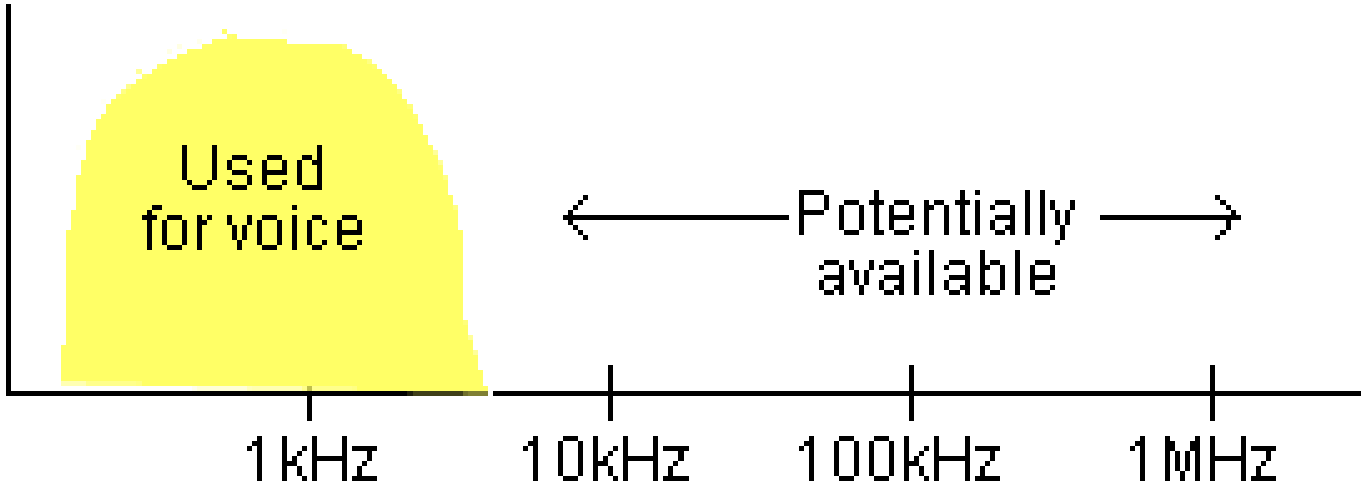


So although we assume that ADSL is used to carry data using Internet protocols, how this is done is not in fact part of the ADSL specification. This gives rise to some of the variations that occur in practical implementations of ADSL.

ADSL was originally devised as a way of delivering digital television over telephone wires and this may be a significant application in the future. For now, the main use of ADSL is Internet access.

How does ADSL work?

ADSL exploits the **unused analogue bandwidth** that is potentially available in the wires that run from the user premises to the local exchange. This wiring was designed to carry that portion of the frequency spectrum that is occupied by normal speech. The wires can, however, carry frequencies above this rather limited spectrum. This is the portion that ADSL uses.



The diagram above is approximate - voice typically uses the range 300Hz to 3,400Hz.

We can now see how voice and ADSL data can share the same telephone line - in fact, splitters are used to ensure that the data and voice do not interfere with each other.

The frequencies that the local loop can carry - and hence, the amount of data transmission capacity that is available - depend on a number of factors such as:

- the distance from the local exchange
- the type and thickness of wires used
- the number and type of joins in the wire
- the proximity of the wire to other wires carrying ADSL, ISDN and other non-voice signals
- the proximity of the wires to radio transmitters.

ADSL: A comparison with PSTN & ISDN

So, what are the inherent differences between ADSL and 'traditional' dial-up modems and ISDN?

- PSTN and ISDN are dial-up technologies
  - **ADSL is 'always-on'**
  - **ADSL is un-metered and charged at a flat-rate**

- PSTN and ISDN allow you to use fax, data, voice, data to the Internet, data to other devices
  - **ADSL is just about data to the Internet**

- PSTN and ISDN allow you to choose the Internet Service Provider you want to use
  - **ADSL connects you to a pre-defined ISP**

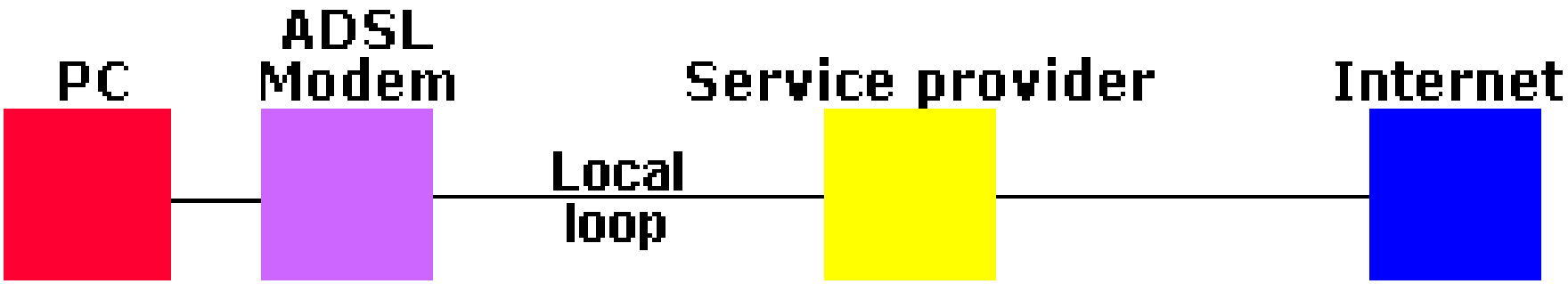
- ISDN runs at 64kbps or 128kbps
  - **ADSL can potentially download at 8Mbps**
  - **Many home ADSL services are provided at around 512kbps**

- PSTN stops you using your phone
  - **ADSL allows you to surf and phone at the same time**

Notes:

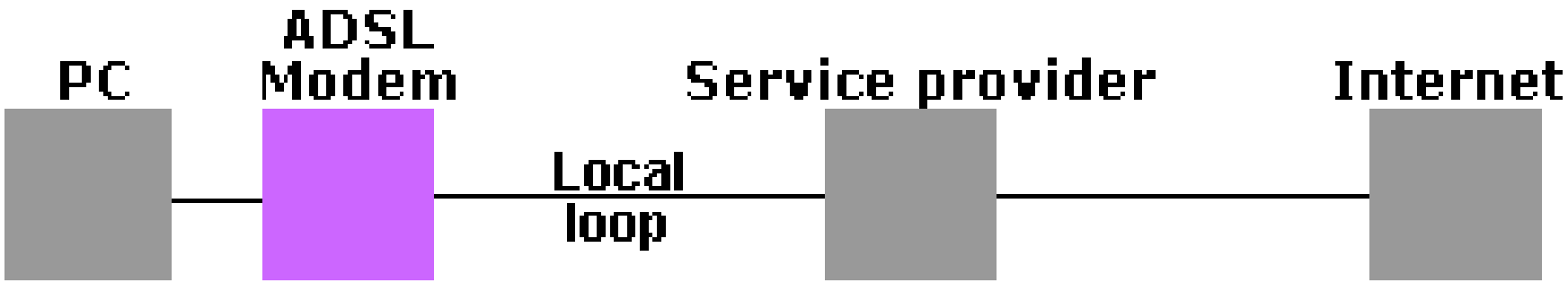
1. While your ADSL modem is permanently connected, it may be necessary to take action on your PC to make the connection to the Internet.
2. Services like fax and voice can be provided over the ADSL data connection to the Internet.
3. In practice, a typical download speed on a home ADSL service will be up to 400kbps

ADSL Components: Introduction



In this section we will describe in turn the function of each component that connects you to the Internet, starting from the ADSL Modem.
We will also look inside the 'Service provider' box and examine the main components that they use to provide your ADSL service.

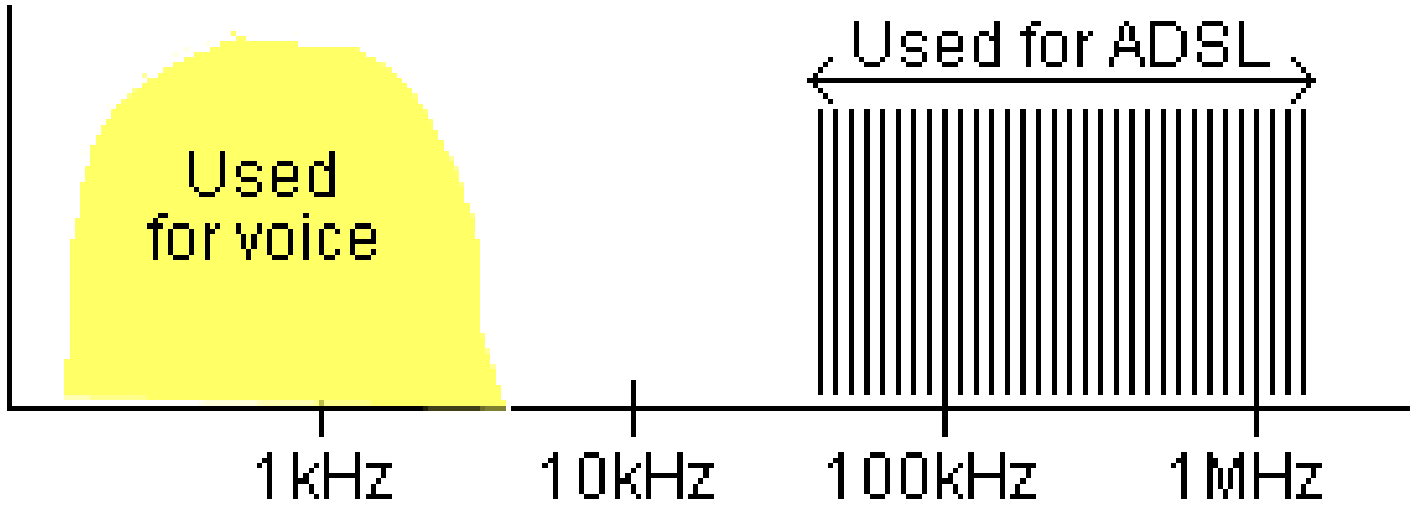
What is an ADSL Modem?



Your ADSL modem is connected to the telephone wiring (called the 'local loop') that connects you to the local exchange equipment.
The ADSL modem uses a combination of several advanced signal processing techniques in order to achieve the required throughput speeds on ordinary telephone wiring at distances up to several miles from the local exchange.

How does an ADSL Modem work?

ADSL works by implementing many modems in parallel, each of which uses its own slice of the available bandwidth.

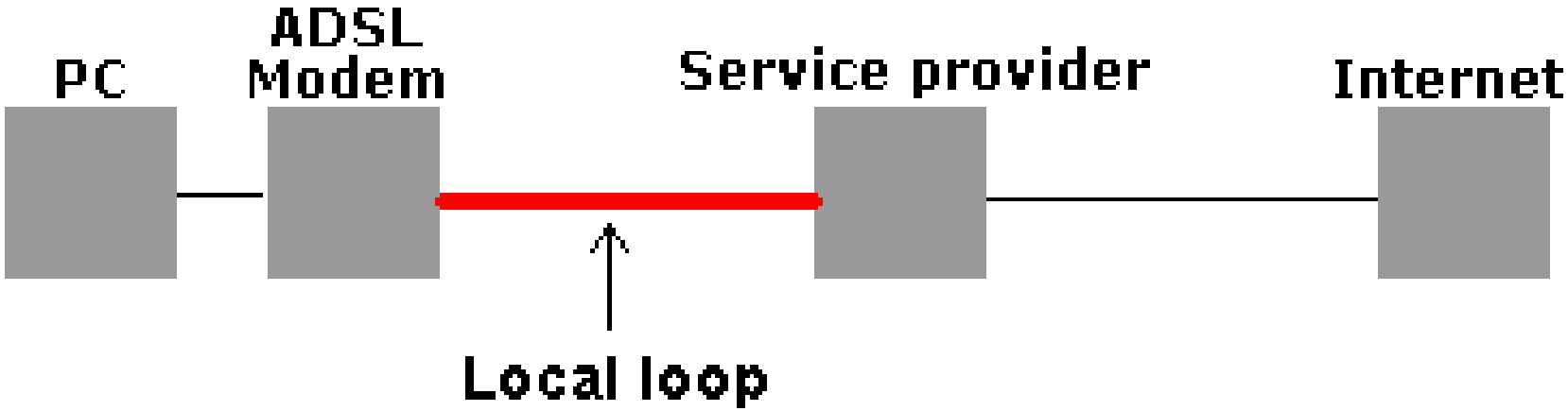


The diagram above is approximate, and shows how **ADSL uses many individual modems working in parallel** to exploit maximum bandwidth and deliver very high speed.

Each black bar represents a modem operating at a different frequency. In fact there are as many as 255 modems operating on an ADSL line. ADSL typically uses the frequency range 26kHz to 1.1MHz. All of the 255 modems are implemented on a single chip. Advances in electronics technology that make this level of integration possible are critical to ADSL.

The amount of data that can be transmitted by each modem depends on the characteristics of the line at the frequency allocated to that modem. Some modems may not work at all because of interference from an outside source such as another local loop or a radio station. Modems at the higher frequencies typically transmit less data than the others because attenuation (losses) are greater at higher frequencies, especially over long distances.

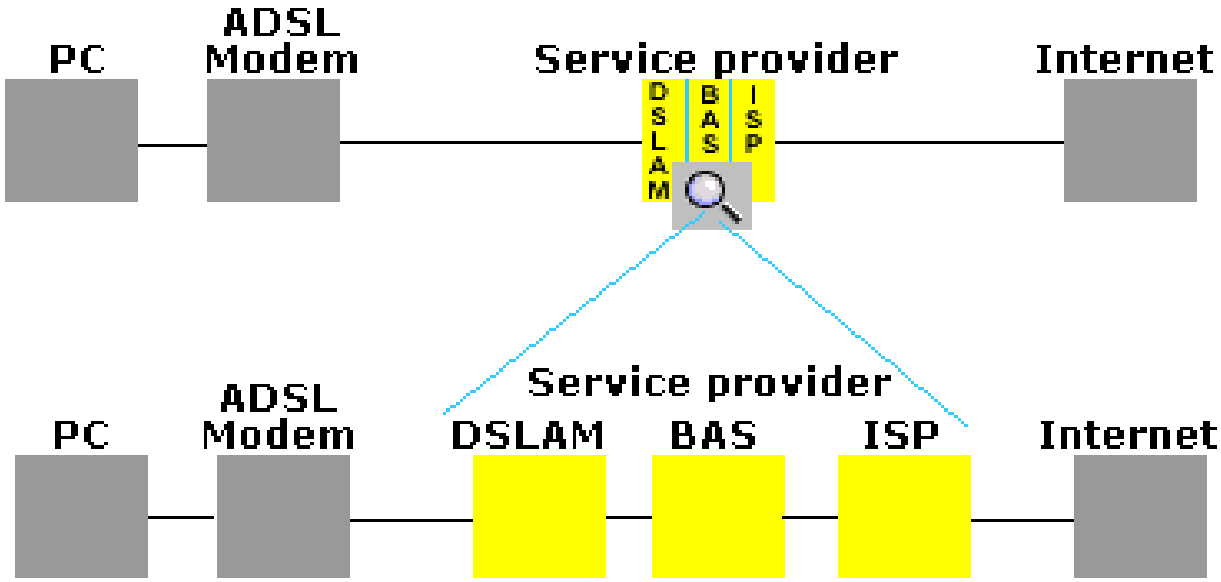
What is the Local Loop?



'Local loop' is the term applied to the **ordinary telephone wires** that go from a user's premises to the telephone company. It is only on the local loop that ADSL communications actually take place.
The reason for the term local loop: the telephone receiver is connected across the two wires, causing them to appear as a loop when viewed from the local exchange.

ADSL Components - Service provider

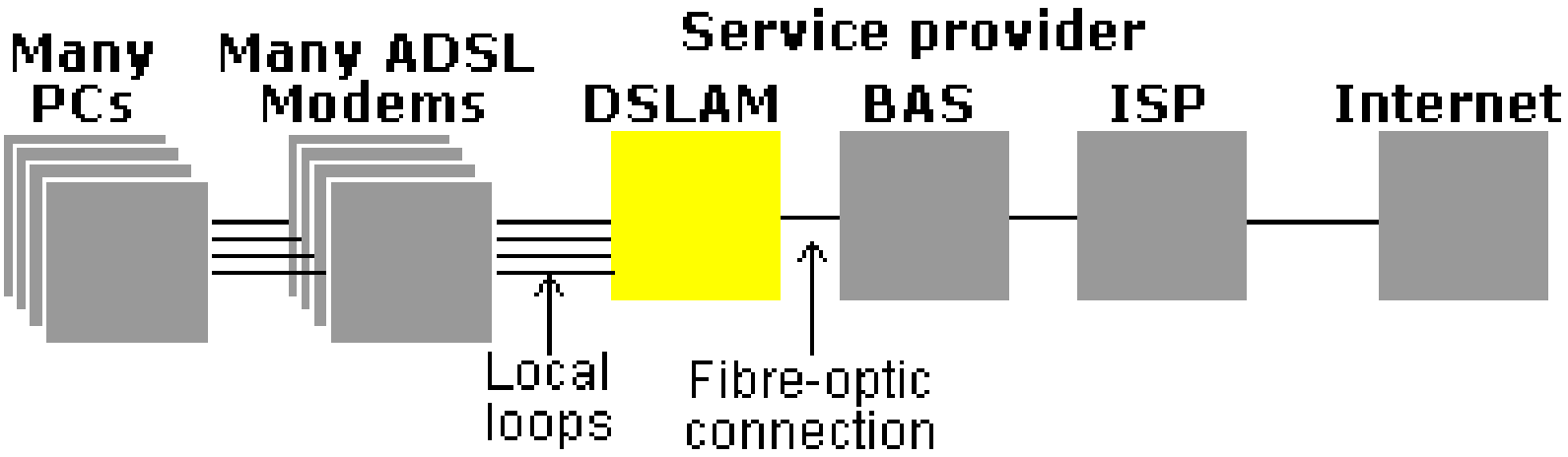
We now need to look more closely at how the Service provider implements ADSL.



Within the block that was previously identified simply as 'Service provider', there are three important components:

- **DSLAM** - **DSL** Access **M**ultiplexer
- **BAS** - **B**roadband **A**ccess **S**erver
- **ISP** - **I**nternet **S**ervice **P**rovider

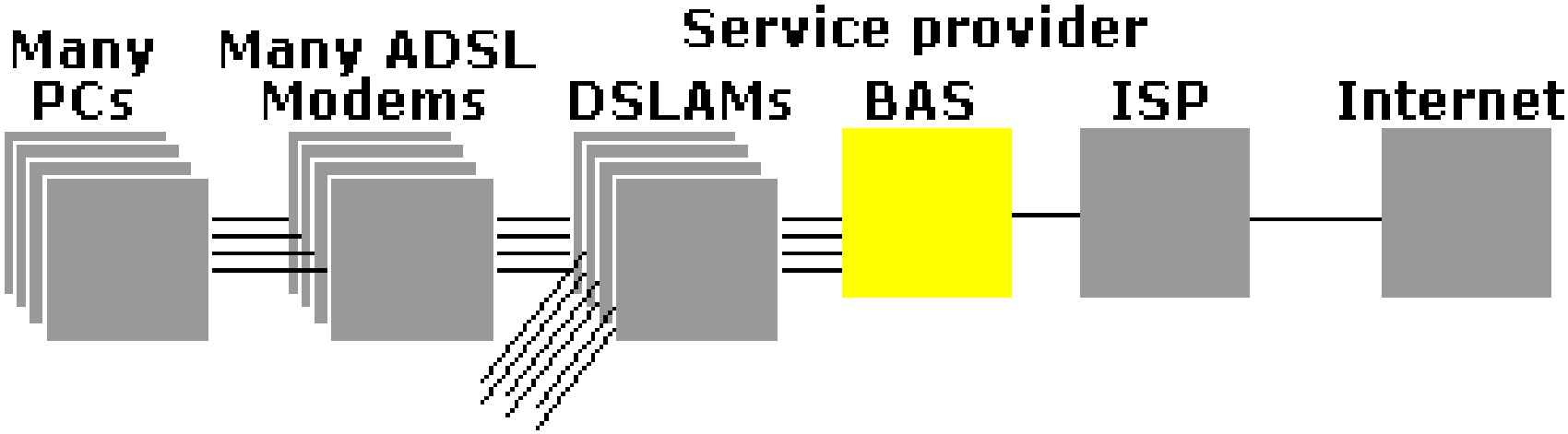
What is a DSLAM?



The DSLAM is the piece of equipment at your local exchange that is at the other end of your ADSL connection. It houses a bank of ADSL modems on one side and has a single fibre-optic data connection on the other.

The DSLAM consolidates a number of ADSL user connections - perhaps as many as several hundred - onto a single fibre connection. This fibre will normally be connected to a Broadband Access Server or BAS, but it may not be a direct connection; the BAS can be located anywhere.

What is a BAS?

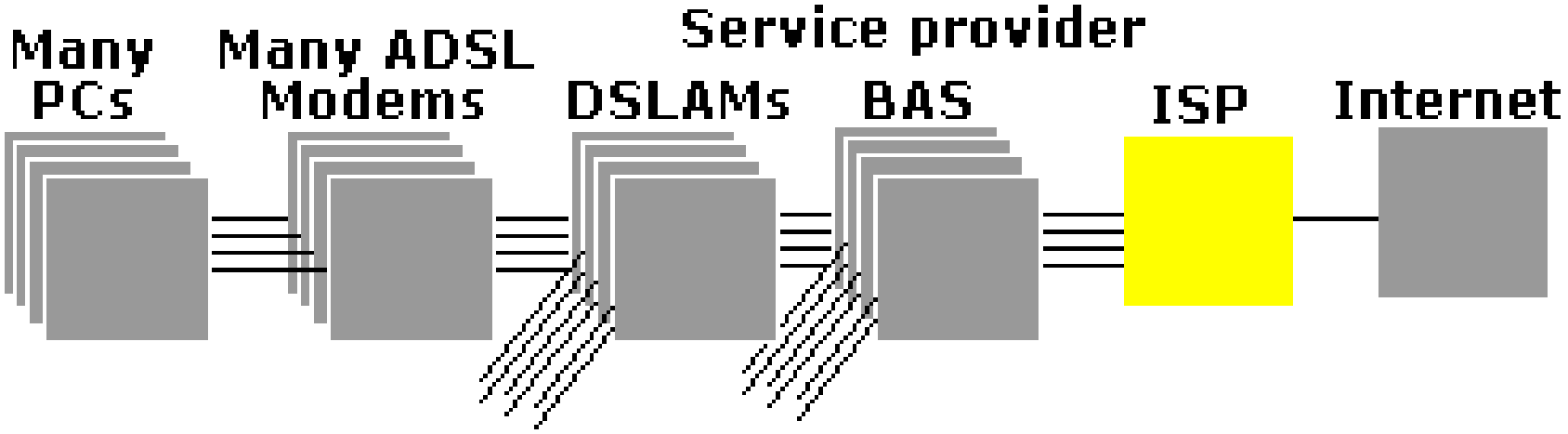


The **Broadband Access Server (BAS)** is the piece of equipment that sits between the DSLAM at the telephone exchange and the ISP that connects you to the Internet. It may be in your local exchange or it may be elsewhere in your service provider's network. A single BAS will probably handle connections from several DSLAMs.

The purpose of the BAS is to unwrap the various protocols inside which your data travels over the ADSL connection. It also makes your connection to the ISP appear exactly as if you had connected using a dial-up modem or ISDN.

As we noted before, ADSL does not specify the protocols that are used to construct the connection to the Internet. The result of this is that there are at least five different ways in which the data can be carried between the PC and the BAS. The method used by the PC and the modem **must** be the same as that used by the BAS for the connection to work.

What does the ISP do?



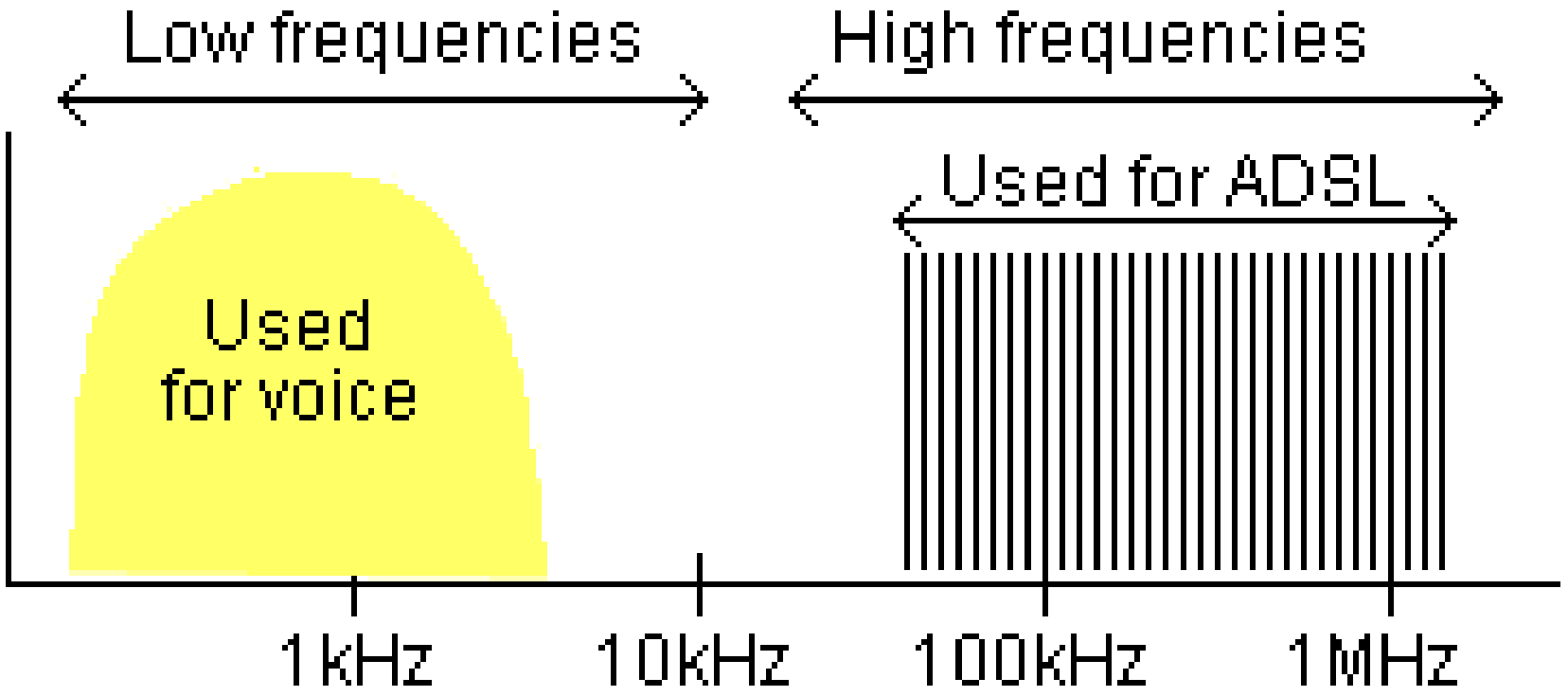
The Broadband Access Servers are connected to an Internet Service Provider or ISP. This is the place where your connection to the Internet is made.

The ISP usually provides other services like mail and news servers, and may cache frequently-used pages from the Internet so that you can access them more quickly.

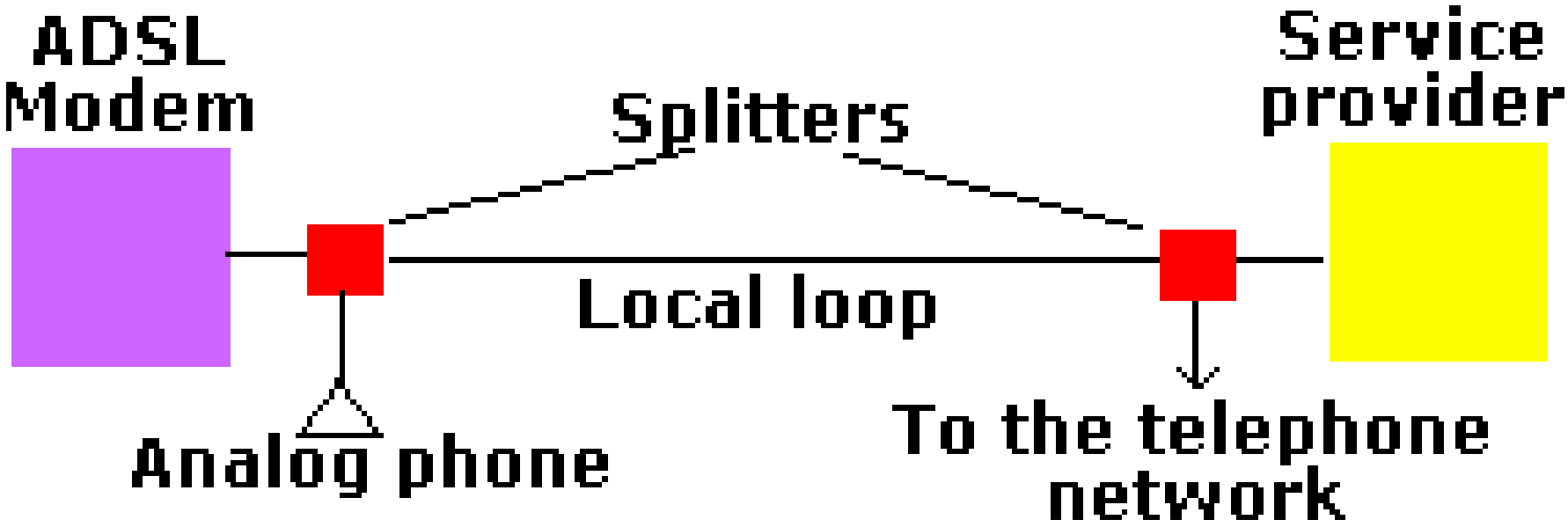
The ISP treats ADSL connections exactly the same as connections made using ordinary dial-up modems or ISDN.

How do voice and data co-exist in ADSL?

If you are surfing the Internet using an ADSL modem, then a telephone call can still be made on the same line.
Splitters that separate the high frequencies used by ADSL from the low frequencies used by voice are situated at each end of the local loop.

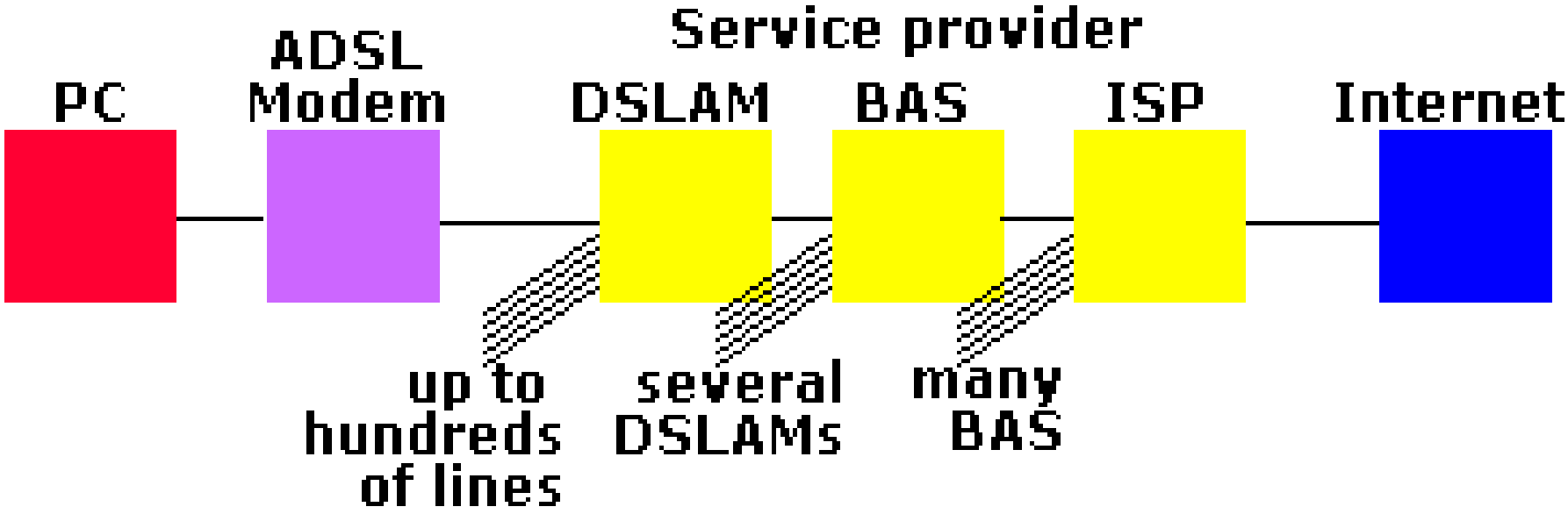


At your end of the connection, the low frequencies go to your phone and the high frequencies go to your ADSL modem. At the local exchange, the low frequencies go to the normal telephone network while the high frequencies go to the service provider.



Speed can be variable

The speed of the connection achieved between your ADSL modem and the DSLAM depends on how far you are from the DSLAM, and the maximum allowed speed for your connection configured in the DSLAM. The speed of your connection to the Internet depends on many more variables.



1. The number of other users connected to the same DSLAM and how many of these users are actively using their connections now
2. The speed of the connection between the DSLAM and BAS
3. How many other DSLAMs are connected to the same BAS as you and how many of these users are active
4. The speed of the connection between the BAS and the ISP
5. How many other BAS are connected to the same ISP as you and how many of these users are active
6. The speed of the ISP's connection to the Internet
7. How many of the other users of the ISP (using dial-up modems and ISDN as well as ADSL) are active.
8. Whether the ISP already has the information you requested cached so that it is not necessary to get the data from the Internet.