The
business potential
of the
Internet

A white paper by Glyn Moody, independent business IT journalist.

Introduction

Five years ago, the Internet was almost unheard of in business. Soon, for a company not to be connected to this global network will be as unthinkable as for it to be without a telephone line.

But the Internet is not just another kind of communication service. It is driving perhaps the most rapid restructuring of business that has ever been seen. In the process, it is enabling companies to cut costs and generate new revenue. More profoundly, it is redefining what exactly a company is, and how it operates with its customers and business partners.

This white paper concentrates on the real-life implications of this revolution, now fully underway. It explores from a business rather than technical viewpoint the characteristics of the Internet, and how they affect the key functions of a company. Its aim is to help businesses deploy the right technologies as efficiently and successfully as possible, and to enable them to meet the challenges and exploit the opportunities that the Internet brings.

After a brief examination of the Internet's key characteristics, the benefits for the main company departments - marketing, sales, management etc. - are considered in detail, with practical examples of how costs can be cut and new revenue generated. This is followed by a look at the various services available - e-mail, the World-Wide Web, e-commerce etc. - and how they can be used on the Internet and in two other crucial areas, known as intranets and extranets. After discussing the practical issues involved in connecting a company to the Internet, the white paper concludes with a short consideration of the likely future Internet trends and their broader implications for business.

Characteristics of the Internet

The Internet derives its name from the fact that it is formed from the *inter*connection of computer *net*works. That is, it is a network of networks - or rather *the* network of networks, since it has evolved into the fundamental connectivity framework that joins together all others.

For those who are interested in some of the technical details of how the Internet functions, Appendix A provides an introduction to the main concepts. But for business purposes, it is sufficient to understand that this global wiring has four crucial characteristics.

The network is bit-blind

The Internet carries bits - the 1s and 0s that make up all digital data. As far as transmission over the Internet is concerned, it does not matter what that digital data refers to, what kind of system originated it, or how the data will be processed when it arrives. In this sense, the Internet is bit-blind, unable to see the difference between data that represents a music CD, a computer program or a digital TV broadcast.

Bit-blindness means that different data traffic can be mixed together and sent down a single Internet link: it is not necessary to have separate connections for each kind of use or for different originating systems. As a result, enormous economies of scale can be achieved by bulking up transmissions through this kind of data aggregation. The individual cost of sending any bit becomes extremely small, and the overall price for Internet-based transfer of any data far lower than for comparable conventional communication circuits.

Bit-blindness is central to the Internet: it lies at the root of its compelling cost-effectiveness, and determines all of its other key characteristics.

Geography is abolished

Because transmissions costs are so low (and constantly diminishing) they are completely masked by fixed expenses such as equipment and personnel. Consequently, the overall cost of using the Internet is independent of distance: it makes no difference whether data is sent across the street or across the globe. In a world linked by the global Internet, all physical locations are collapsed to a single, equally-accessible point.

Data is over-abundant

The Internet's truly global reach means that the range of data and services available to anyone connected to the network is vastly increased. No longer are customers limited to what is local to them: using the Internet they can access information and services from the other side of the world as easily and as cheaply as from a company down the road. In fact, the Internet's abolition of geography means that users are faced with an over-abundance of data and services. Finding the right information and the right service becomes an important skill.

The user rules

In the current business world, competition is often very limited. National markets in particular may have a de facto monopoly or oligopoly. But with the abolition of geography comes true global competition. Whether or not sanctioned by the local government, services and goods (to a lesser extent) can be sold in any country via the Internet.

This over-abundance of offers from around the world means that it is the Internet user who controls business transactions. Where previously customers were largely forced to accept whatever the local monopoly/oligopoly offered them, now they can go online to seek out companies anywhere in the world. The abundance of online data means that they can obtain background details and compare offers, and then make an informed decision on which to accept.

This leads to the apparent paradox that although the global reach of the Internet creates marketplaces measured in tens of millions today, and hundreds of millions soon, each potential customer must be treated as an individual, not as a faceless member of a market segment.

Benefits of the Internet

To derive the maximum benefit from the Internet it is necessary to understand how the characteristics introduced above can transform a company's business operation once the associated technologies form the cornerstone of its IT strategy. It is worth noting that what follow are not airy predictions, but already reality in many companies that have applied an Internet strategy both externally and internally (the distinction is explored in greater detail below).

Marketing

In many ways, employing the Internet as a marketing tool is the most natural application of these new technologies, since much of the Internet's power derives from conveying information. Moreover, its global reach and inherently low cost make it the perfect tool for many marketing activities.

In terms of finding information, the Internet functions like a huge but free research library, and provides marketing departments with access to an unparalleled range of support material. Online information is constantly updated, enabling marketing executives to provide up-to-the-minute reports to managers and sales staff. The fact that competitors are likely to have online presences makes monitoring their activities simpler, and allows counter-action to be put in place more rapidly (though it is worth noting that rivals can do the same). The Internet's global scope permits new markets anywhere in the world to be investigated without costly and time-consuming local groundwork.

Of particular note are the search engines. These services - also free - allow users to search through almost the entire contents of the Internet in seconds to locate particular words or phrases - something that is unthinkable with conventional information resources.

Using the Internet as a medium for sending information to potential customers, it is cheap to conduct very large-scale and even global advertising and marketing campaigns. The other side of the coin is that low costs make micro-markets viable for the first time. Where previously it would not have been practical to seek out and contact very small market segments, the Internet not only provides ways of finding such highly-targeted groups, but also enables them

to be reached - again, for almost no cost. The user power mentioned above means that such personalisation will soon be no luxury, but simple necessity.

One benefit of letting customers drive the business process is that every move they make online can be recorded and analysed, which allows advertising campaigns to be refined constantly in the light of the latest user response. This is economically feasible because the cost of changing electronic marketing materials is relatively small.

The bit-blindness of the Internet means that marketing materials can be multimedia in nature - including sounds and videos - and interactive. However, it is worth noting that simple text-based communications often convey information in perhaps the most concentrated form, and are sometimes easiest for clients to assimilate and evaluate.

Bit-blindness also allows the process of creating marketing materials to be integrated across the network. In practical terms, this means that the marketing department, designers, copywriters, ad agencies, typesetters and video production houses can work together as if they were all located in a single office, even if they are actually on different continents. The creation of such a virtual workgroup across the Internet allows ideas to be proposed, roughs to be discussed online and for the whole creative process to be speeded up considerably. There will be notable savings in terms of couriers etc., and through the elimination of unnecessary work.

Sales

The Internet affects sales in two main ways. First, the abolition of geography means that every company can sell to the world (whether this is appropriate depends on the nature of the goods or services on offer). Its other impact arises from the changed dynamics of the purchasing process. Internet customers will no longer expect to be sold to: rather, they will want the right information that helps them decide which among the many rival offers they will accept. Many such purchases will be handled automatically by software - what is generally known as electronic commerce, or e-commerce - reducing sales costs considerably.

In certain circumstances, customers may be allowed direct access to a company's computer systems - for example, to stock levels in order to check what is available, or to their own account information.

The creation of a single, unified company network based on Internet technologies allows sales orders to be integrated seamlessly into other corporate information systems - accounts, production, marketing, etc. - and permits salespeople to access information about all aspects of an order's fulfilment. This in turn will enable salespeople to resolve customer queries more easily. More generally, sales staff will become increasingly involved in the servicing of current accounts through the intensive use of such information systems, with the aim of maintaining customer loyalty and generating repeat sales. To this end, salespeople will also be able routinely to call on the marketing department to provide personalised electronic materials for customers.

The Internet's global reach means that salespeople will have access to all of these facilities even when they are on the road or abroad visiting clients. And through the use of Net telephony - the transmission of voice calls over the Internet as digital, not analogue, data - they will be able to talk to anyone on the company network for the cost of a local call, wherever they are in the world (provided they can access the Internet there).

Management

The impact of the Internet on management functions is profound, if subtle. For where before managers had at best only partial access to the information they needed in order to control the business functions for which they are responsible, the arrival of Internet technologies potentially makes the entire organisation transparent.

Managers will be able to take part in marketing's online discussions with designers in order to check that the right message is being put across, without leaving their office. They will be able to see how the latest sales of a product are going, and to check the figures against budgets, forecasts, previous years' levels and the performance of different regions. Production processes anywhere in the world can be monitored as they happen, rather than long after anything can be done about emerging problems. And managers can enjoy two-way access to the main corporate accounting system, enabling them to check on how the bottom line is looking, while feeding in up-to-the-minute figures for forecasts to alert senior managers of forthcoming triumphs - or tribulations.

Managers can gather information from a huge range of external services, including automatically-updated streams of data such as share prices, raw material costs and foreign currencies. All of these, along with video feeds, and corporate news flashes sent around a company's internal network, can be delivered to a single desktop system, providing a unified point of access. They can be retrieved while abroad on business, too, or from home - wherever there is an Internet connection - to ensure that managers have key information whenever and wherever they need it.

Internet technologies affect dramatically the working relationship managers have with their staff. Meetings can be set up online, regardless of the physical location of the participants, while management presentations can be sent direct to staff desktops, or stored for deferred broadcasting to absentees.

The existence of a company-wide network means that working groups can be created that are defined by their activities, not geography, as most teams are today. Collaboration among these distributed groups of workers allows projects to move forward far more quickly than would have been possible hitherto - and far more cheaply, since possibly expensive travelling can be eliminated. And once a workgroup has been defined in this way, new kinds of software allows tasks to be scheduled automatically for members of the team, resulting in the more efficient deployment of human resources. Using Internet technology managers can monitor all these activities from their computer - wherever that may be.

The Internet also allows managers to maintain close contact with key clients in a way that is difficult today when 'telephone tag' means that much costly time is wasted just in establishing contact. Direct access to up-to-the-minute information about every facet of a customer's account enables managers to be well-informed about such key individuals and their current purchases and plans.

Production

Like management, production's role is partly to monitor and respond (though obviously the field of action is more limited in production's case). The advent of the Internet means that those in production departments are able to receive a constant flow of information about the relevant production process, wherever they are. In particular, it is possible for notification of errors to be generated automatically and then sent over the network to production personnel.

Perhaps even more dramatic are the effects of links to suppliers. Using the Internet as the common wiring between different corporate networks, the production department can check the stock levels of supplies by accessing the relevant stock control systems of business partners (assuming they have been given permission to do so). Similarly, they can monitor every element of Just-In-Time production processes to ensure that the right materials will indeed be delivered at the correct time.

As more and more companies adopt Internet technologies, it will be possible to extend this approach to the entire supply chain, giving production executives for perhaps the first time a global rather than partial view of production processes, and allowing them to intervene where necessary in a direct and timely fashion.

Links to multiple suppliers offer another advantage. Contracts can be put out to tender electronically, allowing competitive bids to be received and compared more quickly and efficiently. Payments can also be made electronically, allowing the whole process of supply from tender to termination to be carried out more cheaply.

Accounts

Online payments will be a major boon for the accounting function, which will gain a far tighter control over monies coming in and going out of a company. Accounts departments will also be able to use the Internet to gather up-to-the-minute information on financial instruments and currency exchange rates, twenty-four hours a day, and independently of whether the local money markets are open, before taking decisions about when and how to pay or request payment.

Increasingly the purchase and sale of such financial instruments will be carried out online, allowing financial staff to act directly in the relevant markets and so reduce commissions paid to traditional intermediaries. It will even be possible to become independent players in the various online exchanges, allowing more adventurous companies to exploit their financial resources directly and outside their usual market sector.

Another important role for the Internet in the accounting function is to provide instant access to corporate information. Just as managers can update their forecasts directly, so company accountants will be able to see on an hour-by-hour basis how sales are proceeding, the level of outstanding credit, whether production costs are under control, and how much of the month's promotional budget has so far spent by each marketing executive. They will also be able to alert early the managers responsible to any anomalies that they spot.

Personnel

For the personnel department, the company network provides the perfect medium for making corporate information available to all staff. For example, online directories and manuals lend themselves very readily to this approach.

Where previously updates to staff directories needed to be inserted by hand - and were, in any case, probably superseded before they were even distributed - online directories are always available and can be kept absolutely up-to-date. Similarly, even the most complex and lengthy company manuals can be placed online for staff to access at any time without the worry that small changes will require costly reprinting of hard-copy versions. Internal company search engines will allow managers and employees to find any information in seconds without troubling personnel.

It is not just static documents that can be distributed in this way. The network's bit-blindness means that interactive training materials, including audio and video, can be delivered directly to the individual user's desktop. This allows training to be carried out whenever the user has time, without the need to allocate slots in classrooms. It also means that training can be continued when employees move around to different divisions or even overseas, either on secondment, or permanently.

Placing recruitment advertising online internally ensures that all staff members have equal opportunities to apply for jobs - even those in outlying regional offices. This encourages staff mobility within the company - and hence reduces the loss of employees to outside firms. As a result, it may well diminish the need to place costly recruitment advertisements in external media.

If external recruitment is necessary, it is possible to place vacancies on Internet sites instead of with traditional media, often for greatly reduced cost and in front of a worldwide audience (where appropriate) thanks to the Internet's global reach.

Other external uses of the Internet that may be appropriate for personnel include booking tickets and hotel accommodation for staff. This can be done online, at any time of the day, and often for prices below those offered by traditional travel agents.

IT

Not surprisingly, the computing department of a company is greatly affected by the advent of the Internet, and not just in terms of the work required to move older, proprietary systems to the new standards based on the Internet. As well as saving money, the conversion of a corporate network to one employing Internet standards can have a powerful liberating effect on the IT department.

The essence of the Internet - its bit-blindness regarding where data is coming from or going to - allows it to embrace all kinds of hardware and software. IT departments are therefore able to unify the patchwork of technologies often employed by different departments (Apple Macintoshes in marketing, PCs in sales, minicomputers in accounting and workstations in engineering, for example) without the need for compromise or the imposition of arbitrary single corporate standards. In particular, older systems can be incorporated into an Internet-based approach, unlike many proprietary solutions which only work on the latest hardware and software. This allows perfectly usable, if slightly lower-power, equipment to be written off over longer periods, with obvious savings.

Similarly, because the Internet is a network of networks - not a single monolithic structure, but a mosaic of smaller interlocking elements - it is easy to change one part of the company's system built around Internet standards without disturbing the others. This means that it is relatively straightforward to upgrade the cabling, computers or software for any department if their needs dictate it, without obliging the entire building or even company to follow suit.

The increased flexibility that ensues allows the constituent components of a company to function more independently and efficiently. It is also promotes employee satisfaction, since users feel that they are individuals whose preferences are respected, rather than cogs in a machine.

Implementing a corporate network based on Internet standards has another, quite unexpected benefit. It turns out that it is possible to use standard Internet software (specifically, the Web browser - see page 17 for details) as a kind of window into any aspect of the company's operation. That is, instead of needing to know how to operate many confusingly-different software programs, users can instead employ one program as the standard way to gain access to all corporate information, wherever and however it is held.

One of the greatest obstacles to the efficient deployment of new computer systems is the difficulty non-technical users have in mastering anything but the simplest software. This ability to reduce training requirements to a single program - one, moreover, that is so intuitive to use that training is in any case almost superfluous - is another major boon of deploying Internet technology within a company.

Overheads

Alongside the many more subtle benefits it brings, the Internet is also capable of reducing various overheads. For example, Net telephony allows voice calls to be sent digitally for a fraction of conventional telephony costs. Similarly, otherwise prohibitively expensive videoconferencing may become viable if it is routed across the Internet rather than ordinary connections.

Another way to save money is to replace expensive private networks that link the computer systems of physically-separated offices and divisions with what are known as Virtual Private Networks (VPNs). These operate in exactly the same way as private networks, but do not exist as fixed, physical connections. Instead, they use the global network to provide the wiring between different locations, adding extra security to ensure that third-parties cannot eavesdrop as information is sent across the public Internet.

Once a corporate network based around the Internet is in place, there are numerous other ways that money can be saved. For example, virtual meetings can be held across the network, allowing travelling costs to be reduced. Telecommuting enables employees to stay at home but connect over the Internet in order to work with colleagues and access resources as they would if they were in the office. As a result, office space and its related costs can be reduced.

More generally, using the network as a means to allow employees to access anything from any desk with a computer means companies can do away with the idea of fixed offices and set allocations of associated resources. Instead, employees would occupy any empty desk when they needed to access their files or other information; the abolition of geography brought about by the Internet means that an employee's physical location is no longer a key factor in how or with whom he or she works.

Other cost-saving applications of the Internet include online procurement of office supplies, particularly those in the areas known as MRO: maintenance, repair and operation. By ordering such goods online from a supplier that can deliver quickly it is possible to avoid holding extensive stocks and yet ensure that they are always available when needed.

Internet services

So far, the Internet has been discussed generally in terms of how its characteristics can be applied to various company departments. But the Internet is simply a medium, a kind of wiring with certain interesting properties. To realise the benefits discussed above, this medium has to be employed in well-defined services that run across the wiring. Maximising the benefits is about choosing the appropriate tool for the task to hand.

All Internet services are variations on one simple idea: that of communicating between the different computers joined together by the medium of the Internet. Although there are potentially many such services, they can all be categorised according to whether those communications are one-to-one, one-to-many or many-to-many, and whether the communication is symmetric (that is, flows equally in both directions) or asymmetric.

Four main classes of services have evolved, which might be termed Conversation, Community, Content and Commerce.

Conversation

is essentially symmetric and one-to-one: there are just two sides to the conversation, both of which take part as equals.

Community

is also symmetric, but many-to-many: there are several participants, all of whom take part as equals.

Content

is asymmetric, and generally one-to-many: information is sent from the provider to many recipients, who do not generally send similar information back.

Commerce

is asymmetric, and generally one-to-one: goods or services are sold by the merchant to the customer (one-way), who sends back payment (one-way).

The main Internet services for each class are as follows:

Conversation:	e-mail, Net telephony, videoconferencing
Community:	mailing lists, newsgroups, forums
Content:	World-Wide Web, push technologies, streaming multimedia
Commerce:	encryption, digital cash, micropayments, digital certificates

The Internet, intranets and extranets

These Internet services are discussed in greater detail below, but it is important to note that they can all be applied in three distinct domains, in quite different ways. These spheres are known as the Internet, intranets and extranets.

Strictly speaking, the term 'Internet' is reserved for that portion of the global network that is truly public, and accessible by anyone. This is in contrast to intranets, which in a sense are parts of the larger network that exist purely within companies. That is, they employ all the same Internet technologies and services as the Internet proper, but access is generally limited to employees. Virtual Private Networks (VPNs) can be used to tie outlying buildings or subsidiaries into the overall intranet to create a unified corporate system.

An extranet is a kind of half-way house between the public Internet and private intranet. It represents a controlled extension of the corporate intranet to include external partners. Typically these will be other companies that work closely with the owner of the extranet - suppliers, design companies etc. - linked to some or all of an intranet using VPNs. Another interesting application is to use extranets to mesh customers into a company through the granting of direct if necessarily limited access to online corporate resources.

In the long term, intranets and extranets are likely to be at least as important as the Internet for companies. To clarify the sometimes subtle differences between the Internet, intranet, and extranet worlds, typical business applications of the various services discussed below will be given for each of these domains.

E-mail

Electronic mail, or e-mail, represents probably the most important new business communication technology since the introduction of the fax machine. It is extremely easy to use, very cost-effective and yet can be applied in a wide range of situations.

In its most basic form, e-mail consists of sending text messages from one point on the Internet to another. Although it is possible to send the same message to several recipients using what is called a cc (carbon copy) option, it is essentially one-to-one; because messages can be sent back by the recipient, it is clearly symmetric.

Since there is no inherent difference between bits representing letters and those storing images or a video, for example, it is possible to send illustrated documents, video clips, voice messages and computer files like spreadsheets and databases as e-mail, using what are known as attachments.

In practical terms, this means that an electronic file representing a multi-page, full-colour brochure could be sent to the other side of the world for almost no cost and within seconds, even if there is no one there to receive it (because of differences in time-zone, say). The message would simply be stored on an intermediate computer until the next time the recipient retrieved his or her e-mail. And, unlike a fax, reproduction will be perfect since an exact copy of the original electronic file is sent to the recipient. These and other kinds of e-mail messages can also be encrypted so as to prevent third parties from viewing their contents in transit.

Internet: one-to-one customer contact,direct feedback from customers, fast and easy transmission of complex documents for very low cost

Intranets: direct access to all levels of corporate hierarchy, routine communication without telephone tag, searchable archive of messages

Extranets: direct contact regardless of time-zone, ready translation of messages

Net telephony, videoconferencing

E-mail consists of a message that is retrieved some time after it is sent. But the Internet can also be used for conveying what are known as real-time conversations - those that are received almost the instant they are sent.

For example, there is a real-time form of e-mail known as instant messaging that allows text messages to be sent to a designated recipient's computer so that they appear as each sentence is typed.

Bit-blindness means that any kind of digital data can be sent in this way, and an obvious application is to send digitised voice signals over the Internet. This is generally called Net telephony, and allows even international calls to be made for little or no cost (essentially it is the cost of both parties keeping an Internet connection open). An extension of Net telephony is video-conferencing over the Internet.

Internet: low-cost international calls, video conferencing

Intranets: integration with company's computer telephony systems, free calls across VPNs to outlying divisions

Extranets: free calls to global partners across VPNs

Approximate costs of sending a 10 page document

Cambridge UK to London UK		Cambridge UK to Virginia,USA	
post (1-2 days)	£0.38	post (5-7 days)	£1.56
fax (4 minutes)	£0.40	fax (5 minutes)	£2.00
courier (next day)	£27.80	courier (2 days)	£29.27
e-mail (10-60 seconds)	£0.15	e-mail (10-60 seconds)	£0.15

Mailing Lists

The mailing list might seem to be just an extension of the e-mail idea: instead of sending a text message to one recipient, it is sent to many. But the ramifications of this shift are important. For example, the symmetry present in e-mail is lost: it is not generally practical for all of the recipients of mailing lists to respond to the individual sender. Instead, they will tend to reply to the mailing list as a whole: that is, messages are sent not so much to one person, as to the group.

It is for this reason that mailing lists are considered here as Community rather than Conversation services: the members of the list define a group. This is an important point to note, because the Internet's abolition of geography means that workgroups, for example, need no longer be defined by their physical location. Instead, they can be created out of groups of physically-distant individuals who are involved in a common task, linked in part by a dedicated mailing list. Similarly, micro-markets may be serviced by a company through a list designed specifically for its members.

Internet: direct mail campaigns, newsletters, regular product window

Intranets: company updates, project information for teams

Extranets: updates for partners, project information and status for cross-company teams

Newsgroups

A variation on the mailing list is the newsgroup. These can be considered the Internet equivalent of company noticeboards. Instead of sending out e-mail to members of a mailing list, users post messages to a computer: interested parties can then retrieve messages and add their own comments in further posts. Newsgroups are also known as Usenet, which historically was a network distinct from the Internet, and dedicated to such discussion groups.

There are two kinds of newsgroups: public ones, which anyone may read and contribute to, and private ones. The latter will typically be created by a company for a particular workgroup. A complementary class of collaborative software designed for intranets and extranets has sprung up, including group calendaring and workflow management. An alternative way of creating newsgroups is to use the Web technologies discussed below; such discussion groups are usually termed Web-based forums.

Internet: public customer newsgroups servicing communities of users based on products or interests, customer support, help desks

Intranets: project-based discussion groups, group calendaring and scheduling, workflow software

Extranets: team-based discussion across companies, group calendaring and scheduling, workflow software, private customer newsgroups

World-Wide Web

Without doubt the best-known aspect of the Internet is the World-Wide Web. This is made up of hundreds of millions of Web pages, which superficially look like on-screen versions of magazine pages. But where a magazine page is static in its content, and limited in its relation to other pages, the Web page can change as a user interacts with it (by clicking on-screen buttons, for example) and rarely has a simple, sequential relationship to other Web pages.

Typically a Web page will have special regions that are activated by clicking on them to call up other Web pages. These hyperlinks, as they are called, can take advantage of the Internet's abolition of geography to jump to any Web page anywhere in the world. The static and circumscribed magazine page becomes dynamic and nearly limitless in terms of where it can link to; clearly this changes dramatically the way in which information can be presented and referenced.

Web documents are held on a computer called a Web server, which is generally connected permanently to the Internet so that visitors can view its holdings at any time. From it, pages are downloaded across the Internet to be held temporarily on a user's computer. There, they are viewed using an auxiliary piece of software called a Web browser. The two dominant browsers are Microsoft's Internet Explorer and Netscape's Navigator, both of which are available free.

Its origins as an information-distribution system make the Web ideal for marketing purposes. The Internet's bit-blindness allows multimedia elements to be added to the basic text-only Web so that it is easy to create pages containing not just images, but also sounds and video, all of which are sent over the network as digital data.

One of the most popular ways of creating Web pages is to populate them with information drawn from standard corporate databases. This approach often forms the basis of electronic commerce systems: visitors to an e-commerce Web site can view the available goods, select items, enter shipping information into online forms, and pay electronically.

But the Web has turned out to be even more important than just an extremely effective way of distributing marketing materials or displaying the holdings of databases. It has proved possible to turn the Web browser into the basic interface to any information, and to any computerised process.

This is achieved by converting the output of other computer programs into a Web page so that it can be viewed in a Web browser. This has important consequences. It is only necessary to train users how to use a browser rather than many confusingly-different software packages. Moreover, the Internet's abolition of geography means that the HTML version of any program's output can be viewed in a browser from anywhere in the world. The Web browser becomes the global and universal window into a business' data.

Internet: marketing information, product sheets, company news, advertising etc.

Intranets: up-to-the-minute directories, company manuals, vacancies, personal Web pages for employees (for flagging up experience and aspirations), use of Web browser as universal viewer

Extranets: easy access to corporate information across companies, access to stock levels, shipment status etc. via Web browser to effect deeper customer integration into company processes

Push, streaming technologies

Web pages are by far the commonest way of conveying information over the Internet. But there are other Content technologies that allow different data to be passed over the Internet, one-way, and to many users.

For example so-called push technologies send out information to users on a scheduled basis. This can be useful for providing updates to constantly-changing data, for example share prices, and to software programs installed on employees' computers. Once touted as a major breakthrough, push is more correctly seen as an ancillary service.

Streaming technologies are designed to deliver a constant flow of multimedia information, typically sound and video. They have led to the growth of an entirely new online industry that broadcasts digital content across the Internet. As a consequence, streaming technologies on the Internet promise to shake up the film, television and radio sectors radically, but can also be put to good use on intranets and extranets.

Internet: automatic customer updates, research information for staff;streamed multimedia marketing materials, live feeds of product launches, announcements etc.

Intranets: real-time news flashes to employees' desktops, software upgrades, production process monitoring; presentations, training,security monitoring

Extranets: automatic notification of workflow to partners and vice-versa,real-time updates for teams;cross-company presentations

E-commerce

The final group of services, Commerce, is both the least well-developed and also potentially the most important for companies. Electronic commerce, or e-commerce, embraces two main classes of online business activity: one where payment takes place directly, as part of the ordering process, and one where it occurs separately.

A typical example of the former is a customer buying an item from an online retailer like the increasingly famous Amazon.com company (currently valued at around $30 billion). Here, the visitor to Amazon.com's site uses a Web browser to choose among literally millions of books, videos and music CDs (using a site search engine), and then places an order by giving shipping and credit card details. It is widely expected that this kind of customer-driven e-commerce will soon become a very significant force in retailing.

The second kind of e-commerce takes place between businesses, and involves ordering supplies or goods electronically (using e-mail or by entering details on a Web page). Settlement generally takes place separately. This business-to-business e-commerce eliminates paperwork and can reduce order-processing costs dramatically. It largely replaces the older EDI (Electronic Data Interchange) approach.

Clearly, for both kinds of e-commerce to thrive, customers and business users must feel that the entire process is safe, both in terms of payment and confidentiality. For this reason, the use of encryption to keep data transmissions private is a key component of e-commerce.

The simplest form of encryption employs a private digital key to encode a message. But this requires some secure means of conveying the secret key to the recipient beforehand so that encrypted messages can be decoded.

To get round this dilemma, an extremely clever scheme using two digital keys has been developed. One key is kept private, while the other is made public. Messages encrypted using the public key can only be unlocked using the private key. In order to send a message safely, all that is needed is the recipient's public key for the encryption process; the sender can then be sure that only the owner of the corresponding private key will be able to decode the encrypted message.

This technique is employed routinely in e-commerce to allow a customer to send personal information such as credit card details to the merchant. The Web browser handles all the details of the encryption process. This approach, technically known as Secure Sockets Layer (SSL), ensures that personal details are not revealed in transit, though they are unprotected once they arrive.

To forestall the possibility of credit card fraud by the merchant, a more complicated system called Secure Electronic Transaction (SET) has been devised. This ensures that credit card details are hidden both as they cross the Internet, and when they reach the merchant. The latter never sees the details, but instead receives a confirmation from a suitable credit card authority that the transaction is approved. However, the extra complexity and cost of this approach has hindered its deployment, and SSL remains the dominant way of conducting business securely on the Internet. SSL encryption can be regarded as effectively unbreakable - except, perhaps, for a few security agencies like the CIA.

Another interesting approach that has also failed to take off so far, but which could have a major impact on the future, is the use of digital money. This involves the creation of messages with a nominal worth - rather like bank notes, which are not themselves worth anything, but can, through their guarantee from some trustworthy bank against an indicated sum, be exchanged for goods and services.

A variation on this theme is the micro-payment. Since no physical object is created, and the cost of creating and processing a digital message is so low, virtual bank notes can be for sums as low as hundredths of a cent. Once micropayment systems of this kind are in place, whole new areas will be opened up. For example, in e-commerce, information providers could charge by the page (or even word), while on intranets, departmental use of internal computing resources like e-mail or the Web could be charged back to departments on a per-message or per-page basis.

Internet: servicing new markets, both geographically and in terms of niches, 24 hours a day, seven days a week, micropayments

Intranets: ordering supplies internally, allocation of resources

Extranets: online purchase of supplies, with all paperwork sent electronically (replacing old and expensive EDI - electronic data interchange - technologies)

E-identity

Encryption can ensure that no third party is able to read communications as they pass across the Internet between buyer and seller. But encryption on its own does not address another fundamental problem: how to establish that online customers are who they say they are, and not impostors. This central issue of what might be called electronic identity (e-identity) is resolved using digital certificates - digital documents containing information about a person whose contents are guaranteed by a trustworthy authority (called a Certificate Authority).

Although digital certificates are still at an early stage of their development there is no doubt that they will become an indispensable element in e-commerce, and for identification and authorisation purposes on company intranets and extranets.

Internet: establishing credentials of customers

Intranets: determining access permissions to corporate resources, establishing internal purchasing authority

Extranets: determining access permissions to corporate resources across companies, establishing cross-company purchasing authority

Practical Issues

The preceding sections have sketched some of the considerable benefits that can accrue from using the Internet. But a corollary is that as a business takes advantage of these, its Internet connection will start to become indispensable. This makes choosing the right Internet Service Provider (ISP) one of the most important issues that companies need to address.

The ISP's role is superficially similar to that of a telephone company: in return for a fee it provides a connection to the larger network. But an ISP's role is both more complex and more far-reaching. As well as transmitting information sent to or from a client, the ISP must ensure that its system is secure against attempts to infiltrate it. And in the absence of a formalised structure to the Internet's connectivity (there are no national carriers as in the world of telephony - see Appendix A), an important aspect of an ISP is the size and reach of the communication links it has put in place to the rest of the world. These are to ensure its customers have fast and reliable connectivity to other Internet sites, wherever the latter may be.

There is no simple prescription for selecting the right ISP, since it is important to find the supplier that meets a company's particular needs. However, there are a number of key areas that must be addressed by potential suppliers.

General

One key parameter is the bandwidth, or overall size of the Internet connection (measured in terms of the total rate at which data can be sent to and from the ISP). The greater the bandwidth, the faster data can be sent and received, and the higher the number of simultaneous corporate users able to enjoy good performance. Most ISPs can supply any of the standard bandwidths (though very high ones are naturally only available from the largest suppliers), so the real focus is on price and reliability.

Price will obviously be an issue, though a business would be foolish to try to cut corners in this area, since an apparent saving bought at the expense of reliability will soon prove more costly in terms of lost business and wasted employee time. It is important to explore with potential ISPs not just prices for the initial configuration, but also the upgrade paths, including installation lead-times and the costs involved. Alternative pricing structures are also an area worth exploring.

For example, alongside flat-rate schemes, many ISPs offer tiered levels of supply, whereby the network manager can increase bandwidth as required, or the ability to exceed the nominal bandwidth in bursts rather than consistently. Here as elsewhere it is important for a company to discuss with potential suppliers exactly what it expects the patterns of Internet usage to be, how they will vary during the day or month, and what its future plans are.

Perhaps even more important than overall price is reliability: a lower-cost service that offers a lower availability is not acceptable for what will soon become a mission-critical factor for business. If possible, service level agreements (SLAs) should be part of the final contract, with guaranteed compensation if specified levels of availability, speed and bandwidth are not met.

One issue that may be relevant is the availability of Points of Presence (PoPs). These are the telephone numbers that employees out on the road will use when connecting to the Internet in order to pick up and send e-mail, or to log in to a corporate intranet. Ideally an ISP will be able to offer many PoPs with a geographical coverage closely matching that of a company's sales force so that employees will only run up local call charges. If salespeople travel abroad regularly, overseas PoPs may be important.

One possibility is the use of Internet roaming agreements. Like those found in the mobile phone industry, these enable customers of one ISP to use the PoPs of an affiliate when they are abroad in a country not covered directly by the first ISP. For occasional connections these may well suffice, though companies making frequent use of PoPs abroad will probably prefer the advantages of cost, reliability and speed offered by ISPs with a network that extends overseas.

Corporate

Other issues concern the ISP's corporate background. For example, potential suppliers will need to provide details of their financial history, their track record in offering Internet connections, as well as references from other customers.

Companies should ask about the current, past and planned investments in network infrastructure, since the ability to meet the rapid growth of demand for bandwidth is a critical skill for ISPs. Information about customer service departments and the availability of engineers for call-out should be sought. Other services that may be offered by an ISP include consultancy for general Internet, intranet and extranet planning, as well as Web-site design and Web hosting (where the ISP runs a Web server at its site holding pages of a customer).

Technical

On the technical side, a company may wish to discuss with potential suppliers security - the ability to block hostile attacks to its network - and junk e-mail. Unfortunately, together with the increasing use of e-mail by companies for legitimate purpose there has been a corresponding rise in the sending of unsolicited junk e-mail. This is often called spam, although strictly speaking this refers to similarly abusive postings in public newsgroups. ISPs should be able to block at least the bulk of such messages.

Other

Alongside those areas where choosing the right ISP can help enormously in solving any problems that arise, there are others that are so new that no one - including the world's governments - has come up with satisfactory solutions. These involve issues such as the impact of the abolition of geography on trademarks and taxation, how to formulate appropriate copyright laws and the safeguarding of customer privacy.

The outstanding problems must, however, be resolved, and soon: the momentum behind the move of business to the Internet is now so great that comprehensive, consistent and enforceable regulatory frameworks will soon be indispensable if commerce is to function smoothly there. In any case, the lack of these frameworks should not be seen as an obstacle to engaging in online business activities now.

Future technologies

In the five years since its appearance on the corporate scene the Internet has already gone through several generations of technology, and there is little sign that the pace is slackening. Indeed, as more companies join the Internet so the demand for innovative ways of gaining competitive advantage increases. As a consequence, companies need constantly to plan for the future so as not to find themselves trapped in a technological dead-end.

Unfortunately this heady pace also makes prediction particularly difficult. However, the general characteristics of the Internet, described at the start of this document, are so fundamental to its nature that it is possible to gaze forward a little by extrapolating from their current manifestations - noting, where possible, which of the latest technologies seem to be part of these trends - and by speculating on what the longer-term effects might be.

The developments sketched below will not affect every company immediately, but their broader impact for all will certainly be considerable. At the very least they should provide a stimulus for further thought about how a particular business sector will need to adapt to flourish in the newly-emerging Internet landscape.

Digital electricity

As this document has described, it is the Internet's bit-blindness that drives all the other radical features of the medium. And yet bit-blindness has so far been exploited only in a very limited way. For example, it is only now that the world's leading telecom companies are starting to move Net telephony into the mainstream.

In the not-so-distant future is seems likely that the cost of a voice call to any country will be close if not equal to zero. Already there is more data traffic than voice traffic passing over the world's networks, and in time data traffic will completely dominate to the extent that voice calls may be bundled free along with data services. And if a phone call costs nearly nothing it will be possible to leave lines open all the time - to anywhere in the world - changing considerably the dynamics of how businesses communicate, especially if videoconferencing can be employed on a similar basis.

The current transition to digital television and, to a lesser extent, digital radio, will inevitably see these data bits moved across the Internet as well as broadcast, with interesting ramifications for their respective industries and audiences.

But even these uses of bit-blindness are trivial compared to what will follow. A next-generation Internet technology (called IPv6) already exists that potentially will allow Internet addresses to be allocated not just to every computer and piece of intelligent office equipment, but to every electrical device everywhere. Once this is in place the potential for monitoring and controlling devices across the Internet will increase dramatically.

To give a trivial example, using these Internet technologies it will be possible to control every light-bulb in a house from any room, any building and, indeed, anywhere on the planet. Similarly, once cars and other transport devices become part of the Internet, they can also be co-ordinated automatically - allowing more efficient use of road-space and ensuring that collisions are avoided.

These and other uses represent a broadening of the category of Internet services termed Conversation above. They will lead to the Internet being used as the medium for all communications between people and computerised equipment. In a sense, the Internet will disappear as a separate network, and become simply the basis of every electronic conversation on the planet.

This passage of the Internet towards digital electricity, taken for granted just as much as the conventional kind, requires a number of enabling technologies. In addition to IPv6, a new kind of very lightweight software framework is needed that allows even simple electrical devices to be controlled and to interact among themselves. The US computer company Sun has proposed just such a scheme called Jini, and Microsoft is working on a similar project it has dubbed Universal Plug and Play. The other key advance that will be needed to realise this vision is wireless connectivity.

Wireless connectivity

Currently, the Internet has abolished geography only crudely: users can access all points on the globe that are connected to the Internet, but these are still quite sparse. Moreover, it is not possible to access the Internet from anywhere: normally users must be connected by some kind of wire to a larger network that is part of the Internet.

There are already significant moves to end this dependence on fixed connections. Indeed, it is possible to connect to the Internet using mobile phones now, though the throughput of data is relatively slow. However, the so-called 3G or third-generation mobile telephony standard IMT-2000 (International Mobile Connectivity 2000), currently being drawn up, will allow wireless connection at speeds approaching that of a company network.

Some wireless systems will function as part of the public mobile phone network, but others can be deployed within companies, for example, to provide private wireless access to the Internet by hooking into the main corporate connection. This will allow employers to work literally anywhere in the building, giving a further impetus to the dissolution of conventional offices and their associated corporate structures.

Even more ambitious is the Teledesic project. Partly funded by Microsoft's CEO Bill Gates and U.S. mobile phone pioneer Craig McCaw, this aims to put no less than 288 satellites in a low (non-geostationary) orbit to provide high-speed wireless Internet connectivity anywhere in the world. Once this and similar projects have been realised, geography will be truly abolished, since it will be possible to access via the Internet any part of the world from anywhere.

Such wireless networks, whether supplied through local, private radio networks, or via global satellite systems, will provide the new "wiring" for the Internet's digital electricity - one that will be present at every point in space. For example, portable and palmtop computers or intelligent mobile phones will be permanently hooked into intranets via the corporate wireless network. All the electrical devices in an office would be able to communicate with each other: data could be extracted from computers, sent to printers, displayed on monitors - all without wires. Every aspect of an office - lighting, heating, security etc. - could be monitored and controlled from anywhere.

Once geography is pervasively abolished in this way, the Community services discussed before will play an even more important role in defining how people work and live. Since physical location will no longer be a barrier to any kind of digital operation - which will soon mean most practical operations in the real world - there will be a fundamental shift in how people think about the idea of place: in terms of the way they live and work, and, more profoundly, how they relate to the concepts of nation and government.

Intelligent information

The current over-abundance of data is more apparent than real. It is not that users are faced by too much of what they want, rather that it is hard to extract precisely what they require from among the huge number of superficially similar options.

For example, when carrying out Web searches, users are typically confronted with thousands of possible sites that meet the criteria for selection, but which are mostly irrelevant. The problem is that it is hard for the search engine computer to tell from the words in a Web page what the document is really about.

The solution is to create Web documents using something called Extensible Markup Language (XML). XML differs from the HyperText Markup Language (HTML) currently used for writing Web pages in that it can be used to describe the content of a document in a way that is useful to a computer.

For example, if a Web page contains contact names and addresses for a company, XML can be used to mark which words are names and which are addresses - something not possible with HTML, which is simply used to format those names and addresses for display purposes. Using XML in this way enables searches to be carried out specifically for names or addresses within Web pages, not just words.

In a sense, XML documents "know" what they are about, and once XML is widely used, this built-in intelligence will allow the over-abundance of data to be tamed. Search engines will be able to interrogate Web pages more precisely and so narrow down the list of possible sites.

XML is the natural format for use with the Content services discussed earlier. HTML, it turns out, is better employed for creating versions of content that can then be viewed in a Web browser, whose role as the universal viewer for information emerges strengthened in this approach.

XML will also allow most commercial transactions between business partners to be completely automated. Because XML provides a way for a document to describe itself, it will be quite clear which parts of it refer to quantities of goods, delivery times and costs etc., without the need for human input.

Similarly, XML documents will become the main way of exchanging information between companies with possibly incompatible storage formats. By converting a database file into an XML file for transmission it can be imported into another, perhaps quite foreign system by using the intelligence stored within the XML to put the right data in the correct database slots.

Software agents

The rise of XML will have an important consequence in terms of how users interact with the Internet. Currently, human intervention is indispensable when comparing goods or services since these are all presented in different, incompatible ways. In general it is not easy to automate the process of picking the best among the various incommensurate options.

However, once XML is used to store the data that forms the basis for e-commerce, it will be feasible to design software to interrogate the information directly in order to determine what goods and services are offered at what price, and under what conditions.

This new transparency will lead to the rise of the software agent - a program that becomes the user's proxy on the Internet, acting with varying degrees of authority in finding, selecting and buying. The software agent represents the ultimate in user power since agents cannot be misled by ambiguous wording on Web pages (because they access the underlying unambiguous XML files) and never tire as they compare hundreds or even thousands of potential suppliers from around the world.

The software agent also represents a further stage in the evolution of Commerce services. It will do this by interacting on behalf of the user first with e-commerce Web sites, and later with other agents on those sites acting for the seller. This will lead to the routine negotiation of billions of software agents across the Internet, which will exist as virtual embodiments of the users they represent.

As suppliers become more sophisticated in the use of their own software proxies, they will move towards increasing customisation whereby their own software agents negotiate in detail the data, goods or services required by the user. Ultimately even the production process required for these may be under the control of an agent.

One interesting feature of these agents is that they will probably be voice-controlled. Because they will be charged with extremely complex tasks it will be more or less impossible to program them using conventional point and click programs. Instead, users will talk to their computers - or rather the program generating the proxy - explaining what they require, what the constraints are in terms of price or timing, and any other considerations that are relevant for them.

Future trends

Like today's technologies, the future developments described above will have a significant but varying impact in all of the Internet's three main spheres.

The Internet/the world

It is clear that the Internet is already a key medium for public discourse - as was demonstrated in a most dramatic manner by the publication of the Starr report online - and in time it will become the central public space. It will be the medium for global, wireless communication, the meeting-point for the creation and exercise of communities, the repository of every kind of information, and the marketplace for the negotiation and payment of commercial transactions.

The impact on business will be profound. The physical aspects of a business will diminish in importance; instead, the crucial characteristics will be its attributes in the online world. For example, no longer will the prime location be in a shopping precinct (for retail) or in prestige areas of city centres (for services): instead, the key spots will be high-profile placings on the descendants of what today are called portals - the main online entry points through which millions of Internet users pass every day.

This move of nearly all business online means that competition will sharpen, and the over-abundance of offers to the customer will grow even greater. Correspondingly, personalisation of offers will become the crux of winning business - providing customers with exactly what they want, how they want it, when they want it.

The intranet/the company

Just as the Internet will revolutionise the dynamics of the external business space, so will intranets transform the classical notion of a company. Indeed, as geography is completely abolished, and wireless communications mean that employees are connected wherever they are - at home, on the road, abroad - the intranet will become the defining element of the company. That is, the company is formed by whatever is joined together by the private intranet.

Everything will be on the intranet - from marketing through sales to production - and hence transparently accessible from any point on the globe by anyone with the appropriate authorisation, defined through digital certificates. All data will be stored as XML, allowing it to be extracted, mixed, exchanged, and analysed - the ultimate management information system.

Software agents operating across the corporate intranet will be used to flag up exceptions in production systems, marketing budgets, sales forecasts etc., and may even intervene directly, taking corrective actions within predefined limits.

Other agents will be used to negotiate short-term contracts with workers, for particular projects, for example. As well as allowing companies to employ just the staff they need for the work they have on the books, this will also empower workers. Through their own software agents they will be able to negotiate personal, flexible working patterns to meet their own particular needs - to spend time with their families, to work wholly or mainly at home etc. - not those arbitrarily imposed by companies.

Here too the central importance of the intranet is manifest: workers become employees of a company by virtue of their access to an intranet, not where they are physically. They cease to work for that company when they lose access rights to its intranet - by which time their software agents will presumably have negotiated access to another intranet through another contract.

The extranet/the customer

The use of corporate software agents with the ability to make legally-binding contracts through digital certificates that confer this and other powers will not be limited to negotiations with employees. They will also ride across extranets to work with business partners' agents. These will sign contracts - digitally - for the supply of goods, rights of access to intranet systems, payments etc.. The abolition of geography allows collaboration with partners anywhere in the world (subject to physical constraints like the delivery of heavy raw materials, parts or finished goods).

Extranets will therefore no longer be confined to a small circle of previous working partners, but like everything else on the Internet will multiply beyond the point where human control would be feasible. The common use of XML will mean that when authorised, information can pass instantly between the various partners, even if hitherto they have never worked together, without any need for detailed knowledge of the computer systems employed.

These shifting extranet coalitions will define fleeting supra-corporate groups that come together for particular business projects and then dissolve once they are finished. All of the intranet-based integration described above can be extended to an extranet for the duration of the project, subject to the authorisations negotiated by the relevant software agents.

This will lead to a new flexibility and responsiveness for companies, which will permit them to re-configure themselves through these variable partnerships to meet shifts in demand. Indeed, it will enable them to meet the challenge of the need for the personalisation of goods and services born of the online user's power.

As the coalition system develops and becomes more efficient, it will be possible for many companies to supply goods on a customer-by-customer basis - and to emulate the extremely successful personalised online approach that already provides the US computer manufacturer Dell with 20% of its revenue, and Internet sales of more than $10 million a day.

Conclusion

The Internet will inevitably bring about huge shifts not only in business, but also in the social and political realms, which are beyond the scope of this paper. If the above vision seems distant, it should be borne in mind that five years ago barely a company in the world had even heard of the Internet. If it seems daunting, it is worth remembering that the extraordinary and completely unplanned transformative process underway today began with the simplest of acts: connecting just two networks.

The first step for a company wishing to join this exciting and challenging new world is equally simple: to echo that historic move by linking itself to the Internet.

Appendix: How the Internet functions

The Internet is what is known as a packet-switching network: it breaks up the digital data that it carries into small units irrespective of their content. This allows these units to be transported separately, even by different routes, before the data is reconstituted by the recipient computer. This is in contrast to a conventional telephone call, say, where the voice traffic is sent over a fixed path or circuit.

Packet switching is both more cost-effective and more robust than using circuits. Since packets can take different routes, it is possible to aggregate them together for efficiency, regardless of how they were produced, to achieve great economies of scale. And if one path should suddenly fail, the packets can be re-directed to take another route without interrupting the overall flow.

Packet-switching works because each packet carries with it the final destination address. This is given as four numbers, each less than 256: a typical address would therefore be 207.46.130.150. These addresses correspond to individual computers on the global network.

Clearly, such addresses are inappropriate for direct use by humans, so a parallel system called domain names is used. These take the form of www.microsoft.com, which is the human-friendly version that can be used instead of the Internet address 207.46.130.150. The conversion is effected using the Domain Name System (DNS).

Domain names possess a structure, with more general elements to the right. For example, in www.microsoft.com, the .com refers to the global commercial domain - essentially any kind of company. Similarly, .microsoft.com is Microsoft's group of computers in the commercial domain. In this case www.microsoft.com further specifies that the computer is a World-Wide Web server of Microsoft (although it is not obligatory to use the name www for a Web server, most companies follow this convention).

The Internet is a network of networks, joined by routers, but without any overall structure to the way these networks are joined up. Given this unorganised state of affairs, it is perhaps not surprising that there is no one Internet organisation overseeing its development. Instead, there are various national bodies charged with specific tasks, such as the allocation of domain names and Internet addresses for a particular country.

The great advantage of this unstructured approach is that extra networks can be added to the Internet at any point. This means that companies can hook up their corporate networks by linking to another already connected. Networks that offer this service commercially are called Internet Service Providers (ISPs). Typically it is the ISP that handles all the details of obtaining Internet addresses and registering a customer's domain name.

In order to offer Internet connectivity to companies in many countries, and to improve the links between those markets, some ISPs have large networks spanning much of the world. Because they carry significant proportions of the Internet's total traffic, they are often called Internet backbones.

There are two main types of connections offered by ISPs: leased line and dial-up. A leased-line is a permanent connection to the Internet, and requires a router to act as the knot tying the company's network to the ISP. Dial-up connections use the public telephone system to effect the link (either conventional analogue or the digital ISDN variety), and are most appropriate for single users connecting from home or on the road. Connection in this case is via a modem (Terminal Adapter or equivalent for ISDN).

Leased line connections are typically faster and far more reliable than a dial-up one, and are constantly available. This makes dial-up more suitable for employees on the road or at home, whereas the main company link will nearly always be a leased line.

Thanks to its simple approach to expansion, the Internet is growing extremely rapidly. According to figures from the US company Network Wizards, the number of computers on all connected networks has gone up from 1.3 million in January 1993, to 2.2 million in 1994, 4.8 million in 1995, 9.5 million in 1996, 16.1 million in 1997 and 29.7 million in 1998 - roughly doubling each year. Inevitably this geometric rate of increase will slow down, but the online population seems certain to reach hundreds of millions of users in the not-too-distant future.

Similarly, where once the Internet was initially the private network of a few privileged Western countries (having its origins in the US nearly 30 years ago, first as a military and then a research network), it has become now a truly global institution, with almost every country on the planet represented.

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