Going the last mile: what's stopping a wireless revolution?

For many people in the world, communication facilities are unreliable, slow and costly. The use of wireless technology is one way in which this situation could be transformed. So why are some governments restricting its wider use?

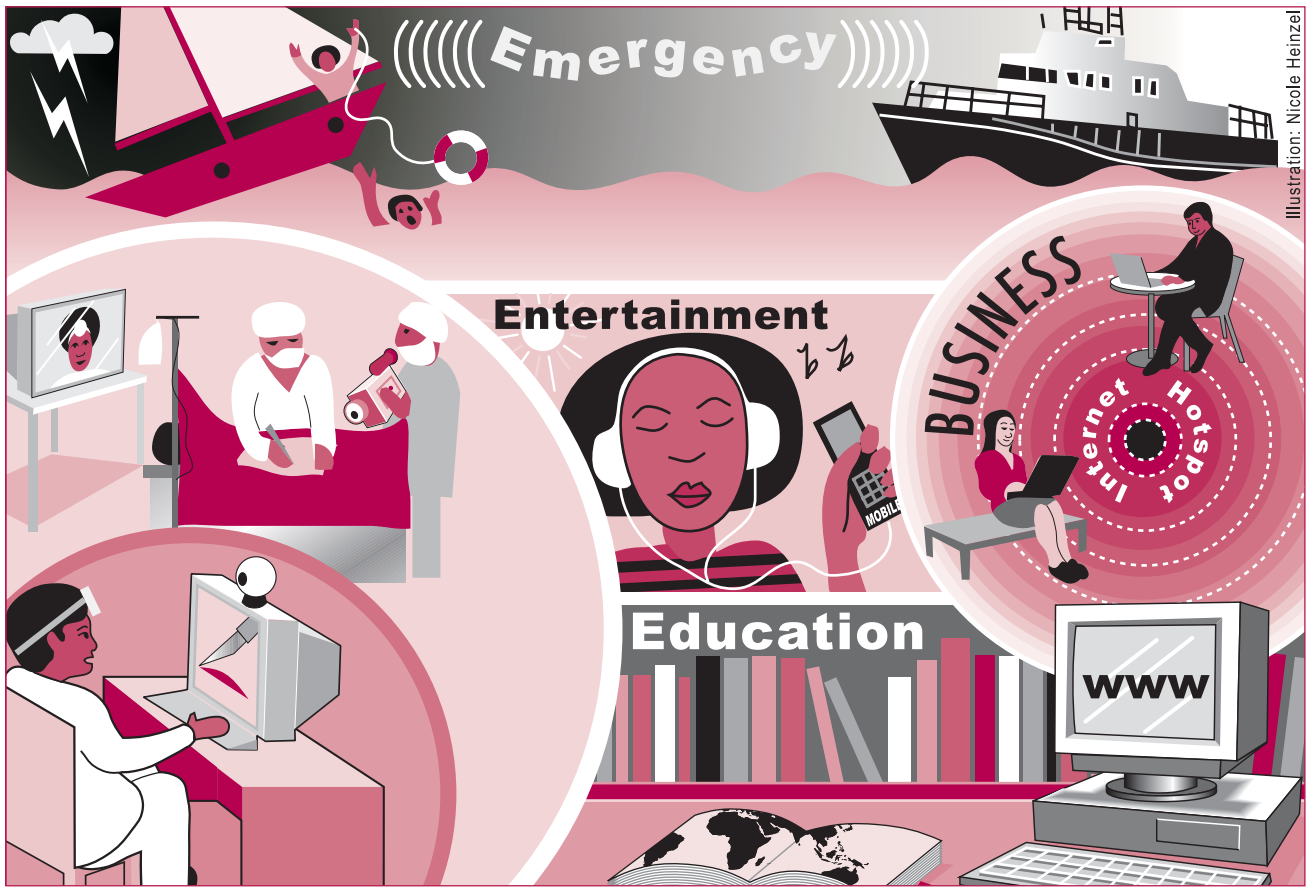

Illustration: Nicole Heinzel

Many uses of wireless technologies

'Wireless' used to be a term used in radio broadcasting. The term still describes a communication appliance that uses radio waves, but now there are many different applications. Wireless communication networks are being set up in organisations such as health services, local government, education institutions and businesses. Wireless 'hotspots' are also being established in public places such as airports to offer internet access to the public.

Media toolkit on information and communication technologies (ICTs)

This is the fourth in a series of short briefing documents for journalists on different aspects of ICTs and the 'information society'. It is offered as a service to non-specialists, and in particular to journalists wishing to cover information society issues following the World Summit on the Information Society (WSIS) in November 2005.

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Why wireless technology matters

Wireless technologies can play an important role in social and economic development by making the exchange of information faster, cheaper and more widely accessible. The massive growth in the use of mobile phones, for instance, has revolutionised business communications in many countries. But some governments, especially in Africa, have put policies and regulations in place that limit the introduction of these technologies. For instance, high licence fees, high customs duties on imported equipment, and lack of competition among service providers all keep the costs of using wireless technologies high.

Journalists can encourage debate about the positive role governments could have in promoting the potential advantages and applications of wireless technology, and draw attention to any existing restrictive policies.

The advantages of wireless

The 'digital divide' between North and South, rich and poor, urban and rural, is still wide. In many developing countries, particularly in rural areas, internet access is still rare, slow and unreliable, as well as prohibitively expensive. In Africa only 2.6 per cent of the population have internet access and 3.7 per cent access to either a fixed line or a mobile telephone.[1]

Wireless provision of internet access, for example, could make an important contribution to bridging the digital divide. Wireless technologies have several advantages over fixed-line systems:

Low cost

- Setting up and maintaining a wireless communication system is much quicker and cheaper than setting up a fixed-line system. There is less infrastructure such as cables and fibres to lay down and maintain.

Below: Wireless technology can bring an affordable telephone system right to the heart of a community.
SVEN TORFINN | PANOS PICTURES

Good for rural areas

- Wireless internet is quicker to deploy compared with fixed-line infrastructure and it allows the scattered rural population to exchange information and talk at a lower price
- Wireless services, generally, are cost-effective for rural areas where the population of users is thinly scattered, whereas fixed-line services are not cost-effective in thinly populated areas
- Wireless is therefore a particularly good solution for 'last-mile' services.

Better services

- Wireless services are more adaptable than fixed-line services
- Wireless can also provide better and more useful services where there are poor fixed-line facilities, thus promising more opportunities in rural areas
- Many wireless applications are mobile.

In Lusaka, Zambia, a wireless internet provider simply needed to erect one antenna in the centre of town, and potential customers anywhere in the city could have immediate access.

Small-scale and community uses

- Wireless technologies have many small-scale applications, and are suitable for small investments and for innovation by small-scale entrepreneurs and users
- Local wireless networks suitable for community sharing of information resources can be designed, built and adapted from the bottom up, by the users themselves.

Flexible uses

- Different sorts of network are possible: computers communicating directly with one another; computers linked to one another through a fixed coordinating centre; mobile computers linked to a fixed internet access point; and others
- Many of the end-user technologies are movable, either fully mobile (like a mobile phone) or nomadic (for example, a laptop computer which can be moved temporarily from one internet access point to another). This mobility provides freedom and efficiency.

Growth in the national economy

According to the latest World Bank report entitled *ICTs for development: Global trends and policies*, telecommunications and the use of various new ICTs has strengthened economies and public service delivery around the world.

The UK government's Commission for Africa report, *Our Common Interest*,[2] claims overall infrastructure (including ICTs) is a fundamental prerequisite to advances in agriculture, and a key enabler of trade and integration: 'increasing the stock of infrastructure by 1 per cent could add 1 per cent to the level of GDP'.

Similarly, the Cellular Operators Association of India claims that for every 1 per cent increase in telephone penetration, there is a 3 per cent increase in GDP.

1
International Telecommunications Union (ITU) 2006

2
Commission for Africa (2005), *Our Common Interest*, London: DFID

Some governments see the potential of wireless applications such as television and are using them to communicate their own messages; at the same time, however, they may be restricting wider use of the technology.
MARK HENLEY | PANOS PICTURES

The radio frequency spectrum and how it is managed

One of the main differences between different wireless technologies is the radio frequency they use.

Radio waves spread through space, oscillating at different speeds or 'frequencies'. The frequency of a wave means the number of times it changes direction (oscillates) per second. Frequencies are named after German physicist Heinrich Hertz, who built apparatus to send and receive radio waves in 1888. One Hertz (Hz) is a frequency of one oscillation (also called a cycle) per second.

Different frequencies have different uses. Low frequencies are used for military communication, for instance with submarines, while high ones are used for radar, radio astronomy and microwave applications. Broadcasting uses the middle range of frequencies.

The International Telecommunications Union (ITU), established in 1865, is responsible for standardising and managing the use of frequencies to ensure that different uses do not interfere with one another. Its guidelines recommend that the same frequencies are used for the same applications worldwide.

A frequency of 1,000 oscillations per second = 1 Kilohertz (kHz)

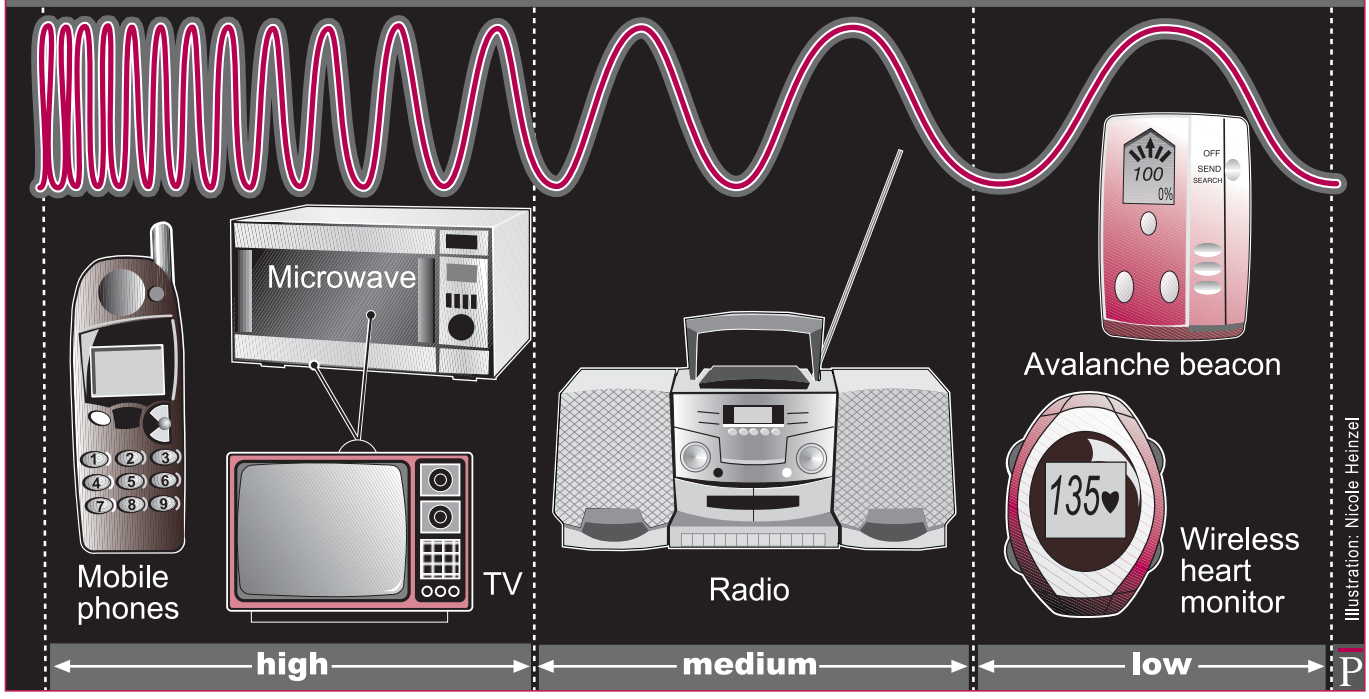
1 million oscillations per second = 1 Megahertz (MHz)

1,000 million oscillations per second = 1 Gigahertz (GHz)

For convenience, the ITU divides the spectrum – the whole range of frequencies – into bands. These range from Band 1, Extremely Low Frequency (from 3 to 30 Hz) up to Band 11, Extremely High Frequency (from 30 to 300 GHz). Frequencies below and above this range have no practical applications.

Use of different radio frequencies

Different applications must use separate frequencies in order to work effectively



Setting industry standards

The Institute of Electrical and Electronic Engineers (IEEE) is an international non-profit organisation, incorporated in the state of New York, dedicated to the advancement of electricity technology. It is a leading developer of standards in a broad range of disciplines including information technology, electronics and telecommunications. In 1990 the IEEE established the 802 standard for networking. This is still being developed, with standards being established for new technologies as they emerge.

Different wireless technologies

There are several different wireless technologies for internet access, and new ones are evolving. They have different characteristics:

- Some require a fixed power supply, others are mobile
- They vary in scale and the distance between users. The smallest networks are described as personal area networks (with a range of only about 10 metres). Local area networks (LANs), metropolitan area networks and wide area networks cover distances of up to 100 metres, 50 km, and hundreds of kilometres respectively
- Wireless can be used for 'backhaul' purposes (providing main highways from the internet to fixed distribution points) or for 'last-mile' distribution to consumers.

Some technologies are known as 'line of sight' (LOS) and require that there be no obstacles between the source of signal and the receiver (after the first 10–100 metres); others, known as 'non-line of sight' (NLOS), in which the signal can travel through obstacles to the receiver, are useful in urban systems, for example.

Questions to ask

- **Is the cost of telecommunications affordable for ordinary people in your country?**
- **Are the rural areas of your country well connected?**
- **Are government-owned service providers rolling out services to people in rural areas?**
- **Is the private sector in your country rolling out services, offers and plans to people in rural areas as eagerly as in urban areas?**
- **Is your government providing enough infrastructural support to encourage private providers to roll out services in rural areas?**

Some popular technologies

WiFi (Wireless Fidelity)

This allows several personal computers (PCs) or mobile notebooks using wireless cards to connect into a small local area network (LAN) around a fixed-access point to share resources such as an internet connection or printer. It is one of the standard ways of sending and receiving data, used for example for public 'WiFi hotspots'. Compliant with IEEE standard 802.11 (see box, Setting industry standards), it uses frequencies in the range 2.4 to 2.4835 GHz, and needs 'line of sight' to obtain better performance (i.e. no obstacles between the mobile user and the nearest base stations).

Mesh networks

A number of WiFi devices can be linked together, creating a wider networked area. A well configured mesh network is self-healing: if one node is out of action, data can travel by different routes.

WiMAX (Worldwide Interoperability for Microwave Access)

Can deliver broadband connectivity from a fixed-base station to thousands of users over a distance of 50 km, without 'line of sight'. WiMAX complies with IEEE standard 802.16, and uses frequencies between 2 and 11 GHz. It can provide 'backhaul' for WiFi hotspots (connecting a number of them to the internet) or provide connectivity for institutions such as campuses.

Orthogonal Frequency Division Multiplexing (OFDM)

Many people expect this emerging technology will prove to be one of the best for mobile wireless internet access, including for 'voice over internet protocol' (VOIP) telephone services. It can transmit large amounts of data, by splitting a radio signal into smaller sub-signals and sending them to the receiver simultaneously on different frequencies.

3G mobile services

Systems developed from third generation (3G) mobile phone technologies are rivals to OFDM. The 1G, 2G and 2.5G mobile systems (first and second generations, developed from the mid-1980s to mid-1990s) provided principally voice (phone) services, with only low capacity for transmitting data. Today's 3G systems have enough capacity to provide fast data transmission over wide areas and networks, allowing mobile users to access the internet, email, video-conferencing, and other applications.

There has been a lot of excitement about 3G, and the technology has been developed rapidly by different companies in different places. In order to enable the different products to operate with one another, the ITU is coordinating the development of definitions and technical and frequency standards. This group of standards is known as IMT-2000 (International Mobile Telecommunications 2000).

How governments can help

Governments play an essential role in enabling wireless systems to be made available to people quickly and cheaply. They can create an enabling environment that makes it easier for entrepreneurs to invest and innovate, and for government, NGO or private users to adopt new technologies. However, many governments (particularly in Africa) instead have policies that constrain the introduction of wireless technologies.

Government policies and regulations influence the roll-out of wireless in four areas:

- Prohibiting its use to protect the state-run monopoly operators or other licensed operators
- Limiting the availability of the radio spectrum – through frequency allocation and licensing
- Elevating the costs of providing services – through licence fees and taxes
- Reducing the ease of importing equipment – through lengthy and non-transparent approval procedures that are also open to corruption.

Frequency management and licensing

If the radio frequency spectrum was not managed, many users might try to use the same frequencies, and their signals would interfere with one another. Governments have to allocate space in the spectrum in a planned way, through licensing, to avoid overcrowding and interference. However, most countries in Africa lack clear and innovative frequency management plans. It is often hard for a potential investor to know which bands are available and whether a licence is required.

Countries and regions develop national and regional frequency plans, which set the strategic directions for spectrum usage. These plans are usually based on ITU recommendations, which allocate frequency bands for the same uses worldwide, according to the characteristics of the different bands. The national and regional plans then form the basis for national licensing bodies to issue licences.

A national plan allocates ranges of frequency for different services, and lays out some criteria and restrictions; for example, the maximum power allowed within a certain range. The purpose of these plans is to avoid overcrowding and interference, and to make the licensing process simple and transparent.

In a national plan, most potential users will be required to apply for a licence from the national licensing authority. This licence gives them exclusive rights to use a certain bandwidth, and imposes certain limits on their use of it – geographic range, power output, service offered or technical characteristics.

Unlicensed bandwidths

Some bandwidths may also be made available for unlicensed users, as long as they keep to moderate power levels. The ITU allocated a bandwidth of 2.4–5 GHz globally for industrial, scientific and medical (ISM) uses, and the ITU World Radio Conference in 2003 recommended this bandwidth should be made available within countries for unlicensed uses – small-range applications that won't conflict with one another, such as domestic remote control devices and portable phones. However, a survey in 2004 found that more than half the countries in Africa (and other developing countries) still require licences for these types of use. Some champions of wireless internet technologies are arguing that a greater number of uses should be allowed without licences. In the past, licensing was required because spectrum bandwidth was regarded as a scarce resource, to which access had to be controlled. The champions of unlicensed access argue that today's technologies use less power, are 'smart' (that is, they can use a very small range of spectrum) and with broadband can share bandwidth.

Costs

Many countries charge high fees for licensing networks or equipment. Lower fees encourage new operators to enter the market, but then the government may have to pay a disproportionate amount to collect these fees. This is one argument put forward by champions of 'less licensing' (see box).

Other reasons for high costs include high customs duties for importing equipment, unfavourable interconnections regimes (where existing providers refuse to interconnect or charge high prices for doing so), and lack of competition among operators.

Importing equipment

In the past, most countries had their own process for granting approval for the import of wireless equipment. Regulators in each country assessed that the equipment was safe and reliable and would not interfere with existing products and services. Manufacturers who wanted to sell a model in a country had to submit an application to the country's regulator, and usually pay a fee for the assessment process.

Now in many parts of the world, where neighbouring countries have similar regulatory environments and frequency bands, they have grouped together to establish regional type-approval procedures. ('Type approval' means granting approval for the import of unlimited numbers of a specific model or 'type'.) This reduces the time and costs involved when each country duplicates the work of its neighbours. However, in Africa each country still carries out its own procedures and some lack adequate resources, so this can take months. Establishing an Africa-wide approval procedure would be an important step in facilitating the efficient use of wireless equipment.

How to promote wider use of wireless technologies

- Open up the market to greater competition and allow users to provide their own infrastructure for themselves
- Establish forward-looking national plans for frequency allocation, including non-licensed use for some bandwidths and applications
- Establish low taxes, import duties and licence fees
- Establish regional type-approval procedures for importing equipment
- Work towards better infrastructure such as stable power supply and creation of local cadres of technicians.

Phones can minimise travel, reduce cost and increase access to information and knowledge. There is no doubt that communication technologies in rural areas can increase socio-economic opportunities.

Questions to ask

- **Is there a commitment by your government to implement policies to ensure everyone has access to communication facilities?**
- **Is your government allowing phone, internet, phone using an internet connection and other wireless technologies to be accessible to everyone?**
- **Does your government allow private companies to own wireless frequencies?**

Finding out more

To find out more about what the situation is in your country you could contact:

- The press officer in your government communications department
- The press officer in your government telecommunications department
- The press officer in your country's communication commission (some countries don't have this commission).

The Panos i-Witness website lists experts who can be contacted for interviews:

i-Witness website – www.panos.org.uk/iwitness/experts/

The experts and independent ICT-for-development consultants who were involved in the preparation of this brief are willing to be interviewed:

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Alberto Escudero-Pascual – expert in wireless technologies – aep@it46.se

Onno W Purbo – expert and wireless technology activist – onno@indo.net.id

Useful websites for more information

http://ictinafrica.com/vsat/ – The VSAT (very small aperture terminal) buyer's guide for Africa. Detailed descriptions about what options are available in the market and various policy and technology options.

www.idrc.ca/acacia/ – Canadian donor agency. Easily understandable telecommunication maps of Africa are useful.

www.panos.org.uk/iwitness/experts/ – Useful resource for journalists who want to contact experts to comment on ICT policies.

http://rights.apc.org/policy_sites_list.shtml – List of national ICT policy websites. You can find out what is happening in your country.

http://eassy.org/ – The official website of African telecom operators' plan of developing the Eastern Africa Submarine Cable System (EASSY).

www.fibreforafrica.net/index.shtml – Civil society's view on EASSY.

www.balancingact-africa.com/about.html – Clearly written website on African communications policy issues.

www.it46.se/list_entries.php?id=2 – Useful resource on emerging communication technologies.

www.cipaco.org – An initiative by Panos West Africa to strengthen capacity for people interested in African ICT policies.

www.vsat-systems.com/satellite-internet/how-it-works.html – Satellite internet explained in plain English, glossary and FAQs from a provider.

http://en.wikipedia.org/wiki/VSAT – Popular glossary on VSAT and wireless technologies.

www.oceansatlas.com/servlet/CDSServlet?status=ND0xODU1JjY9ZW4mMzM9KiYzNz1rb3M~ – UN Atlas of the oceans on marine telecommunications.

www.Catia.ws – The CATIA programme aims to enable poor people in Africa to gain maximum benefit from the opportunities offered by ICTs and to act as a strong catalyst for reform.

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Panos Media Toolkit on ICTs

1 **Who rules the internet? Understanding ICANN**
2 **Why calls in Africa cost more: the need for VSATs**
3 **Dollar divide, digital divide: funding the ICT revolution**
4 **Going the last mile: what's stopping a wireless revolution?**

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