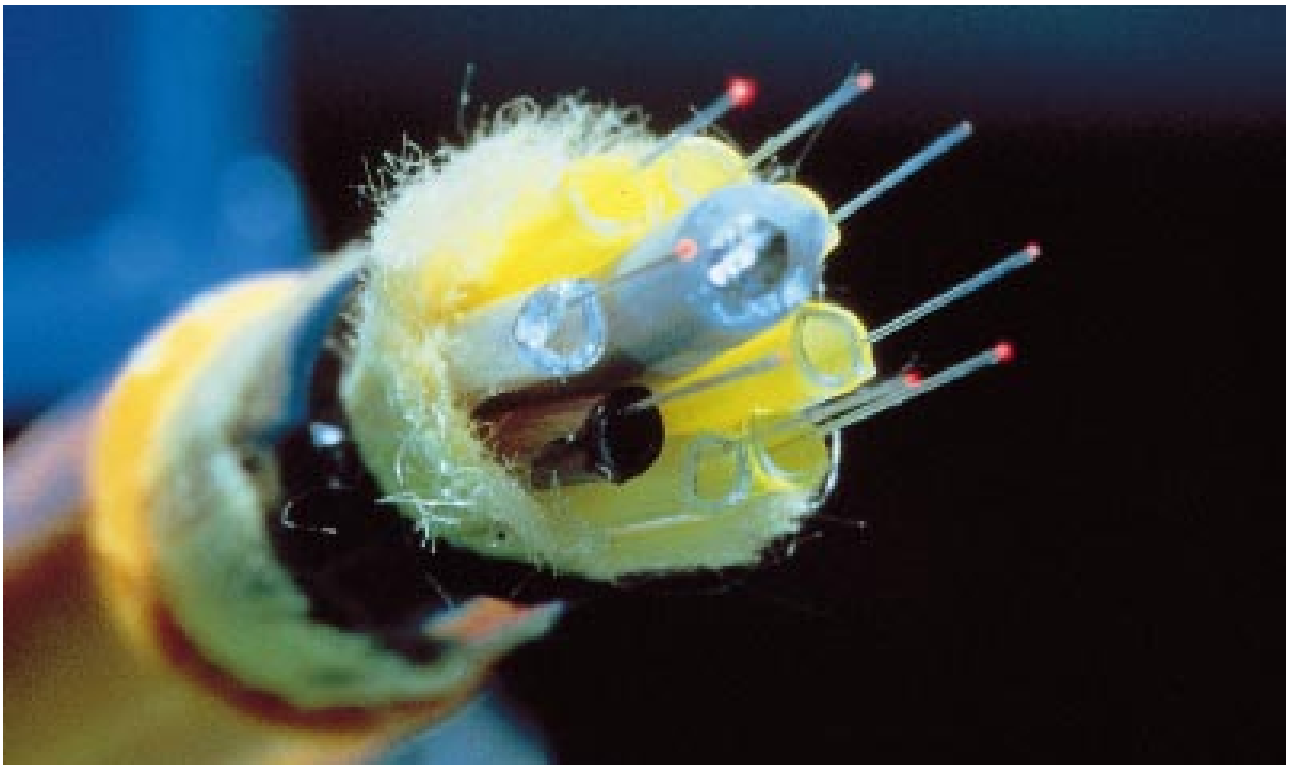
# Technology *Overview*



Siemens

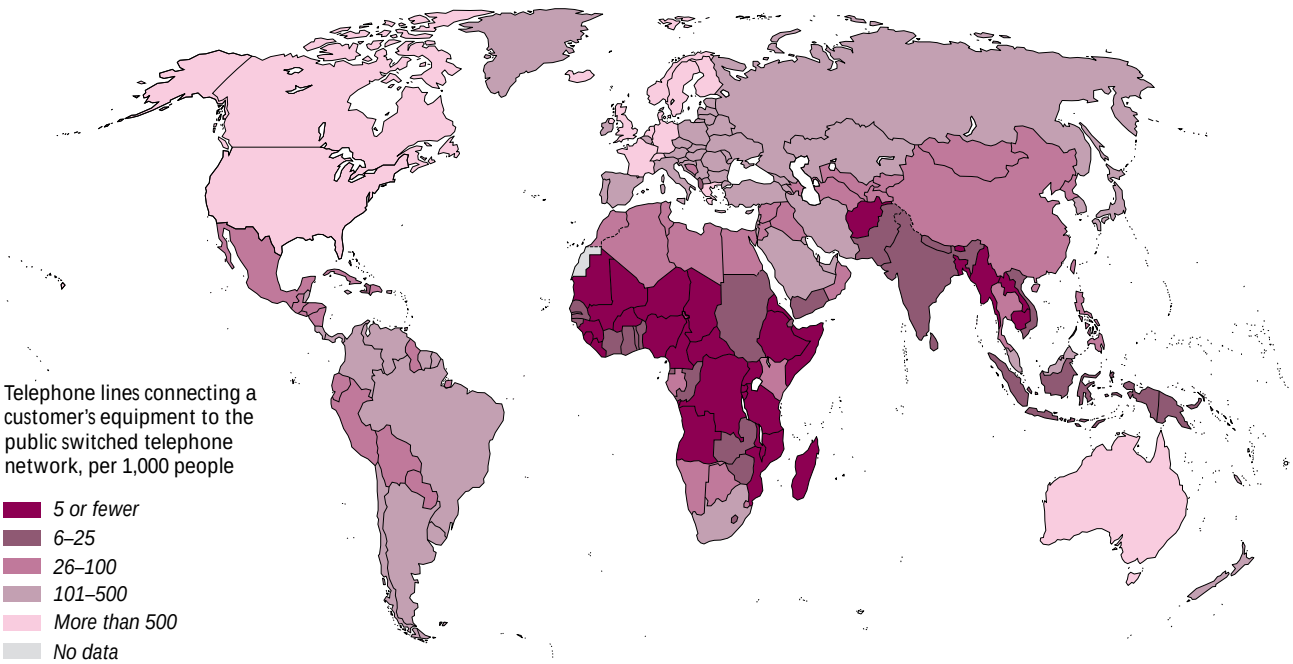
IT IS NOW WIDELY RECOGNIZED that access to efficient telecommunications is a major developmental driving force. In the various sections of *Telecommunications in Action* which follow, telecom applications in use worldwide are discussed and their contribution to the overall development process assessed. For decision makers and planners who wish to explore some of these applications with a view to implementing them in their own countries, it is helpful to understand something about current telecommunication services and technologies. Acting as background and glossary to the rest of the book, this section of *Telecommunications in Action* provides a non-technical description of the various networks and the great variety of services available today and in the near future. Topics covered include telephony services, both "wired" and wireless, highlighting the latest developments in this area. Radio and television broadcasting, and the convergence with telecommunications and computers, are discussed, as well as the ever-widening role of the Internet. Issues surrounding regulation for telecommunications, and the opportunity it provides to encourage universal access, are also referred to. Universal access is the first goal, from which the possibilities for future applications are many.

## telecommunications *in Action*

THE INDUSTRIALIZED WORLD and, increasingly, some of the developing nations, enjoy the many and varied benefits of modern, efficient telecommunications. The "information society" depends on the circulation of information through multiple networks and systems of telecommunications. Radio and television broadcasts carry information; transportation systems on air, sea and land depend on telecommunications for management, traffic control and safety; commercial transactions are carried out largely thanks to data transmission; and interpersonal communications rely on telephone, fax, Internet and e-mail. Telecommunication systems are about communicating knowledge – and knowledge is vital for development. In the United States there are more than 600 telephone lines for every 1,000 people, while in South Asia and sub-Saharan Africa, there are only 20 telephone lines for every 1,000 people.[1] There appears to be a correlation between "teledensity" and indicators of development, even if it is not possible to quantify how much the latter depends on the former. The role of telecommunications in helping to bring the industrialized world to its present state of development is certainly beyond doubt.

But it is only in recent times that technological developments, convergence among broadcasting, computer and telecommunication systems, and new economic and political forces have fuelled and propelled rapid development for a limited number of countries which had the means to react and take advantage of these processes. This convergence has led to a vast range of enhanced services that combine techniques from the three previously separate technologies into what are known as information and communication technologies. It is crucial that the developing world be able to harness these

**Main telephone lines per 1,000 people, 1997**




Source: *Basic Indicators, 1999*, ITU

most powerful technological means to advance the development process. By benefiting from the experience of what has been done in the industrialized world, in some cases developing nations are able to "leapfrog" ahead, moving straight to using the most recent technologies.

Although such telecommunication applications as the Internet, telemedicine, distance education or geographic information systems (GIS) are now available, the potential they offer, particularly in non-industrialized countries, is often not well understood by those practitioners who need them most, whether in government, education, the health services, agriculture and the environment, or business and industry.

*Telecommunications in Action* has been written to help clarify the advantages arising from having a reliable telecommunication infrastructure, which acts as the basis from which to initiate development in numerous other sectors. It lays out clearly, in non-technical language, analyses of current developments; examples of telecommunication applications in use worldwide; and working

**CORPORATE VIEW**

## Immediate access to basic telephony

TELESYSTEM International Wireless (TIW) is a global wireless operator, with operating subsidiaries in Asia, Europe and Latin America.

In Romania, its subsidiary MobiFon achieved one of the fastest start-ups of digital cellular services and surpassed the 300,000 subscriber mark after only 20 months in commercial operation. This enormous success has enabled the company to extend its licence by a further five years to 15 years. The company, which markets its cellphone services under the brand name CONNEX in Romania, where it is the leading operator, has also successfully closed the syndication of loan facilities totalling US$105 million jointly arranged by the ABN AMRO bank and the European Bank for Reconstruction and Development (EBRD).

These funds, combined with US$50 million shareholders' contribution, will allow the company to complete the expansion of its digital network in Romania as well as finance the licence extension. Currently covering 80 per cent of the Romanian population and 60 per cent of the territory, MobiFon will reach 90 per cent of the population by the end of 1999.

In Brazil, TIW is one of the country's largest cellular operators with a total of over 828,000 subscribers and four licences covering a total of 52 million people. The company is one of only two international operators with a presence in four regions. With its cluster of two recently privatized operators (A-Band) and two start-up operators (B-Band), it is positioned for high growth and enhanced operating efficiency. Only ten months after receiving its licence, the company's affiliate Telet launched digital cellular services in the two main cities in the country's southernmost state, Rio Grande do Sul. Telet now covers 50 per cent of Rio Grande do Sul's 10 million people and is well positioned to build a strong subscriber base. In addition to Telet, the company's operations include Brazil's first private sector cellular operator, Americel SA, as well as Telemig Celular, which serves the state of Minas Gerais, and Amazonia Celular, which covers the five northern states of Brazil.

In China and India, TIW has entered the markets with a long-term view based on the potential of its licensed areas. Chinese services were launched in Changsha, the capital of the province of Hunan, with a population of 1.5 million. The network was extended to Zhuzhou and Xiangtan, which completed the Golden Triangle region of Hunan with a total population of 12 million. In India, five of the largest cities in the state of Rajasthan were provided with a high-quality cellphone network.

**Telesystem International Wireless**
E-mail: mboutet@tiw.ca
Website: http://www.tiw.ca
*For more information see Annex B*

models for the introduction and augmentation of telesystems and tele-access. Annexes give key details of sources of funding for telecommunications in the developing world, and industry contacts who can help with their introduction to organizations or governments.

Separate sections deal with the application of information and communication technologies to issues of development in the fields of health, agriculture, education, business, the environment, governance, and urban and rural development. The current situation worldwide in these eight areas has been researched, and relevant examples and case studies have been provided to illustrate the potential and possibilities of applying technology as a cost-effective means of progressing sustainable development. As much information as possible has been provided on the costs and funding of these activities. The figures given, however, should be considered as indicators for general guidance since they can vary and depend so much on local conditions and the equipment and technology chosen. Moreover, it should be remembered that prices of most information technology

**CORPORATE VIEW**

## Personal communication services

THE DEMAND for personal communication services is set to create one of the fastest-growing markets worldwide over the next decade. This is increasing the pressure on mobile telephone companies to provide networks that give fast, national coverage, better-quality calls, more calls that are successful first time and, of course, lower tariffs.

New high-performance networking technologies not previously used in conventional cellular systems could provide such benefits to providers and users alike. Silicon Wireless was founded in 1995 to deliver these.

The company is developing a unique design and operating process for wireless networks which is built around a distributed radio network operating system. It will initially support industry standards and handsets for GSM (global system for mobiles) digital cellphone communications and promises to improve mobile communication coverage by up to threefold, while reducing total capital and network operating costs by up to 50 per cent over the entire life of the network. Customers for the initial products will be regional and national mobile communication service providers throughout the world, which deploy GSM-based systems in networks.

The system incorporates the latest technologies from the telecommunication and computing industries, and combines leading-edge design with a novel method of processing system and speech signals to deliver superior radio link performance for today's wireless networks. The core technology and innovative system design can be employed to improve the performance of a variety of international standards. Silicon Wireless will first offer a version tailored for GSM-based systems, but future products may permit connection for a variety of other cellular network standards.

A feature of today's telecommunication revolution is that the unit cost of computer processing has decreased a thousandfold since the introduction of the first cellular systems. Current real-time processing capabilities make it possible to apply a new approach to the fabric of radio networks.

But the network design developed by Silicon Wireless also solves several of the basic limitations imposed on networks by current systems, and in doing so dramatically improves network performance. For example, network coverage can be significantly extended, while reducing the number of cellular transmitter sites an operator must deploy throughout an area. This new network design also enables network planners to design networks that provide better call quality, fewer dropped calls and a generally more efficient network. Importantly too, including for users, the new technology will enable mobile telephone service providers to sharply reduce the time it takes to deliver services to customers.

**Silicon Wireless**
E-mail: paul.healy@siliconwireless.com
Website: http://www.siliconwireless.com
*For further information see Annex B*

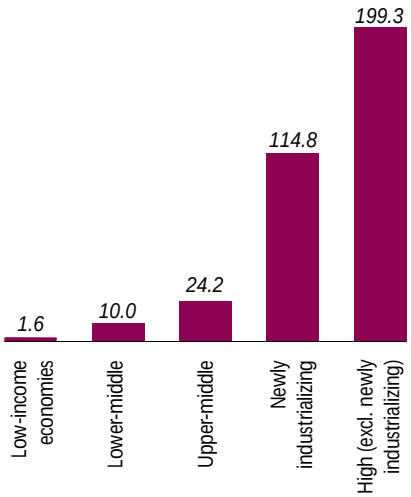
equipment and services are diminishing almost daily while their capabilities are being multiplied. For example, the cost of sending information down a fibre-optic line has fallen dramatically over the last 25 years, while the amount of information that can be carried has risen by a factor of a thousand.

## TELECOMMUNICATION SERVICES TODAY

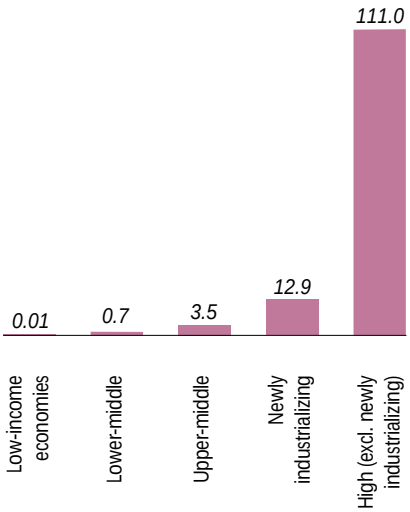
When rural and remote areas were being connected into the telephone network 50 or more years ago, there were few choices on how to proceed but to build pole lines and string wires or cables through largely uninhabited territory. This required spending large amounts of capital with returns from the revenues from rural customers that were simply insufficient to pay back the capital expenditures. This led to the practice of subsidizing rural services from urban and long-distance revenues. Today, technology provides a number of better solutions, such as wireless and satellite systems, and services to rural and remote areas can prove, under the right conditions, to be profitable. One factor which can enhance the profitability of providing telecommunication services, especially at the critical start-up period, is the involvement of several different parties (often referred to as "stakeholders" because of their interest in having available a telecommunication infrastructure to serve their needs) to share the start-up and operating costs. This team approach is seen in, among others, the development of multi-purpose community telecentres, discussed in the section of *Telecommunications in Action* dealing with rural development. Putting telecommunications to work requires both the right technology and a suitable political and regulatory situation which is conducive to finding the necessary investment funding. These two areas, which are critical to the establishment of a solid and sustainable telecommunication infrastructure, are discussed later in this section.

Telecommunication networks do their work so well that users are usually unaware of the various automatic processes that come into operation when they call each other. The fact that the service works well is what matters and the topic can be so complicated that descriptions tend to be filled with jargon which is incomprehensible to non-experts. Some appreciation of the various telecommunication services is nevertheless desirable and this section offers a non-technical description of the various networks and the great variety of services available today and in the near future.

**PERSONAL COMPUTERS PER 1,000 PEOPLE, 1995**




**INTERNET USERS PER 1,000 PEOPLE, 1995**

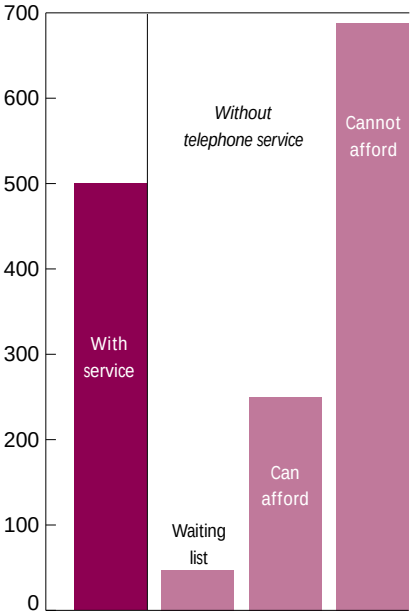



Source: *World Development Indicators 1998*, World Bank

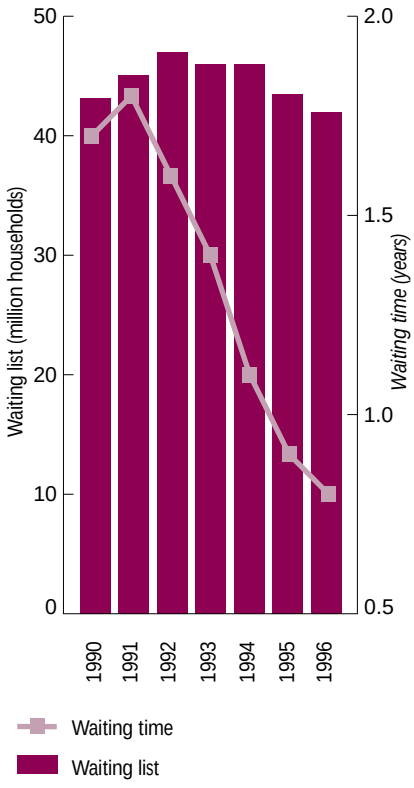
### Making the connection

The classical telecommunication network, which started out purely for making and receiving voice telephone calls, is known as the public switched telecommunication network or fixed-line network. It consists of subscriber lines, exchanges (switching centres) and inter-exchange lines. When a call is made, the digits entered on a telephone set provide the instructions that cause the circuits to be linked in tandem to provide the connection between the caller and the person called. There are two circuits, one at each end of the connection, called local loops that connect users to the nearest exchange. The connection between the two exchanges (trunk) may be built up from several interconnected pieces and pass through several other exchanges.

**WORLD ESTIMATED HOUSEHOLD TELEPHONE DEMAND BASED ON AFFORDABILITY, 1996** *(millions)*




**WORLD WAITING LIST FOR TELEPHONE SERVICE AND AVERAGE WAITING TIME**




Source: ITU, at <http://www.itu.ch/ti/publications/WTDR_98/index.htm>

Local loops and trunks may use a variety of technological means, either wired or wireless, to carry the users' voices or data from one point to another.

Once this link, which has certain characteristics and capacities (the word "bandwidth" is associated with them), is established, the two users can hold a conversation or can send text or images in the form of data to each other, for example, between their computers. The capabilities of the connection depend on the nature of the link and also on the equipment connected at each end. To hold a conversation requires two telephones connected by a narrow-bandwidth wire circuit, whereas to hold a video conference requires a microphone, a video camera, a video monitor (television) and possibly a computer at each end, and the circuit has to be capable of transmitting large bandwidth signals.

**Analogue** refers to signals or information represented by a continuously variable quantity. In the telecommunication context, it is a communication signal represented by the pitch and volume of a voice.

**Digital** information is encoded in binary format – the "ones" and "zeros" that have always driven computers and microprocessors and now, increasingly, many other applications. It varies in distinct steps.

The capability to convert or encode analogue signals into a complex set of digital codes has existed for years: digital voice transmissions have been carried on terrestrial cables and satellites for some 20 years. While digital transmissions are much more robust, a digital signal requires at least as much if not more bandwidth for transmission than the original analogue signal.

**Bandwidth** is the capacity of the communication path. It affects both the quantity and the speed of the information transmitted.

**Broadband** is transmission capacity with sufficient bandwidth to permit combined provision of voice, data and video.

**ATM** stands for asynchronous transfer mode. This method of conveying data at high speed does not differentiate between voice, video, file transfer and the Internet, but treats all forms of information in the same way and transmits them at high speed. It is especially suited to real-time voice and video.

**Frame relay/packet switching** is a method of coding where the information or voice being transferred is gathered into small bundles or packets and sent across the network. Each bundle of information is wrapped in a coded address recognized by the switching exchanges, which then send it on to the next exchange. Should the network develop a problem the system can send the bundles of information in another direction to bypass the problem and ensure continuity of service.

**ISDN** stands for integrated services digital network, which supports simultaneous transmission of voice, data and images over conventional telephone lines.

**xDSL** is an acronym referring to different types of digital subscriber line technology used to increase the bandwidth of the main telephone lines. Examples include ADSL (asymmetric digital subscriber line), HDSL (high-data-rate digital subscriber line) and VDSL (very-high-data-rate digital subscriber line).

## Wired services

In wired services, the classic connection from the local exchange to the subscriber's telephone is made of copper wire, designed to carry the frequencies equivalent to the human voice. Copper wire can also serve the role of a trunk circuit, but technological innovations, including carrier systems which use frequencies much higher than audible sound, can make it capable of carrying many conversations simultaneously.

Other increases in efficiency or carrying capacity can be obtained by using different types of physical support.

**Coaxial cable** is made of copper but is constructed differently from the basic copper wire pair; it can carry several hundred simultaneous conversations and is the support typically used for cable broadcasting.

**Optical fibres** are made of glass and plastic and the signals are transmitted on a beam of light through the fibre which is 0.01-1 millimetre thick. They can carry several thousand simultaneous conversations or other data.

CORPORATE VIEW

## Shared information

THE NEXT century promises a revolution in shared information through seamless instantaneous communication. As the heavy demands placed on existing older networks expose their limitations, fibre-optic networks will increasingly offer solutions to handle the explosion of interactive services.

International Fiberoptic Technologies designs and manufactures fibre-optic cables and jointing equipment for a number of markets. As a key player in the fibre industry, the company has been involved in the changing face of cable design and technology. Today, glass-fibre threads act as conductors, carrying tens of thousands of paths of information. Advances in laser light generation and the technical design of digital terminating equipment now enable many different services to be transmitted down one fibre simultaneously. This modern digital technology carries up to 120,000 voice circuits or a number of other services over one fibre system, using a very small percentage of the available capacity. Offering a secure transmission system, fibre-optic networks are difficult to monitor illegally, weigh less than their copper counterparts, are lighter to support and easy to transport.

As fibre-optic networks are made up of both passive and complex electronic components, one of the industry's main concerns is component reliability, particularly when networks are exposed to humidity, heat or uncontrollable environmental conditions. Although manufacturers had made some headway in solving these problems, the key questions continued to be long-term exposure to changing environmental conditions, and the extreme fragility of some of the components. These factors adversely affected the reliability of the components, which in turn affected the efficiency of the system.

Recognizing the problem and wishing to offer its customers the best possible quality, International Fiberoptic Technologies has designed, tested and patented a revolutionary process which protects and hermetically seals passive fibre-optic components, preventing them from being damaged by the external hazards of heat, moisture and movement. Offering five levels of protection, the company's cutting-edge process is unlike any other device available on the market, providing low-cost manufacturing solutions without compromising product quality. The company's research team is developing several new products and processes, ensuring its position as a leader in the market place. Committed to the continued development of innovative problem-solving processes, the company has gained a reputation for providing solutions.

**International Fiberoptic Technologies**
E-mail: jproctor@ift-info.com
Website: http://www.ift-info.com
*For further information see Annex B*

## Wireless services

In a wireless (radio communication) situation, services use radio frequencies rather than wires or cables to make a connection. The exchanges can be the same but the circuits between the callers and their closest exchange use radio links (sometimes called wireless local loops) that require no physical support structure. This technique is therefore particularly useful in rural and remote areas where the terrain may be difficult, distances are great and the population is sparse. Subscribers to ordinary telephone services are in fixed locations and the same type of service can be provided by radio systems, but the flexibility of certain radio systems can permit the subscribers to be mobile.

**Spectrum** is an arrangement of frequencies or wavelengths. In this context it refers to the frequency spectrum of radio waves, measured in hertz, used as a transmission medium for cellular radio, radio paging, satellite communication, over-the-air broadcasting and other services.

**Microwave** is a term which indicates that the frequency of the signals used is greater than about 1,000 megahertz, i.e. higher than normal radio waves.

### *Fixed radio*

The more traditional fixed-radio access systems can be of varying capacity, providing for situations where there are only one or two subscribers using single-channel radio systems or where initially small but growing numbers of subscribers will require services using point-to-multipoint (i.e. out from one central transmitter to a number of receivers) microwave radio.

Another class of system which can provide fixed-service uses has been developed out of the second (digital) generation of cordless telephones which were introduced to provide limited mobility in the home or office. There are several different versions of these systems, developed in Europe, the United States and Japan, which provide a basic telephone service plus additional services with varying degrees of sophistication and capacity.

### *Mobile radio*

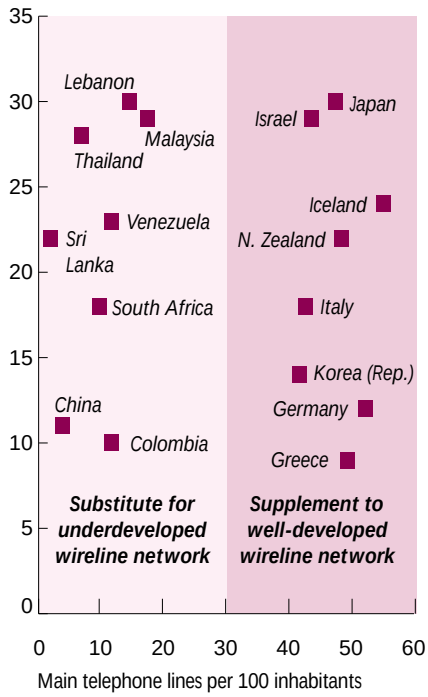
True mobile (cellular) systems can also be adapted to provide fixed services in rural or urban environments; when used in a fixed rather than mobile capacity the result can be improved operating efficiencies with some systems. The cellular systems once again have been developed independently in different regions of the world and, while capable of providing basically the same service, have different individual characteristics and capabilities and are for the most part incompatible.

**Cellular** is a communication service in which voice or data is transmitted by radio frequencies. The service is divided into cells each served by a transmitter. The cells are connected to a mobile switching exchange which is connected to telephone networks worldwide.

**GSM** stands for global system for mobiles (it originally came from the French acronym for groupe spéciale mobile) and it is a European-developed standard for digital cellular telephones.

The latest generation of cellular services for mobile telephones is known as personal communication system (**PCS**) in the United States, personal

**MOBILE CELLULAR SUBSCRIBERS AS % OF TOTAL TELEPHONE SUBSCRIBERS, SELECTED COUNTRIES, 1996**




Source: ITU adapted from Smith, P., at <http://www.itu.ch/ti/publications/WTDR_98/index.htm>

communication network (**PCN**) in Europe and personal handyphone system (**PHS**) in Japan.

Cellular systems continue to evolve and a third generation, likely to be guided by rules which the International Telecommunication Union (ITU) is helping to develop and standardize, is called International Mobile Telecommunications–2000. This will define a number of interfaces in order to ensure worldwide compatibility among all systems in this third generation and thus provide a wide range of globally accessible telecommunication services. An interface, in this context, is the junction between two systems, and equipment can be installed at this point to convert signals used in one system to signals usable in the other so that information can be passed between them.

***Satellite services***

Wireless services can also be provided using either geostationary or non-geostationary satellites.

**CORPORATE VIEW**

## Two-way voice mail

MOBILITY IS ESSENTIAL in today's business environment and people on the move need access to quick, reliable, efficient and cost-effective communication tools to be able to perform to their maximum potential. To meet these needs ReadyCom, a pioneer in portable two-way voice mail, has combined the power and simplicity of voice messaging with the convenience and portability of two-way wireless communication in a single service.

The Responder service is a new category of wireless communication – portable voice mail – and reflects a new way of thinking about how people communicate with each other. The service enables users to conveniently receive, store and reply to voice messages from a pager-sized handset. Customers can also simply speak into the handset and send a voice message to, or reply to a message from, anywhere served by a cellular network. A Responder can be called from, and is capable of sending a reply to, any telephone. Users are guaranteed to receive every message they have been sent and are able to create and send messages to other users or groups of users. The service is also capable of placing a live telephone call to an emergency service number as well as to a limited list of key personal numbers.

SK Telecom, one of the world's largest wireless communication companies, has formed a strategic alliance with ReadyCom to distribute its products and services in Asia and to test the digital cellular signal coding technology, which will provide an increased capacity of channels over a set number of frequencies throughout Asia. Responder hardware will be part of the Republic of Korea's cellular system, where it will be tested by SK Telecom for other Asian carriers interested in the service. Through its distribution and cross-licensing agreements, ReadyCom has access to the Asian market and an opportunity to develop advanced applications for this market.

The company's technology is enabling carriers and distributors to offer two-way voice messaging services over cellular and personal communication systems. By building relationships with cellular carriers, distributors and manufacturers, the company is making its service available to customers worldwide. Combining the reply capability of e-mail with the tone and inflection of voice, this an ideal service for mobile workers who can send and receive messages without having to find a telephone.

**ReadyCom**
E-mail: bkinahan@readycom.com
Website: http://readycom.com
*For further information see Annex B*

Geostationary refers to the fact that the speed of the satellite which is launched into orbit around the Earth coincides with the rotational speed of the Earth so that the satellite appears to be fixed, or stationary, above a specific point on the Earth's Equator.

- Fixed satellite services are provided by satellites in geostationary orbit and operate using fixed terrestrial infrastructure for transmission, reception and distribution. Technological advances in these services have permitted the use of increased satellite transmit power and more compact antennas and Earth stations, which in turn reduce deployment costs and encourage the expansion of existing services and the development of new ones. The lower costs increase the suitability of these services for rural and remote areas.

**VSAT** (very small aperture terminal) is used to describe satellite receiving dishes of less than 2 metres in diameter.

- The global mobile personal communication by satellite system (GMPCS)

**CORPORATE VIEW**

## Economic connections

REVCOM, an experienced and highly regarded turnkey supplier of satellite Earth stations, has installed over 300 satellite systems in 80 countries. Specializing in both permanent and temporary Earth stations, the company provides satellite terminals for many purposes around the world.

Fixed-site Earth stations are often chosen by telecommunication carriers to provide international links for both voice and data traffic, as this offers a cost-effective means of serving carriers in countries that are not linked to the rest of the world by fibre-optic cable. Although the company supplies Earth stations with antennas up to 21 metres in diameter to service the demands of large, established carriers, mini-satellite terminals with antennas as small as 2.4 metres have proved especially popular with newly licensed carriers. Such terminals are designed to allow carriers to connect their customers quickly and economically to the international telecommunication network.

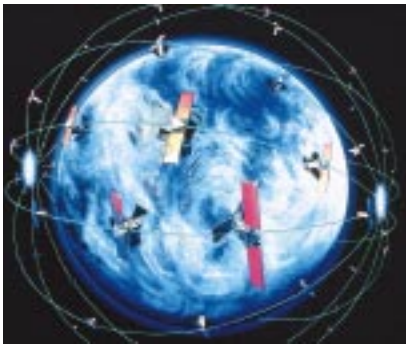
In most instances Earth stations can be assembled and shipped three to four weeks after the order is placed. On-site installation and commissioning is usually completed in three to four days. These terminals can also form the core of private networks using smaller satellite dishes installed in remote areas. As a result of its modular design, the equipment can easily be upgraded to accommodate increased levels of traffic.

Another of RevCom's products is the "digital flyaway terminal", which has revolutionized the speed at which information can be relayed from disaster zones. This aptly named piece of equipment can be assembled and ready for use within 30 minutes, and is so compact that it is accepted by most international airlines as checked-in baggage. Terminals can also be designed and built to match the requirements of regular users. Highly mobile satellite terminals like these are essential when large-scale disasters occur, as they can start to transmit information immediately and, as a result, are vital to both the agencies coordinating the relief and rescue programmes and the news media.

RevCom has also found that there is significant demand for this product from sports event organizers and conference holders staging a one-off event at a temporary location. The installation of a permanent transmitter would not be cost-effective, while small satellite dishes can easily be attached to roofs and balconies. Mobile terminals are also useful when space is limited or there is no time to bring in a broadcast vehicle with transmitting facilities. Interview teams are able to carry these small satellite terminals with them by aircraft, radically reducing the amount of time and money spent on sending a vehicle to a remote and possibly inaccessible location.

**RevCom**
E-mail: info@revcom.com
Website: http://www.revcom.com
*For further information see Annex B*

can operate using satellites in the normal geostationary orbit (36,000 kilometres (km) above the Earth) and also with non-geostationary satellites in medium (8,000 to 20,000 km) or low (700-2,000 km) Earth orbits (MEOs or LEOs, respectively).



Iridium

*Satellite systems provide mobile services anywhere in the world, and are especially useful in rural and remote areas.*

LEO systems are divided into Big LEOs, intended primarily for the delivery of voice and Internet services, and Little LEOs, designed for the delivery of text and data.

The first LEO system, which came into service at the end of 1998, is designed to provide mobile services anywhere in the world, and is therefore able to operate in rural and remote areas in any country without the need for the usual infrastructure. Costs to use the associated "satphones" are currently high at some US$6-14 per minute, but should drop rapidly with future competition and service development.

### *Stratospheric services*

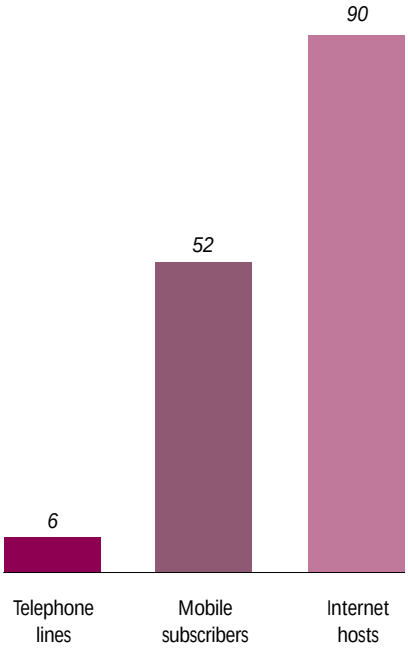
Somewhat similar to satellites, a further system of providing low-cost wireless telecommunications to specific, otherwise unserved, areas uses what is called stratospheric telecommunication service. This service uses an untethered balloon, maintained in place by a propulsion system and equipped with electric power-generating systems and telecommunication relay equipment. Such a platform is capable of providing various types of telecommunication services from its position at some 23 km altitude to an area about 1,000 km in diameter and would be linked into national and international networks via gateway ground stations. A similar system using a specially designed aircraft called Proteus, which will circle over a fixed location to provide telecommunications from a high altitude (20 km), underwent preliminary flight trials and telecommunication system testing in the second half of 1998.[2]

## THE TECHNOLOGY

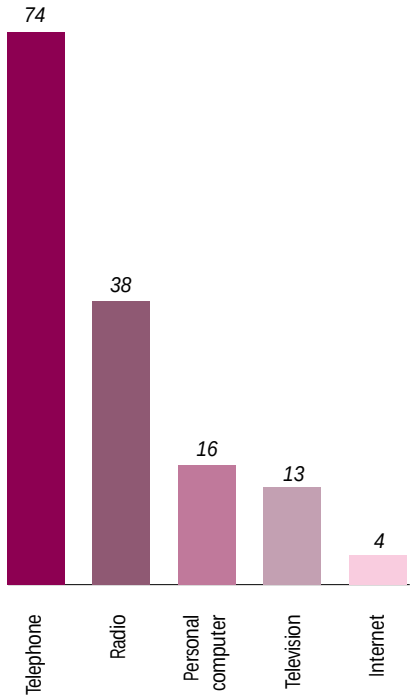
## Hardware and software

The equipment necessary to be able to make use of telecommunication networks is discussed in context in the sections that follow. The figures presented here provide an outline guide, but costs will vary in different situations and settings, and all are falling fast. Basic telephone handsets cost very little now, from US$20 or even less, and mobile telephones can be bought for between around US$150 and US$500, though usage tariffs vary widely. Personal computers costing between US$1,000 and US$2,000 are likely to include a CD-ROM or DVD (digital versatile disc) drive, and possibly a modem as well. Otherwise a modem costs around US$100-200. A fax machine, printer, copier and scanner combined into one unit can be as little as US$500, though for heavier business use it may be wiser to buy these items separately. Costs then depend on size and quality. Similarly, the costs of radios, televisions and video cassette recorders vary greatly, depending on the model that is chosen. A simple video camera and digitizer, for use in video conferencing and to put pictures onto the Web, costs under US$1,000. Software now comes free with personal computers or from Internet service providers; can be downloaded from the Web; or is otherwise low cost.

**INCREASE IN TELEPHONE LINES, MOBILE SUBSCRIBERS AND INTERNET HOSTS WORLDWIDE, COMPOUND ANNUAL GROWTH RATE 1990-1997** *(%)*




**YEARS IT TOOK TO REACH 50 MILLION USERS WORLDWIDE**




Source: ITU World Telecommunication Indicators Database, Network Wizards, Compaq, RIPE, at <http://www.itu.int/ti/publications/INET_99/index.htm>

## Broadcasting technology

### *Radio and television broadcasting*

These technologies have existed for many years and have, especially in the case of radio, provided indispensable information services to rural and remote areas that would otherwise be isolated. Broadcasting has traditionally been a one-way medium (technically called point to multipoint) with transmission from fixed transmission towers and more recently from geostationary satellites to receivers in private homes or schools.

### *Cable broadcasting*

This is a variation which has existed for many years in a number of countries, where use is made of coaxial cable for television and radio broadcasting.

It is predominantly in this area that there have been a number of developments which have led to the convergence with telecommunication and computer technologies:

- the use of optical fibres in place of coaxial cable to provide much greater channel capacity;
- digital compression technologies that have greatly reduced the signal information content needed to transmit video images, sound and data, enabling more channels to be transmitted over a transmission system;
- the use of two-way communication, providing users with the possibility of controlling the programming received;
- the transmission to subscribers of programme content channels plus ordinary telephone service and data transmission capabilities in the same optical fibre;
- digital technologies that are rapidly modernizing the transmission and receiving chain so that interactivity is becoming a reality and the very nature of broadcasting is therefore also changing.

As an example of convergence, where regulations permit, this type of service may be offered today by either the telephone company or the cable company and, with the addition of a television set-top box, Internet services can also be offered.

### *Satellite broadcasting*

Perhaps the most significant development in satellite television has been the introduction of digital video compression technology. By applying a series of computer technologies to the raw digital information, it is possible to "throw away" over 90 per cent of the data and the picture can still be received by a consumer with little, if any, noticeable reduction in picture quality. The digital picture is either perfect or there is no picture, compared with traditional analogue reception quality which degrades gradually. This complex computer-driven technology allows for the delivery of up to 200 channels at once, compared with cable systems that deliver 35-50 channels.

## The Internet

The Internet grew out of a network of telecommunication links set up between academic and military computers in the United States. Engineers at CERN (the

European Centre for Nuclear Research) developed a way to provide a user-friendly Internet interface called the World Wide Web that opened all the knowledge stored on Internet computers to anyone with a personal computer. Thanks to the utility of the network for data interchange and other capabilities, plus the fact that no charges were made for its use, other users were attracted, leading to extremely rapid expansion (at a rate of more than 100 per cent per year over the last ten years). Most countries – some 200 worldwide – now have access to the Internet. The United States Agency for International Development (USAID) Leland Initiative and the United Nations Development Programme (UNDP) Internet Initiative for Africa are two programmes which can help countries get connected via a national Internet gateway.

***Internet services***

With rapid technological innovation, the capacities of the network and the services offered grew in parallel with its expansion. Initially, services on the

**CORPORATE VIEW**

## More information, more quickly

TECHNOLOGY frequently applies new techniques to old ideas. Morse code is transmitted as a combination of short and long digital signals. The coding device is either as simple as a set of rules written on paper or a highly complex mechanism. Both the originator of the message and the recipient need either the written rules or the coding device to be able to communicate effectively with one another.

Parallels can be drawn between the coding of a digital Morse code message and the more recently developed signal modification process which compresses digital signals. Both the coding and compression principles modify transmitted information for specific purposes: the former hides information while the latter squeezes more information into the same radio signal or fibre-optic laser carrier. This new technology has made it possible for digital signals to be transmitted at high speed and for the data carried within these signals to be compacted by the compression process. Compression is achieved when the signal is altered by a set of mathematical rules, enabling additional information to be transmitted within the same signal.

By compressing digital signals, broadcasting companies worldwide are now able to transmit multiple channels of high-definition television, high-quality radio and high-quality data to the millions of receivers who have licences to tune in as well as possessing the necessary decompression components.

Keytech, an experienced digital images company based in Buenos Aires, Argentina, has become a market leader in digital technology, supplying broadcasting and cable companies with the necessary equipment to enable them to transmit compressed digital signals around the world. Working alongside both national and international companies, Keytech also provides satellite-linked corporate communication channels which include both coding and compression solutions. The company has developed and installed the technology for Buenos Aires International Teleport, Argentina's first private Earth station for broadcasting business and entertainment television via satellite using digital compression technology.

While digital technology enables speech to be transmitted clearly and at high speed, it is also able to utilize the entire signal, increasing the amount of information that can be transmitted and improving the quality of signal reception. With the added benefit of compressed digital signals, the process has become more cost-effective and efficient. As analogue television and radio services give way to digital networks, compressed digital signal technology will become the norm for all transmissions of broadcast material.

**Keytech**
E-mail: alvarezs@keytech.com.ar
Website: http://www.keytech.com.ar
*For further information see Annex B*

Internet, using a computer with a modem connected via a telephone line, consisted of the following:

- electronic mail (e-mail), which permits users to send messages electronically from their computers to recipients who could be on the other side of the world, with only a short delay (seconds to minutes depending on distance), and for the cost of a short local telephone call in most cases;
- electronic bulletin boards, which allow users to post messages that can be read and picked up by other users;
- electronic file transfer, which permits rapid transmission of documents between computers.

A modem is the device used to transform digital computer data into an analogue signal capable of being transmitted over the telephone network.

Services today include telephony (where voice services are bundled with Internet access), fax, data transmission, video telephony, video conferencing, broadcasting via the Internet and many others, which provide competition to

**CORPORATE VIEW** Interactive television

WITH the marriage of television and the Internet becoming a reality, WorldGate Communications has developed a way of making the Internet available to cable television viewers, together with e-mail and other new services.

It is the cable industry's first interactive Internet television service, and it uses a standard advanced analogue or digital cable box, the television set itself and a remote control. It is not necessary for cable television viewers to have a computer or set-top box, or use the cable company's video spectrum.

Instead, by using a WorldGate wireless keyboard and their television as the monitor, viewers have full unlimited Internet access and up to six e-mail addresses for a monthly subscription, saving the expense of buying a personal computer.

Thanks to the company's innovative "channel hyperlinking" technology, a viewer needs to press just one button on his or her remote control – the same device which switches the television channels – to call up a webpage or pages associated with the programme or commercial which he or she is watching. There is no need to enter the website address. The viewer receives the webpages in real time, getting far more information than would be available in, for example, a short commercial.

The service uses an encoding system, developed by Nielsen Media Research, that puts a "heartbeat" in the programme broadcast stream. The technology recognizes this heartbeat and does a database search for the required Internet site.

The Internet information is delivered to the viewer at an impressive speed, four times faster than a conventional telephone modem. In technical terms, this fast data rate is achieved by using the vertical blanking interval, a normally unused portion of the video spectrum, within the broadcast signal. The text is resized by the server to be easily readable on the television set. Two-way communication is possible by using the existing "store and forward" addressable communication system to operate in real time.

The service has opened a new era for interactive television and for advertising. To date, more than 60 television networks, including CNN, have signed up to promote the convergence of the Internet and television through the WorldGate system. In doing so, they will make it possible for communities unable to afford a computer to have inexpensive access to both the Internet and e-mail.

**WorldGate Communications**
E-mail: hkrisbergh@wgate.com
Website: http://www.wgate.com
*For further information see Annex B*

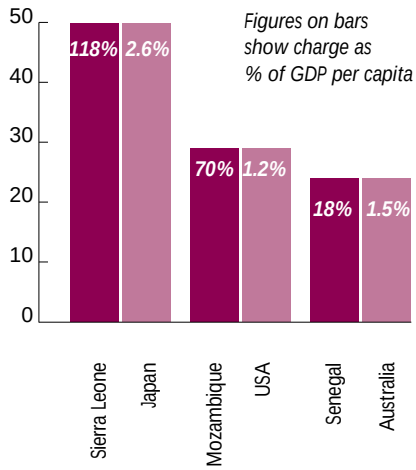
the services offered by regular communication carriers. In addition, there is the possibility, from a graphical (multimedia) interface on a home computer, to search worldwide for information on almost any topic imaginable and download useful documents or software. It is also possible to examine catalogues of goods and buy products electronically as electronic commerce grows in importance.

***The Internet and development***

The Internet and multimedia techniques are powerful tools that can open many new possibilities for development. In *Telecommunications in Action*, the use of the Internet is proposed for distance learning, telemedicine, access to government information and citizen networks, and as a source of information in agriculture, business, tourism, public health, marketing, and rural and urban development. But it must be borne in mind that while Internet services are now being introduced in most developing countries, they are, in most cases, far from widespread amongst the population. Two principal factors are responsible. The first is that most people do not earn enough to own a computer (costing some US$1,000-2,000) or to get connected to the Internet, even though costs may be relatively low and dropping (around US$5-30 per month). The development of telecentres is one way that access to the Internet, as well as to basic telephony services, is being made available to more people. But, for the moment, users are mainly businesses and institutions.

Connected with this is the fact that a basic level of literacy is necessary to be able to make use of Internet services, and adult literacy rates worldwide are still low – only 49 per cent of adults in South Asia, for example, are literate.[3] The second factor is that the Internet is for the most part built on existing telecommunication infrastructure and where this does not exist, for example in rural areas, Internet services cannot be introduced. If the power of the Internet is to be harnessed, the building of telecommunication infrastructure is a crucial step on the road to rational development. Today, however, traditional sound broadcasting is clearly still of the greatest importance in the rural areas of developing countries.

**INTERNET MONTHLY ACCESS CHARGE IN SELECTED AFRICAN AND OECD COUNTRIES, MID-1996** *(US$)*




Source: *OECD Communications Outlook 1997*, Organisation for Economic Cooperation and Development, and M. Jensen, at <http://www.itu.int/ti/publications/INET_99/index.htm>

## REGULATION FOR TELECOMMUNICATIONS

Since the regulatory function will effectively be the pacemaker for the development of the information and communication technology infrastructure within a country, it is of crucial importance that its establishment be accomplished as well and as thoroughly as possible. It will be the essential precursor to a telecommunication network that functions efficiently, and on which the applications described in the rest of this publication can be built. Many people worldwide want to be connected to the telephone networks but the services are just not available. Many households and businesses in developing countries are on waiting lists for telephone lines: for example, statistics for 1996 show that there were 3.4 million on the waiting list in Africa, waiting an average of 3.5 years, and 14 million in Asia, waiting an average of 8.4 months.[4]

Governments can play a role by ending monopolies and encouraging competition. In Ghana, for example, the number of telephone lines increased

by 25 per cent in the first year after the market was opened to competition. Other regulatory means can be used to encourage universal access. In Chile, for example, an innovative scheme awarded subsidies to companies which installed payphones in remote rural villages. By the end of 1998 most people in Chile had access to a telephone.[5] The most effective role for government is to recognize the needs and provide the support and, where necessary, the incentive needed for others to work on bringing telecommunications to everyone, i.e. the suppliers and constructors have to be given the opportunity to make a reasonable return on their investment. A summary of the issues involved in regulating the telecommunication sector can be found as Annex C at the end of this publication.

## PUTTING IT INTO ACTION

Decision makers and planners in developing countries face many obstacles and difficulties as they work to bring development to their people. Given the scarcity of resources, finding the most efficient and effective way ahead is important. The purpose of *Telecommunications in Action* is not to suggest that ready-made solutions exist, but rather to provide some guidance and demonstrate that certain activities have resulted in fruitful outcomes in certain places and under certain conditions. International financial institutions and others have recognized the positive influence of information and communication infrastructure in stimulating and facilitating overall development, and the ITU is working to help bring universal access to telecommunication services to people throughout the world.

The examples and case studies in the application of information and communication technology provided in the different sections of *Telecommunications in Action* should provide guidance or suggest possible directions. However, it is necessary to tailor the use of such telecommunication applications to the individual needs of a country, department, school or hospital – and for this, the experience and technical expertise of the ITU are extremely useful. The ITU is not the only organization that can provide technical help. There are many others including the World Bank and its branches; United Nations organizations such as the United Nations Educational, Scientific and Cultural Organization and the United Nations Environment Programme, and development agencies such as the International Development Research Centre and the United States Agency for International Development. As discussed in the material that follows, funding possibilities exist from international organizations, banking or donor organizations and from the private sector, and all should be explored. A list of funding organizations and contacts forms Annex A of this publication.

## *References*

**1.** *World Development Report 1998/99*, World Bank/OUP, New York, 1999.

**2.** *Air and Cosmos*, October 1998.

**3.** *Social Indicators of Development 1996*, World Bank.

**4.** *World Telecommunication Development Report 1998*, International Telecommunication Union, Geneva, 1998.

**5.** *World Development Report 1998/99*, op. cit.