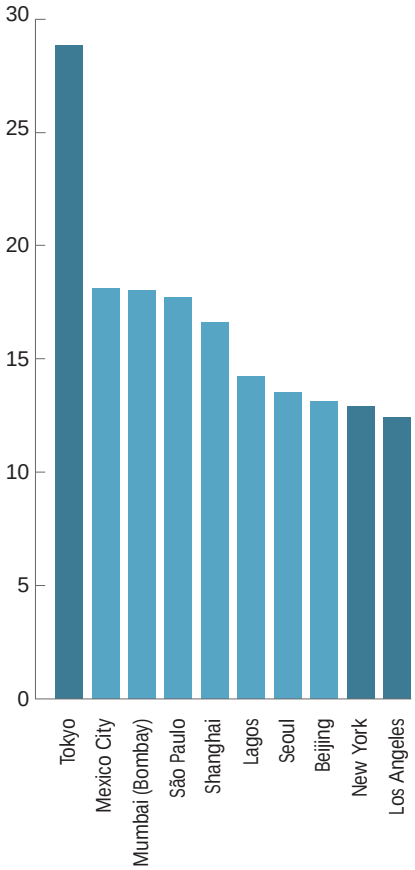
Telecommunications *& Urban Development*

Dario Bitzaya/UNEP/Topham

WORLDWIDE, it is urban areas that have traditionally been the first to have access to telecommunications, both basic voice services and advanced applications such as the Internet and local networking capabilities. But, particularly in the developing world, such access has not been available to all sectors of the population, nor have the benefits of telecommunications for urban development necessarily been realized. This section of *Telecommunications in Action* explores some applications of information and communication technologies for urban development, including new technologies for access and connectivity in an urban setting. It suggests ways forward in making access available to those previously excluded; encouraging the growth of healthier communities that are connected to each other and to government; and using information and communication technologies for urban planning and development. A number of case studies provide further detail and show what can be achieved, and where help may be obtained. Costs and financing are discussed; a city action plan is proposed, with guidelines on implementation, including working models for some of the new access technologies; and overall benefits are briefly summarized.

PROJECTED POPULATIONS OF THE TEN LARGEST MEGACITIES IN 2000 *(millions)*



Source: United Nations, *World Urbanization Prospects*, New York, 1998

NEARLY HALF of the world's population lives in cities and urban areas that cover just 2 per cent of the land mass. In Latin America, four out of every five people will live in urban areas by 2015, while "India's urban population alone – 256 million – could constitute the world's fourth most populous nation," according to Molly O'Meara of the Worldwatch Institute.[1] The ten largest metropolitan areas in the year 2000, of which seven are in the developing world, are projected to have populations of 12-28 million each, and they are growing fast, with annual growth rates since 1975 ranging from 1.9 per cent for Mexico City to 5.8 per cent for Lagos.[2]

These megacities face enormous challenges in delivering jobs, shelter and services, and need the information and communication technologies and systems that would improve urban planning, development and governance. Additionally, "burgeoning African cities of several hundred thousand are 'mega-villages' that are growing too fast for local authorities to manage", says O'Meara.[3] The numbers can forecast a nightmare of collapsed, ungovernable cities or a vision of what a sustainable city could be. One of many elements to a possible solution will be information and communication technologies.

In urban areas there are usually long waiting lists of people who want telephones, and a large potential market for advanced telecommunication services. Large national and transnational companies, including banks, with facilities in developing countries are well aware of the strategic value of such services and can afford to build or lease their own networks. By contrast, small enterprises and public institutions, such as factories and government departments, even in large cities in many developing countries, may be only vaguely aware of the possibilities offered by advanced telecom services and often consider themselves fortunate if they have access to a working telephone. The efficiency of public services, such as education, health care, security, transport and processing of information, could be greatly enhanced by improved access to telecom services. In particular, the efficiency of banking services and financial markets, which are so crucial for development, depend heavily on telecoms.

WHAT TELECOMS CAN DO

Applications of information and communication technologies in the sectors of health, education, business, governance, the environment and agriculture, discussed in the relevant sections of *Telecommunications in Action*, support sustainable development and contribute to urban development. Cities are the commercial centres and the nation's point of connection with the global market place. Access to advanced telecom services gives enterprises the tools they need to compete in the global economy and makes it possible for academic institutes to benefit from the wealth of on-line information and "knowledge networks". Health and education services can be delivered more efficiently, including to underserved neighbourhoods. For example, the educational network, Edunet, was set up in 1995 in Lahore, Pakistan's largest city, to link state schools in the city's disadvantaged communities. Through its 20 digital telephone lines, users take part in discussions, access a huge teaching resource database, use e-mail and exchange experiences. Telecom

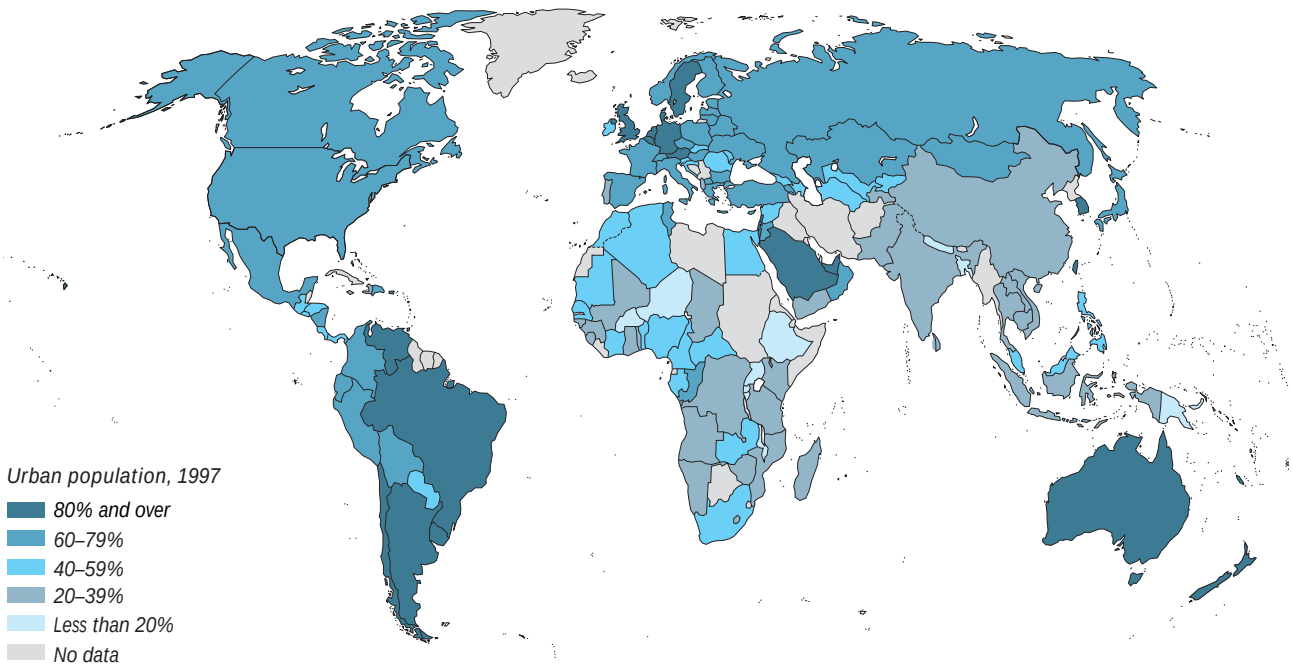
applications can help city administrators to deliver citizen services, which are often largely information related, and provide utilities that are accurately metered, billed and collected. Geographic information systems (GIS) have many applications in city planning, infrastructure development, utility distribution networks and matching population distribution with housing or services. Whether the city is less than a million or 15 million, the communication services and infrastructure that serve its residents also provide the hub that can support similar services in rural areas. Cities are the foundation on which the national systems for health, education, business and governance are built, and that practitioners in towns and villages can tap into.

New technologies for access and connectivity

New technologies make it possible to connect buildings throughout a city so that voice, data, video and Internet are delivered to offices and other users. A network of telecentres in a city can bring access to information and communication technologies on an as-needed basis. Affordable access is the measure. Even a basic voice telephone service enables people to receive and answer calls or faxes. A single line can serve many users, like the community telephone centres in Peru that serve an average of 640 low-income customers who use the telephone not only for emergencies but to search for jobs as well.[4] New technologies, coupled with new policies that allow private sector investors and service providers to come on board, are working together to create a communication market that can deliver a telecom line for US$500, down from a worldwide average of US$1,500 quite recently.

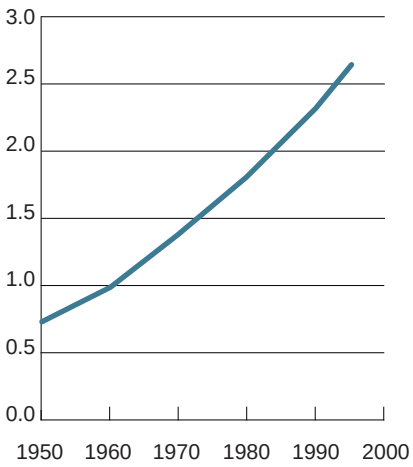
Business enterprises or industrial zones can connect area networks with

How urban is the population?

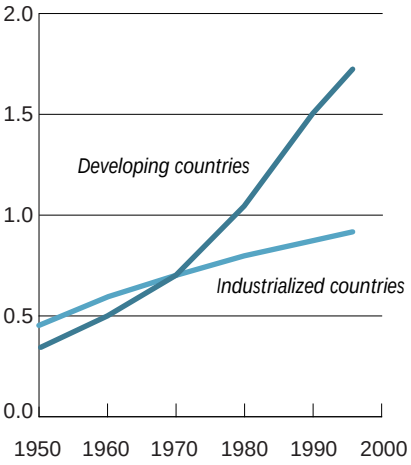


Source: *World Development Indicators, 1998/99,* World Bank

GROWTH OF WORLD URBAN POPULATION *(billions)*



URBAN POPULATION IN INDUSTRIALIZED AND DEVELOPING COUNTRIES *(billions)*



Source: United Nations Department of Statistics

a cost-effective digital radio link. Recent advances in point-to-multipoint broadband wireless (i.e. connectivity using a certain range of frequencies to send data without the need for a physical link) provide high-capacity local access that is less capital intensive than wire line, faster to deploy and able to deliver a comprehensive set of applications. Known as local multipoint distribution service, it can be an economical and efficient network solution to the "last mile" problem in cities. This promising technology is a new type of cellular connection – one that carries combined voice, data, video and Internet. It is discussed in more detail in the working model later in this section. Its low upfront costs make it feasible for service providers to enter the market and rapidly connect customers. Incumbent telecom operators can also deploy such systems to expand access and enter the interactive multimedia business. By some calculations, to connect an office building by fibre-optic cable takes several months and costs US$300,000, while the building can be connected by local multipoint distribution service in days for US$7,000.[5]

Other high-speed technologies that offer alternatives for "last mile" access include those discussed below.

■ xDSL (digital subscriber line) technologies improve existing copper lines to allow high-speed data to operate at the same time as basic voice telephone services. They are an alternative form of ISDN line (an integrated services digital network line that carries much larger amounts of data than a normal telephone line). One example, called ADSL Line Coding, subdivides voice and data channels so that many messages can be carried simultaneously.

■ Where houses are already connected by coaxial cable to receive video programming, as is beginning to be the case worldwide, including in developing countries, the connection can be upgraded to provide two-way communications. (Coaxial cable is made of copper but is constructed differently from the basic copper wire used in telephony so that it can carry more information.) A recent United States example comes from the telecom operator AT&T which is using Time Warner's existing coaxial cable to provide telephone services to 12 million people.

■ Satellites can provide direct two-way access to the Internet, or one-way downstream from the satellite to the personal computer (PC) by a service that utilizes the public switched telephone network and an analogue modem as the return channel. For example, specialized systems for distance learning deliver digital video lectures and multimedia content to the personal computer with response systems over the Internet or telephone network.

Many other services can be provided to urban residents such as voice telephony by cellphones, messaging by paging or cellphone, local wireless telephone network and mobile radio for fleets of vehicles. Several that are described in the section of *Telecommunications in Action* dealing with business applications can be deployed effectively in urban areas.

TELECOM APPLICATIONS

The urban telecentre

Multi-purpose community telecentres, which are discussed in the section of *Telecommunications in Action* dealing with rural development, can provide

access to telecommunications for individuals and small businesses in urban as well as rural settings. They make access affordable for all. The shanty towns that surround many large cities in developing countries are socially isolated and have many characteristics in common with rural and remote areas, and consequently have similar needs for telecommunications. According to the national telecom operator in Senegal, Sonatel, there were more than 1,000 franchised telecentres in Dakar and its suburbs in 1996. These telecentres offer telephone and fax services, plus Internet in some cases. The average total annual revenue was US$5,544, of which the franchisee paid US$3,960 to Sonatel and kept the rest (US$1,584). The franchisee may increase the tariff from CFA50 (US$0.09) per call unit (Sonatel's tariff) to a maximum of CFA120 per unit for local calls. There is also revenue from incoming calls. This is good business for Sonatel, at least in Dakar where the cost per line is low, and also attractive for the franchisee, judging by the demand for franchises (1,599 requests in 1996). The statistics from Dakar indicate that people in a

CORPORATE VIEW

Upgrading the infrastructure

MIAP & SATEL, which is based in Poland, is a key telecommunication player in eastern Europe. Offering digital transmission services via cable and satellite networks, it integrates modern technology with the older existing network infrastructure. By upgrading and restructuring these cable networks to digital systems, Miap & Satel is able to avoid the high costs involved in changing to a completely new fibre network. Acting as a distributor for leading telemedia businesses, it supplies a wide range of products such as fibre, coaxial copper and aluminium cable, continuous power systems, active and passive network equipment, and complete satellite systems.

In the past, the older infrastructure was capable of delivering only one channel to subscribers. Now cable customers can receive a range of television and radio channels as a result of combining sophisticated terminating equipment with existing cable infrastructure. The growth in digital technology and the use of fibre-optic cable systems was prompted by the fact that older networks needed regular amplification to stop the signals being affected by electrical interference. As the older style, coaxial cable infrastructure has probably already recovered its costs and may be capable of operating for some years, it is important to strike a balance between it and the modern demand for high-speed, high-capacity networks capable of delivering information technology and multimedia applications.

A new network operating system has evolved to take advantage of the massive capacity available on fibre distribution cables while maintaining existing copper coaxial cable infrastructure. The hybrid fibre-coax network distributes communication traffic over an optical fibre network to equipment cabinets established at convenient points in a given area where it interfaces with the older coaxial cabling. The fibre ring provides alternative paths which deliver a minimum service should a network fault occur. Optical fibre signals are converted at equipment cabinets into electrical signals which are distributed to subscribers over coaxial cables.

By integrating fibre and coaxial cable technology it is possible to deliver an economically sound alternative network to homes and businesses while making full use of existing infrastructure investments. These cables are capable of carrying an enormous load and will comfortably transmit subscribers' requests for Internet data, television shopping, specialist programming, business video conferencing, telecommunications, multimedia for personal banking, educational and leisure pursuits, and security video using slow-scan and high-resolution television. As this technology has proved to be so cost-effective and efficient, it has obvious benefits for those wishing to upgrade their existing infrastructure rather than replace it completely.

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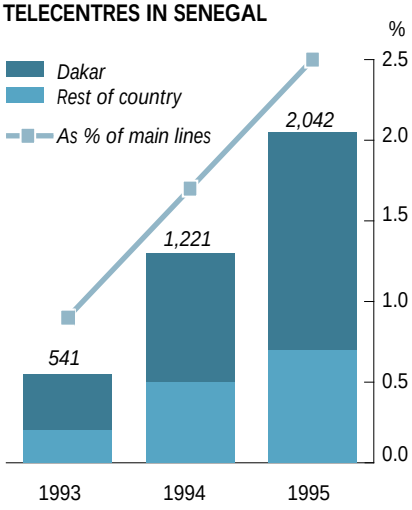
For further information see Annex B

PRIVATELY OPERATED PUBLIC TELECENTRES IN SENEGAL



Source: ITU World Telecommunication Indicator Database and Zongo G., in *World Telecommunication Development Report 1998*, ITU, Geneva

country with an average gross domestic product of US$479 per capita are prepared to spend money for public telecommunication facilities.[6]

The community learning centres in Asunción, Paraguay, discussed in the case study, provide access to computers, telecommunication resources, free e-mail accounts and the Internet to poor communities of its capital city. They emphasize the educational and civic development benefits of computers and information and communication technologies, particularly information and services from municipal sources. Being part of the community neighbourhood is important: the first centre was located next to the main bus terminal and the second in a public library in a popular part of the city.

Making connections for urban development

India has the world's second largest population following China, and some of the largest cities. Mumbai, formerly Bombay, has a population of around 18 million; Calcutta, Madras and New Delhi are nearly as large. In 1996 India had a residential telephone penetration rate of 7.8 per 100 households, but only 0.15 PCs per 100 population, and 0.85 per 10,000 population connected to the Internet. There were only 0.03 cell phones per 100 population. India has a gross national product (GNP) per capita of US$380 and over half the population earns less than US$1 per day.

Lindsey Elmendorf, an international expert on housing and urban development, who has been working in India since 1996, observes that infrastructure and delivery of basic services, such as water and electricity, could be improved with the use of information and communication technologies. The role of non-governmental organizations in finding, or developing, solutions to the problems in the poor neighbourhoods and megacities of India is critical. For example, those in poor neighbourhoods in some cities pay 28 times as much for water as those in wealthy neighbourhoods because it must be bought from water vendors in the absence of a piped supply. Non-governmental organizations connected to each other and to information sites discovered that in other cities the savings generated by fixing leaking pipes and having a reliable metering and billing system could then serve to build the infrastructure.

The Sustainable Development Network Programme (SDNP) project in India described in the case study opposite will enable non-governmental organizations to be more effective and collaborate in a more integrated manner. As the resulting applications, databases and information exchanges become established among the non-governmental organizations, the use of the Internet and demand for capacity will grow. In 1998 the Government of India also deregulated the Internet service, and several private sector initiatives are under way to build a very high-speed Internet connection between the universities in major cities. With the commissioning of the new network in 1999, India will become the second country after the United States to have a high-speed, fibre-optic network. The total cost of the project is estimated at US$35 million.

A basic network infrastructure is necessary in order to connect countries and

CASE STUDY

Sustainable development

OBJECTIVE

■ To bring Internet access to cities in India and so promote the process of sustainable development, including urban development, by organizing accessibility to and exchange of information by non-governmental organizations and government agencies.

BACKGROUND India is one of several countries to develop a national Sustainable Development Network Programme (SDNP-India) under the umbrella of the United Nations Development Programme's SDNP. This currently offers assistance in establishing connectivity to national networks and the Internet, content provision and user training in 40 developing nations and 36 small island developing states.

DESCRIPTION The SDNP Internet nodes (points of connection) being established in cities across India link the participants in a nationwide data network and give access to the systems and services highlighted below. The nodes will all be linked to the Web server in the SDNP-India office in Delhi <www.sdnp.ernet.in>. They will usually already be information providers or carriers in a position to automate some databases on sustainable development subjects almost immediately. For example, the first eight nodes were built on existing Environmental Information System (ENVIS) centres, a system of distributed environmental databases.

A number of operational systems – guidelines and procedures – are being developed for the network, including systems to:

■ update the sustainable development sources directory;
■ make an inventory of information providers and information;
■ organize data for decision making;
■ encourage and enable players to share information;
■ make information accessible and transparent;
■ disseminate information to automated and non-automated users;
■ coordinate information providers;
■ train SDNP staff and users;
■ train providers how to collect, store, assess and transform data into usable information and computerize and mount the information on the network.

Other systems will collect feedback from users, including action taken as a result of information and impact of action.

COSTS The start-up costs for Year 1 (1998) and the recurring costs were shared by UNDP and the Indian government.

Funds for SDNP nodes	US$*
Node costs (10)	28,000
Subscription costs	14,000
For database development:	US$*
Automating (5)	28,000
Developing (5)	56,500
For training/promotion:	
Meetings	28,000
Fellowships (10)	31,000
Promotions	14,000
Training (5)	14,000
Total	**213,500**

Front-end costs	
Hardware	
486 Server (2)	14,000
Modems (2)	3,500
Router	25,500
Software	22,500
Leased line (9,600 bits per second)	4,000
Telephone lines (2)	1,500
Total front-end costs	**71,000**

Recurring costs for Year 1	
Line rental for 9,600 bits-per-second line	4,000
Hardware & software maintenance	7,000
Miscellaneous costs	14,000
Staff costs (9)	21,000
Travel	5,500
Office expenses	5,500
Telephone costs	5,500
Total recurring costs	**62,500**

** The United Nations official rate of exchange on the date of signature was US$1.00 = 35.5 rupees.*

RESULTS Urban development experts recognize the key role that access to information and communications plays and this project has been instrumental in getting the Internet established and used for development purposes in Delhi, the first of the nodes. Nine further city-based nodes are scheduled to be operational in the first year, with 20 more planned. A query response service is up and running, and applications and databases are being developed that will enable non-governmental organizations to operate more effectively and in a coordinating manner with shared information.

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CASE STUDY

Geographical and statistical analysis

OBJECTIVE

■ To provide detailed geographical and demographic knowledge about the whole of Qatar to planners and others.

BACKGROUND Qatar's Centre for Geographic Information Systems was created by the country's Cabinet of Ministers in 1990. Qatar is the world's first country to implement a nationwide geographic information system (GIS).

DESCRIPTION The Centre is responsible for establishing and maintaining national standards and procedures for GIS implementation, including the development and maintenance of the country's on-line base map. The Centre also provides GIS training, product development and other support services for Qatar's government and private GIS and mapping agencies.

The Centre specified hardware and software products to maximize ease of use, minimize the learning curve and maintain easy compatibility among the various agencies using the system. Component standards adopted by the Centre include ARC/INFO and ARCVIEW as its GIS and Oracle as its relational database.

Geographic data for the entire country were initially collected by aerial survey in 1987. These data, as well as existing maps, were used as a basis for on-site inspections and measurements. The aerial photography includes such building features as overhangs and balconies, which must be appropriately coded in the final vector database. The country's urban areas were surveyed again in 1993, and in 1995 the entire country was surveyed again, to improve the accuracy of the data.

COSTS Qatar's national GIS, including all stages of data collection, has cost some US$100 million. However, this is a total national programme, for all ministries, the first such comprehensive one in the world, and much of the cost was to develop the database and administer the programme, as well as to construct the Centre's building. It is possible to have a GIS system for much less if the relevant data already exist, or to have a less comprehensive system focused on particular areas or applications, also at a lower cost. Additionally, if the costs of a system can be shared by a number of different ministries or departments, then the cost to each user can be affordable. As a guide, hardware and software for one GIS project for a single sector or ministry could be budgeted at some US$250,000, with consultation and training another US$300,000.

RESULTS The Centre has approached Qatar's national GIS network as if the entire country were a single organization. So far, ten of the country's 14 ministries have adopted GIS as part of their information management strategies, while the remaining four ministries are in the process of implementing it. A dedicated, fibre-optic wide area network known as GISnet connects all agencies that are part of the GIS implementation, allowing immediate access to all publicly available GIS data.

Under the direction of Zul Jiwani, head of the Centre for GIS, the concept of mapping has changed in Qatar. It has evolved into a dynamic, continually updated network of interrelated databases with volumes of geographically referenced information linked to a comprehensive, digital, land database.

"Our first consideration was how the maps were to be used," explains Jiwani. "Engineers, for instance, use maps to determine what is in the field. They must know the precise location of a building and the dimensions of its footprint for the widening of a road or the installation of new utility lines. The methodology employed here provides the engineer with the information he needs in the format that he needs it." The rule at the Centre for GIS is to input the exact measurements of the building, rather than squaring them off. "Buildings are simply not constructed with perfect angles," says Jiwani. "Introducing known errors into our database can only lead to greater inaccuracies in the future."

The elimination of redundant data is an important aspect of managing Qatar's national GIS. A lamp-post may seem an unimportant object for inter-ministry cooperation, but one lamp-post may have flag standards, street signs and a rubbish bin attached to it, as well as the lighting element, with different agencies responsible for each of these fixtures. The Civil Engineering Department is responsible for maintaining the post, the government's public relations agency has responsibility for the flag standards, the Planning Department for the street signs, the Parks and Gardens Department for the rubbish bin and the Ministry of Electricity and Water for maintaining the lighting itself. The agencies get together and agree which one will have responsibility for maintaining locational information for the post, and that information is then available to all the other agencies.

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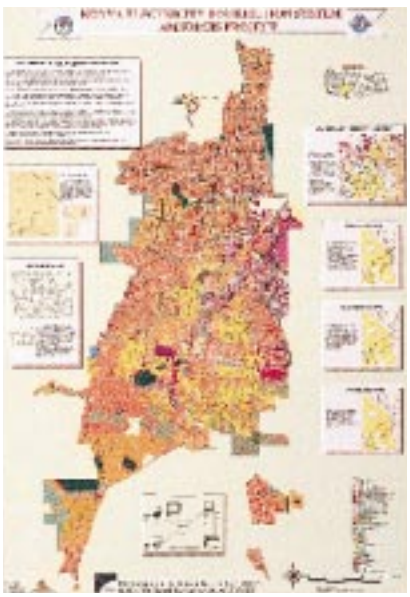
cities to the Internet. As part of the United Nations Development Programme (UNDP) Internet Initiative for Africa, The Gambia has recently planned and contracted for the building and operating of an Internet gateway and central network, so that urban residents will have full access to global information services. The central network will provide fast and reliable communications for the country and allow for future growth. Internet service providers will be able to route traffic from users through local area networks to the central network, and so to the Internet via the main gateway.[7] USAID's Leland Initiative also provides assistance in funding Internet gateways and networks in Africa.

Urban planning and development

Planners and decision makers who are concerned with the future of urban environments often use documents, maps, drawings, photographs, statistics and other information in their work, and the effective use of information and communication technologies can help integrate all these. Michael Shiffer of the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (MIT) in the United States has described how to use a multimedia information system to aid city planning. The technology combines maps, interactive video, text, sound and other forms of data with analytical tools and an information structure starting from a city map. This allows immediate navigation through related information during city planning meetings. The technology also makes it possible to link descriptive images, such as digital video and sound, to information that would normally be represented quantitatively. For example, the planning meeting might be considering changes to an existing street network. In addition to representing average daily traffic numerically, the system uses a fluctuating bar that allows users to compare levels of traffic graphically as a pointing device is passed over a map. Video clips help the information to be more easily understood by providing visual examples of levels of traffic. Finally, digital sound represents traffic audibly by recreating the noise level experienced in the field.[8]

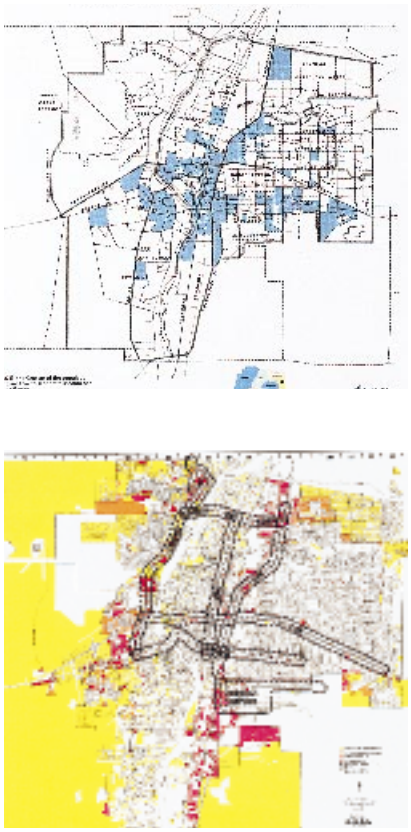
In urban planning, interactive multimedia planning support systems have been used to make complex information understandable. Planners can organize and browse related information with hypermedia links for cross-referencing.[9] Shiffer anticipates that the Internet and Web will allow for global collaboration with the ability to form links with remotely accessible information. This also suggests that in addition to using the technology with people gathered in a planning session, an international planning expert could be brought in from another country to collaborate, and models of other cities accessed.

Geographic information systems, discussed in detail in the section of *Telecommunications in Action* dealing with the environment, are also used for urban planning and development. Qatar's national GIS database is discussed in the case study opposite. It lists more than 450 pages of geographic features captured to within a few centimetres of accuracy. Included within this substantial collection of data are the utility connections for every residential and commercial building in the country, a small accomplishment



ESRI

Geographic information system of the Konya Electricity Distribution System, Turkey.



ESRI

GIS of the city of Albuquerque, USA, showing community planning areas (top) and transport evaluation corridors.

in terms of the national database, but an extremely important one for those living on the small, crooked footpaths or sikkahs, still common in some parts of the country. Abu Thila, for example, is one of these tiny lanes. A scant 200 metres long and a few metres wide, it is tucked behind busy Abdul Aziz Bin Ahmed, a bustling high street running through the centre of Doha, the capital of the country. A dozen families live along Abu Thila, entered through a walkway tucked behind a small grocery shop. Without inclusion in the national database, these families would face many bureaucratic difficulties when trying to obtain such essential services as electric, water and telephone connections or emergency services. GIS has put Abu Thila on the map.

Urban advocacy and evaluation

Information and communication technologies can also act as advocacy and evaluation mechanisms to spread the word about specific projects that may improve the quality of life in low-income urban communities.[10] The technology can capture community and stakeholder concerns and deliver them to decision makers and agencies where they might not otherwise have an opportunity to be heard. By collecting periodic soundings, planners can develop a dynamic multidimensional case history.

For example, the United States government made available special funding to address the issue of distressed urban areas. After defining an area that qualified for the funding programme, the city of St. Louis developed a strategic plan, including community input through meetings and interviews with residents, to support its application. The result was a fairly sizeable paper document. Concerned about the communication limitations of such a document, the city worked with MIT's Department of Urban Studies and Planning to create an electronic version of the plan using interactive multimedia technology. The electronic version linked the text with descriptive maps of the affected areas, and interactive video interviews with community members, business leaders and other parties with an interest in these areas.

This resulted in a rich and compelling snapshot of an urban community and its associated issues. Such snapshots can be combined over time to tell a story about the relative successes or failures of an urban intervention, thus providing an effective evaluative mechanism. When implemented in a networked environment such as the Internet, this technology can also provide a foundation for community empowerment through a greater degree of communication and access to relevant information.[11]

Communities in healthy cities

"Healthy cities" is a term which emerged from an international meeting in Canada in 1985. The theme was that health is the result of much more than medical care; people are healthy when they live in nurturing environments and are involved in the life of their communities, when they live in "healthy cities". A need was identified for a central clearing house for the movement and the International Healthy Cities Foundation (IHCF) was formed as a broad, sharing network of interrelated groups with similar concerns and values about health and community issues. The IHCF develops communication and

resource tools, and training and advisory services, and works extensively through its website.[12] One example of local action featured on the site is the

CASE STUDY Community learning

OBJECTIVES

- To establish 12 community learning centres, known as Amic@s (Aulas municipales de información, comunicación y aprendizaje), in poorer urban areas to increase civic participation and enhance basic education.
- To enable municipal officials and citizens to communicate easily in order to discuss and debate critical community issues.
- To allow citizens access to government information and services and eventually to have many such services delivered interactively.

BACKGROUND The community learning centres build on the idea of business centres which offer a variety of electronic and communication services.

DESCRIPTION Each centre has three multimedia Pentium personal computers (PCs) with modem and CD-ROM, one of which is connected to the municipal government offices and the Internet. The other PCs are networked to the connected PC and used off-line for reading and composing e-mail, reviewing websites, computer training and using applications and educational courseware. There are also a combined printer/copier/fax, a telephone, and video cassette recorder and television with educational videotapes.

Visitors can explore electronic resources for education including software programmes, Spanish-language reference CD-ROMs and the Internet. Introductory computer training is offered to municipal training officials and mostly younger residents on a regular basis. Visitors can also access voter registration information on a CD-ROM.

In April 1998 the first of a series of "cyber conferences" was held at the first centre. The aim was to establish a direct and personal line of communication among different municipal authorities and local citizens. Citizens with access to the Internet and those at the Amic@ asked the Mayor questions on a variety of topics. The session was transmitted live via RealAudio and Video (a software application for sending audio and video across the Internet) allowing all participants to both view and listen to the interview.

COSTS Start-up and recurring costs are about US$15,000-20,000 per centre. This covers the PCs, peripherals, licensed software, maintenance contracts, insurance and supplies such as paper, toner, diskettes and video cassettes. The computers cost around US$2,000 each and a printer/copier/fax was budgeted at US$1,000.

This project is being financed by USAID. The telephone line for the Internet connection was donated by the city and ANTEL, the telecom operator. The Internet service and Web hosting were donated by a local Internet service provider. Typically those costs are about US$40-60 per month for the service and up to US$100 per month for Web hosting of a medium-sized site. A major computer equipment vendor donated the equipment needed to connect the centres' computers and peripherals to form a local area network and to access the Internet.

RESULTS The first Amic@ opened in January 1998 and by January 1999 a second was operating, two more were ready to start and a fifth was planned. Local and international businesses are expressing interest in sponsoring essential services and providing needed hardware. Cultivating public-private partnerships is crucial to the long-term sustainability of this initiative.

Local students and groups have found many uses for the centre's environmental and health education CD-ROMs, and they use the Internet for other educational resources, to browse websites and chat with people around the world.

The initial cyber conferences achieved two important objectives. First, they demonstrated what was possible through the use of the technologies at the centre, thereby stimulating the creativity of all participants to think of ways to use these tools to enhance education and civic participation. Second, they secured the enthusiastic support of the Mayor, other influential people and the citizens visiting the centres.

The municipality is currently automating some of its services and creating databases containing information important to local business development, voting and education. Once municipal services and resources are available on-line, including access to a municipal website, it is likely that more citizen-municipal interaction will occur.

The residents of Asunción now have access to computers and modern telecommunication technologies and can participate in the government's decentralization and modernization efforts.

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collaboration across six town lines in the Lower Naugatuck Valley of Connecticut, United States, where an organization of providers of health and human services was created to help build a regional vision and plan. It has developed 28 initiatives, including Electronic Valley, which contains over 1,000 pages of community information; Project CoNECT, a programme to administer 5,000 health risk assessments; and a guide to arts and recreation in the community. As access to telecoms spreads in the developing world, such pioneering initiatives can be replicated in a variety of settings.

The International Council for Local Environmental Initiatives (ICLEI) is an association of local governments whose mission is to achieve tangible improvements in global environmental conditions through the cumulative impact of local actions. Members communicate through an interactive website.[13] The website has stories of action taken by communities from Chile to Uganda. The goal of the Sustainable Santiago project, for example, is to secure a healthy natural environment, a liveable, people-centred urban

CORPORATE VIEW Local engineering value

FOR GRINTEK Telecom, telecommunications mean providing optimal access to appropriate information by remote means. This can include anything from conventional point-to-point voice telephone calls, accessing a remote expert database through value-added networks, or the provision of video broadcast information services.

Industries which are responsive and flexible have demonstrated that they can beat the "economy of scale" paradigm by producing low-cost, high-quality products at low volumes. In developing countries in particular, the best way to use resources effectively is to focus them on problem-solving activities.

Grintek Telecom is positioning itself as a flexible, small-industry player specializing in bringing local engineering value to the African market, in many cases through partnerships with international companies.

Its approach has delivered a number of innovative solutions to corporate and other customers. The company gives a high priority to investment in technical training, spending about 5 per cent of its revenue on this, with the result that about 70 per cent of employees hold a technical qualification. The company also invests heavily in research and development.

It operates in four main business areas. Two business units concentrate on providing equipment, systems and associated services for public and corporate networks respectively, either from international suppliers or own products developed through joint ventures. Products include transmission and access systems, and business solutions (call centres, video conferencing, distance learning, integrated trading systems). The third unit focuses on business and end-user applications, and the fourth on service provision issues usually associated with network operations.

For one customer, the company configured and supplied a universal business services network for a telecom operator providing various data communication transmission standards and other services at an affordable price. Optimizing costs and performance of such networks is vital to the overall development of a country's infrastructure, including the provision of basic services to underserved areas. In another case, the company designed, configured and supplied a complete integrated voice communication system for a local financial institution that included a call centre and trading system with data network integration. This has increased operations efficiency by more than 300 per cent.

Altogether, Grintek Telecom has added value to more than 50 corporate clients' businesses through its telecommunication engineering programme, and by tailoring solutions specifically to meet their needs.

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For further information see Annex B

environment, and a vibrant economy for residents of metropolitan Santiago in the 21st century. The municipal environmental evaluation process is being assisted by Canadian technology partners from the city council of Ottawa and the software company which supplies the environmental assessment software Calyx-EA.[14] The evaluation process will define a development strategy for a sustainable Santiago and design the database which will be incorporated into the Calyx program. Implementation has begun with the development of a systematic structure for collecting and analysing urban environmental data. Preparations are under way for workshops that will cover knowledge acquisition and how to integrate spatial data into the system. This training element is an important part of the whole process.[15]

COSTS AND FINANCING

Collaborative approach for cost savings

Using telecommunications, cities in the developing world can deliver education to universities, schools, libraries, technical institutes and neighbourhood telecentres. Using the same infrastructure, doctors and health care workers can provide medical diagnosis, treatment and training. Local businesses can use the same network to communicate among themselves and internationally, and conduct electronic commerce with other businesses or directly with consumers. Government employees and citizens can communicate with peers in other countries on better city management and non-governmental organization programmes for sustainable development. Where one sector alone might not produce enough demand to pay for such networks, the aggregated demand of all these users creates the economies of scope and scale that make the networks financially feasible. If the leaders, decision makers and practitioners in each of these sectors can identify the needs and applications of information and communication technologies in their sector and estimate the requirements for the different forms of communications, the aggregated demand can be measured and planned for, and the capacity built to deliver the services. Collaboration with network operators and service providers in planning how to meet the city's broad needs can help ensure that the most cost-effective and financially feasible systems are deployed.

The presence of a relatively large, concentrated market usually makes provision of telecommunication services in large cities a profitable enterprise and, therefore, providing that appropriate policies are adopted, the necessary investments are likely to come forward. Still, to promote widespread use of telecoms, governments may need to subsidize public sector users' tariffs (at least initially) and considerable efforts will be required to train and support end-users.

Philips

Pipe laying and installation of a distribution vault for an urban telecom system in Saudi Arabia.

Financing

Building the telecommunication infrastructure in urban areas is carried out by the various network operators who typically finance the upfront construction costs with a combination of equity and debt financing, and frequently vendor financing for the equipment. The International Finance Corporation (IFC) of the World Bank loans some of the capital requirements and helps syndicate the debt financing from investment banks and lenders. The Inter-American

Development Bank and other regional development banks have similar affiliates that lend to private sector enterprises. (See Annex A for a list of funding organizations and contacts.) Project financing is available for privatized telecom operators as well as cellular and other wireless operators, data networks and advanced broadband networks.

A specialized agency is the United Nations Centre for Human Settlements (Habitat). It assists governments in policy and strategy formulation to improve the living conditions of people in their communities by expanding universal access to adequate shelter, infrastructure and services, including telecommunications; and strengthens the capacity of national governments and local authorities to mobilize public and private resources to improve urban environmental conditions and productivity. Habitat currently has more than 220 ongoing technical cooperation programmes and projects, with project budgets totalling over US$180 million and leveraging national investment commitments ranging from US$1 to US$3 billion annually.[16]

CASE STUDY On-line development

OBJECTIVE

■ To build and use e-mail, wide area networks and the Internet to promote sustainable social and urban development in Bulgaria and the surrounding region.

BACKGROUND Starting with just a telephone and fax in 1994, a sophisticated technology-based communication system has been created as a result of a series of projects that introduced distance learning, brought the Internet to Bulgaria and planned a network of information kiosks in the capital city, Sofia, to serve citizens and tourists.

STAGE 1* – *e-mail, audio and video conferencing networks

DESCRIPTION The 1995-1997 Regional Distance Learning Project implemented interactive courses on management, policy and technology to telecom managers in cities in Albania, Bulgaria, Hungary and Romania. The project started with video cassettes, telephone and fax. Soon an early form of e-mail was developed, which then became available for general use.

Audio conferences were conducted using a specialized sound station, so that participants could speak and be heard with high-quality audio in a biweekly seminar discussion with experts from Brussels, Paris and Washington. Again, a new technique became part of the available repertoire.

Video conferencing equipment for multimedia conferencing based on personal computers was bought for the second year. Countries with full Internet access (excluding Albania) used specialized software for the multisite teleconferences with teachers and experts. Albania used a different system that operates over regular telephone lines but provides the same voice, video, text chat and shared applications.

COSTS The budget for the six 12-week professional courses, held in four countries for 20 participants per course in each country, was US$273,600. The sound station[17] cost around US$700; audio conferences averaged US$150-200 per one-hour session. The cost of each video conferencing system was less than US$400 in hardware and software,[18] and the usage costs were the costs for use of the Internet for 30-60 minutes, or for Albania the US$2.60 per minute cost of an international call.

RESULTS A set of experts was created in each of the cities, with knowledge and skills for telecom privatization and new technologies, at one-twentieth the cost of traditional overseas training.

The use of e-mail, audio and video conferencing and finally Internet was developed and became available for urban users generally.

STAGE 2* – *the Internet

DESCRIPTION The Internet arrived in Bulgaria when several entrepreneurs and non-governmental organizations, with support from the United Nations Development Programme (UNDP) Sustainable Development Network Programme (SDNP), worked with the telecom industry. One of the leaders was Dr. Shentov of the ARC (Applied Research in Communications) Fund which established Bulgaria Online <http://www.online.bg>: a virtual network of government, civil society and the private sector. The

The calculations on how to finance telecoms in developing countries and emerging markets have changed. The consensus is that such investments will and should be made by the private sector, and that the role of the government is to create the policy conditions that will encourage such investments by local companies and foreign firms and investors. Privatization and liberalization leading to competitive markets are seen as the policies that will produce the networks and services. The International Telecommunication Union (ITU), World Bank and other multilateral and bilateral donor agencies are financially supporting assistance in policy and management development, pilot programmes, and applications of information and communication technologies and knowledge management in key sectors of development. The ITU also advises national telecom operators on network modernization and technology options and financing strategies.

Joint ventures are the most common means of providing both infrastructure and services. Local enterprises and entrepreneurs team with a foreign partner

On-line development *(continued)*

network also hosts and supports a similar group in Albania <http://www.online.bg/acer>.

COSTS	**US$**
International experts and consultants	9,000
Administrative support personnel	9,700
Duty travel	8,300
National experts	187,000
Internet provider	120,000
Publications	40,000
Training workshops	75,000
Equipment	121,695
Operations and maintenance	10,000
Reporting costs	3,000
Sundries	24,000
Total	**607,695**

RESULTS Institutional and technical capabilities have been created for virtual networking through the Bulgaria Online site, connecting over 120 governmental and non-governmental organizations. An electronic information pool in the form of locally established databases, non-governmental organization websites and directories to thematically related information worldwide has been created and is updated regularly. Training seminars are being carried out to enable non-governmental organizations to make effective use of the Internet for substantive dialogue and exchange of information.

A national exchange point between different Internet service providers in Bulgaria has been organized to provide easy and reliable access for users connected to different providers. This will be reflected in optimizing the international Internet traffic for all Bulgarian institutions and faster access for everyone to the content of information being collected under the current initiative.

STAGE 3* – *Infokiosks in Sofia

DESCRIPTION The Mayor of Sofia is now planning an Infokiosk network for the city. Telecom specialist Victoria Damyanova says the kiosks will improve the services provided by public administrations to citizens and provide access to interactive information about public services, laws, cultural events, local news and tourism information.

COSTS The project envisages 20 kiosks in Sofia at an estimated cost of under US$500,000.

RESULTS Following the first stage of providing information, the second stage will use the kiosks and networks to deliver legal documents to citizens, including birth certificates and property deeds. The programme might also expand to other cities in Bulgaria. Additionally, the Sofia municipality is beginning to use the Internet to communicate with other cities and for municipal governance.

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– a vendor, operator, service provider or development expert – who provides technical knowledge, assistance and guidance on building and operating the network, equipment procurement, software to operate and manage it, front and back-office systems, business case development and analysis, and access to capital or project finance. The strategic and technological knowledge of the foreign partner is one key element; local knowledge of markets, government regulations and business operations is the key contribution of local partners. Such joint ventures are what have enabled cellular and satellite networks in developing countries, and indeed industrialized countries, to date. Usually the local partner will manage the business following the start-up phase when foreign managers have trained their partners.

Funding applications such as urban planning using GIS or electronic delivery of government services is quite different from funding infrastructure. Costs include hardware and software procurement, the costs of which are rapidly falling, and the recurrent costs of services and staff. Funding may be

CORPORATE VIEW Small and medium-sized businesses

THE FIRST commercial trial in the United States of the Bosch Telecom local digital wireless network in July 1998 proved that the system could pave the way for easy, flexible and reliable communication networks for small and medium-sized businesses.

The company supplies a local communication distribution service. To provide this it uses a digital wireless system which supplies not only voice telephony but also enhanced multimedia services such as video conferencing, telephone shopping, e-mail and Internet access.

As well as simultaneously providing services to a large number of sites, the use of wireless signalling avoids copper or fibre cable installation, which can require major road works and is less physically secure. The difficulties presented when providing access to public networks in complex terrain are resolved with wireless telephony, which can handle the communication channels necessary for both simple voice and high-speed data.

A Bosch telephony system has a central transmitter base station which includes the equipment to control, send and receive signals. At a typical customer's premises, the signals are sent and received via a roof or wall-mounted antenna connected to a digital unit that converts the wireless signal back to voice, video and/or data. A single telephony transmitting tower can deliver, within a radial distance of up to five kilometres, data and telephony lines for up to 80,000 customers, or up to 4,000 customers if 132 video channels are received as well as the basic telephony for voice and data.

During the United States trial conducted by Bosch Telecom and the local licence holder, US Unwired, large and medium-sized users such as hospitals, banks and petrochemical plants successfully received high-quality data, voice and video services via the system.

Smaller companies, which also have their demands for flexibility in data, telephony and video and may not be able to afford a significant network investment, can be comprehensively provided with what they need by this wireless technology.

Internet traffic is becoming a major data contributor to total network traffic, but voice remains the dominant use. Therefore the ability to handle voice exchange, and accommodate the increasing computer processing speeds demanded when transferring large data files, gives the network clear advantages.

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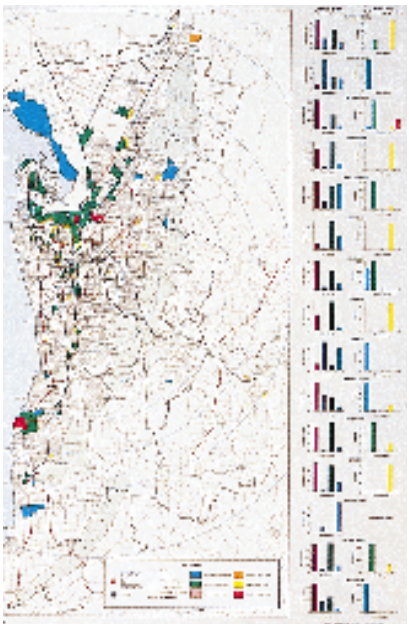
For further information see Annex B

possible for pilots to demonstrate and promote these applications. These applications are cost-effective and can result in productivity gains, efficiencies and economic benefits that pay for themselves. Eventually, national sector budgets for health, education, environment or municipal budgets will allocate the funds to pay for their respective usage of communication service, network use and applications.

PLAN OF ACTION

To develop an integrated view of what can be done, based on what has helped other cities and urban areas, steps that might be considered are:

1. Form a city-wide task force with all the stakeholders: users in all sectors, local municipal officials, universities, large and small businesses, teachers, doctors, mass media, librarians, non-governmental organizations and the telecom industry providers (operators, Internet service providers, computer and software firms).
2. Take an inventory of what is there now, the existing infrastructure, networks and services. List how it can be used, what the constraints are, and what additions would improve it.
3. Request industry representatives to give an overview of the new technologies and delivery systems becoming available; explore with them what applications can be implemented using the different technology options.
4. Brainstorm among the users what applications and services would be useful in their businesses and programmes. Begin to prioritize. Make a plan to get systematic feedback from each user community on the needs and applications in their sector.
5. Organize groups in each sector to do a systematic needs assessment that covers all neighbourhoods, that talks with teachers and community representatives in poor areas as well as rich ones, and that contacts entrepreneurs and small businesses as well as corporations. Identify what access they currently have to any communications, and particularly note those groups that have no access.
6. Invite industry to give a series of tutorials or short courses on the new technologies to the task force; consider using Web-based or distance learning courses on technologies, which industry representatives could facilitate.[19]
7. Invite government regulators to join in discussions about new wireless technologies that use various frequencies for fixed and mobile services, and ask them what frequencies could be made available. Discuss the new local multipoint distribution service for high-speed delivery of voice, data, video and Internet.
8. Begin preliminary reports from sector teams on the findings of the needs assessment, and input the information into a database. On a map of the city, make notations of where the needs for various services exist. Produce an overlay of the map for each sector, so that the cumulative, aggregated requirements become apparent.
9. Review the case studies, projects and models identified in *Telecommunications in Action* and mentioned on the websites or other references. Compare their situation with your city. What similar systems and programmes



ESRI

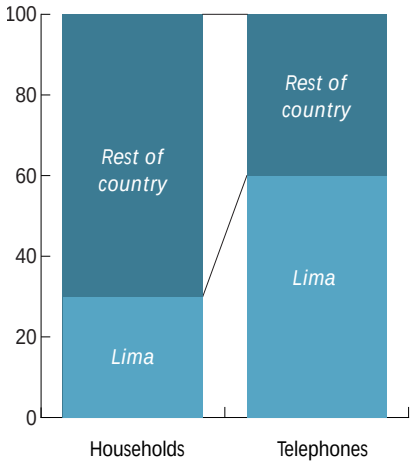
Industrial database, Adelaide, Australia, set up to guide industrial and urban planning.

exist and can be tapped; what lessons can be applied? Which models are relevant?

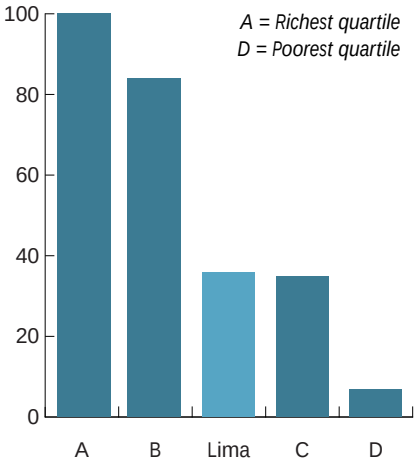
10. Develop plans for one or more pilot projects to try out applications in some sector(s) in the city with the cooperation of the information and communication technology industries. Consider a pilot that serves more than one sector and stakeholder, and uses more than one technology.
11. Draft a report on findings, observations and recommendations to the municipal officials and relevant national policy makers on strategies for the urban information and communication infrastructure. Organize a symposium to discuss the report with public and private sector decision makers.
12. In all probability, the industry players are already planning or assessing the business opportunity in your city. Invite leaders from the network operators, service providers, the equipment and software vendors, and applications and content providers to share their potential plans.
13. Plan the transition to the next phase of activity for the task force. Consider having a consultant advise the group and/or the city; a consultant can help the community carry out the feasibility study, assess the technology options for specific requirements, evaluate the proposals and claims of vendors and operators, and suggest how a mix of technologies and service providers will give the city flexibility and options.
14. Maintain continual, two-way communications between sector representatives on the task force and the constituents and members of their professions, organizations and community. Keep them informed through meetings, a "technology primer", seminars, articles in the media and discussions on radio. Continue gathering their input as they learn more about the opportunities and how to use the technology.
15. Advise business and other end-users on available training programmes for their key staff who would become telecom managers and chief information officers. Offer training to people in local community and non-governmental organizations who will implement the new technologies in their own programmes and provide critical skilled personnel for government and businesses.
16. Offer to help plan telecentres that can be managed by local people and can provide access and tools city-wide in neighbourhoods that need integrated services. Residents can plan, jointly with a telecom provider and vendors, the location, the building, equipment, furnishings, staff and training, and educational materials. A network of groups across the city could work together on developing telecentres, sharing resources and experience, training staff and procuring equipment, software and communication services at advantageous prices.

It is the end-users who will adapt and implement the applications to help meet the needs in their sector. These applications will operate over the information infrastructure that is being developed in cities and metropolitan areas. The diverse needs of the urban areas will be best met if representatives of the different users, user groups and sectors become engaged in planning the infrastructure and ways to access it and the services. For example, the

DISTRIBUTION OF HOUSEHOLDS AND TELEPHONES IN PERU, 1996 *(%)*



PERCENTAGE OF HOUSEHOLDS WITH TELEPHONE SERVICE, BY INCOME LEVEL, LIMA, 1996



Source: Organismo Supervisor de Inversión Privada en Telecomunicaciones (Perú), in *World Telecommunication Development Report 1998*, ITU, Geneva

European Information Society under the umbrella of the European Union has involved users and operators teaming up to plan a wealth of applications from telework to telemedicine. The Asia Pacific Information Infrastructure is conducting studies and sponsoring pilot projects. Africa and Latin America have similar regional initiatives.

Cities are the easiest group to provide with access to communications. Existing infrastructure reflects this, since 75 per cent or so of the current telephone lines are in urban areas. Major advances have been made in recent years in getting services to subscribers, both in terms of regular telephone lines and cellphones. The economics of operating networks in urban areas are much better than in rural markets. There is generally both demand and ability to pay in the cities of the world. Even Internet and advanced digital services are likely to have enough aggregated demand from all the sectors to support building and operating a central network. Almost every country now has Internet access, and either has, or plans to build, a high-speed Internet gateway. The number of PCs or hosts worldwide connected to the Internet in 1998 was 37 million, with about 150 million users. The average monthly cost to access the Internet is US$40, and often as little as US$10 for e-mail access only. It is also possible to have free e-mail accounts now, although the user still has to pay for access to the Internet. City dwellers and businesses have some access to e-mail in all countries.

IMPLEMENTATION

Working models for urban overlay networks

The voice, data and video networks that service a city are a network of networks. They are overlay networks, on top of the existing basic telephone network. Digital overlay networks were built in the 1990s in central and eastern Europe and Latin America for quick upgrading of services for businesses. Data networks were the next to be installed in the cities, providing e-mail, database access and file transfer to businesses, universities and government. The city had the beginnings of modern digital communications. The next overlay networks were cellular. They interconnected with the public telephone network and rapidly expanded the access to voice communications. Cellphone users generally had fixed-line telephones too, often of poor quality, but cellphones were sometimes used as public payphones in local shops. Cellular wireless overlay networks are well suited to expand access to telephone services. The networks can be installed in months rather than the years necessary for copper wire, and at about the same cost. They can be interim solutions to provide services until a fixed-line network is built.

A variety of wireless networks provide different voice and data services including cellular telephony, paging, mobile radio for transport fleets, point-of-sale and bank cashpoint networks, digital radio and microwave networks for Internet and private networks, and now satellite telephones and local multipoint distribution service networks. The critical resource in building these networks is the radio spectrum, and the allocations of frequencies and licences to operators. Spectrum frequencies in a certain range[20] are the natural resource that carries the above services: comparatively lower

frequencies for cellular and radio; higher ones for the digital microcellular personal communication service as deployed by AirTouch and Vodafone that provides voice service at competitive rates with the wireline service in most countries; and higher again for the new broadband wireless or local multipoint distribution service. The most recent overlay networks are the Internet or Internet protocol networks that now carry data, video and voice in interactive multimedia. The Internet as an alternative, overlay network offers all users powerful access to global information, information technology, software, applications and the means of communicating at low cost around the world.

A model for urban networks is in fact a combination of some or all of these overlay networks that could be operated by various private enterprises and the national public telecom operator. Overlay networks can be visualized by drawing network diagrams on transparencies to place on a city map and examining them by mixing and matching them to see what combination will best deliver the services needed by the urban users.

A topographical map of the city will indicate line of sight as required for many wireless networks, and show existing towers and high buildings where antennas could be placed. A social and demographic map will give population concentrations, residential and business users, as well as schools, clinics and community centres. Maps of existing communication networks provide a starting point. A GIS system will help urban planners develop the models that address all the critical factors. Industry representatives are likely to have such maps, models and software to depict how coverage is best achieved. Remembering that access is a key issue, the overlays should indicate strategies to extend the service to parts of the city and groups of citizens who do not currently get service.

ITU/Jean-Marie Micaud

This microwave antenna helps bring telecom services to the citizens of Totonicapán, Guatemala.

Model of local multipoint distribution service

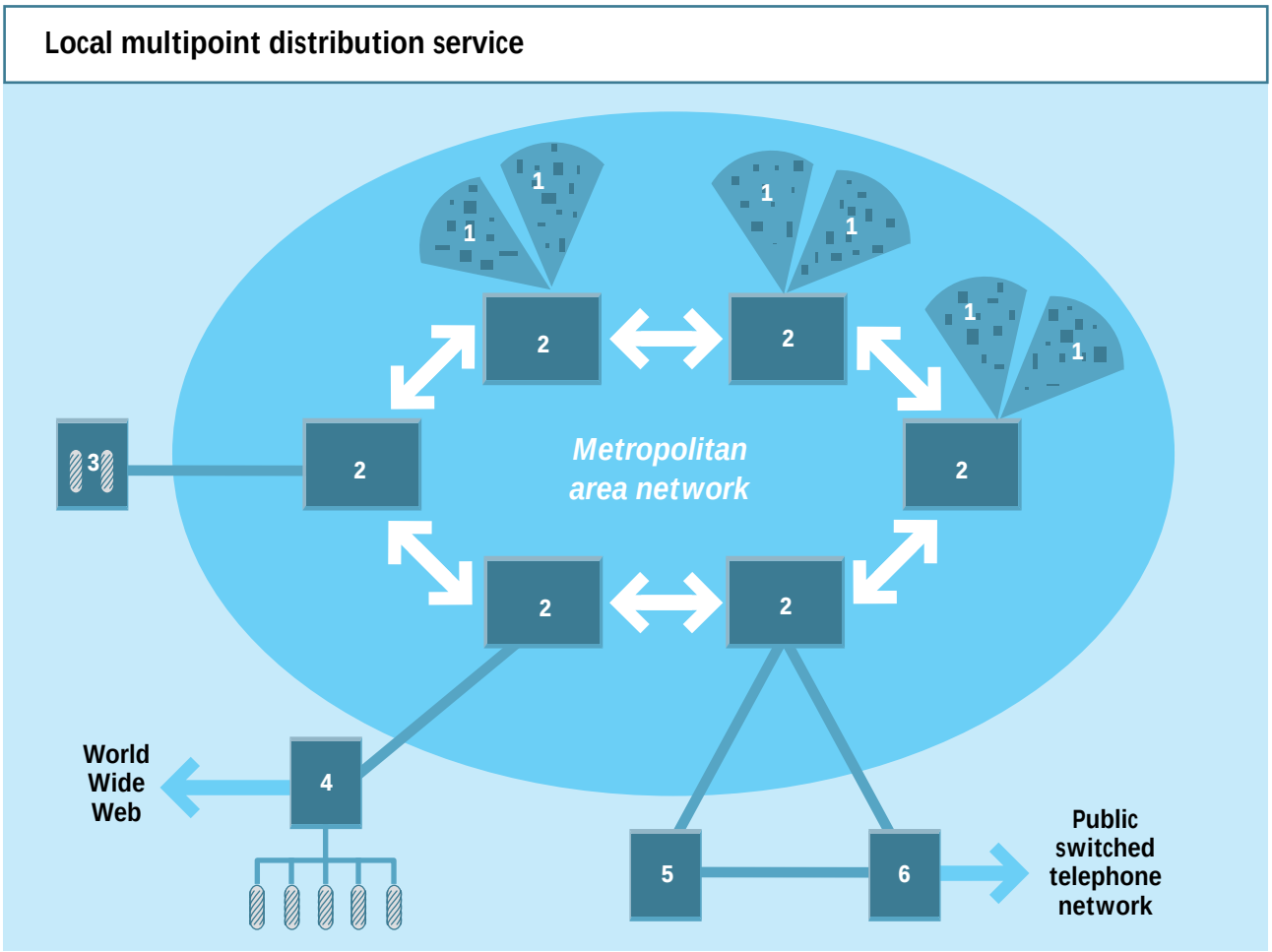
A metropolitan network can be based on a local multipoint distribution service system. The operator's infrastructure includes hub sites that collect traffic from customer buildings and route it to the switches, and a small antenna and radio on the roof of each customer's building. The cost of a hub is approximately US$370,000.[21] The switches are interconnected to the public telephone network for both local and long-distance services as well as to Internet and video service points. The other costs to the operator are fees to use the necessary frequencies and charges for access rights to the building rooftops. Since there are no construction costs to run wire or fibre, the operator's costs are correspondingly lower. The signals travel over a short distance of up to seven kilometres (km), with line-of-sight transmission. One hub can typically serve a cell of 4 km x 4 km, supporting 13,000 users per cell. A city might have ten cells, all connected to a central network.

The roof-mounted transceiver or antenna on the customer's building receives and transmits the signal from and to the hub. The customer's office or home also needs to have special equipment to convert the signals and to connect multiple computer devices. The equipment cost to the customer is about US$650. There will also be a network interface unit to control the

interaction of all the devices with the transceiver. A telephony interface allows for telephone lines, and a television set-top box will receive both analogue television and digital video for video conferencing. Between the roof and the offices the signal is carried over a wired cable. A business customer would connect its computers, televisions, telephones, faxes and other devices in a local area network, which is then connected by the cable to the rooftop antenna. Many tenants in the same building would be served by the same rooftop antenna access, making the service affordable and cost-effective. The high speed of the transmission enables the simultaneous delivery of full-motion video, plus high-speed Internet, video conferencing and voice calls.

In Latin America, Chile and Argentina have made the relevant frequencies available for this new service, and the company that pioneered the technology plans to deploy its local multipoint distribution service network in Buenos Aires during 1999. It is also linking an inner-city housing project in the United States, in Washington DC, with neighbourhood elementary, middle and high schools, and a local home for senior citizens, so extending education into the home and encouraging communication between senior citizens and children.[22]

Local multipoint distribution service



1. *Customer buildings*
2. *Switches*
3. *Video service point*
4. *Internet service point*
5. *Long-distance service point*
6. *Local telephony service point*

Model of spread-spectrum digital radio/microwave system

This model of wireless data networks has already been built in many countries in Africa, Asia and Latin America. It is used to build the basic telecom infrastructure of local exchange networks and competitive access providers, and to interconnect private networks for hospitals, businesses and the base stations of cellular, paging and mobile radio networks. These spread-spectrum digital radio/microwave systems in some countries do not require a licence since they do not interfere with other users of the spectrum.

Wireless access to the Internet and intranet (a virtual private network) connectivity are two key applications in growing demand. Financial and transaction processing has been one of the major applications. Hundreds of remote connections or networks up to 32 km away are supported from a single central location. A general model would configure up to nine central units per central site location. In each of these up to 40 remote units can be supported, up to a total of 360 units per central site.

CORPORATE VIEW No licensing

IT IS NOT ALWAYS possible to provide voice and data communications via a cable network. For example, the cost of the infrastructure may be too much. In those cases, the answer can be to use wireless technology in radio bands that do not need licensing. Wi-LAN delivers cost-effective, efficient and reliable data communication networks through wireless technology to businesses, industries and governments across the globe.

One example is a major stock exchange in west Africa, which needed a reliable and efficient high-speed computer network to provide up-to-the-minute communication links between brokerages, in a region of approximately 60 million people. A series of satellite base stations was set up in bigger cities and towns to provide a network covering more than 4,000 kilometres, which replaced the old, outdated, dedicated data lines. The company's equipment was chosen for its transmission and interface capabilities, as well as its price, to supply the final vital bridge between the base stations and the individual banks and brokerages. The resulting network was fast and dependable.

In another example, Wascana Energy, a subsidiary of Canadian Occidental Petroleum, chose the company to supply the radio equipment for its field automation initiative in western Canada. Wascana Energy currently uses 750 of Wi-LAN's wireless modems, and it expects to double that number in the next few years. The equipment withstands the rugged and demanding environment of the "oil patch" and constantly monitors well status to deliver the information to a processing station in just seconds. Before it was installed, the company's automation field personnel had to cover 700 different sites over an area of 31,080 square kilometres. Wascana Energy says that the flexibility, ease of use and low price of wireless telemetry made it the obvious technology of choice for transmitting from remote sites which had little existing network infrastructure.

Peru Internet, which is based in Lima, bought the company's units to provide direct access to the Internet for more than 20 corporate and residential clients, which included hotels, publishing houses and schools. And in Argentina, a network of wireless bridge transceivers was implemented to bring high-security network connectivity to Martin Fierro, a transport company in the region. The new equipment has made it possible for the company to interconnect its six office sites, located more than 40 kilometres apart. Wi-LAN's easy-to-use and adaptable technology is bringing sophisticated communication services to both rural and urban areas for the first time.

Wi-LAN
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For further information see Annex B

Another configuration of the model, for point-to-multipoint wireless narrowband systems with a range of 50 km using the 400 or 800 megahertz frequencies, provides such applications as:

- automated teller machines;
- point of sale;
- small-branch banking;
- the international airline reservation system;
- temporary links for fairs and trade shows;
- disaster recovery;
- lottery networks.

BENEFITS

The use of telecommunication tools and techniques for urban development will vary with the country, just as strategies for urban planning will need to fit the realities of the city, its priorities and its resources. Urgent problems of drinking water, sanitation, transportation and housing can make limited use of GIS tools. Schools, hospitals and clinics can share limited human resources of master teachers and medical specialists by connecting facilities throughout the city and provide access to their expertise through distance learning and telemedicine. Small businesses need not locate in the core downtown if they have access to good communications and can exchange information electronically. Government can be distributed and some workers can "telework" from satellite offices closer to home. Viable neighbourhoods or peri-urban communities can have access to community services of health, education, training, jobs and social services if they have access to communication networks and the information infrastructure. Improved communications mean urban traffic can be reduced, also cutting pollution and time lost in travelling.

ITU/Jean-Marie Micaud

Public or community payphones are one way of widening access to telecom services in urban areas.

People in communities in inner city or slum areas, who may be effectively as isolated from government, services and opportunities as many rural citizens, can be connected into the national development strategies by means of telecommunications. They can communicate with each other and with the wider world via the Internet, and be given a voice to talk to government and other officials.

Urban development also means controlling the growth of urbanism, as well as managing it better. Better communications make rural development feasible and thereby lessen the pressures on urban centres to support the total national economy. Urban centres can become a hub, with viable enterprises operating at remote sites or secondary cities and towns. Employment can be distributed nationally, so that the metropolitan urban areas need not absorb all the people and provide all the jobs and business activity. More balanced national growth can be achieved by using communication networks to facilitate decentralization. Small towns and rural areas can have access to most of the same services as central urban enterprises. By linking the capitals with the rest of the country, the employment, business, education, health and urban management resources can be shared on a distributed basis. Operating outside the largest city now becomes viable.

Plan of Action, United Nations Conference on Human Settlements, Istanbul, 1997.

World Bank, Urban Initiatives Team.

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7. Further information is available from Raymond U. Akwule, Professor of International Telecommunications
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11. Dr. Michael Shiffer, Planning Support Systems Group, Department of Urban Studies & Planning, Massachusetts Institute of Technology, USA.

12. <http://www.healthycommunities.org/>
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13. International Council for Local Environmental Initiatives (ICLEI)
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E-mail: iclei@iclei.org
<http://www.iclei.org>

14. Nobility Software Ltd.

15. The Sustainable Santiago project is a joint initiative of ICLEI, the municipality of Santiago and the Corporation for the Development of Santiago and is funded in part by the Canadian International Development Agency (CIDA) Southern Cone Technology Transfer Fund. For more information, contact
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<http://www.iclei.org>

16. Habitat: <http://www.unchs.unon.org/unon/unchs/habrief.htm>

17. Sound station from Polycom.

18. CU-SeeMe for those with full Internet access; ShareVision for Albania.

19. IEC Web ProForum are Web-based and video-based tutorials. The International Engineering Consortium: <http://www.iec.org/>

20. From 200 megahertz to 38 gigahertz.

21. For operators in the United States.

22. WinStar: <http://www.win4edu.com>