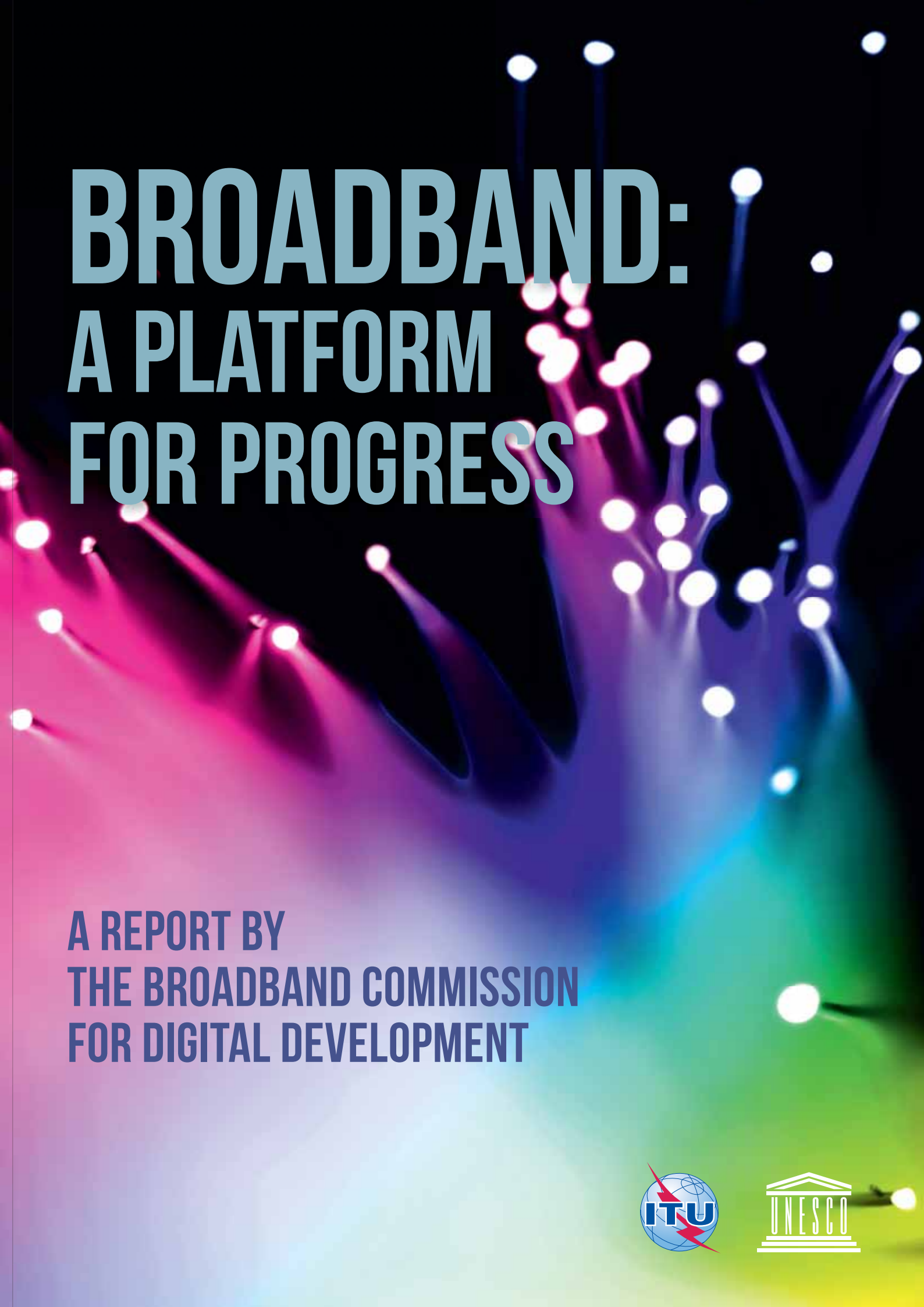

BROADBAND: A PLATFORM FOR PROGRESS

A REPORT BY
THE BROADBAND COMMISSION
FOR DIGITAL DEVELOPMENT

ITU

UNESCO

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www.broadbandcommission.org

FOREWORD

The Broadband Commission for Digital Development, launched in May 2010 by the International Telecommunication Union (ITU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), comprises government leaders from around the world, and the highest-level representatives of relevant industries, international agencies, and organizations concerned with development.

Ahead of the UN Millennium Development Goals Summit, held in New York in September 2010, the Broadband Commission presented to United Nations Secretary-General Ban Ki-moon "A 2010 Declaration of Broadband Inclusion for All," as well as Recommendations and a Plan of Action, in a report entitled "A 2010 Leadership Imperative: Towards a Future Built on Broadband".[1]

A LIVING RESOURCE FOR BROADBAND DEVELOPMENT

This report is the second outcome to be issued by the Broadband Commission in support of its recommendations. It offers more detailed examples, evidence, technical choices and strategies for extending broadband networks within the reach of all.

"Broadband: a Platform for Progress" is also designed to be the introduction to an evolving collection of resources in the form of an online database to carry forward the work of the Broadband Commission. This repository will carry the outcome reports of the Broadband Commission, as well as numerous research reports, case studies from both developed and developing countries, and other materials to encourage and inform governments and industry — and individual communities themselves — on why broadband is crucially important in today's world and about ways to get connected.

The Broadband Commission's repository of information can be visited at:
www.broadbandcommission.org/sharehouse
All are welcome to access its content, and to submit contributions.

1 The report is available in six languages at www.broadbandcommission.org/outcomes.html

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BROADBAND COMMISSION
FOR DIGITAL DEVELOPMENT

The Broadband Commission for Digital Development at its first meeting in July 2010, held at ITU Headquarters in Geneva

The Broadband Commission's first report was issued in September 2010 and presented to the UN Secretary-General ahead of the MDG Summit in New York. (Left to right) Commission Vice-Chair Irina Bokova, Director-General, UNESCO; Co-Chair Carlos Slim Helú, Honorary Lifetime Chairman of Grupo Carso; Vice-Chair Hamadoun Touré, ITU Secretary-General; UN Secretary-General Ban Ki-moon, and CoChair President Paul Kagame of Rwanda

1 INTRODUCTION AND EXECUTIVE SUMMARY

1.1 BROADBAND: A PLATFORM FOR PROGRESS

The world today is faced with growing challenges — rising population, poverty, epidemics, climate change. But we also have tools of unprecedented power in helping us to meet those challenges: information and communication technologies (ICT). Prime among them is broadband access to the Internet, which is creating a revolution in how services are delivered, industrial processes are managed, research is carried out — and much more.

In order to make progress in achieving the Millennium Development Goals[1] (see Box 1.1) by the target date of 2015 as set by the United Nations, it is essential that countries and communities everywhere are enabled to take advantage of this revolution. If they are not, they will lose the opportunity to reap the economic and social benefits that broadband brings.

Box 1.1 The Millennium Development Goals

1. **Eradicate extreme poverty and hunger**
2. **Achieve universal primary education**
3. **Promote gender equality and empower women**
4. **Reduce child mortality**
5. **Improve maternal health**
6. **Combat HIV/AIDS, malaria and other diseases**
7. **Ensure environmental sustainability**
8. **Develop a global partnership for development**

1 www.un.org/millenniumgoals/

1.1.1 A COORDINATED TRANS-SECTORAL APPROACH

To achieve the expansion of broadband requires top-level political leadership and joint efforts by the private sector and by governments. Most important of all, these efforts should be coordinated across all sectors of industry, administration and the economy. Developing isolated projects or piecemeal, duplicated networks, is not only inefficient; it also delays provision of infrastructure that is becoming as crucial in the modern world as roads or electricity supplies.

When a trans-sectoral approach is taken — that shares infrastructure and builds synergies among the applications that use it — investments can yield major multiplier effects that benefit healthcare, education, energy efficiency, environmental protection, public safety, civic participation and economic growth. Such a trans-sectoral approach should lead to the development of smart interconnected and sustainable communities, homes and businesses.

A trans-sectoral way of thinking can also be applied across infrastructure projects. The construction of smart grids for electricity supplies, for example, should prompt the installation of communication networks at the same time. It is essential that the various industrial sectors become key users of the new infrastructure, so that its financial and social benefits can be fully realized. As well as facilitating these moves through such measures as improving regulations, governments should show leadership by making sure that their various administrative departments work together to use the infrastructure and to create relevant and useful e-applications.

To optimize the benefits to society, broadband should be coordinated on a countrywide basis, promoting facilities-based competition and with policies encouraging service providers to offer access on fair market terms. Eventually, this can lead to broadband becoming a highly advanced and fundamental infrastructure for modern society.

1.1.2 LOOKING AT THE DETAILS

These principles are among those laid out fully in the first report from the Broadband Commission for Digital Development, "A 2010 Leadership Imperative: Towards a Future Built on Broadband,"[2] which includes recommendations for action. This second report presents a closer look at the facts and figures that could put the recommendations into effect.

"Broadband: a platform for progress" considers ***what*** broadband is — how it can be defined, and ***why*** broadband is so valuable is demonstrated in evidence of its powerful economic effects, as well as an overview of its importance in creating knowledge societies and the multitude of services it can carry. Also examined is ***how*** various types of infrastructure can produce these networks, with examples of broadband deployments being achieved in various countries, including developing ones. Issues of ***policy*** are covered too, such as regulation, spectrum management, and questions of universal service.

In addition, there is an overview of the ***current status*** of broadband deployments on a global and regional basis. Figures 1.1 and 1.2, for instance, show how broadband subscriptions have grown worldwide in recent years.

2 The report is available in six languages at www.broadbandcommission.org/outcomes.html

Figure 1.1 Fixed broadband subscriptions per 100 inhabitants, 2000-2010*

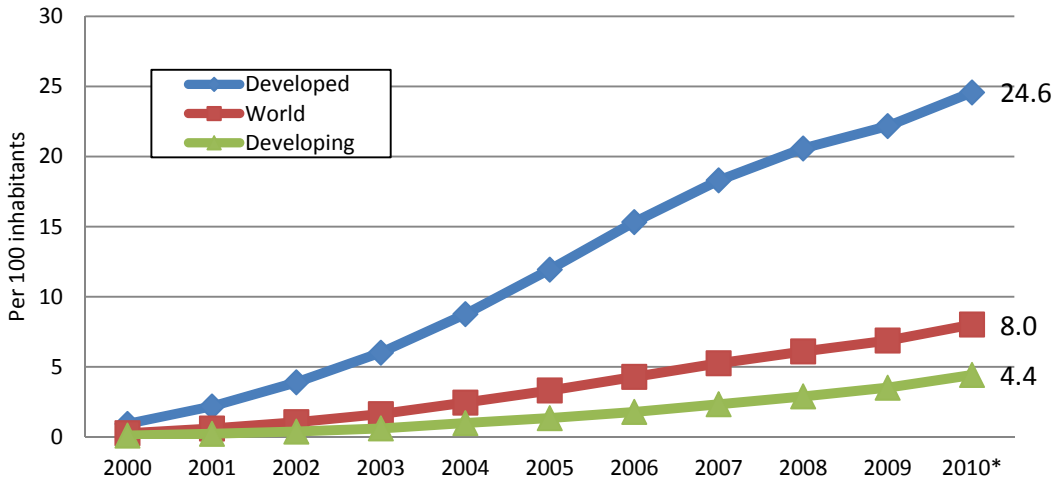
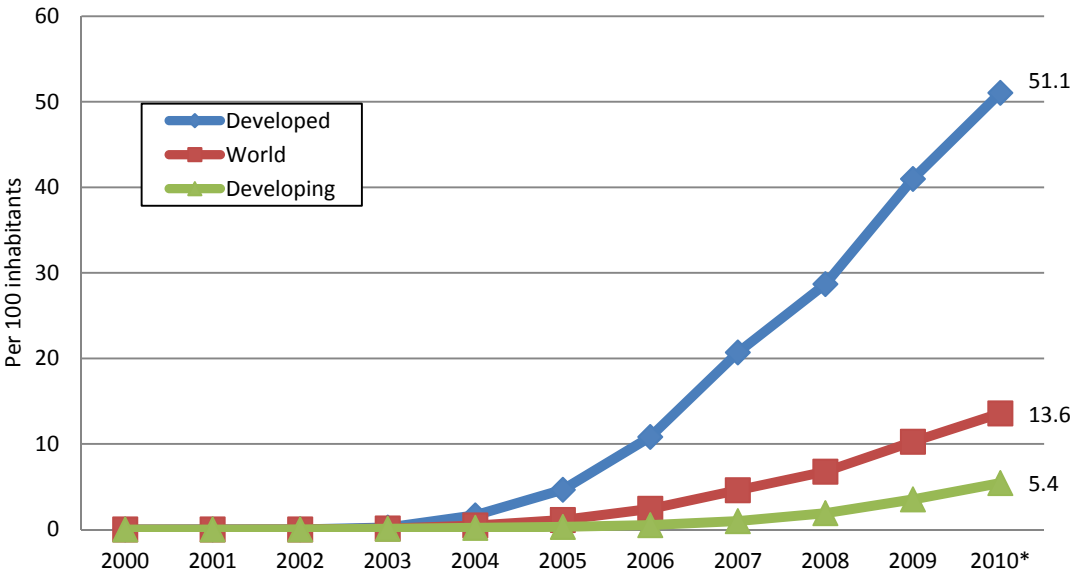


Figure 1.2 Mobile broadband subscriptions per 100 inhabitants, 2000-2010*

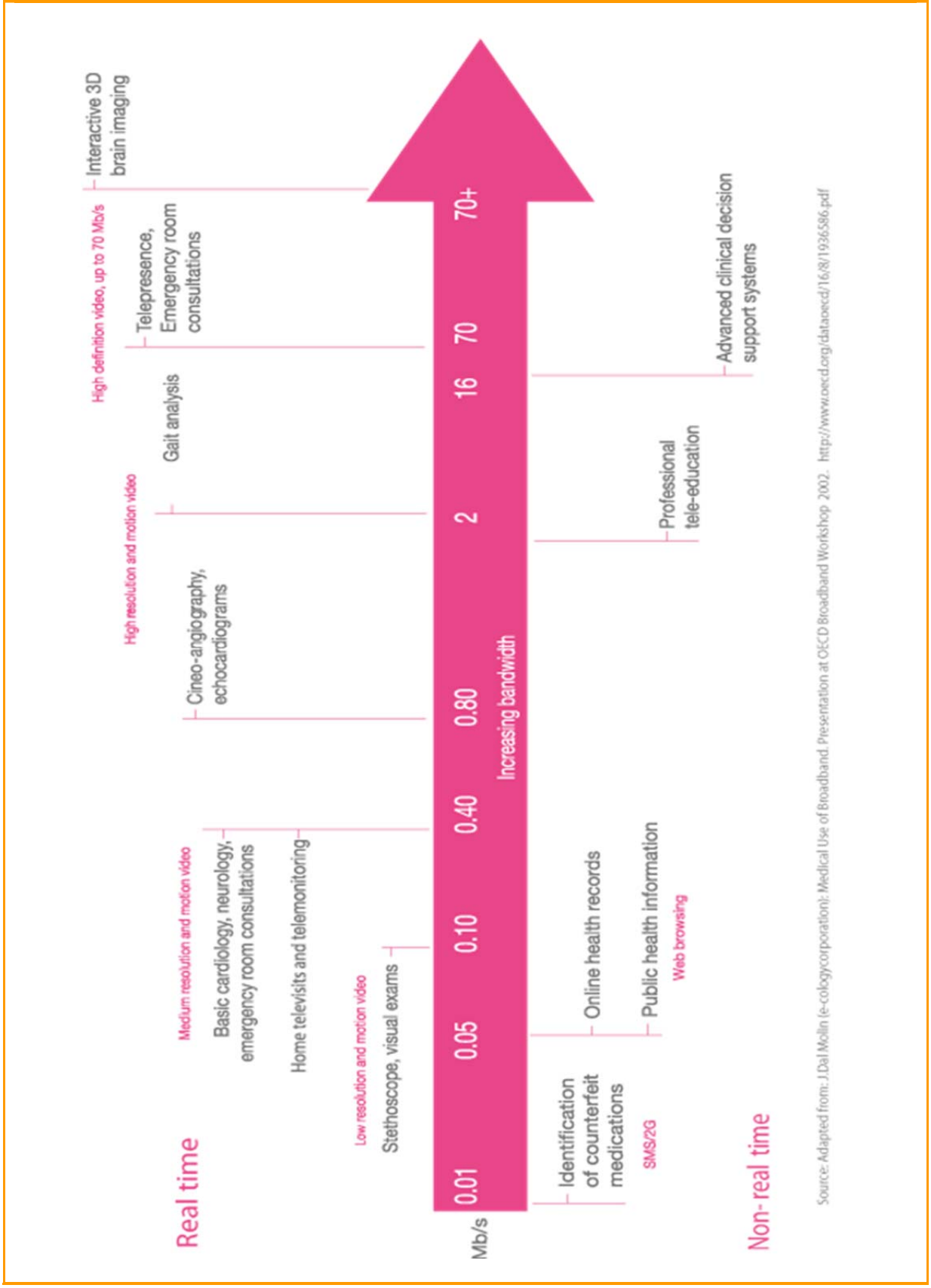


* Estimates for 2010 figures

For developed/developing country classifications, see: www.itu.int/ITU-D/ict/definitions/regions/index.html

Source: ITU World Telecommunication /ICT Indicators database

Figure 1.3 How various broadband speeds can support e-health



1.2 WHAT IS BROADBAND?

Chapter 2 of this report examines the possible ways to define broadband; for example, as minimum upstream and/or downstream transmission speeds, or according to the technology used or the type of service that it can deliver. However, countries differ in their definitions of broadband, and, as technologies advance, the minimum defined speeds are also likely to increase rapidly.

In its Report "A 2010 Leadership Imperative: Towards a Future Built on Broadband," the Broadband Commission therefore decided to focus on considering broadband as based on a set of core concepts, such as an *always-on* service (not needing the user to make a new connection to a server each time), and *high-capacity:* able to carry lots of data per second, rather than at a particular speed.

The practical result is that broadband enables the *combined provision* of voice, data and video at the same time.

Just one of many applications that can be enabled by broadband is e-health. Figure 1.3 shows the types of service that can be provided, from basic e-mail and web browsing to find and exchange medical information, to real-time high-definition video transmissions of medical procedures for diagnostic and training purposes. These valuable health services are highly relevant to achieving several of the Millennium Development Goals.

Figure 1.3 illustrates the different bandwidth requirements for various e-health services. These include non-real-time low-bandwidth messages, such as the transmission of health records via e-mail, but also high-definition emergency room video-conferencing, which may require several tens of megabits per second. Whether broadband or not, most of the applications mentioned are built on technical standards, starting with the underlying networks.

For example, the technical standard ITU-T H.323 (from ITU's Telecommunication Standardization Sector), a call signaling and multimedia transport protocol, is widely implemented by voice and video-conferencing equipment manufacturers. It enables real-time communication to take place between different video-conferencing units, such as at a medical practice in a rural area and a hospital in the city.

Multimedia encoder/decoders, such as ITU-T H.264 for videos and ITU-T T.800 for images; security standards (including the public key infrastructure defined in ITU-T X.509), and the ITU-T G.1000 family of Recommendations ensuring multimedia quality of service and performance, are crucial for many e-health applications.

1.3 WHY IS BROADBAND IMPORTANT?

Can broadband create jobs? How soon would investment in these networks pay for itself? What would be the impact on a country's gross domestic product (GDP)? **Chapter 3** provides links to around a hundred research reports and case studies on the economic effects of providing broadband access to the Internet, alongside use of ICT in general. Examples of this research are given in Tables 1.1 and 1.2.

Nearly all studies suggest positive returns can be expected from investment in broadband infrastructure. For example, an analysis for the European Commission estimates that broadband can

create more than two million jobs in Europe by 2015, and an increase in GDP of at least EUR 636 billion. A study in Brazil reported that broadband added up to 1.4% to the employment growth rate.

In China, every 10% increase in broadband penetration is seen as contributing an additional 2.5% to GDP growth. In Thailand, where in 2010 only some 3% of households had broadband and 12% of individuals, it has nevertheless been forecast that if broadband is promoted, it could add 2.4% per cent to the country's GDP growth rate.

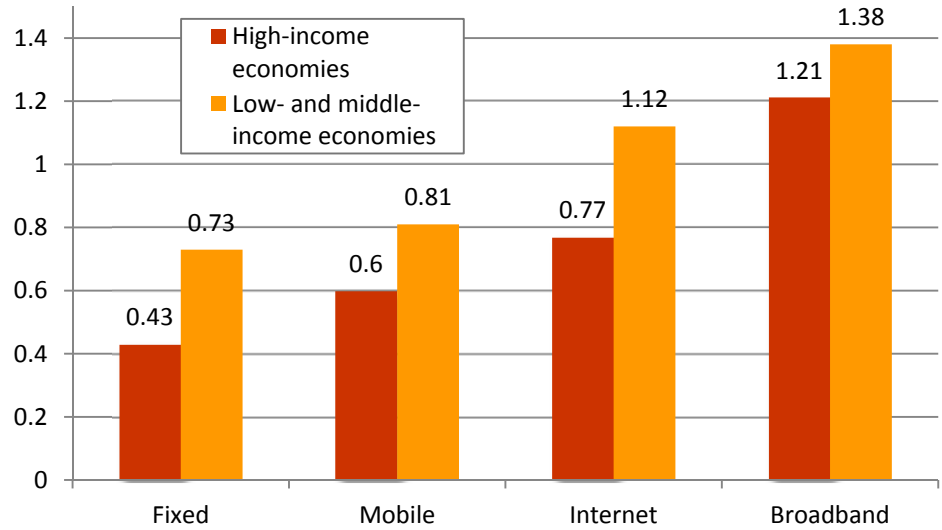
A 2009 study by management consultants, Booz & Company[3] found that "10% higher broadband penetration in a specific year is correlated with 1.5% greater labour productivity growth over the following five years." The report by Booz & Company also suggests that "countries in the top tier of broadband penetration have exhibited 2% higher GDP growth than countries in the bottom tier."

Another management consultancy, McKinsey & Company[4], estimates that "a 10% increase in broadband household penetration delivers a boost to a country's GDP that ranges from 0.1 percent to 1.4 percent."

For developing countries in the low- and middle-income brackets, broadband is a key driver of economic growth and, according to a study by the World Bank, provides a boost of 1.38 additional percentage points to GDP growth for every 10-percentage-point increase in broadband penetration — higher than any other telecommunication service (see Figure 1.4).

And following the recent global financial crisis, many countries included the expansion of broadband networks as crucial elements in their economic stimulus plans[5].

Figure 1.4 How investing in broadband can boost economies



Source: World Bank (2009).
Note: The vertical axis is the percentage-point rise in economic growth per 10-percentage-point rise in penetration.

3 Booz & Company "Digital Highways: The Role of Governments in 21st Century Infrastructure (2009)

4 McKinsey & Company "Mobile Broadband for the Masses" (2009)

5 See ITU "Confronting the crisis: ICT stimulus plans for economic growth" (2009), available at www.itu.int:80/osg/csd/emerging_trends/crisis/fc01.html

Table 1.1 Broadband's impact on economic growth: examples of research

Country Focus	Report Title	Institution	Key Findings
Germany	The Impact of Broadband on Jobs and the German Economy (2010)	Columbia Business School, Telecom Advisory Services LLC, Polynomics AG	An investment of EUR 36 billion will return EUR 22.3 billion to the economy during network construction, as well as externalities of EUR 137.5 billion
Thailand	Broadband Thailand 2015 (2010)	Center for Ethics of Science and Technology, Digital Divide Institute, Thailand	In 2010 the Thai broadband penetration rate was only 3.4% of households and about 12% of individuals, but it is forecast that broadband will contribute 0.9% to Thailand's GDP growth rate.
Japan	Investment in Broadband Infrastructure: Impacts on Economic Development and Network Neutrality (2009)	Kyushu University, Japan	If the Japanese economy grows and the potential of ubiquitous networks is fully utilized, the real GDP growth rate will be about 1.0 to 1.1 points higher than otherwise
China	Broadband in China: Accelerate Development to Serve the Public (2009)	Value Partners	The development of China's dial-up and broadband Internet together may contribute a combined 2.5% to GDP growth for each 10% rise in penetration.
Global	What Role should Governments Play in Broadband Development? (2009)	The World Bank/InfoDev	Broadband is a key driver of economic growth, providing a boost of 1.38 percentage points in GDP growth in developing countries, for every 10-percentage-point rise in penetration.
Latin America, Caribbean	The Impact of Taxation on the Development of the Mobile Broadband Sector (2009)	Telecom Advisory Services LLC	In 24 Latin American and Caribbean countries (controlling for educational level and development starting point), a 1% rise in broadband penetration yields a 0.017 point rise in GDP growth. Broadband growth between 2007 and 2008 (prorated average of 37%) contributed between USD 6.7 billion and USD 14.3 billion, including direct and indirect effects, and preservation of an economic growth rate.
15 OECD nations, 14 European	Economic Impact of Broadband: An Empirical Study (2009)	LeCG Ltd., for Nokia Siemens Networks	One more broadband line per 100 people in these "medium or high ICT" countries raises productivity by 0.1%.
Republic of Korea	Broadband as a platform for economic, social and cultural development: Lessons from Asia (2008)	The World Bank/InfoDev USA	The contribution of telecom services and broadband to GDP more than doubled between 1995 and 2005: the decade of broadband's expansion in the Republic of Korea
UK	The Economic Impact of a Competitive Market for Broadband (2003)	Centre for Economics and Business Research Ltd The Broadband Industry Group, CEBR	By 2015, the productivity benefits of broadband could result in the GDP of the UK rising by up to GBP 21.9 billion

Table 1.2 Broadband's impact on jobs: examples of research

Country Focus	Report	Institution	Key findings
Germany	The Impact of Broadband on Jobs and the German Economy (2010)	Columbia Business School, Telecom Advisory Services LLC, and Polynomics AG	Broadband network construction will create 304,000 jobs between 2010 and 2014, and 237,000 between 2015 and 2020. Also, it is estimated an additional 427,000 jobs will be created: 103,000 in 2010–2014 and 324,000 in 2015–2020. The accumulated total jobs over a ten-year period (2010–2020) will reach 968,000.
Sudan	Economic impact of mobile communications in Sudan (2010)	Zain, Ericsson	In addition to providing over 40,000 jobs to the Sudanese economy, the mobile telecommunications sector is related to demand-side GDP growth rates of 0.12% for each 1% rise in market penetration.
Brazil	Economic Development and Inclusion through Local Broadband Access Networks (2009)	The Multilateral Investment Fund, Inter-American Development Bank	Broadband has added about 1-1.4% to the employment growth rate
UK	The UK's Digital Road to Recovery (2009)	LSE enterprise ltd, and The Information Technology and Innovation Foundation	An additional GBP 5 billion investment in broadband networks would create or retain an estimated 280,500 UK jobs for a year.
USA	Economic Impacts of Broadband, Information and Communications for Development: Extending Reach and Increasing Impact (2009)	The World Bank	Broadband added 10-14% to the growth rate in the number of jobs between 1998 and 2002.
USA	The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of US Data; Robert Crandall, William Lehr,Robert Litan (2007)	"Issues in Economic Policy" July 2007 (The Brookings Institution)	For every one percentage point increase in fixed broadband penetration in a US state, employment is projected to increase by 0.2 to 0.3% per year.

1.4 CONTENT, CREATIVITY AND CAPACITY BUILDING

Broadband networks are, of course, pointless without connectivity — not simply to objects in what has been called "the Internet of things," but to people, in every community around the globe. **Chapter 4** looks at the essential role of broadband in the creation of "Knowledge Societies."

The four key principles identified for development of truly inclusive Knowledge Societies are:

- Freedom of expression
- Universal access to information and knowledge
- Respect for cultural and linguistic diversity, and
- Quality education for all.

Chapter 4 examines issues in each of these areas, and highlights projects that are being carried out to meet the challenges. These include efforts to make Internet access easier for people with disabilities, as well as gathering together scholarly and cultural resources in digital format and making them freely available in multiple languages (see Box 1.2).

Box 1.2 The World Digital Library (WDL)

WDL is an online resource that has been developed to provide free, multilingual access to documentary heritage held in institutions around the world, aiming at a wide audience ranging from students and researchers to the general public. The content is contributed by partner institutions in the language of origin and is accessed through an interactive interface in seven languages: Arabic, Chinese, English, French, Portuguese, Russian, and Spanish. Furthermore, voice-enabled browsing permits easy access by people with visual disabilities, as well others interested in this tool, such as language students. WDL provides speedy, reliable delivery of content and complies with the W3C Web Content Accessibility Guidelines WCAG 2.0. Each item can be viewed using state-of-the-art zoom features.

The impact of WDL has already been considerable. Within 20 months of its launch in 2009, 13.2 million visitors had accessed the site. Users have come from all around the world, the highest numbers have been from Spain, the United States, Mexico, Brazil, Argentina, China, France, the Russian Federation, Portugal, and Colombia, with the Spanish language interface being the most often consulted. By December 2010, more than 2.7 million links had been made to the WDL from other websites.

Source: UNESCO

The need to build capacity and well-trained personnel is noted — especially among women and girls, who tend to be on the wrong side of a digital divide when it comes to ICT. At the same time, education through broadband networks can be a powerful part of the solution.

The chapter stresses that the global roll-out of broadband networks offers vast potential for development. However, for this potential to be realized, a level playing field must be created for users, content providers and network developers alike. This implies the adoption of policy frameworks which minimize the risk that unequal broadband access might create new knowledge divides between developed and developing countries, and between privileged and disadvantaged populations.

1.5 WHAT CAN BROADBAND DELIVER?

It is essential that, as broadband networks are rolled out and capacities improve, the applications using broadband are created at the same time, because improvements in demand can often drive supply. **Chapter 5** gives an overview of some of the vast and quickly expanding range of services that can be delivered by broadband networks, and illustrates their impact on society.

E-commerce, for example, is an area that is increasingly familiar. According to one report,[6] in 2012 more than a billion people worldwide will spend the equivalent of over a trillion US dollars on business-to-consumer transactions, while the value of business-to-business trade will be ten times greater. Broadband accelerates the whole process, making it faster and more convenient and attractive for sellers and buyers.

Financial transactions and banking are also fast-growing applications carried over broadband. For mobile devices, m-banking is particularly significant in developing countries, where many people

6 IDC “Number of Mobile Devices Accessing the Internet Expected to Surpass One Billion by 2013” (2009)

would not otherwise have access to such services. It has been forecast that by 2012, around 190 million consumers will be making mobile payments worldwide, with the number in emerging markets growing quickest[7].

Governments too are increasingly using broadband to provide online portals where citizens can both receive information and interact with the administration — by applying for licences, for instance. Government departments themselves become much more efficient when their systems are coordinated through broadband networks.

Healthcare is potentially one of the most important areas where broadband can make an impact. It has been estimated that at least USD 5.5 trillion is spent worldwide on providing healthcare[8], but cost savings of between 10% and 20% could be achieved through the use of telemedicine delivered by broadband. And if such systems are *not* put in place, many people could be left without adequate care: a World Health Organization report[9] revealed an estimated shortage of almost 4.3 million medical staff worldwide, with the situation being most severe in the poorest countries. Medical advice, monitoring, diagnosis and training delivered through broadband can help a great deal to overcome these gaps.

Training of professionals in all sectors can be delivered through broadband video and other applications. And this has the potential to take education in general to every school or home, however remote. One example is the partnership announced in late 2009 between Ericsson and the Indira Gandhi National Open University (IGNOU), based in New Delhi, India, which will allow up to 2.5 million students from India and 34 other countries to download IGNOU course contents to their mobile phones via a third-generation (3G) network that Ericsson plans to build.

Another example can be found at the primary school level in Uruguay, where every child has been provided with a laptop and Internet access at school. The total expense of the "Ceibal" project, completed in October 2009, came to less than 5% of the country's education budget — but the "connected" children are likely to reap tremendous educational rewards.

Box 1.3 India joins Africa to offer broadband e-education and e-health

Launched in February 2009, the Pan African e-Network Project is an initiative of the President of the Republic of India, which aims to connect 53 African countries through satellite, fibre-optics and wireless links, with each participating country connected to a Continental Hub Earth Station. The Pan African Online Services Network will provide tele-education and telemedicine to the 53 States. The services will be provided by seven universities (two in India and five in Africa) and eight hospitals (three in India and five in Africa).

Meanwhile, digitization is making more and more information available via broadband. E-newspapers, e-books, scientific journals online and digital libraries, for example, are changing the pattern of access to valuable content in many countries, and modifying the way we read or do research (see Box 1.2). Efficient access to these innovative resources, which are increasingly providing sophisticated value-added services, could be of interest for many developing countries. The development of local content is also a "must" for promoting cultural diversity on the Internet, which is a goal of a wide variety of countries.

7 Gartner Research "Gartner says number of mobile payment users worldwide to increase 70% in 2009" (2009)

8 The Boston Consulting Group (2011)

9 World Health Organization & Global health Workforce Alliance "Scaling up, saving lives" (2008)

Scientific research on a major scale is greatly assisted by broadband networks. Not only can researchers now exchange vast amounts of data of all kinds extremely rapidly, but new ways have emerged for tackling highly complex topics. Distributed or "grid" computing permits thousands of small computers to be joined together to analyse huge amounts of data and transmit the results to a central point.

More broadly, the arrival of "cloud computing" makes sharing information easier and frees individual users and businesses from having to store data and programs on their own computers. Such systems are based on broadband networks, and offer substantial savings in the costs of hardware, software, premises and personnel. One forecast by market analysts[10] suggests that at least 52 countries could benefit from cloud computing services through the addition of around USD 800 billion in net new business revenues between 2009 and 2013.

The power of broadband also underpins the collection, sharing and analysis of vital data on the environment, gathered via satellite, for example, or by direct sensor technology. This information can be used to predict natural disasters such as floods or famines. Wireless broadband in particular also provides a platform for reliable communications in the event of natural disasters, when terrestrial communication networks are often damaged or destroyed. In addition, broadband can deliver such services as telemedicine to disaster sites.

Climate change — an origin of extreme weather events — can be tackled through the energy efficiencies that broadband brings across industrial sectors. Better stock control and distribution through using networks to track radio-frequency identification (RFID) tags on goods, means fewer trucks on the road. Video-conferencing means less travel. Electronic media, such as e-books, mean that fewer physical products need to be manufactured.

Box 1.4 Broadband supports intelligent energy use

Broadband technologies are enabling intelligent home networks that can assist in controlling indoor climates and monitoring energy. Taking these concepts further leads to the development of smart buildings, smart cities and smart communities.

An example is the Urban Energy Management project for apartment complexes launched in 2009 in Madrid, Spain. In each apartment, a smart meter and the building's broadband infrastructure enable residents to manage their consumption of electricity, gas and water. The system also allows building managers and relevant authorities to monitor and manage energy use across different buildings and urban areas and provide a wider community view of energy consumption. It can provide, for example, real-time graphs displaying energy use, as well as comparison data.

The pilot scheme is the beginning of a project that aims to incorporate such innovations as heating and cooling using geothermal and solar panel technologies. With the management and control systems, it is estimated that these innovations can deliver major energy savings.

When it comes to power supplies themselves, "smart grids" allow electricity companies to limit losses, prevent outages and provide customers with real-time information they can use to manage their own energy use at home or at a business (see Box 1.4). In addition, smart grids make it easier for locally generated electricity (including from renewable sources) to be integrated, stored and shared as demand fluctuates across the grid.

10 IDC "Aid to Recovery: the economic impact of IT, software, and the Microsoft ecosystem on the global economy" (2009)

Some studies in the United States have suggested that savings of between 10% and 25% in electricity demand are achievable through using smart grids — and the same communication networks used to create smart grids can deliver broadband connectivity to homes and businesses.

In summary, **Chapter 5** concludes that broadband has important benefits to offer in enabling the provision of a wide array of services in areas as diverse as public health and climate monitoring. Broadband is not an end in itself: it is an important means of meeting a wide variety of goals in highly diverse sectors.

1.6 HOW CAN BROADBAND BE DEPLOYED?

1.6.1 INFRASTRUCTURE CONSIDERATIONS

Chapter 6 of this report seeks to identify key factors in a nation's physical communications infrastructure, and to identify the path for expanding and improving that infrastructure so that broadband connectivity can be delivered to all.

Some of the main conclusions emerging from the review of measures to deploy a national broadband infrastructure include:

- Infrastructure policy should take account of rapid technical advances and be focused on larger goals, not directed towards a specific technology mix. Legacy infrastructure (or lack thereof) constitutes both a constraint and an opportunity.
- Infrastructure goals are separate from questions of public ownership of facilities and the role of competition in spurring private investment.
- Pricing or other barriers that restrict access to networks or infrastructure must be removed as far as possible.
- Preserving flexibility and innovation at the network's edges is essential. It must be possible to attach new applications and access devices, such as smartphones — which is much easier than replacing core infrastructure.
- The physical network is distinct from the services and functions that travel across it, and, in the interest of competition and technical progress, too close an association between infrastructure and a particular service should be avoided.
- Fibre-optic networks are likely to be preferred as backbone wired infrastructure for high-volume users, but these must be complemented by rapidly evolving wireless (terrestrial and satellite) infrastructure that will provide more bandwidth more economically as technology develops. Countries all differ in terms of geography, topology and existing infrastructure, and satellite services will continue to be very important in serving the lowest-density areas, due to the high costs of deploying terrestrial technologies.
- The sharing of infrastructure should be facilitated and encouraged, and policy-makers should consider how best to ensure synergies among applications and services. This means adopting an integrated, trans-sectoral approach.

Chapter 6 examines specific areas such as the design of next-generation networks, and wireless broadband infrastructure that is of particular significance to developing countries and remote areas.

Box 1.5 From IPv4 to IPv6

A crucial aspect of broadband connectivity is the ability to connect to end-user devices and the dramatically growing world of machine-to-machine communications. All this needs an enormous supply of Internet addresses — but these are beginning to run out.

Currently, the vast majority of links use version 4 of the Internet protocol, or IPv4, which was defined in 1981 for a much smaller network. Deployment of a new version of the Internet protocol, IPv6, using 128-bit addresses, will generate a total number that is so huge it would yield trillions of addresses for every person on Earth, and for the Internet of things. The challenge is to manage the transition so that the Internet does not fragment, while maintaining services and expansion.

There have been many discussions of the technical, administrative and coordination issues that the migration to IPv6 entails, but much more work remains to be done. In addition, there are immediate costs associated with deployment of IPv6, whereas many benefits are long-term and depend on a critical mass of actors adopting it. Migration to IPv6 requires planning and co-ordination over several years, and this means that increased awareness of the issues is needed among all players, including governments.

1.6.2 COUNTRY CASE STUDIES

Chapter 6 also provides examples of how broadband infrastructure and services are being provided in various countries. Successful examples are highlighted of how government initiatives, alongside private-sector investment, have succeeded in extending access to more and more citizens, as national broadband networks are being planned and established.

In **Malaysia**, for example, a National Broadband Plan was announced in 2004, and in 2008 an agreement was signed between the Malaysian government and Telekom Malaysia to build a high-speed broadband network at an estimated cost of MYR 11.3 billion, with the government contributing MYR 2.4 billion and Telekom Malaysia paying the rest. The project is to take ten years with the initial phase to cover major cities and towns. This was expected to boost the country's broadband household penetration rate to 50% in 2010, as targeted by the government. In early 2010, the Malaysian regulator said the aim was to have broadband connections to 3.2 million homes across the country by the end of the year, which it saw as adding 1% to GDP and 135,000 new jobs.

Morocco is an example of a country that has achieved very rapid adoption of broadband services, based on affordable prices for consumers, even though the incumbent Maroc Telecom has had a dominant share of the market. Within four years of its introduction in 2003, more than 40% of Morocco's 1.3 million fixed phone lines were using a digital subscriber line (DSL) broadband service. In 2007, the first 3G services were made available for mobile broadband, and by March 2010, 3G had acquired a 65% share of the broadband market. To accommodate the increasing Internet traffic, international connectivity and the fibre-optic national backbone network are being upgraded.

Meanwhile, the Moroccan government launched a "Maroc Numeric 2013" initiative in October 2009. It aims to have one in three Moroccan families use broadband Internet access by 2013, and 400 computer centres will be built in low-income districts and remote areas.

In 1999, **Sweden** was the first country in Europe to develop a broadband policy, and, according to a report from the World Economic Forum,[11] in 2010 it was the most digitally connected economy in the world. The Swedish government promotes broadband provision in rural areas where there is little market incentive to do so, and for the period 2009 to 2013, has committed some SEK 4.4 billion in

11 WEF "The Global Information Technology Report 2010-2011"

grants to municipalities and operators to expand broadband infrastructure (particularly fibre-optics). Government funding is limited to 50% of the costs, with operators and local governments providing the balance.

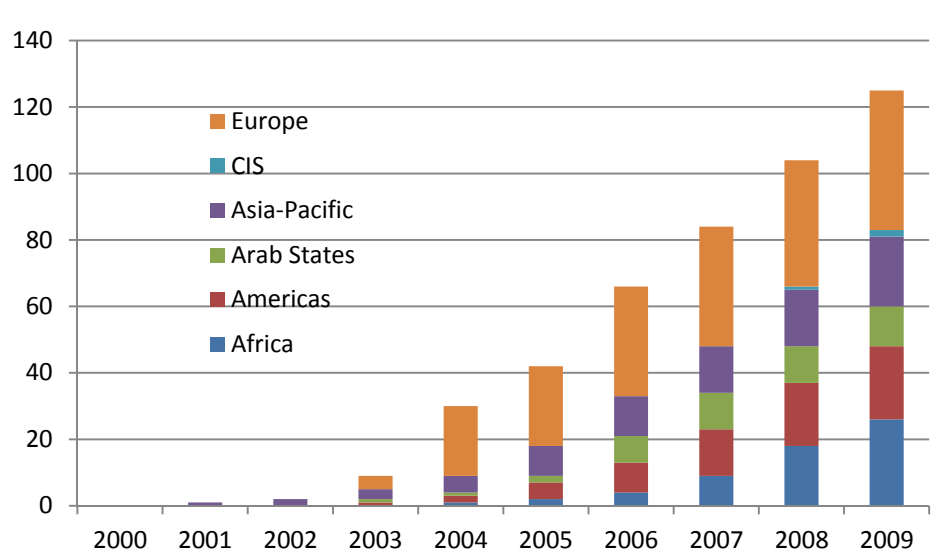
A highly successful example of a Swedish municipality's support of broadband can be seen in the capital, Stockholm. In the mid-1990s, the Stockholm government established a company called Stokab to build an open-access fibre-optic network. This network is now over 4,500 kms long and connects competing service providers with government and business customers. Stokab also provides broadband access to over 95,000 low-income households in public housing.

1.7 POLICY ISSUES

Broadband is clearly an enabler of economic and social development. However, as broadband adoption and usage widens, growing policy challenges are emerging, which are examined in **Chapter 7.** The first concern is regulation of broadband access, services and applications. A new vision is needed of reduced regulatory burdens, innovative incentives, and coordinated efforts by all links in the broadband value chain, in order to unleash opportunities for commercial deployments.

Chapter 7 provides a road map of the policy and regulatory issues related to broadband, with a focus on developing countries. It discusses the elements of sound and forward-looking regulatory frameworks to enable broadband access for all. It addresses the core layers of modern regulation, including competition, liberalization, authorization regimes and universal access from a broadband perspective. It examines the various tools that regulators can use to reshape the national ICT sector and open up new broadband opportunities across the economy. And the chapter also highlights some of the ancillary issues related to pro-broadband regulation, such as ownership structures, infrastructure sharing, technical standards and intellectual property rights.

Figure 1.5 Number of countries having assigned spectrum for IMT-2000



Source: ITU World Telecommunication/ICT Regulatory Database.

Another important policy concern is the allocation of radio frequency spectrum — a limited natural resource that is in growing demand. Since the launch of the first mobile broadband network in 2001, no less than 130 countries had launched commercial IMT-2000 (3G) services by the end of 2009 (See Figure 1.5). Mobile WiMAX services were gaining ground and services were available to customers in 76 countries. Technological progress and the transformation of telecommunication markets mean that traditional approaches to allocation are set to change, and the chapter considers how the use of spectrum can best be optimized.

Chapter 7 also discusses the issue of universal service for broadband, which is vitally important in ensuring that citizens in remote and rural areas can have access, even though they live outside more profitable urban areas. Countries are now beginning to include broadband as part of universal service obligations, regarding access to the Internet as a utility and an essential tool for social and economic welfare.

Out of 132 countries worldwide having established a definition of universal access and/or universal service by 2009, more than two-thirds had included Internet access in that definition. And at least 30 countries had explicitly mandated access to broadband, including Brazil, China, Ghana, Kazakhstan, Malaysia, Morocco, Nigeria, Peru, Spain, Sri Lanka, Switzerland and Uganda. Their number is constantly growing, while some countries have gone even further. For example, Finland was the first nation to declare broadband a legal right in 2009, entitling every person to have access to a 1 Mbit/s Internet connection by mid-2010.

1.8 BROADBAND FOR THE FUTURE

Some researchers have indicated that there is a “tipping point” at which the penetration rate of broadband services within a nation becomes large enough to begin to rapidly influence all sectors in a significant and highly productive way. Mandating universal access to broadband identifies that goal, at least, while practical ways are developed to connect to the last mile and the last community and household.

Whether or not broadband access to the Internet is considered a universal service, however, it is clear that its expansion to as much of the population as possible has enormous potential to sustain and improve social and economic benefits across the board. Nevertheless, more research is required on sustainable business models for infrastructure and services, especially in relation to developing countries. This will include further examination of the economic impact of broadband across all sectors, as well as its social effects.

The Broadband Commission’s online repository of case studies, recommendations and research materials (www.broadbandcommission.org/sharehouse) will continue to be an interactive resource that is aimed at becoming the focus of such research for the future of broadband — a platform for progress.

2 WHAT IS BROADBAND?

2.1 POSSIBLE DEFINITIONS

It is possible to define "broadband" in various ways: as a minimum upstream and/or downstream transmission speed, for example, or according to the technology used or the type of service that can be delivered. However, countries differ in their definitions of broadband, and, as technologies advance, the minimum defined speeds are likely to increase at the same pace.

These various definitions have been debated by the Broadband Commission for Digital Development. An online discussion among Commissioners, for example, considered whether any of the following options (or a combination of them) could be used:

- ***Option 1***: Broadband could be defined with **quantitative** indicators, in terms of bandwidth and technologies.
- ***Option 2***: Broadband could be defined with **qualitative** indicators, in terms of the applications that can be made possible, and/or the impact that broadband infrastructure could have on social and economic development.
- ***Option 3***: A **combination** of the above, or other possible options.

2.1.1 QUANTITATIVE INDICATORS

In general terms, using quantitative indicators alone was seen as insufficient to build a global common definition of broadband. Most Commissioners putting forward this view were reluctant to prescribe specific speeds of transmission over networks, due to the varying capacities of infrastructure in different countries, and the dynamic nature of the industry.

However, there was overall agreement that "speed" should at least be included as one of the reference indicators, and that a minimum speed should aim at ensuring access for everyone to online public services. The main arguments presented in relation to this option of quantitative indicators are summarized in Table 2.1.

Table 2.1 Option 1 – Using quantitative indicators to define broadband

Arguments for	Arguments against
• Having a definition which refers to data speeds can help to provide a baseline for the roll-out of broadband and the comparison of national efforts. However, finding a universal definition could be a challenge, as there are important differences between the developed and the developing world. • In relation to developed countries, some Commissioners defined broadband as having a minimum transmission capacity of 1 Mbit/s, although more ambitious targets were also mentioned, such as using a minimum of 10 Mbit/s, as well as plans from the private sector to deploy networks of at least 1 Gbit/s. The provision of good quality services will be improved by defining and encouraging higher speed broadband connections. • In relation to the developing world, some Commissioners suggested defining broadband networks as having a bandwidth of 512 Kbit/s downstream and 256 Kbit/s upstream, in line with ITU's current definition. However, it was widely acknowledged that any such indicators need to be regularly reviewed to take into account technological advances. • As well as speed, other indicators that might need to feature in a quantitative definition are price, latency, jitter, burstiness and "always on" connectivity.	• Some Commissioners argued that a quantitative definition of broadband could lead to continuing debate and become outdated with time, as definitions would be tied to the services that we know now. For example, a speed of 100 Mbit/s is available today, but might not be sufficient for some applications in a few years' time. • Many applications require the two-way exchange of data. Therefore, "speed" needs to be defined for both upstream and downstream transmissions. This differentiation must be recognized as an important characteristic of modern broadband connections. • Commissioners highlighted the difficulty of trying to define universal speeds that could be applied at the global level. It will be impossible to create a "one size fits all" solution, since the capacity of each country to supply broadband infrastructure will vary. Developing countries, for example, are not in the position to provide broadband on the same scale or at the same transmission rates as developed countries. • Therefore, national definitions of speed need to be considered, within an international framework that allows national and regional circumstances to be taken into account.

2.1.2 QUALITATIVE INDICATORS

Some Commissioners said that having too strict a technical definition could undermine the progress of developing countries towards deploying broadband; conversely, a technical definition could encourage them to install infrastructure with at least this capacity.

In line with this argument, many Commissioners argued that basing a definition on qualitative indicators could be more realistic for developing countries, as it would help to overcome some of the issues raised against quantitative indicators: namely, that not every country's broadband solutions will be the same, and that innovation is constantly raising the bar, in terms of the data rates which can be provided.

Therefore, the best solution could be for definitions of broadband to emphasize its potential for service delivery and for stimulating economic growth, both locally and nationally. The main arguments presented in relation to this option are summarized in Table 2.2.

Table 2.2 Option 2 – Using qualitative indicators to define broadband	
Arguments for	Arguments against
• A definition of broadband based on services will generally be flexible enough to evolve. It can also take into account the varying capacities of individual countries and provides a framework around which they can develop national broadband plans, policies and regulations that will be most attractive for investment in the sector. • Broadband could be defined as "*a data transfer capability sufficient to deliver streamed video and audio into a consumer terminal (via wired connections into computers, or via wireless networks to converged mobile handsets or satellite terminals), and to provide a sufficient upload capability for e-mail and document transfer from mobile consumer terminals*". • In defining broadband, emphasis should be given to the potential for economic growth, both locally and nationally. Broadband access should, furthermore, support the provision of services in key government sectors, such as health and education.	• This option could arrive at too loose a definition, making it difficult to measure and compare broadband infrastructure and national plans among countries. • Although countries need to be able to identify realistic targets for themselves, there is a chance that governments might begin to pursue other policy priorities instead of broadband. Technical assistance in such cases should therefore include the top levels of policy-makers. • Without reference to a specific target in terms of broadband speed, there will be no baseline against which to monitor progress. • A good approach would be to develop a guide indicating the kinds of applications that can be delivered at each speed (as well as the time taken to deliver them). Countries will then be better prepared to identify the services they wish to make available in each sector, and identify the speeds needed to deliver them efficiently.

2.1.3 COMBINING BOTH OPTIONS

Defining broadband using both quantitative and qualitative indicators is a potential compromise that overcomes the limitations of using only one of these options. Therefore, Commissioners suggested that the possibility should be explored of having a general definition at the highest level (with certain parameters that would allow the definition of a global benchmark), while leaving the quantitative and technical aspects to national policy-makers or regulatory bodies. Parameters for assessing broadband development could include the following elements:

a) Level of access and penetration

b) Data, voice and video transfer speeds above some minimum level

c) Whether ubiquitous coverage is available, and

d) The criteria mentioned in favour of the previous options (see Tables 2.1 and 2.2).

However, such a combined definition might remain incomplete. The wide range of broadband indicators, the lack of homogeneity in broadband data transfer speeds and bandwidth, and a broad diversity of regulatory and geographic factors do not facilitate an accurate global definition of broadband. It would therefore be desirable to refocus the definition beyond the traditional elements and involve high-speed networks, services, applications and users, alongside policies regarding the promotion of investment, affordability, demand, availability and access.

Regardless of which option for defining broadband is selected, a global and updated definition would need to be reviewed regularly, in order to keep up with the pace of technological change and the demand for new types of service.

2.1.4 SPECIAL CONSIDERATIONS FOR DEVELOPING COUNTRIES

The Broadband Commission agreed that definitions of broadband should, as far as possible, take into account the particular challenges faced by developing countries. Accordingly, many Commissioners argued that although a reference level can give developing countries a goal at which to aim, setting the bar too high might discourage them from implementing their broadband initiatives.

To overcome this challenge, tiered definitions could be useful. For example, countries could aim for a speed of "Level 1" by 2015 (the target year for the Millennium Development Goals). They could then aim for Level 2 by 2025, and finally a Level-3 speed by a later date. Tiered targets could allow policy-makers to be more effective in setting out road maps for broadband development, and in comparing the progress of countries, regardless of their starting points.

Establishing a broadband "tool kit" could be helpful in defining desirable applications and the speeds of Internet access required to deliver them efficiently. Countries could then distinguish the services they hope to provide via broadband networks, and work to establish the infrastructure capable of achieving those goals.

By using this approach, it would be possible to avoid settling on a specific figure in terms of speed alone, and instead make recommendations to individual countries based on their level of existing infrastructure and their target services for the future. For example, the kinds of applications that would become available at speeds of Level 1, Level 2 and Level 3 could be listed, and countries could devise their national broadband plans accordingly.

2.1.5 A WORKING DEFINITION

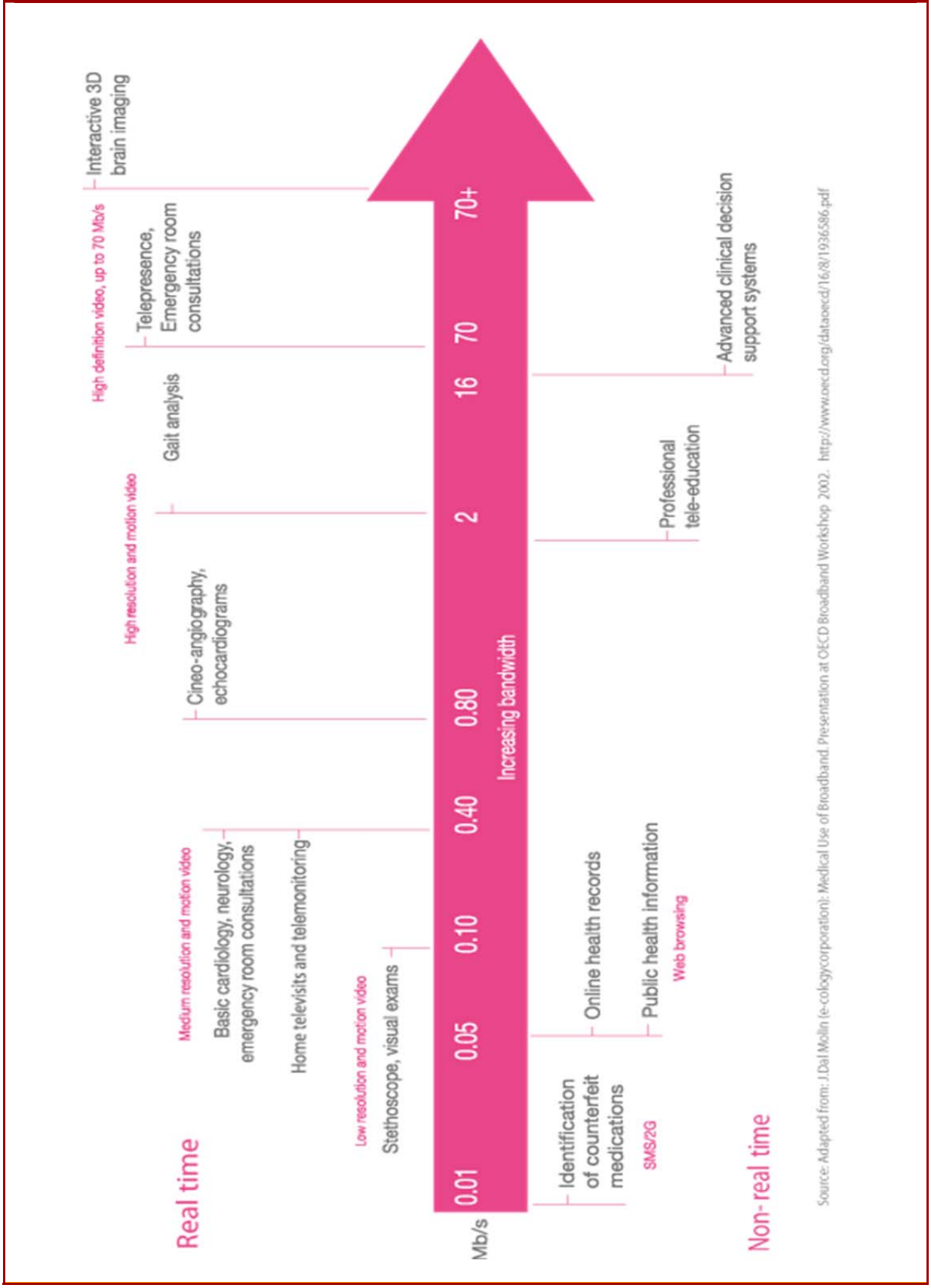
The Broadband Commission sought to focus on considering some of the core concepts of broadband as an ***always-on*** service (not needing to make a new connection to a server each time a user wants to go online), and ***high-capacity****:* able to carry lots of data per second, rather than the particular arrival speed of the data.

The practical result is that broadband enables the ***combined provision*** of voice, data and video at the same time. Table 2.3 shows the types of service that can be provided at various capacities of broadband.

Table 2.3 Theoretical time to download data online at different connection speeds

Download type	56 Kbit/s (dial-up)	256 Kbit/s	2 Mbit/s	40 Mbit/s	100 Mbit/s
Google home page (160 KB)	23 seconds	5 seconds	0.64 seconds	0.03 second	0.01 second
ITU home page (750 KB)	107 seconds	23 seconds	3 seconds	0.15 second	0.06 second
5 MB music track	12 minutes	3 minutes	20 seconds	1 second	0.4 second
20 MB video clip	48 minutes	10 minutes	1 minute	4 seconds	1.6 seconds
CD, or low quality movie (700 MB)	28 hours	6 hours	47 minutes	2 minutes	56 seconds
DVD, or high quality movie (4GB)	1 week	1.5 days	4.5 hours	13 minutes	5 minutes

Figure 2.1 How various broadband speeds can support e-health



A practical example of what various broadband capacities can achieve in the field of telemedicine is provided in Figure 2.1, in terms of real-time applications as well as those that do not need to be real-time.

This demonstrates that even at low speeds and basic Internet access, very useful functions can be carried out, such as exchanging e-mails and web browsing for medical information. With broadband and as capacities improve, more advanced services become available, including real-time, high-definition consultations with doctors in remote locations.

2.2 A SNAPSHOT OF THE STATUS OF BROADBAND

2.2.1 THE WORLDWIDE PICTURE

According to ITU statistics, by 2011 the global number of Internet users had surpassed 2 billion. In terms of broadband development and usage, there has also been a dramatic global increase over the last few years. At the end of 2010, the world total of fixed (wired) broadband subscriptions was an estimated 555 million, up from 471 million a year earlier. Worldwide mobile broadband subscriptions reached 940 million in 2010, and are expected to top 1 billion in 2011 — up from 73 million in 2005.

These rises are reflected in the growing percentages of the population with access to broadband (the "penetration" level), as indicated in Figures 2.2 and 2.3. However, a wide gap remains between developed countries and the developing world. By 2010, nearly a quarter of people in developed countries had fixed broadband access, and more than half had mobile broadband. The corresponding figures for developing countries are estimated at 4.4% and 5.4% respectively.

2.2.2 THE GAPS IN AFFORDABILITY AND RURAL ACCESS

The price of broadband is another issue. ITU calculates a "price basket" that includes what it costs for someone to have a broadband connection to the Internet. Figure 2.4 shows the dramatic difference between developed and developing countries for fixed access.

In 2009, an entry-level fixed broadband connection cost on average 190 PPP (purchasing power parity) dollars per month in developing countries, and this represented more than the monthly gross national income (GNI) per person in almost 30 countries. In comparison, fixed broadband cost an average of only 28 PPP dollars per month in developed countries.

Not surprisingly, mobile broadband is used more than fixed access in the developing world. However, although the prices of services and handsets are dropping, the basic costs of mobile telephony in these countries remains higher in terms of monthly GNI per capita, at an average 7.5%, compared with 1.2% in developed countries. In Africa, the figure is 16.7% (see Figure 2.5).

Figure 2.2 Fixed broadband subscriptions per 100 inhabitants, 2000-2010*

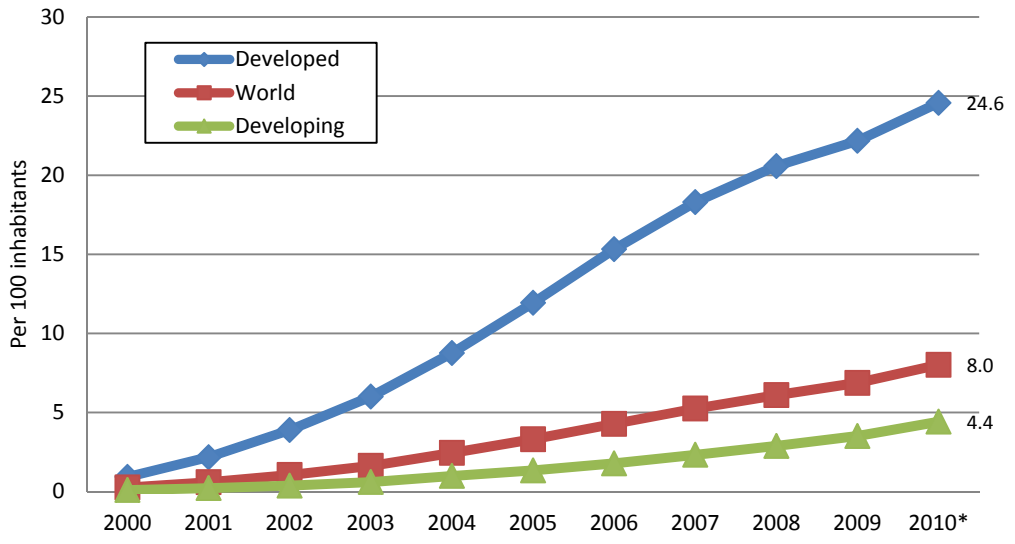
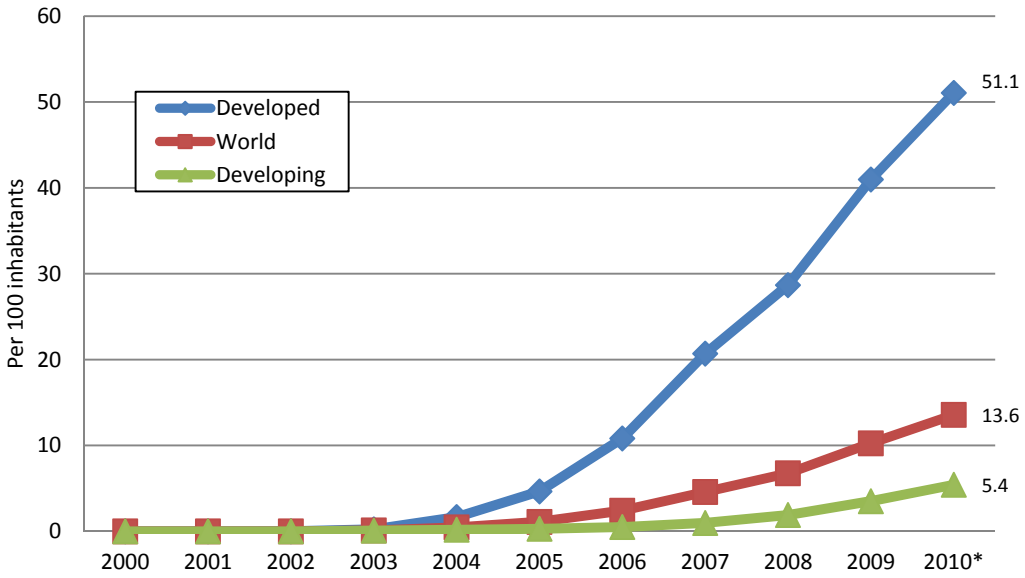


Figure 2.3 Mobile broadband subscriptions per 100 inhabitants, 2000-2010*



* Estimates

For developed/developing country classifications, see: www.itu.int/ITU-D/ict/definitions/regions/index.html

Source: ITU World Telecommunication /ICT Indicators database

Figure 2.4 Fixed broadband costs by region, 2009

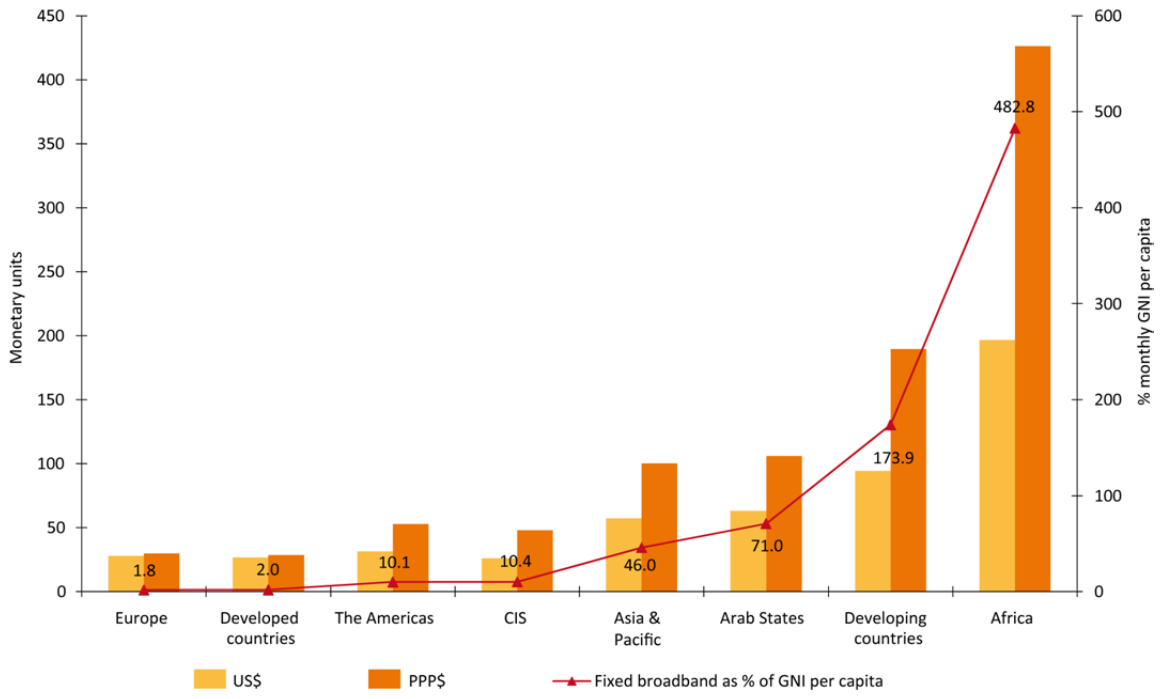
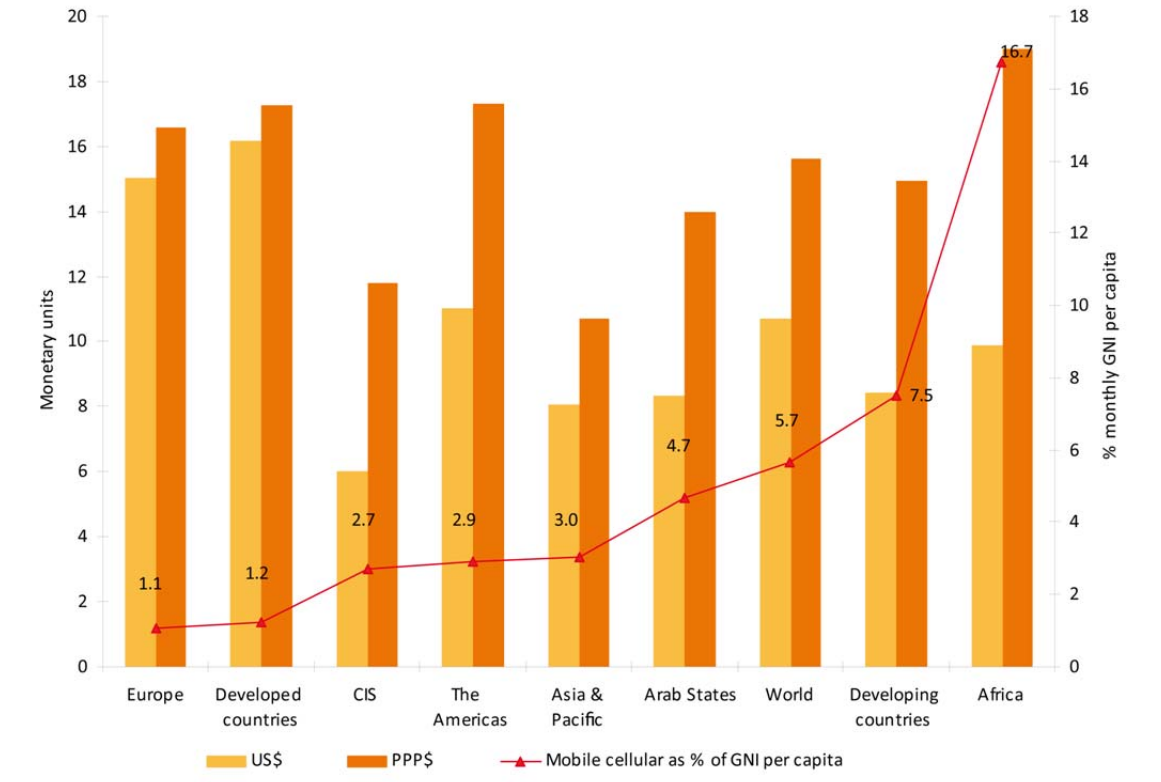


Figure 2.5 Mobile phone costs by region, 2009

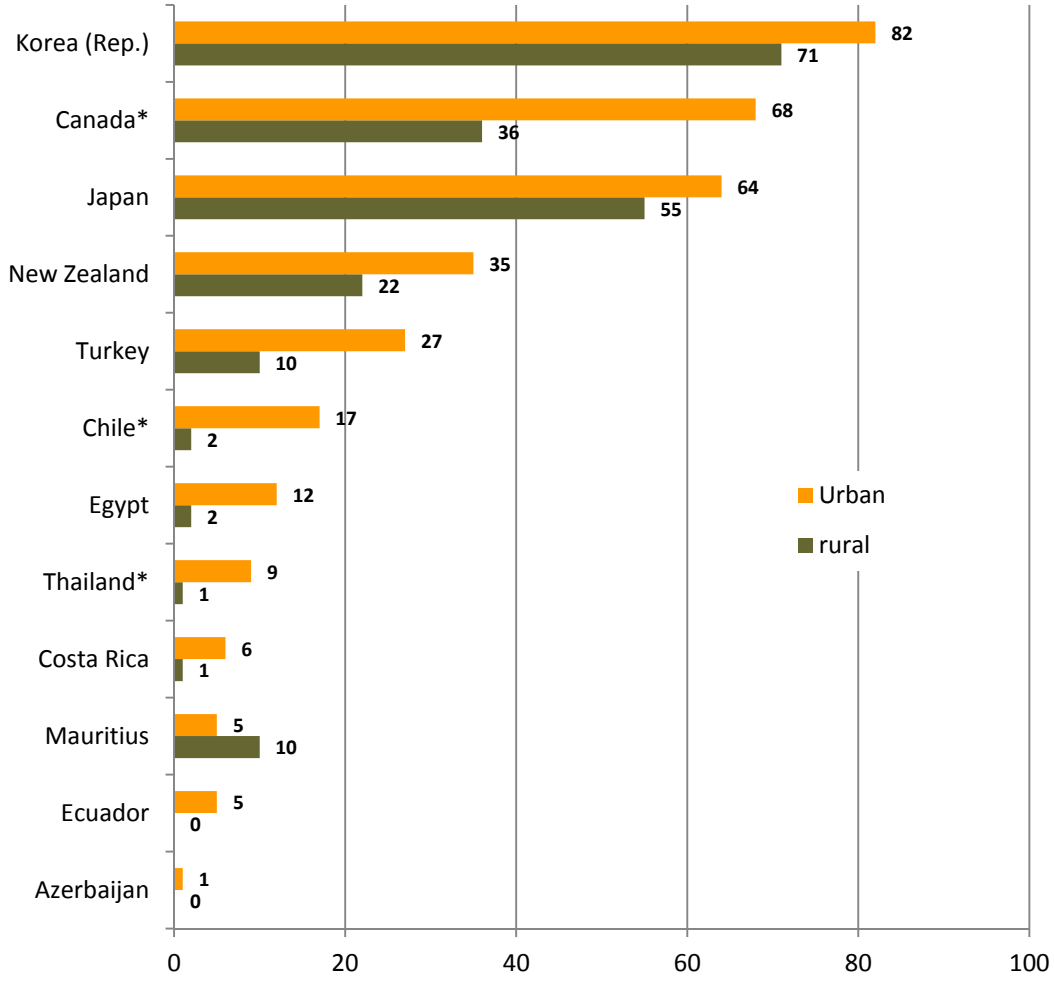


Source: ITU "Measuring the Information Society, 2010"

It should be noted that gaps in broadband penetration and affordability remain not only among countries, but also between rural and urban areas within a nation. For example, in Turkey between the end of 2007 and the start of 2008, the proportion of urban households with either fixed or mobile broadband (or both) was 27%, while only 10% of rural households had broadband. In Canada at the same time, 68% of urban households had either fixed or mobile broadband (or both), while only 36% of rural households had broadband (see Figure 2.6).

Although the situation is improving, in many countries there are still big gaps between rural and urban access to broadband, and the challenge of providing connectivity to the countryside remains. Poorer populations within cities also need to be better served, which reflects back onto the issue of affordability.

Figure 2.6 Proportion of rural and urban households with broadband Internet access, 2007-08**



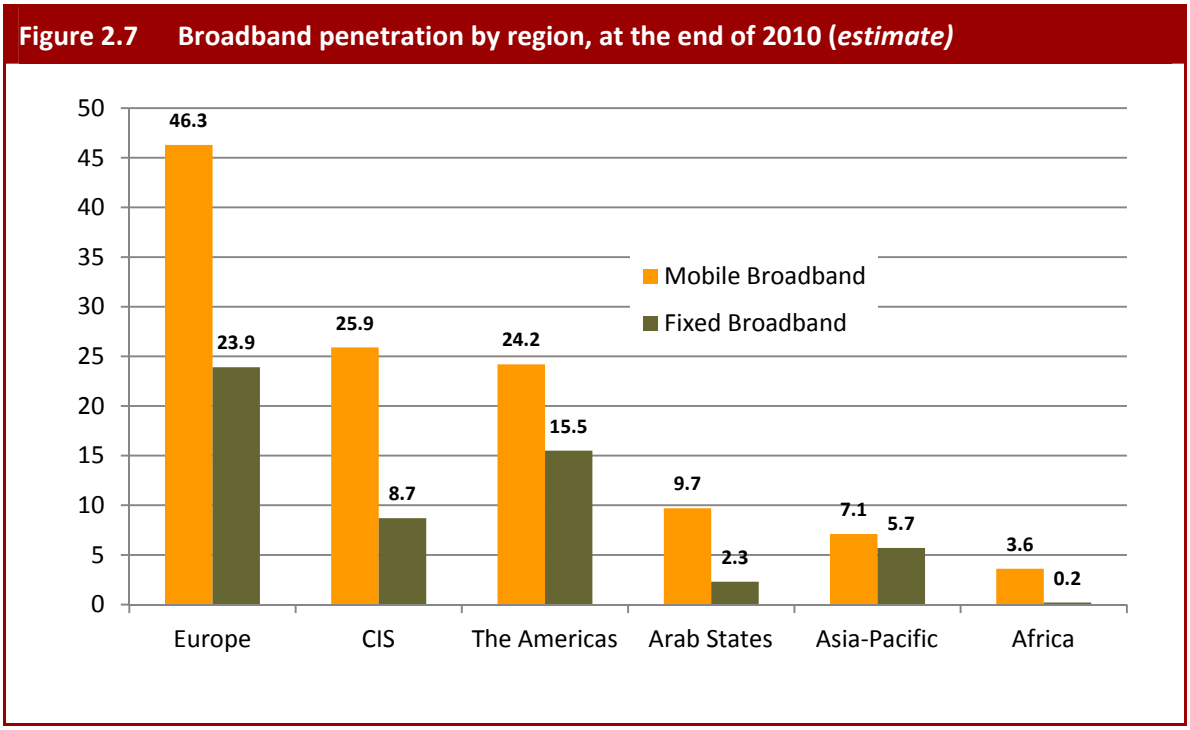
Note: * Data refer to 2006
** Broadband refers to both wireless and fixed (wired) broadband access

Source: ITU World Telecommunication /ICT Indicators database

2.2.3 A REGIONAL PERSPECTIVE

The digital divide is also clear when focusing on specific regions of the world. As Figure 2.7 indicates, at the end of 2010 nearly half of the population of Europe, for example, used mobile broadband and almost a quarter had fixed access, while less than 4% of people in Africa had mobile broadband and very few had fixed access.

Figure 2.7 Broadband penetration by region, at the end of 2010 (*estimate)*



Source: ITU World Telecommunication /ICT Indicators database

The rate of growth in broadband also varies; some regions are advancing faster than others, as indicated in the changes between 2005 and 2009 (see Figures 2.8 and 2.9). During this period, the greatest rises in fixed and broadband subscriptions were in the Asia-Pacific region, in Europe and in the Americas. Africa and the Arab States had the lowest number of subscribers.

The most dramatic surge was seen in the Commonwealth of Independent States (CIS), where mobile broadband subscriptions rose from only three hundred or so in 2005, to more than 53 million in 2009.

Each of these regions experienced an increase in broadband penetration over these five years, mainly through mobile networks. As with the number of subscriptions, the penetration levels were similarly varied across the regions (see Figures 2.10 and 2.11).

Figure 2.8 Regional Mobile Broadband Subscriptions

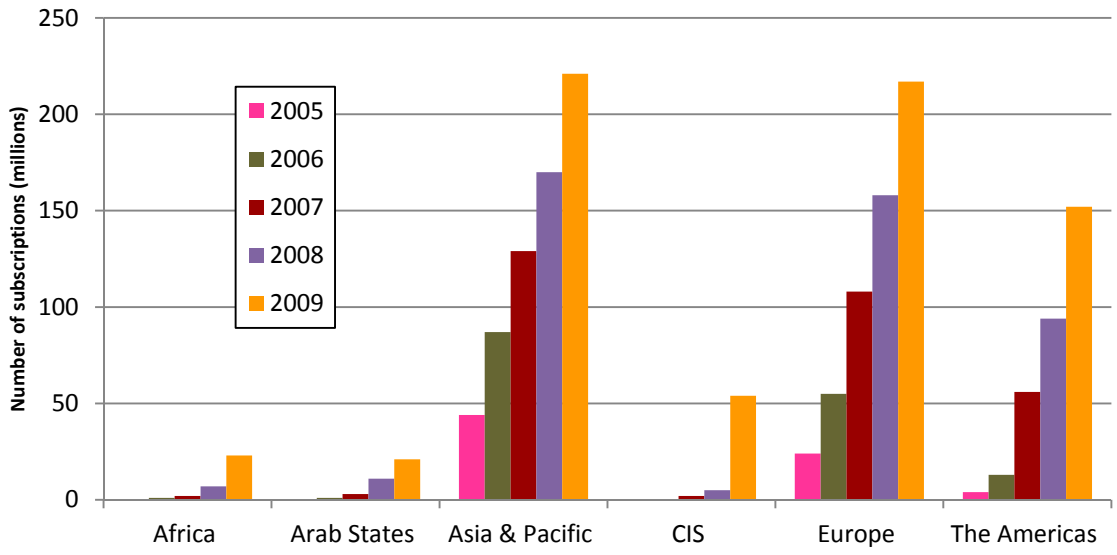
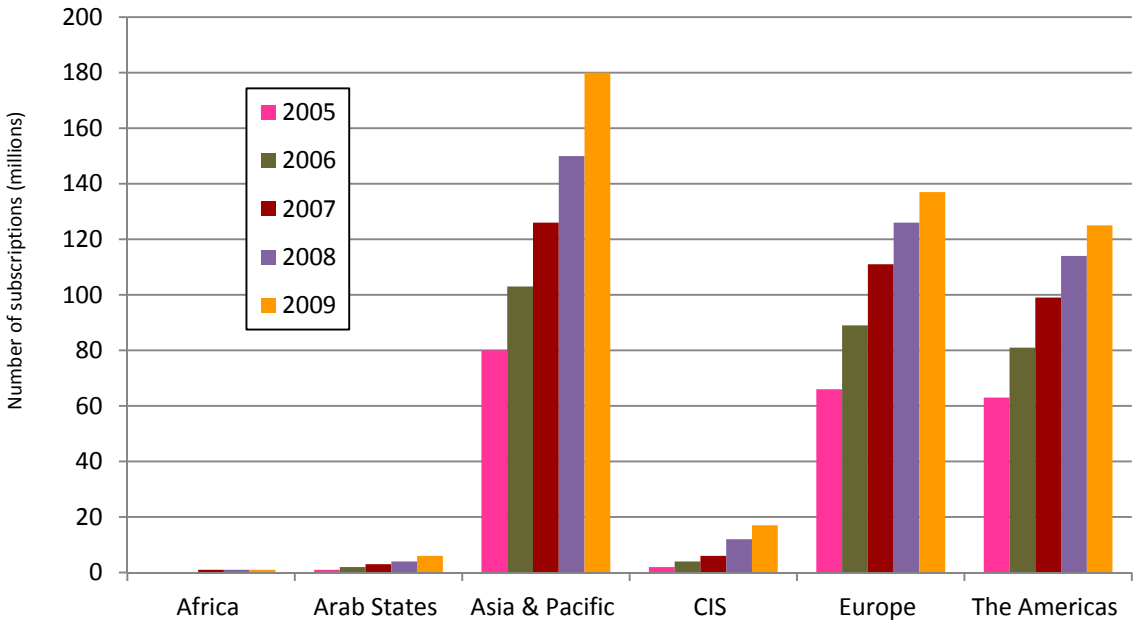


Figure 2.9 Regional Fixed Broadband Subscriptions



Source: ITU World Telecommunication/ICT Indicators database*

* The countries in each region are those listed in ITU regional statistics, (see www.itu.int/ITU-D/ict/publications/). For example, Europe includes 42 countries; for details of the 27 Member States of the European Union, see http://ec.europa.eu/information_society/newsroom/cf/pillar.cfm?pillar_id=46

Figure 2.10 Regional Mobile Broadband Penetration

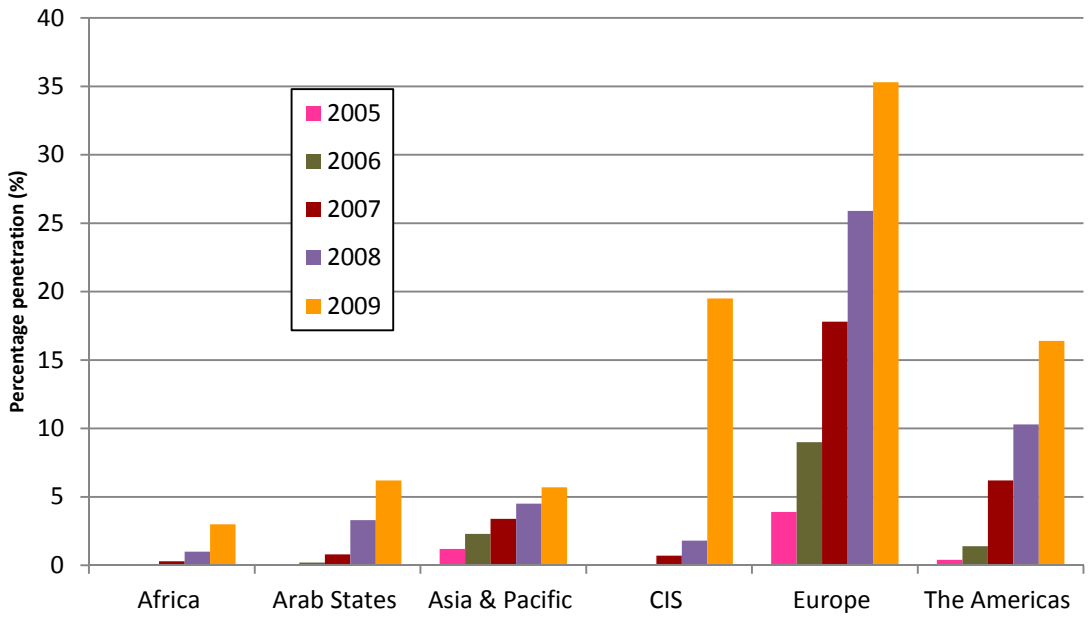
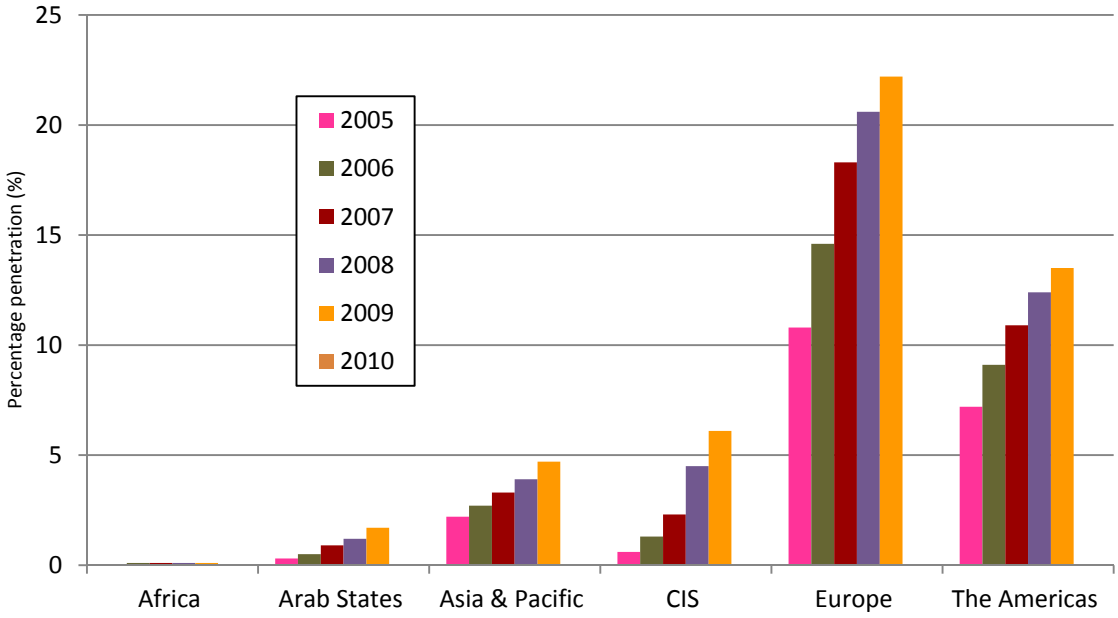


Figure 2.11 Regional Fixed Broadband Penetration



Source: ITU World Telecommunication/ICT Indicators database*

* The countries in each region are those listed in ITU regional statistics, (see www.itu.int/ITU-D/ict/publications/). For example, Europe includes 42 countries; for details of the 27 Member States of the European Union, see http://ec.europa.eu/information_society/newsroom/cf/pillar.cfm?pillar_id=46

AFRICA

In Africa, fixed broadband penetration was virtually zero in 2005, and just 0.1% in 2009. This compares with a world average that year of 7%. The penetration rate is estimated to have risen to only 0.2% by the end of 2010.

There are clear variations among the different parts of the continent. The statistics show that sub-Saharan Africa contributed most to the increase in mobile broadband subscriptions, whereas North Africa contributed most to the increase in fixed broadband subscriptions.

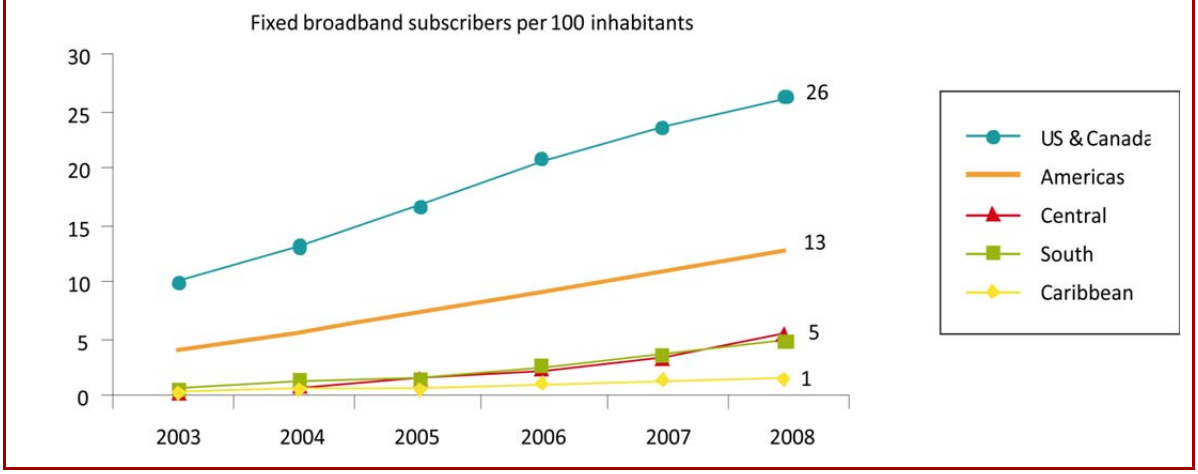
By 2009, there were some 900,000 fixed broadband subscribers in Africa, compared with almost 17 million subscribers to mobile broadband. This is reflected in the mobile broadband penetration rate of 2.2% in 2009, which rose to an estimated 3.6% by the end of 2010.

AMERICAS

The penetration rate for fixed broadband access in the Americas doubled between 2005 and 2009, from 7.1% to 14.3%, reflecting some 132 million subscriptions in 2009. A very much bigger rate of growth was seen in mobile broadband penetration, which rose over the same period from 0.5% to 16.1%, representing more than 148 million subscriptions in 2009. By the end of 2010, an estimated 24.2% of people in the Americas used mobile broadband, and 15.5% fixed broadband.

However, Internet usage in the Americas is led predominantly by the north, as demonstrated in Figure 2.12, which shows the growth in fixed broadband subscriptions between 2003 and 2008. Penetration levels in the United States and Canada were twice the regional average in 2008. And as regards the region's number of mobile broadband subscriptions, almost nine out of ten were in North America in 2008.

Figure 2.12 Fixed broadband subscribers in the Americas



Source: ITU World Telecommunication /ICT Indicators database

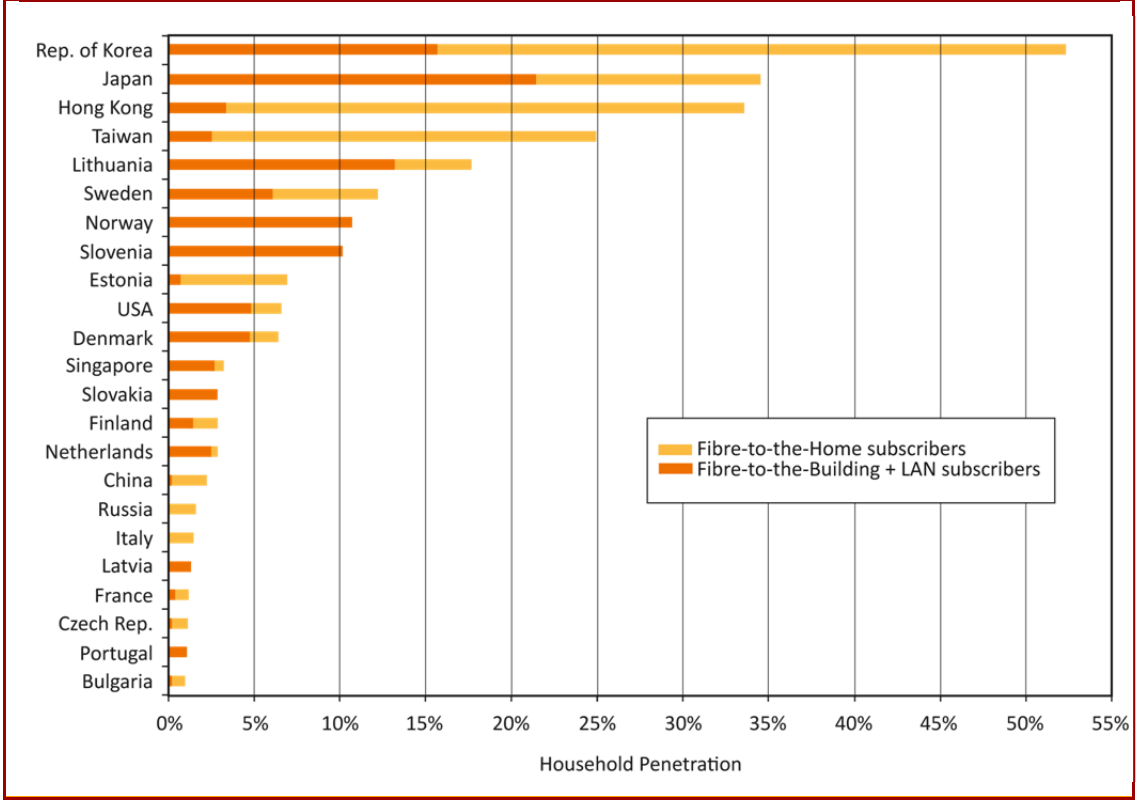
ARAB STATES

In relation to ITU statistics, the Arab States region comprises Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen.

Compared to other regions of the world, the Arab States are in the early stages of adopting broadband. However, between 2005 and 2009, fixed broadband subscriptions increased by some 4.75 million in the Arab States, while mobile broadband subscriptions rose by over 19 million. Penetration of mobile broadband rose from zero in 2005 to reach 5.7% in 2009, while penetration of fixed broadband increased from 0.3% to 1.7%.

There continues to be significant growth. According to ITU estimates, by the end of 2010, 9.7% of people in the Arab States region subscribed to mobile broadband, while 2.3% had fixed broadband access to the Internet.

Figure 2.13 Economies with the highest fibre-to-the-home-building/building + LAN penetration, 2010



Source: FTTH Council-EU, "G20 need to speed up on Fibre to the Home", Press Release, February 26, 2010, at: www.ftthcouncil.org/en/newsroom/2010/02/26/g-20-need-to-speed-up-on-fiber-to-the-home

ASIA-PACIFIC

The Asia-Pacific region has seen considerable growth in broadband. From 2005 to 2009, it recorded the world's highest numbers of mobile broadband subscriptions, although the penetration rate only reached 5.4% by 2009. Over the same period, the region also saw the world's biggest increase in fixed broadband subscriptions and penetration rose to 4.6% of the population. By the end of 2010, these figures had jumped to an estimated 7.1% of the population with mobile broadband, and 5.7% with fixed broadband.

In 2010, of the world's economies with the highest penetration of fibre-to-the-home (FTTH) or building plus LAN penetration, the top four were the Republic of Korea, Japan, Hong Kong (China) and Taiwan. China itself also featured in the list (see Figure 2.13), as did Singapore, which started to roll out a next-generation network in 2009 and is on track to cover all premises in the country by 2012. But there is huge variation in the region, with developing countries at much lower levels of broadband penetration.

COMMONWEALTH OF INDEPENDENT STATES

In 2005 in the CIS, there were only 302 mobile broadband subscriptions — among the lowest in the world. But in 2009 the CIS leaped ahead of Africa and the Arab States to reach some 53 million mobile subscriptions and a penetration rate of more than 19%. Fixed broadband subscriptions increased too, and between 2005 and 2009 the penetration rate rose from 0.7% to 6.5%, or around the world average.

Growth continued to be impressive in 2010; by the end of the year, an estimated 25.9% of the CIS population had mobile broadband, and 8.7% had fixed broadband.

However, there is wide variation among member countries of the CIS in terms of broadband penetration. In 2009, for example, Belarus had the largest penetration of fixed broadband, with 11.34% of the population having subscriptions, followed by the Russian Federation with 9.16%. In contrast, several countries had less than 1% of the population with fixed broadband connectivity.

EUROPE

Europe is currently the world leader in terms of broadband penetration. For fixed services, the rate more than doubled between 2005 and 2009, from 10.9% to 22.4%, while for mobile broadband, penetration boomed over the period from 4% to 33%.

By 2009, the region had some 203 million mobile broadband subscriptions — almost the same number as in the much more populous Asia-Pacific region. In the same year, with nearly 138 million fixed broadband subscriptions, Europe was slightly ahead (by about 6 million) of the Americas.

According to ITU estimates, 46.3% of people in Europe were subscribers to mobile broadband services at the end of 2010, and 23.9% had fixed broadband access to the Internet.

3 WHY IS BROADBAND IMPORTANT?

3.1 THE ECONOMIC IMPACT OF BROADBAND

The importance of the information and communication technologies (ICT) for economic development has been widely acknowledged. Their positive impact on innovation, productivity, trade, employment, foreign investment, economic growth and, consequently, a country's competitiveness, has been widely proved and documented — not only in the case of developed countries, but also in developing countries and economies in transition. For a long time, a deep appreciation of the benefits offered by these technologies has been the foundation of work aimed at the creation of policies and strategies for fostering the development of ICT at national, regional and international levels.

Now that ICT are moving towards a new paradigm in which broadband infrastructure and applications are winning more and more recognition by end-users, it is necessary to evaluate the potential economic impact to be derived from wide deployment and use of high-speed networks by the public and private sectors, as well as by individuals. Even though, intuitively, few people would deny the positive effects of broadband, the details still require more investigation. In particular, for developing countries and economies in transition, where access to, and use of, broadband remains limited, it is a challenge to collect data on how broadband can play a significant role as an enabler for economic and social progress.

Against this background, this chapter provides a brief overview of existing research and the main approaches used to address the question of the economic impact of broadband. In Table 3.3 it refers to some one hundred studies showing the potential of broadband as an efficient tool for development. The list is not exhaustive, and much research continues into this important topic.

3.2 DIRECT AND INDIRECT BENEFITS

One can assume that users of broadband buy these services (and the necessary hardware to receive them) when they perceive that the benefits gained outweigh the price paid for connectivity. Based upon this, it is possible to estimate the overall economic effects, which consist of two components:

- The end-user's payment for broadband connection and equipment, based on the perception of its direct benefits to the consumer.

- Indirect benefits, such as cost savings for service providers and the gains in productivity and earnings in other industrial sectors brought by broadband applications and services.

Following this approach with regard to the United States, for instance, it has been estimated that the level of the benefit generated by universal broadband access could reach more than USD 500 billion a year.[1] In the case of Eastern and Southeast Europe, such benefits could reach up to USD 9.2 billion (in present value terms) within the next ten years.[2]

Even though the impact of broadband differs from country to country and region to region, thanks to the migration to the broadband ecosystem, the volume of untapped customer demand is significant everywhere. This potential highlights the economic dimension of the debate on broadband deployment, and draws attention to the market opportunities and possible savings, as well as the need for next-generation infrastructure.

3.3 ECONOMIC IMPACT OF BUILDING OR UPGRADING INFRASTRUCTURE

The move towards a new communication paradigm (of "always-on" connections to the Internet with high transmission capacities) requires significant investment in the upgrading of existing infrastructure or the construction of new broadband networks. As a consequence, direct and indirect employment effects are to be expected, as well as growth in a country's gross domestic product (GDP).[3]

Such effects are directly related to the scale of investment programmes and their time frames. Even though the impact of broadband construction is much smaller than the utility derived from the use of networks[4], it is an important factor that needs to be taken into account when developing strategies for deploying broadband infrastructure, and in particular strategic private or public investment programmes.

In general, there are three types of network construction effect (see Table 3.1). First is the direct effect upon jobs and output. In the course of deploying network facilities, additional employment and economic production is generated. There will also be increased demand in the labour market for the construction workers and telecommunication technicians who are needed during this phase.

Second, the indirect effects refer to employment and production generated by buying and selling in support of direct spending. The third type of effect of broadband network construction consists of the secondary jobs and output generated by household spending based on the income earned from the direct and indirect effects, such as sales of consumer durables, and increased retail trade or consumer services.[5]

1 Criterion Economics LLC "The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access" (2001)

2 Telekom Austria Group, Frontier Economics "The impact of broadband in Eastern and Southeast Europe" (2010)

3 Dr. Raul L. Katz, Columbia Business School "Estimating broadband demand and its economic impact in Latin America" (2009)

4 Pantelis Koutroumpis, Imperial College London "The Economic Impact of Broadband on Growth: A simultaneous approach" (2008)

5 Dr. Raul L. Katz, ibid.

Table 3.1 Employment impact of broadband network construction in selected economies

Country	Investment (USD millions)	Employment Creation (number of jobs)				Multiplier	
		Direct	Indirect	Secondary	Total	Type I*	Type II**
United States	6,390	37,300	31,000	59,500	127,800	1.83	3.42
Switzerland	10,000	80,000	30,000	N.A.	110,000	1.38	N.A.
Germany	47,660	281,000	126,000	134,000	541,000	1.45	1.93
United Kingdom	7,463	76,452	134,541	211,000	-	2.78	

Note: * (Direct + Indirect)/direct; ** (Direct + Indirect + Secondary)/direct

The interrelationship of these three effects is measured through multipliers, which quantify the total employment change throughout the economy from one unit change on the input side.

Source: Dr. Raul L. Katz, Columbia Business School, 2009

3.4 THE SPILL-OVER EFFECTS OF BROADBAND INFRASTRUCTURE

The use of broadband infrastructure spreads to other industries than ICT and contributes to their profits, thus stimulating overall economic growth. While the ICT industry is primarily affected by the infrastructure upgrade itself, broadband infrastructure has major results in externalities in the other sectors of the economy.[6] By externalities is meant the transaction spill-over, or a cost/benefit that is not transmitted through price and is incurred by a party who did not participate in the original action causing the cost or benefit. These areas comprise the positive externality (external benefit) or negative externality (external cost).

3.4.1 PRODUCTIVITY

Improvement of productivity is a result of the adoption of more efficient business processes enabled by broadband, such as optimization of supply chains, marketing of excess inventories, and so on. Companies are using broadband to improve productivity through remote monitoring, logistics management and online procurement, for example. They are also using broadband to more efficiently to provide services such as media content, online shopping and electronic banking.[7] The level of impact on productivity differs among industries, depending on the intensity with which they use ICT.

Recent studies show that, in the European Union for example, companies adopting broadband-based processes improve their employees' labour productivity on average by 5% in the manufacturing sector and by 10% in the services sector. However, due to the relatively slow adoption of broadband-based value-added services in Europe, in particular among small and medium-sized businesses (3% per year on average), the macroeconomic broadband-related productivity improvement in Europe came to only 0.29% on average per year over the period 2004–2006.[8]

6 Pantelis Koutroumpis, Imperial College London "The Economic Impact of Broadband on Growth: A simultaneous approach" (2008)

7 infoDev/OECD "What Role should Governments Play in Broadband Development?" (2009)

8 MICUS, Management Consulting GmbH "The Impact of Broadband on Growth and Productivity" (2010)

3.4.2 INNOVATION

Over the last decade or so, it has been clearly proved that ICT are not only a dynamic and fast-growing sector per-se, but also a pre-requisite for advances in other industries. From this perspective, the role of broadband as a source of potential innovation needs to be seen from two different angles: one related to innovation within the ICT sector itself, and the second as triggering innovation in other fields of economic activity.

Even though, at first glance, innovation in the broadband ecosystem might seem to be associated mainly with countries at the technological forefront, in reality this open platform offers equal chances to all stakeholders. Several examples prove that acceleration of innovation results from the introduction of new broadband-enabled applications and services, such as telemedicine, online education, video-on-demand, or new forms of commerce and financial transaction.

Broadband is also increasingly the primary mechanism for accessing information via the Internet, which is becoming essential for economic activity and government administration. In this sense, broadband is an effective means of fostering research and development activities for industry, as well as the transfer of technical and other types of knowledge. Broadband provides access to new technologies, and allows companies to explore new business opportunities, access customers and obtain information about market prices. Better access to information makes markets work more efficiently and raises producers' incomes.

Easy access to information about government services and activities helps to improve accountability and the quality of the services that an administration provides. Broadband networks are increasingly being used to deliver public services. In addition, by making it easier and cheaper to access information, broadband connectivity is becoming a key facilitator of good governance.

3.4.3 RESTRUCTURING THE VALUE CHAIN

Broadband is also an important factor in changing the composition of the value chain in many sectors. Reliable and affordable high-speed connectivity encourages enterprises to move into international markets. Broadband removes geographical barriers, and its minimal usage costs create incentives to adjust value chains to the new reality in communications. New services offered over the Internet, as well as the use of remote services such as virtual call centres or cloud computing, can help to optimize operational costs.

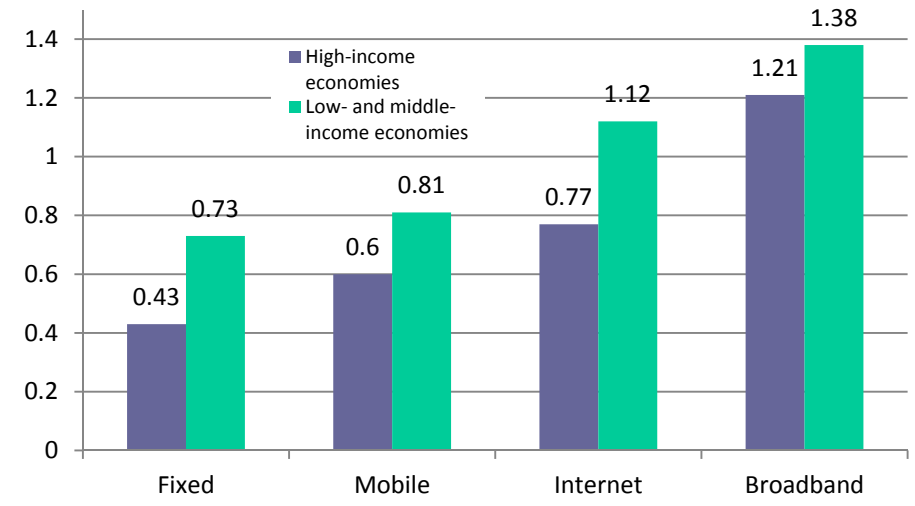
3.5 OVERALL IMPACT ON ECONOMIC GROWTH

Broadband is widely recognized as a critical enabler of economic activity. In its "IC4D 2009" report[9], the World Bank reported that in low- and middle-income countries, every 10-percentage-point increase in broadband penetration accelerates economic growth by 1.38 percentage points — more than in high-income countries and more than for any other telecommunications service (see Figure 3.1).

9 World Bank "Information and Communications for Development 2009: Extending Reach and Increasing Impact" (2009). For a comprehensive review of the literature, see also Christine Qiang, Carlo Rossotto and Kaoru Kimura "Economic Impact of Broadband," in Information and Communication for Development, World Bank (2009)

In a similar study, management consultants McKinsey & Company estimated that "a 10% increase in broadband household penetration delivers a boost to a country's GDP that ranges from 0.1% to 1.4%."[10] Booz & Company, another management consultancy, found that "10% higher broadband penetration in a specific year is correlated to 1.5% greater labour productivity growth over the following five years." Booz also suggested that "countries in the top tier of broadband penetration have exhibited 2% higher GDP growth than countries in the bottom tier."[11]

Figure 3.1 How investing in broadband can boost economies



Note: The vertical axis represents the percentage increase in economic growth per 10% increase in telecommunication penetration.

Source: World Bank (2009)

Nina Czernich et al. (2009)[12] estimated the effect of broadband infrastructure on economic growth in OECD countries between 1996 and 2007. They found that an increase in broadband penetration by 10 percentage points raised annual per-capita growth by 0.9-1.5 percentage points.

There are also studies of particular countries that demonstrate the potential of broadband to boost economic growth. In Thailand, for example, broadband penetration amounts to just 3.4% of households and about 12% of individuals in 2010. However, it is forecast that broadband will contribute 0.9% to Thailand's GDP growth rate.[13]

In Japan, ICT and broadband have a direct and measurable impact on GDP. It has been indicated that the country's broadband networks can increase GDP by up to 5%.[14] Due to the series of initiatives taken by the government, coupled with private investments, people in Japan can now enjoy a highly advanced broadband environment which has opened up a wide range of business opportunities and resulted in significant economic benefits. If the potential of ubiquitous networks is fully utilized, it is

10 McKinsey & Company "Mobile Broadband for the Masses" (2009)

11 Booz & Company "Digital Highways: The Role of Government in 21st Century Infrastructure" (2009)

12 Czernich Nina, Falck Oliver, KretschmerTobias and Woessmann Ludger "Broadband Infrastructure and Economic Growth" (2009)

13 Craig Warren Smith, Chulalongkorn University Meaningful Broadband Working Group "Broadband Thailand 2015" (2010)

14 Nextbigfuture.com "Ultra-Broadband Worldwide and GDP Boost" (2009)

predicted that the real GDP growth rate in Japan will be about 1.0 to 1.1 points higher than otherwise.[15]

In Malaysia, the National Broadband Initiative set a target for broadband to achieve 50% household penetration by the end of 2010. Based on the statistics for 2008, the communications and multimedia industry contributed 6.1% in term of revenue to the country's GDP.[16] And in the Republic of Korea, the percentage contribution of telecommunication services and broadband to GDP more that doubled, from 2.05 to 4.99 per cent, between 1995 and 2005, the decade of broadband's expansion in the country's economy.

3.6 THE WAY FORWARD

In the wake of the global financial crisis that erupted in 2008, many countries recognized that, as part of economic stimulus plans, investments in ICT infrastructure can play a major role in regenerating economic growth and promoting recovery. In particular, they specified the expansion of broadband networks as a priority target[17]. Although such large-scale public infrastructure investments take longer to implement, they are also seen as likely to generate more robust and durable economic growth than some other types of stimulus measures.

A large number of countries have included broadband and ICT investments in their stimulus plans and are exploring new state financing packages for national broadband infrastructure. These are alongside measures to facilitate investment by the private sector, which is increasingly active as the major source of funding in many markets (see Table 3.2). There are new opportunities for governments to become involved in the financing and regulation of national networks; however, it is necessary to ensure that strategic decisions are based on a well founded understanding of the relationship between broadband infrastructure and applications and their economic impact. This means that more research is required, as well as raising the awareness of policy-makers.

Few people would question the positive effects of access to broadband; nevertheless, there are still several issues which remain to be explored further. In particular, there needs to be greater focus on the role of broadband in supporting progress in developing countries and economies in transition. Very often, the scarcity of statistical data for these areas does not permit detailed investigations to be carried out as the basis for strategic and political guidance. Indicators relating to Internet technologies and their impact on economic performance are of special value in this regard.

While advocating that a trans-sectoral approach should be taken in broadband development, it is necessary that all stakeholders involved in expanding the broadband ecosystem should have a clear understanding of the micro and macro effects, including upon innovation, job creation, productivity, economic growth, trade openness, and competitiveness. In this context, further investigations need to be undertaken into the effectiveness of existing policies aimed at leveraging the undoubtedly beneficial effects of broadband in countries at every level of development.

15 Toshiya Jitsuzumi, Kyushu University "Investment in Broadband Infrastructure: Impacts on Economic Development and Network Neutrality" (2009)

16 Malaysian Communications and Multimedia Commission "National Broadband Initiative" (2010)

17 ITU "Confronting the Crisis: ICT Stimulus Plans for Economic Growth" (2009)

Table 3.2 Selected investment plans for ICT infrastructure and national stimulus plans

Country	Announced by	Date	Investment	Goals and targets	Speeds
United States	Government	2010	USD 15.5 billion (from USF)	Connect 100 million households that have no broadband access to the Internet	100 Mbit/s by 2020 and 1 Gbit/s to institutions
Australia	Government	2009	AUD 43 billion	Fibre to the premises for 93% of Australian homes and workplaces. Next-generation wireless and satellite technologies provided to the remaining 7%, subject to the final design	100 Mbit/s
Canada	Government	2009	CAD 225 million	Broadband coverage for unserved rural and remote communities over three years	N/A
Germany	Government	2009	EUR 150 million	Nationwide capable broadband access no later than end 2010. By 2014, 75% of households with broadband	Target 50 Mbit/s
United Kingdom	Government	2009	N/A	Universal service commitment for broadband for almost every community by 2012	2 Mbit/s by 2012
Ireland	Government	2009	EUR 223 million	Universal broadband coverage in 2010	1.2 Mbit/s
Latvia	Lattelecom	2009	N/A	Plans to replace DSL by FTTH 2009–2012, FTTH under trial in some cities	100 Mbit/s 500 Mbit/s
Portugal	Government	2009	EUR 800 million	Subsidized investments in optical fibre for 1.5 million users	N/A
European Union	European Commission	2008	EUR 1 billion	100% coverage of high-speed Internet by 2010, focusing on rural communities	N/A
Republic of Korea	Government	February 2009	USD 890 million	Increase national broadband infrastructure speeds tenfold by 2012	1 Gbit/s by 2012
New Zealand	Government	2009	NZD 1.5 billion	Ultra-fast broadband by 2019; 75% population coverage	Fibre
Japan	Government	2008 - 2009	JPY 37.1 billion	Intelligent transport systems, improving ICT infrastructure, training staff, new industries, and broadband roll-out to rural areas	N/A
Spain	Government	2008	N/A	Installing next-generation fibre and regulating broadband	Up to 30 Mbit/s
Poland	Telekom.Polska (TP)	2008 NGN and FTTx	EUR 400 million	TP is investing in passive optic networks from 2009–2011	50 Mbit/s
Finland	Government	2008	EUR 200 million in public-private partnerships	Extending ultra-fast broadband for 100% of households by 2016	1 Mbit/s 2010; 100 Mbit/s 2016

Country	Announced by	Date	Investment	Goals and targets	Speeds
France	Government	2008	N/A	Access to broadband by 2010; mobile broadband by 2012 for all	N/A
Singapore	Government	2007–2008	SGD 1 billion	NGN Broadband Network to cover 60% of premises by 2010 and 95% by 2012	1 Gbit/s+
Nether-lands	KPN	2005–NGN 2008–FTTH	EUR 6–7 billion	Migration of network to NGN — all IP backbone planned for 2010	N/A
Belgium	Belgacom	2007	EUR 647 million	High-speed broadway project for IP/MPLS network 2008–2012 for 80% of homes	100 Mbit/s
France	France Telecom	2006	EUR 3–4.5 billion by 2012	1 million households passed with fibre in 2008; 4 million households passed in 2012	N/A
Denmark	TDC	2006	N/A	TDC to establish NGN single IP-based network for 75% of households 2009, 90% of households 2010	20 Mbit/s 20 Mbit/s 100 Mbit/s
Ireland	Eircom	2006	EUR 60 million upgrade	Migrate NGN core network and deploy fibre network in towns	1–24 Mbit/s
Italy	Telecom Italia	2006	EUR 60 million over 2007–2017	Migration of access network to NGN for 98.5% of population, 5.2% fibre, in 2009	4–100 Mbit/s
Spain	Telefónica	May 2006	EUR 1 billion	Investing in next-generation FTTx with 40% population coverage in 2009	25 Mbit/s
Norway	Telenor	2005–NGN 2007–FTTH	N/A	Core IP MPLS network by 2010, using PON, DSL and WiMAX for full coverage	FTTH
Germany	Deutsche Telekom	2005	EUR 3 billion	PSTN to be fully substituted by 2010 VDSL and HDTV for 30% of households	50 Mbit/s VDSL and FTTC
Slovak Republic	Slovak Telekom	2004	N/A	Digital NGN core network and overlay for 40% of households by 2010	Fibre
Sweden	TeliaSonera	End 2004	SEK 200 million	Multiple operators moving to IP and IMS core networks; National target of broadband for all households by 2010	10 Mbit/s
United Kingdom	BT	2004	GBP 1.5 billion	BT launched 21st Century Network in 2004 and its super-fast broadband plan in Openreach in mid-2008, for 40% or 10 million households	40–100 Mbit/s
Austria	Telekom Austria	2004	EUR 780 million	Full conversion of core to NGN started in 2004; to be completed by 2012	20 Mbit/s

Sources: Christine Zhen-Wei Qiang (2009), OECD (2009), Dr Vaiva Lazauskaite (2009), Booz & Company (2009).

Note: The data were compiled for the ITU report “Confronting the Crisis: ICT Stimulus Plans for Economic Growth" (2009)

TABLE 3.3 REFERENCES TO STUDIES ON THE ECONOMIC IMPACT OF BROADBAND

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
1	World Economic Forum (WEF); INSEAD	The Global Information Technology Report 2010-2011	2011	The Global Information Technology Report 2010-2011	A "Networked Readiness Index" (NRI) — developed by INSEAD and WEF in 2002 — is used to score 138 countries. The NRI measures the conduciveness of national environments for ICT development and diffusion, including the broad business climate, some regulatory aspects, and the human and hard infrastructure needed for ICT; the degree of preparation for and interest in using ICT by individuals, the business sector, and government in their daily activities, and the actual use of ICT by these three stakeholders.	Chapter 1.2 of the report, on "The emerging Internet economy: looking a decade ahead," is authored by Enrique Rueda-Sabater and John Garrity of Cisco Systems. They analyse the likely dynamics, and the options countries face, as Internet use becomes more intensive (through faster and higher-quality broadband) and more widespread (as networks, both fixed and wireless, connect more and more people around the world).	The Internet will become dominated by emerging economies over the next decade. Improved speed and quality of broadband, with Web 2.0 technologies and applications, will make for huge productivity gains. This presents an opportunity for economies — and cities — all over the globe to take decisive steps to gain the competitive advantage that can be derived from widespread use of broadband networks.	http://reports.weforum.org/global-information-technology-report/
2	International Telecommunication Union (ITU)	Trends in Telecommunication Reform 2010-2011: Enabling Tomorrow's Digital World	2011	Global	The report takes stock of ICT developments around the world, with a particular focus on regulatory issues.	Section 2 of the report covers "The Impact of Broadband on the Economy: Research and Policy Issues"	There is fairly conclusive evidence of the positive contribution of broadband to GDP growth. Broadband improves productivity and contributes to employment growth, both as a result of network construction programmes and spill-over effects on the rest of the economy. Broadband also has a positive effect on consumer surplus in terms of benefits to the end user that are not captured in the GDP statistics.	www.itu.int/ITU-D/treg/publications/trends10.html
3	Arthur D Little	Global study commissioned by Ericsson	2010	Global	The Arthur D Little study covered more than 120 academic reports and business papers published between 2001 and 2010. It included key observations from both developing and developed economies. (Note: many of the individual studies are noted in Table 3.3)	The conclusions reveal the importance of broadband investments to both developing and developed economies.	For every 10-percentage point rise in broadband penetration, GDP grows about 1%. Also, for every 1000 additional broadband users, roughly 80 new jobs are created. In additions, increased broadband penetration has social and environmental benefits, such as in education, health conditions (especially in rural areas of less developed countries), energy consumption and reduced CO2 emissions	www.adl.com

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
4	Telekom Austria Group, Frontier Economics	The impact of broadband in Eastern and Southeast Europe	2010	East & south-east Europe	This comparative analysis of Eastern and Southeastern European countries reveals notable similarities and differences within the region in terms of fixed and mobile broadband penetration.	The region's gap with its western European neighbours, in terms of access to high-speed Internet, is widening. Enhanced efforts are needed to help close it by 2013.	Even under conservative assumptions, the potential total benefit of broadband for these countries amounts to EUR 9.2 billion, in present value terms, within the next ten years.	www.telekomaustria.com/presse/news/2010/0512-broadband-bruessels.php
5	EHR IMPACT (for the European Commission)	Interoperable e-Health is Worth It: securing benefits from electronic health records and e-prescribing	2010	European Union (27); United States; Israel	The project core is a qualitative analysis of 11 good practice cases in Europe, the USA and Israel. Nine of these also undergo a quantitative evaluation of their socio-economic impacts.	There is reason for optimism in the value demonstrated by these examples of well designed and implemented interoperable e-health systems across Europe. They save money while increasing social benefits.	The financial gains may be up to 60% of total socio-economic benefits, but with an average of only 13%. Financial outlays were between 20% and 85% of total socio-economic costs of investment, and reached an average of about 50%.	http://ec.europa.eu/information_society/activities/health/docs/publications/201002ehrimpact_study-final.pdf
6	Chulalong-korn University, Meaningful Broadband Working Group	Broadband Thailand 2015	2010	Thailand	Econometric regression is one of many tools used in this forecast, which include on-the-ground interviews with insiders.	The report examines the most important aspects of broadband and the economy in Thailand, such as the broadband penetration rate, GDP boost, and e-inequality.	In 2010, estimated Thai broadband penetration was 3.4% of households and about 12% of individuals. It is forecast that broadband will contribute 0.9% to Thailand's GDP growth rate.	www.stc.arts.chula.ac.th/MBR2.0-broadband-Thailand-2015.pdf
7	Indian Council for Research on International Economic Relations (ICRIER); Nokia Siemens Networks	Research and Action Agenda for a National Broadband Initiative — Technological Development	2010	India	This is a report based on several tables presenting the correlation of broadband penetration and economic growth.	Universal access to ICT boosts countries' economic and social development	Countries could add billions to their revenues. Low frequency gives wider cell reach and lowers initial investment for mobile broadband. The 700 Mhz band should be auctioned for rural broadband.	www.icrier.org/pdf/16apr10/Theme%202%20-%20Mr%20Ajay%20Ranjan%20Mishra%20-%20Presentation.pdf
8	Organisation for Economic Co-operation and Development (OECD)	The Information and Communication Technology Sector in India: Performance, Growth and Challenges	2010	India	This report contains various analyses of the ICT sector in India.	The Indian economy has grown at an impressive rate in recent years and has created opportunities in the domestic ICT market and for exports. The contribution of the Indian ICT segment to national GDP rose from 1.2% in 1997-98 to 5.8% in 2008-09. The Indian ICT sector is a major exporter and employs more than 2 million people.	Internet penetration is very low. But 2007 was declared the "Year of Broadband" and up to 2008 the number of Internet subscribers nearly doubled and broadband subscribers rose from 2.7 million to 4.9 million. By April 2010 broadband subscribers had almost doubled again to 9 million. Cheap and accessible wireless broadband will radically increase broadband access and use.	www.oecd.org/dataoecd/55/56/45576760.pdf

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
9	ICRIER	India: The Impact of Broadband (Ongoing study; see also number 65 below)	2010	India	The study is in the process of examining international experience, highlighting successes and drawing lessons from them. It will focus on aspects such as national broadband strategies, deployment of broadband infrastructure, and efficient regulatory approaches.	Broadband in India is still at a nascent stage and specific policy initiatives may be required to boost penetration to levels that voice telephony has achieved in recent times.	Indian regions with higher mobile phone penetration grow faster. This results from integrating businesses with the global economy, linking citizens with economic and social opportunities, and allowing governments to extend public services while controlling cost. The impact of broadband in India could be even higher than this.	www.icrier.org/page.asp?MenuID=5&SubCatId=173&SubSubCatId=724
10	Paul Budde Communication Pty Ltd	Rwanda - Telecoms, Mobile, Broadband and Forecasts	2010	Rwanda	This report contains an overview and analysis of Rwanda's telecommunications market, profiles of the major players in all market sectors, relevant statistics, and scenario forecasts to 2012 and 2015 for the country's mobile market.	The legacy of a monopolistic market until 2006 has weighed on the Rwandan telecoms sector, but the country is now rapidly catching up with other African markets. Rwanda is also a key partner in the One Laptop per Child project and has a major e-government programme.	The prospect of intensified competition has sparked a new subscriber growth phase at nearly 100% per annum, but the average revenue per user has fallen below USD 10 per month. Market penetration rates are mobile 38%, fixed 0.2% and Internet 6.5%	www.researchandmarkets.com/research/e6c2db/rwanda_telecoms
11	Democratic Leadership Council	Where Jobs Come From: The Role of Innovation, Investment, and Infrastructure in Economic and Job Growth	2010	United States	This is an overview of the labour market situation in the United States.	The key to a successful economic recovery is robust job creation. The article gives an overview of findings about the conditions that foster job growth.	Investment in ICT, including broadband, contributed 0.8% to average annual real GDP growth in the United States from 1994 to 2000.	www.dlc.org/documents/WhereJobsComeFrom.pdf
12	The American Consumer Institute	The Internet Ecosystem: Employment Impacts of National Broadband Policies	2010	United States	These are empirical studies of the impact on employment of broadband investment and penetration.	In a weak economy and given the limited ability of monetary and fiscal policies to create jobs, regulatory forbearance for broadband networks could be a means of stimulating investment and job creation.	Historical data suggest that for every USD 1 billion in revenue, "core" network companies provided 2,329 jobs, while non-network "edge" companies provided 1,199.	www.theamericanconsumer.org/wp-content/uploads/2010/01/aci-jobs-study-final1.pdf

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
13	Consumer Communicat-ion Services (CCS)	Net Neutrality: Impact on the Consumer and Economic Growth	2010	United States	The study used an estimate from the Interactive Advertising Bureau that each Internet job drives at least 1.54 additional jobs in the economy, and a total of 2.8 to 3.7 million jobs are dependent on the Internet. This drives direct and indirect salaries of approximately USD 285-370 billion.	Broadband has been described as the new infrastructure on which the economy of the 21st century is being built. As such, its ubiquity, ease of access and cost to consumers are all of great relevance to public policy and regulation.	Nearly four billion jobs are dependent on the Internet, resulting in up to USD 370 billion in salaries and wages.	http://internetinnovation.org/files/special-reports/Impact_of_Net_Neutrality_on_Consumers_and_Economic_Growth.pdf
14	Malaysian Communicat-ions and Multimedia Commission	National Broadband Initiative	2010	Malaysia	This report gives a general overview of initiatives under The National Broadband Implementation Strategy.	The aim is to bring broadband to the whole nation. In 2007 the government of Malaysia set an initial target to achieve 50% household broadband penetration by the end of 2010.	Broadband will benefit Malaysia's GDP. Based on the statistics for 2008, the communications and multimedia industry contributed 6.1% in term of revenue to Malaysia's GDP.	www.skmm.gov.my/index.php?c=public&v=art_view&art_id=36
15	Korea Communicat-ions Commission	Annual Report 2009	2010	Republic of Korea	This report is a general overview of the communications sector in the Republic of Korea.	A summary is provided of the main activities of the Korea Communications Commission.	In 2010, the global telecoms market is forecast to grow 2-3%. To take information security to a higher level, the "Master Plan for Internet Information Protection" was drawn up, and the guaranteed minimum broadband speed was raised hugely, to improve service quality and broaden consumer choice.	http://eng.kcc.go.kr/download.do?fileSeq=28211
16	Digital Impact Group, Econsult Corporation	The economic impact of digital exclusion	2010	United States	This analysis develops a taxonomy of negative economic impacts associated with digital exclusion, articulates the mechanisms through which digital exclusion has adverse impacts, and qualitatively and quantitatively evaluates important categories of significant impact.	In the US, over 100 million individuals from over 40 million households do not use broadband because they cannot access it, afford it, do not know how to use it, or are not aware of its benefits. This digital divide is also costly for businesses, government, and the nation as a whole.	An aggregate estimate of the current costs of digital exclusion comes to more than USD 55 billion per year.	www.digitalimpactgroup.org/costofexclusion.pdf

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
17	Columbia Business School; Telecom Advisory Services, LLC; Polynomics AG	The Impact Of Broadband On Jobs And The German Economy: future investment until 2020	2010	Germany	The study gives an input-output analysis to evaluate the impact of the German national broadband strategy.	This study assessed the impact of the government's national broadband strategy, which has the goal to achieve broadband penetration at speeds of at least 50 Mbit/s for 75% of households by 2014, followed by a 50% household penetration of services with 100 Mbit/s by 2020.	About EUR 36 billion costs of building networks yield benefits of EUR 22.3 billion and network externalities of EUR 137.5bn. For every EUR 1 million investment, about 20 jobs would be created in the project's first phase, and about 36 jobs in the second phase. Overall, about 1 million new jobs would be created.	www.polynomics.ch/dokumente/Polynomics_Broadband_Study_E
18	Pyramid Research (UK and US)	The Impact of Mobile Services in Nigeria: How Mobile Technologies are Transforming Economic and Social Activities	2010	Nigeria	Pyramid analyzed mobile adoption trends, examples of mobile applications, as well as the perspectives of key players and 1,500 Nigerian end users.	Mobile communications are having a positive impact in Nigeria by attracting investment and stimulating the development of commercial activities.	In Nigeria mobile broadband subscriptions from 2009 to 2014 CAGR will reach 30%. The mobile industry is generating substantial investment in infrastructure and employing significant numbers of workers.	www.ncc.gov.ng/industrystatistics/studies/pyramid-impact_mobile_services_nigeria.pdf
19	Kellogg School of Management and the Department of Economics, Northwestern University, United States	The Broadband Bonus: Estimating Broadband Internet's Economic Value	2010	United States	The study focused on measuring the factors that shaped the anticipated incremental costs and benefits from the national upgrade to broadband.	Prior research does not measure correctly broadband's true economic impact in the US. This is the first study to provide estimates consistent with broadband's historical diffusion.	Broadband accounted for USD 28 billion of GDP in 2006, and about USD 20 to 22 billion was associated with household use. Broadband generated between 40% and 50% of measured GDP in new additional revenue, of which 31-47% comprises consumer surplus. The upgrade has resulted in an unmeasured fall in all Internet-access prices of 1.6%—2.2% per year.	www.kellogg.northwestern.edu/faculty/greenstein/images/htm/Research/WP/Broadband%20Bonus%20-%20GreensteinMcDevitt-4.pdf
20	Telecom Advisory Services LLC	The Impact of Taxation on the Development of the Mobile Broadband Sector	2010	Brazil, Mexico, Bangla-desh, South Africa, Malaysia	A quantitative analysis of the impact of levies on service adoption, and consequently on economic growth, concludes that the taxation approaches of South Africa, Mexico, Brazil and Bangladesh will have a negative impact on the diffusion of wireless broadband, with a consequent detrimental effect on economic development.	The purpose of this study is to assess the impact of taxation on the development of the mobile broadband sector in emerging countries. It is based on case studies of five countries, four of which have enacted fairly heavy taxation regimes (Brazil, Mexico, Bangladesh and South Africa) and one (Malaysia) exhibiting a benign taxation approach.	In a recent study of 24 countries in Latin America and the Caribbean, it is estimated that when controlling for educational level and starting point of development, a 1% rise in broadband penetration yields 0.017 point in GDP growth. Broadband growth in 2007 and 2008 contributed USD 6.7 -14.3 billion. This includes direct and indirect effects.	www.gsmamobilebroadband.com/upload/resources/files/15072010174953.pdf

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
21	ITU	Connect Africa: Broadband set to boom in Africa; New projects, new hope.	2010	Africa	Case studies and articles on financing, infrastructure development, and other topics relating to broadband deployment. The publication is part of the follow-up to the Connect Africa Summit, held in 2007 and organized by ITU, the African Union, the African Development Bank and the World Bank	Although Africa has, at present, low penetration of broadband, many initiatives are taking place to improve connectivity. These include national plans for backbone infrastructure, and new international links via submarine cables.	The goals of the Connect Africa Summit include interconnecting all African capitals and major cities with broadband by 2012. There has been major considerable progress towards this, with major commitments by the private sector as well as governments.	www.itu.int/ITU-D/afr/ConnectAfrica/HD_ConnectAfrica_Vol3_E.pdf
22	Earth Institute; Ericsson, Millennium Promise; Millennium Villages	Millennium Villages Project — The impact of mobile connectivity on the Millennium Development Goals in Africa	2010	Sub-Saharan Africa	The study combines quantitative and qualitative methods to identify trends and assess the potential impact of mobile communications. It analyzes Millennium Villages Project baseline survey data and interviews at four sites in Ghana, Nigeria, Kenya and Tanzania, with varying levels of mobile connectivity, and across various groups and sectors: health, education, small businesses and households.	ICT and mobile phones can bring new growth. They give villages enhanced access to people, information and economic opportunities, and help support agriculture, small business development, education, health, and environmental sustainability. ICT is seen as a key enabler in accelerating achievement of the MDGs, and public-private partnerships have contributed greatly to the progress.	The results show that the introduction of mobile networks has the potential to influence human development in remote villages. This is in line with the studies done on country level by Waverman and Deloitte showing that 1.2% growth GDP is achieved in developing countries on average for every 10% increase in mobile penetration rate.	www.ericsson.com/res/thecompany/docs/corporate-responsibility/2010/MVP_M_&_E_Final_Report_August_31_2010.pdf
23	Ericsson and Zain	Economic impact of mobile communications in Sudan	2010	Sudan	The report builds on two years of research and covers four basic areas: Khartoum, Juba in the south, Darfur, and the north. It comprises three separate sub reports, covering many dimensions of social and economic development including assessment of the needs of mobile customers in Sudan, with more than 1000 survey respondents from the four different areas	Mobile telephony in Sudan has undergone a period of substantial development and change. The report highlights that in 2008, the total economic benefit of the mobile industry to the Sudanese economy was SDG 5.4 billion (USD2.4 billion). At the time this was 4% of GDP with a possible additional 1% in hidden impact.	In addition to providing over 40,000 jobs to the Sudanese economy, the mobile telecommunications sector is related to demandside GDP growth rates of 0.12% for each 1% increase in market penetration.	www.ericsson.com/res/thecompany/docs/sudan_economic_report.pdf

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
24	Access Economics (for the Department of Broadband, Communications and the Digital Economy)	Impacts of teleworking under the NBN	2010	Australia	The methodology involved cost-benefit analyses of needing fewer workers in an office and reduced travel. A general equilibrium model assessed the impact of increased workforce participation upon Australian GDP.	Analyses the broad quantitative benefits of teleworking (time and cost savings) under Australia's National Broadband Network (NBN).	In 2006, only 6% of workers in Australia reported having teleworking possibilities. If 10% were to telework half the time, the total annual gains would be AUD 1.4-1.9 billion per year.	www.dbcde.gov.au/digital_economy/benefits_of_digital_economy_from_nbn
25	Access Economics (for the Department of Broadband, Communications and the Digital Economy)	Financial and externality impacts of high-speed broadband for telehealth	2010	Australia	This is a qualitative discussion of telemedicine and remote training of medics, as well as a quantitative analysis of associated costs and benefits.	Analyses impacts of telehealth under Australia's NBN. Identifies benefits for healthcare, medical effectiveness, employment and decreased travel.	The benefits of wide-scale implementation of telehealth in Australia could be AUD 2-4 billion per year.	www.dbcde.gov.au/_data/assets/pdf_file/0019/130159/Financialandexternalityimpactsofhighspeedbroadbandfortelehealth-311.pdf
26	Australian Government Information Management Office	Interacting with government: Australians' use and satisfaction with e-government service	2010	Australia	Usage and satisfaction levels were tracked for services delivered by phone, Internet, mail, and in person. The methodology was a phone survey and questionnaire, and qualitative focus group research.	The fifth in a series of studies on this topic, examining how people interact with government and their preferences for the delivery of services.	The Internet was the most used channel (38% of respondents) and 85% thought government websites can be trusted. The overall satisfaction level was 87%, but security remained an underlying concern.	www.finance.gov.au/publications/interacting-with-government-2009/docs/interacting-with-government-2009.pdf
27	Access Economics (for IBM)	The economic benefits of intelligent technologies	2009	Australia	Draws on literature from Australian and international studies and (using a general equilibrium model) estimates the economy-wide benefits of adopting smart technologies and systems, including broadband.	Adopting smart technologies in energy, water, health, transport and high-speed broadband could add jobs and raise Australia's GDP. The benefits are also social and environmental, with better standards of living.	Adopting smart could: (a) Increase net present value of GDP of AUD 35-80 billion in the first ten years; (b) Raise labour productivity by 0.5% (at full employment); (c) Add 70,000 jobs by 2014 (at below full employment).	http://www.accesseconomics.com.au/publicationsreports/getreport.php?report=201&id=257

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
28	ITU	Confronting the Crisis: ICT Stimulus Plans for Economic Growth	2009	Global	Comparative analysis of stimulus plans in the wake of the global financial crisis	This report examines the scope for public financing and the role that the ICT sector (including specifically broadband) can play in regenerating economic growth and promoting economic recovery.	More than 50 countries launched stimulus plans that include ICT and broadband expansion. Among them are 25 OECD countries, and transition economies such as Brazil, Chile, China and the Russian Federation.	www.itu.int/osg/csd/emerging_trends/crisis/confronting_the_crisis_2.pdf
29	Czernich, Nina, Falck, Oliver, Kretschmer, Tobias and Woessmann, Ludger	Broadband Infrastructure and Economic Growth	2009	OECD	This study is an instrumental-variable model and derives its non-linear first stage from a logistic diffusion model where pre-existing voice-telephony and cable-TV networks predict maximum broadband penetration	The study estimates the effect of broadband infrastructure, which enables high-speed Internet access, on economic growth in OECD countries in 1996-2007.	A 10-percentage-point increase in broadband penetration raises annual per-capita growth by 0.9-1.5 percentage points. The analysis method is verified as predicting broadband penetration, but not simultaneous diffusion of other technologies such as mobile phones.	www.cesifo-group.de/pls/guest/download/ifo%20Schnelldienst/ifo%20Schnelldienst%202008/ifosd_2008_19_3.pdf
30	Booz & Company	Digital Highways:The Role of Government in 21st-Century Infrastructure	2009	Global	Comparative analysis	The benefits of a next-generation national broadband network (closing information gaps, expanding economic growth, raising productivity) all depend on a broad and affordable deployment of infrastructure. That deployment is a national imperative, and a great challenge for policy-makers.	10% higher broadband penetration in a specific year is correlated to 1.5% greater labour productivity growth over the following five years. Countries in the top tier of broadband penetration have exhibited 2% higher GDP growth than countries in the bottom tier of broadband penetration	www.booz.com/media/uploads/Digital_Highways_Role_of_Government.pdf
31	McKinsey & Company	Mobile Broadband for the Masses	2009	Global	Comparative analysis, including a simulation to show the effects of the various options for broadband deployment in a typical developing country.	Analysis of the impact of regulatory decisions on the economics of mobile broadband, focusing on poorer and less densely populated areas. The study discusses the levers that regulators could use to stimulate mobile broadband deployment and adoption (such as spectrum being made available, and reformed regulations and licensing fee structures).	Bringing broadband penetration levels in emerging markets to today's Western European levels could potentially add USD 300-420 billion in GDP and generate 10-14 million jobs.	www.mckinsey.com/en/Client_Service/Telecommunications/Latest_thinking/Mobile_broadband_for_the_masses.aspx

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
32	Intel	The Economic Impact of Broadband: Best practices enable developing nations to reap the economic benefits of broadband.	2009	Global	This report determines the specific impact of broadband network deployment and penetration upon an economy.	Broadband networks are an increasingly essential part of the global information society, enabling overall economic growth, and creating new jobs, fostering innovation and enhancing national competitiveness. To achieve these and other benefits of broadband, developing nations need to establish enabling environments that support long-term, cost-effective broadband deployments.	Internet business solutions have enabled companies in the US to save USD 155 billion and have helped companies in France, Germany and the UK increase revenues by USD 79 billion. Estimates from 2003 suggest broadband could contribute USD 500 billion to GDP in the United States and USD 400 billion in Europe. For every 1% increase in broadband penetration in an area, employment would increase by 0.2 to 0.3% per year.	www.intel.com/references/pdfs/The_Economic_Impact_of_Broadband.pdf
33	InfoDev /OECD	What Role should Governments Play in Broadband Development?	2009	Global	This report is an evaluation of best practices from different countries in order to define the government “push” role in ensuring the right environment for ICT and broadband deployment.	In developing countries, broadband provides significant economic and social benefits. Expanding affordable access to broadband is becoming a high priority for governments of developed and developing countries alike.	Traditionally, governments have played a “push” role in stimulating provision of ICT infrastructure and growth of the sector. Now they need to move to “pull” strategies aimed at promoting digital literacy, establishing an enabling environment and fostering the development of applications, including local content. Countries with coherent national strategies have been more successful in fostering broadband diffusion.	www.infodev.org/en/Document.732.pdf
34	LSE enterprise ltd; The Information Technology & Innovation Foundation	The UK’s Digital Road to Recovery	2009	United Kingdom	In this document standard economics methodology is used to determine the specific impact of broadband and ICT investments on direct, indirect, and induced employment, by taking estimates of the economic employment and output multipliers from the Office of National Statistics.	Investment in ICT infrastructure not only can provide an important short-term boost to the UK economy; it can also support long-term economic growth, international competitiveness, and significant improvement in quality of life.	An additional GBP 5 billion investment in broadband networks would create, and retain, an estimated 280,500 jobs in the UK for a year.	www.itif.org/files/digitalrecovery.pdf

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35	Information Technology and Innovation Foundation (ITIF)	The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America	2009	United States	ITIF provides a detailed analysis and estimate of the short-term job impact of investment in critical digital networks — broadband networks, smart grids and health IT — and outlines policy choices.	Investing in the new economy of digital infrastructure will provide significant opportunities: for short-term stimulus and job creation, and longer-term economic and social benefits.	Spurring an additional investment of USD 30 billion in America's IT network infrastructure in 2009 would create approximately 949,000 US jobs.	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1334688
36	CISCO	The Role of Income Distribution and Broadband Penetration in Developing Countries	2009	Developing countries	The report provides an analysis of broadband affordability in developing and developed countries using the "Gini" coefficient, which measures the equality of a country's income distribution across its entire population as an index.	To maximize the benefits of broadband investments, developing countries should consider complementary social policies that promote more equal income distribution. Such policies might include investments in primary and secondary education; tax breaks for the lowest income strata, particularly for broadband or IT equipment purchases, and regulatory or competitive policies that reduce the price of broadband.	If Mexico's Gini coefficient falls to 40 by 2029, the broadband penetration rate will rise to 60%. That is, a slightly more equal income distribution enables an extra 3% of the population (3 million people) to afford broadband using a 5%-of-income threshold. If Mexico's Gini coefficient falls to 30, then an additional 13% of the population will be able to afford broadband by 2029.	www.cisco.com/web/about/ac79/docs/pov/Income_Distribution_POV_1123_1207FINAL.pdf
37	National Cable & Telecommunication Association	The Economic Impact of Broadband Investment	2009	United States	This analysis reviews previous estimates of the benefits of broadband in 2001 and 2003. The estimated consumer surplus derived from broadband adoption, and the consumer benefits from universal broadband deployment. It considers investment in both first- and second-generation technologies, and makes forecasts of how this investment will affect economic output and employment.	The study analyses the economic impact of broadband deployment on consumer welfare, job creation, and economic output.	Annualized investment in cable modems from 2003 to 2009 was USD 4.3 billion, which corresponds to 63,400 jobs created. Annualized investment in DSL and fibre from 2003 to 2009 was USD 11.7 billion, corresponding to 202,400 new jobs. Annualized investment in 3G wireless and satellite technologies from 2003 to 2009 was USD 11.6 billion, corresponding to 168,300 jobs created.	www.ncta.com/DocumentBinary.aspx?id=880

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38	Columbia University, US	Estimating Broadband Demand and its Economic Impact in Latin America	2009	Latin America	An analysis using input-output as well as multivariate regression modeling methodologies.	This paper estimates the demand for broadband technology and quantifies the macroeconomic impact of broadband on employment and productivity.	It is estimated that the deployment of broadband in Latin America could result in, at least, 378,000 new jobs.	http://unpan1.un.org/intradoc/groups/public/documents/gaid/unpan036761.pdf
39	Pricewater-house Coopers	Communication Alliance Economic Impacts of Broadband for Australia and Globally	2009	Australia	This report is a comparative analysis of broadband networks and policies in Australia, with conditions listed for maximizing economic benefits.	The report concludes that broadband is clearly related to economic wellbeing and therefore a critical component to national communications infrastructure.	Broadband infrastructure capable of speeds of 10 Mbit/s is likely to have a positive economic impact of approximately 1 to 2% of GDP per annum. Widespread penetration is likely to result in a productivity rise of some 1% per annum.	www.commsalliance.com.au/__data/assets/pdf_file/0006/4758/Mark_Vassaroti.pdf
40	LeCG (for Nokia Siemens Networks)	Economic Impact of Broadband: An Empirical Study	2009	15 OECD nations, 14 European nations	This analysis is based on a study of the impact of fixed-line telecoms (1980s and 90s), ICT studies (1990s and 2000s), “forward-looking” broadband studies, and econometric studies of broadband.	Broadband can have significant benefits in increasing productivity and economic growth. In countries such as the US, technological convergence has had a wide economic impact, and it accounts for a significant portion (in excess of 10%) of recent productivity growth.	The econometric model predicts that a rise of 1% in penetration in these “medium or high ICT” countries raises productivity by 0.1%. In the US, with 10 more broadband lines per 100 individuals, the productivity benefit would exceed USD 100 billion.	www.connectivityscorecard.org/images/uploads/media/Report_BroadbandStudy_LECG_March6.pdf
41	Columbia Institute for Tele-Information	Estimating the Economic Impact of the Broadband Stimulus Plan	2009	United States	Two types of study have been conducted: aggregate cross-sectional research focused on identifying employment and/or output effects on national economies, and localized studies to assess broadband’s economic effects at the regional level.	The objective of this research is to estimate the jobs that can be created as a result of the grants to be disbursed by the broadband provisions of the conference report on the American Recovery and Reinvestment Act.	Network infrastructure construction could produce 128,000 jobs (32,000 per year) over a four-year period. The estimated cost per job is USD 50,000. Network externalities may produce up to 270,000 jobs over four years.	www.elinoam.com/raulkatz/Dr_Raul_Katz_-_BB_Stimulus_Working_Paper.pdf

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42	Empirica Communic-ation &Technology Research, Germany; TanJent Consultancy, UK (for the European Commission)	The socio-economic impact of interoperable electronic health record (EHR) and e-Prescribing systems in Europe and beyond	2009	European Union (27)	The core of the project is a detailed qualitative analysis of 11 good practice cases in Europe, USA and Israel. Nine of these underwent also a quantitative evaluation of their socio-economic impacts.	The European Commission EHR IMPACT study (EHRI) investigates the socio-economic impact of improved systems for healthcare administration using ICT.	Two measures of performance, socio-economic return and a proxy return on investment, show different results. In general, EHRs and e-Prescribing are beneficial socially, but, except in specific circumstances, need net cash injections.	http://ec.europa.eu/information_society/newsroom/cf/itemdetail.cfm?item_id=5452&utm_campaign=isp&utm_medium=rss&utm_source=newsroom&utm_content=tpa-23
43	Melbourne Business School / IdeaCHECK	Impacts of a national high-speed broadband network: Access Economics	2009	Australia	This report is an estimate of the impact on multi-factor productivity from high-speed broadband deployment	The first comprehensive attempt to value investment in a national high-speed broadband network in Australia	High-speed broadband infrastructure may contribute between USD 12 billion and USD 30 billion per annum to the economy.	http://cite.org.au/store/catalog/ideaCHECKGansMarch.pdf
44	Industry Analysis at US Telecom	The Economic Benefits of Broadband and Information Technology	2009	United States	This is an analysis of the ICT sector's contribution to GDP. The data is based on the value-added approach to measuring GDP.	The analysis shows the interdependence and competitiveness of ICT industries, the growing impact of ICT on the broader economy, and the benefits of continued investment.	ICT contributed USD 902 billion in GDP in 2007 — among the top contributing sectors in the US economy and the primary driver of real, inflation-adjusted growth	www.nyls.edu/user_files/1/3/4/30/84/187/245/Brogan,%20SPRING%202009,%2018%20MEDIA%20L.%20&%20POL%E2%80%99Y.pdf
45	CISCO	Broadband, economic growth and sustainable development.	2009	Global	The study gives an econometric analysis of the impact of broadband on economic growth and job creation.	Broadband is nowadays of the same importance as rail or electricity infrastructure. It is a driver and catalyst for economic and employment growth.	In the US, a 1% increase of broadband penetration is equal to 0.2 — 0.3% of growth in employment.	www.cisco.com/web/FR/documents/pdfs/newsletter/ciscomag/2009/03/ciscomag_25_dossier_01_haut_debit_croissance_economique.pdf

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46	The World Bank	Economic Impacts of Broadband, Information and Communicat-ions for Development 2009: Extending Reach and Increasing Impact	2009	Global	The study uses a cross-country empirical model for analyzing broadband's impact on economic growth, using data from 120 developing and developed countries.	Broadband's economic significance can be put into context by referring to similar changes in other areas of infrastructure, such as: road, rail and electricity.	In the US, broadband added 10-14% to the growth rate in jobs between 1998-2002. Broadband added 0.5-1.2% to the growth in the number of firms between 1998-2002. Housing rents were more than 6% higher in 2000 in areas where broadband was available by 1999.	http://books.google.ch/books?hl=fr&lr=&id=_5DL8RXJUbgC&oi=fnd&pg=PA35&dq=Economic+Impacts+of+Broadband,+Christine+Zhen-Wei+Qiang,+C.M+Rossotto&ots=KA4j0lTO1R&sig=ZDH01Ay3L_1k8k4kjrLLn0i7A3g#v=onepage&q&f=false
47	Alcatel-Lucent	Broadband is indispensable for the mass market	2009	Global	This studies the relationship between the global recession and telecommunication service expenditures. The analysis is also related to broadband networks deployment, penetration and impact on economic growth.	According to the research findings, 84% of clients and users believed broadband at home to be an essential part of connectivity.	Internet and broadband services are a priority in consumer expenditure and remain as a resistant service to the economic crisis.	www.aalcatel-lucent.com/wps/portal/!ut/p/kcxml/04_Sj9SPykssy0xPLMnMz0vM0Y_QjzKLd4x3tXDUL8h2VAQAURh_Yw!!?LMSG_CABINET=Docs_and_Resource_Ctr&LMSG_CONTENT_FILE=News_Releases_2009/News_Article_001640.xml
48	CISCO	Intelligent and sustainable growth: recommend-ations for economic recovery in Belgium	2009	Belgium	This is an analysis of ICT use in Belgium, with case studies of best practice from other countries.	Broadband networks are basic infrastructure for social and economic purposes in European countries. The broadband network provides resources that allow small and medium economies to develop.	There is a positive correlation between broadband and GDP growth in 120 countries. On average between 1980 and 2006, GDP growth was about 1. 2% higher for each 10 % growth in broadband penetration.	www.awt.be/contenu/tel/res/Manifeste_09_FR.pdf

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49	National Bureau of Economic Research (NBER)	The Broadband Bonus: Accounting for Broadband Internet's Impact on US GDP	2009	United States	This study is based on the benchmark estimates for 1999 to 2006.	This study answers how much economic value the diffusion of broadband creates.	Households generated USD 20-22 billion of broadband revenues. About USD 8.3-10.6 billion was additional revenue created between 1999 and 2006. That replacement is associated with USD 4.8-6.7 billion in consumer surplus, which is not measured via GDP.	http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1349591
50	CISCO; The Research Team, Saïd Business School, University of Oxford, UK	Broadband quality improves around the world despite the economic downturn	2009	Kenya	This research compares countries according to their stage of economic development.	62 out of the 66 countries analyzed had improved the quality of consumer broadband services over the previous year. But new data from the study highlights the extent of the digital divide between urban and rural areas and, for the first time, compares the quality of fixed and mobile broadband services.	Kenya trebled its “Broadband Quality Score”, but the overall score for Kenya remains well below the threshold required for today’s applications.	www.cisco.com/web/MT/news/09/news_021009a.html
51	The Brattle Group Inc.	The Need for Additional Spectrum for Wireless Broadband: The Economic Benefits and Costs of Reallocations	2009	United States	This analysis estimates the market value of broadcasters’ spectrum if it was available for wireless broadband, at about USD 62 billion.	Access to radio spectrum is the key to robust broadband deployments. Wireless access adds at least three dimensions to US broadband infrastructure	The study estimates ubiquitous broadband deployment will create an additional 1.2 million jobs from infrastructure spending.	www.brattle.com/_documents/uploadlibrary/upload809.pdf
52	The World Bank	Economic & Fiscal Impact of Introducing Broadband Networks and Services in Lebanon	2009	Lebanon	This analysis uses a model developed by the World Bank with an overview of global best practices.	This report examines the impact of broadband networks and services by looking at the state of sector development in Lebanon.	If broadband penetration had risen by 10% in Lebanon in 2008, the model predicts GDP would have increased by between 1.2% and 1.5% or LBP 523,508 to 654,385 million on a recurring basis and the fiscal contribution in that year would have been between an extra LBP 117,789 to 147,273 million, also on a recurring basis.	http://broadbandlebanon.org/Library/Files/World%20Bank%20Report%2003.12.09/WorldBank.pdf

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53	Public Utility Research Center, University of Florida, United States	Broadband and contributions to economic growth: Lessons from the US experience	2009	United States	This study analyzes the connection between ICT and economic growth, as well as between broadband and economic growth. It reviews previous case studies.	The connection between broadband deployment and economic prosperity in the US has garnered public attention due to stimulus plans authorized in February 2009 for broadband planning and deployment initiatives.	An estimated increase of 1.0% in a US state's broadband penetration would yield an increase of approximately 300,000 jobs.	www.sciencedirect.com/science?_ob=MImg&_imagekey=B6VCC-4X8BPDS-3-1&_cdi=5951&_user=1922613&_pii=S0308596109000962&_origin=search&_coverDate=12%2F31%2F2009&_sk=999669989&view=c&wchp=dGLbVlW-zSkzS&md5=e5882a89f8faa9b919c112379ea5c9aa&ie=/sdarticle.pdf
54	North-western University, United States	The Broadband Bonus: Accounting for Broadband Internet's Impact on US GDP	2009	United States	This study provides benchmark estimates for 1999 to 2006 with a simulation model.	The study focused on measuring the factors that shaped the anticipated incremental costs and benefits from the national upgrade to broadband.	Using data from the US to simulate the impact of broadband compared to dial-up between 1999 and 2006, the study shows that between USD 8.3 billion and USD 10.6 billion additional revenue was created through broadband.	www.techpolicyinstitute.org/files/greenstein-broadband%20bonus1.pdf
55	LSE enterprise ltd; The Information Technology & Innovation Foundation	The UK's digital road to recovery: an ITIF and LSE enterprise report	2009	United Kingdom	This report determines the specific impact of investments in broadband on direct, indirect, and induced employment, by taking estimates of the employment and output multipliers.	The study examines future investment in broadband deployment in the UK.	About 38 jobs could be created per EUR 1 million investment in broadband.	www.itsa.org/itsa/files/pdf/digitalrecovery.pdf

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56	Graduate School of Applied Informatics, University of Hyogo, Japan	A Panel Data Analysis of Diffusion of Japanese FTTH	2009	Japan	The report used Prefectural panel data on broadband subscribers	The Japanese success of ADSL development is due largely to a beneficial cycle of deregulation and effective market competition: deregulation caused competition, while competition demanded further deregulation.	Subscribers can obtain economic benefits from broadband, as shown by the Japanese ADSL experience. At the end of 2008, Japanese broadband subscribers reached almost 30 million, including 15 million FTTH, 1.2 million ADSL, and 4.1 million CATV.	www.tprcweb.com/images/stories/papers/Tsuji_Akematsu_2009.pdf
57	Value Partners	Broadband in China: Accelerate Development to Serve the Public	2009	China	This article is a comparative analysis.	Chinese broadband development still lags behind international leaders such as South Korea and Japan, and some European countries. The time is ripe for Chinese companies to catch up and provide even more services.	The development of China's dial-up and broadband Internet together may contribute a combined 2.5% to GDP growth for every 10% increase in penetration.	www.valuepartners.com/VP_pubbl_pdf/PDF_Comunicati/Media%20e%20Eventi/2010/value-partners-PR_100301_BroadbandInChinaZhaoRuan.pdf
58	The Multilateral Investment Fund, Inter-American Development Bank	Economic Development and Inclusion through Local Broadband Access Networks	2009	Brazil, Domini-can Rep., Guata-mala, Peru	This document is an overview based on phone interviews with stakeholders, mapping of existing best practices and country visits.	This report provides a detailed map of best practice for implementing sustainable local broadband access networks, and an analysis of the situation in Brazil, Dominican Republic, Guatemala and Peru.	Broadband added about 1-1.4% to the employment growth rate and 0.5% to 1.2% to the growth of business establishments during the period 1998-2002.	www.iadb.org/en/projects/project,1303.html?id=RG-T1559
59	Brasscom — the Brazilian Association of Information Technology and Communicat-ion Companies	Brazil IT BPO Book, 2008-2009	2009	Brazil	This report provides a wide range of recommendations for the Brazilian government to strengthen the IT-BPO industry and stimulate the national economy.	Information technology is essential to the economic development of any country that wants to be a part of the global market.	The plan is to attract investments of around USD407 million in wireless broadband, generating 15,000 jobs to build this infrastructure, adding one million new broadband access points in Brazil, selling five million new computers, creating 50,000 jobs and adding USD 35 million in investments in Internet access centres.	www.brasscom.org.br/en/content/download/25939/498248/file/BRAZIL%20IT-BPO%20BOOK_.pdf

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60	Indian Council for Research on International Economic Relations (ICRIER); Vodafone	India: The Impact of Mobile Phones	2009	India	This is an econometric analysis of the impact of mobile telephony, and a review of policies for ICT.	Indian states with high mobile penetration can be expected to grow faster than those with lower rates, by 1.2% a year more on average for every 10% increase in the penetration rate. However, access to the Internet is only around 5% nationally and in some states, (e.g. Bihar) it falls to 0.1%.	The correlation coefficients between per capita income and other ICT indicators across states is also positive but not as large; between Internet access and per capita income it is 0.66 while for broadband and per capita income it is 0.62.	www.icrier.org/pdf/public_policy19jan09.pdf
61	Kyushu University, Japan	Investment in Broadband Infrastructure: Impacts on Economic Development and Network Neutrality	2009	Japan	The study is a micro- and macro-analysis of broadband's impact on the economy.	Owing to the series of initiatives taken by the Japanese government, coupled with private investments, people in Japan can enjoy an advanced broadband environment. This has opened up a wide range of business opportunities and resulted in huge economic benefits.	If the Japanese economy grows smoothly and the potential benefits of ubiquitous networks are fully utilized, the real GDP growth rate will be about 1.0 to 1.1 points higher than otherwise.	http://tridi.ntc.or.th/Conference/NTCIC/paper/p62-69.pdf
62	MICUS Management Consulting GmbH (for the European Commission)	The Impact of Broadband on Growth and Productivity	2008	European Union (27)	This report uses input-output analysis to estimate the impact of broadband and ICT on the EU economy. It focuses on the use of value-added services over the Internet such as extranets, e-Business, online shops and web applications. The model takes into account several effects of broadband: productivity improvement in companies, displacement from traditional sectors of the economy towards knowledge-intensive sectors and broadband-based innovation.	Expanding broadband infrastructure, high education levels, adoption of online services and support of innovation are essential strategies for improving the economic impact of broadband in the EU. The study focuses on improving business processes through the using online technologies in large, small and medium-sized firms.	Broadband-related job growth in 2006-2015 could result in 2,112,000 new jobs. Broadband-related GDP growth could mean that European GDP will rise by between EUR 636 billion and EUR 1,080 billion between 2006 and 2015. In 2006, broadband resulted in a net creation of 105,000 jobs in the EU, and growth of the European Gross Value Added (GVA) of EUR 82.4 billion (+0.71%).	http://ec.europa.eu/information_society/eeurope/i2010/docs/benchmarking/broadband_impact_2008.pdf

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63	Imperial College London, United Kingdom	The Economic Impact of Broadband on Growth: A simultaneous approach	2008	European Union (15)	This paper uses a structural econometric model within a production function framework that endogenizes telecommunications investment.	The paper examines how broadband penetration affects economic growth. A macroeconomic production function with a micro-model for broadband investment is used to estimate the impact of broadband structure and growth.	There are increasing returns on broadband investments which are consistent with the persistence of network externalities. There is evidence of a critical mass phenomenon in broadband infrastructure of 20%, which translates to half of the population having access to a broadband connection.	www.canavents.com/its2008/abstracts/102.pdf
64	InfoDev; World Bank	Broadband as a platform for economic, social and cultural development: Lessons from Asia	2008	Asia	This is a paper presented at the Joint OECD-World Bank Conference on Innovation and Sustainable Growth in a Globalized World, held in Paris in November 2008	Asian economies have set the pace in creating broadband networks. Useful lessons can be learned from this, because: • Asian economies often have cheaper broadband services with higher performance (especially when based on fibre) than elsewhere. • The diversity of Asia offers many models for deploying broadband, as well as both developing as well as developed economies.	The evidence suggests that broadband, although still in its infancy, is having a profound and positive effect on economic, social and cultural development. What is more, the vectors of future change, with rising speeds and falling prices, suggest that the best is yet to come.	www.infodev.org/en/Publication.565.html
65	ICT Regulation Toolkit (2008) ITU/InfoDev	Economic impacts of broadband Internet & ICT service deployment: Overview	2008	Global	These studies are assessments of the impacts of ICT, as a system, by looking at inputs, outputs, outcomes and efficiencies.	Like electricity, ICT may be considered general purpose technologies that are characterized by pervasiveness in the economy and society, constant evolution and improvement, and the capacity to create innovation.	ChileCompra, the Chilean government's online procurement system launched in 2000, has saved over USD 70 million in 3 years through increasing efficiency.	www.ictregulationtoolkit.org/en/Section.3346.html
66	Ovum for CTIA; The Wireless Association	The Increasingly Important Impact of Wireless Broadband Technology and						

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71	ICRIER	Addressing Inter-State Issues: Broadband's Impact on Economic Growth	2008	India	This report is based on comparative analysis of Indian states regarding the correlation between broadband penetration and economic growth.	Broadband penetration in India is still very low (fewer that 1 broadband connection per 100 habitants). Rural India had only 3.3 million Internet users, and only 1% of rural India is covered. There is huge variation in per capita income across states in India.	There is a high correlation between broadband access, Internet use and state GDP. (e.g. in Delhi broadband penetration is 0.2% and income per capita is INR 4000. In Kerala, penetration is 1% and income per capita is INR14 000)	www.icrier.org/pdf/16apr10/Theme%203%20-%20Prof%20Rajat%20Kathuria%20-%20Presentation.pdf
72	Strategic Economic Solutions for the City of Cape Town	The Economic Impact of a Metropolitan Broadband Network for the City of Cape Town	2007	Cape Town, South Africa	The study identifies potential benefits of broadband and extrapolates these to the Cape Town economy. It also establishes and replicates international best practices for the analytical part of the study. Financial and economic cost-benefit analyses were performed on the proposed broadband roll-out.	The objective of this study was to identify, explore and, where possible, quantify the potential economic benefits to Cape Town of a proposed dark fibre broadband network.	The broadband network in Cape Town would create direct and indirect jobs totaling 2,412 in 2007/08 and 4,837 in 2008/09. It was expected that 14,828 direct and indirect jobs would be created in 2010 and nearly 252,000 by 2027. Capital expenditure was expected to contribute ZAR 127-266 million to national GDP between 2007/08 and 2011/12 when the infrastructure is developed.	www.knowledgecommune.com/blog/wp-content/uploads/2007/11/ct-broadband-eco-imp-report.pdf
73	McClure School of Information and Telecommuni-cation Systems, Ohio University, United States	Broadband Impacts on State GDP: Direct and Indirect Impacts	2007	United States	A simple econometric model was used to determine the direct impact of broadband on GDP at the US state level, from 2000 to 2006 and for several sub-periods. The model used some new variables, a weighting factor and controls for unmeasured differences between the states.	This study focused on the economic impact of broadband service penetration. The direct effects were estimated by regressing broadband penetration rates on state GDP per capita.	Using data from yearly changes in employment, broadband leads to a 0.2% to 0.3% increase in employment in a state for a 10% increase in broadband lines. No statistically significant effect was found on state GDP.	www.canavents.com/its2008/abstracts/62.pdf
74	The Brookings Institution	The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of US Data	2007	United States	This study provides new estimates of the effects of broadband penetration on both output and employment, in the aggregate and by sector, using state-level data.	High-speed internet access developed rapidly in the previous decade and is increasingly viewed as essential infrastructure for the global information economy.	Employment in non-farm and several other industries is positively associated with broadband use. For every 1% increase in broadband penetration in a state, employment is projected to rise by 0.2 to 0.3% per year. For the entire US private non-farm economy, this suggests a rise of about 300,000 jobs.	www.brookings.edu/~/media/Files/rc/papers/2007/06labor_crandall/06labor_crandall.pdf

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75	TeleNomic Research (American Consumer Institute Center)	Broadband Services: Economic and Environmental Benefits	2007	United States	This is a review of literature, estimating the emission savings that result from the cumulative "network" effects of wide adoption of broadband-based applications, and forecasts the additional environmental benefits if trends continue over the next ten years.	Reductions in greenhouse-gas emissions can be achieved by the widespread delivery of broadband services in the US, and this leads to less expenditure on oil imports.	Wide adoption and use of broadband applications can achieve a net reduction of 1 billion tons of greenhouse gas over 10 years, which, if converted into energy saved, would constitute 11% of annual US oil imports.	http://internetinnovation.org/files/special-reports/ACI_Study.pdf
76	Widener University; University of Pennsylvania, United States	Infrastructure and productivity: An extension to private infrastructure and its productivity	2007	United States	The method of this report was to estimate an aggregate production function for non-residential output in the US economy, in order to quantify statistically the component contribution of ICT capital to GDP growth for the period 1975 to 2001.	Based on regional data from the US, the model implies increasing returns to scale for the US economy in the previous few years.	The economic impact was measured of public and private investment in cable, mobile, satellite broadcasting and Internet facilities. Broadband was included, but due to the time period covered it only constituted a marginal share of the total infrastructure. The findings were that IT was the largest contributing component of growth in the US over the analyzed time period.	www.sciencedirect.com/science?_ob=MiamiImageURL&_imagekey=B6VC0-4KV2YDF-1-10&_cdi=5940&_user=1922613&_pii=S0304407606000145X&_check=y&_orig=search&_coverDate=10%2F31%2F2007&view=c&wchp=dGLbVlW-zSkzS&md5=d15b0bf3963350127155c5ecddd97a97&ie=/sdarticle.pdf
77	Information Technology & Innovation Foundation; House Committee on Appropria-tions, US	The Importance of National Policies to Connect Rural America to Broadband	2007	United States	This is a national overview of broadband's impact on the US economy. It was presented to the Committee on Appropriations Agriculture Subcommittee, of the US House of Representatives.	Universal broadband access would yield substantial economic benefits. But expanded access in rural America in particular will bring major benefits, not just for rural communities, businesses and residents, but for the nation as a whole.	A 2001 study estimated that universal broadband adoption could yield annual consumer benefits of USD 300 billion.	www.itif.org/files/HedlundRuralBroadbandTestimony.pdf

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78	Carnegie Mellon University, United States	Bringing Broadband to Unserved Communities	2007	United States	This paper presents three complementary policy changes that could facilitate the leap into broadband connectivity for unserved communities. Each policy can be advanced in parallel.	Roughly one-third of households in rural America cannot afford to subscribe to broadband Internet services. This disadvantages many rural communities with respect to economic growth, job creation, education, healthcare, and more. Internet users in urban areas are also adversely affected by the exclusion of rural households.	Broadband increased the number of new businesses established by almost 0.5% in a typical region.	www.brookings.edu/~/media/Files/rc/papers/2008/07_broadband_peha/07_broadband_peha.pdf
79	Malaysian Communications and Multimedia Commission	Broadband Access: Trends and Implications	2007	Malaysia	This report is a countrywide broadband policy review, compared with selected benchmark countries.	The Malaysian government has been promoting the use of ICT for the last decade as an accelerator of economic development, growth maintenance, and to reduce the digital divide. In September 2007, the government unveiled plans for an initiative to roll out high-speed broadband services across the country. The target was to cover 2.2 million premises, with investments to cost about MYR 15.2 billion (USD 4.46 billion) over 10 years.	In the 2004 budget, in order to ensure wider access to the Internet at low cost and to promote e-commerce through wider and cheaper access to broadband Internet, local operators were directed to reduce Internet access charges via a 50% discount for industrial and corporate packages, beginning with 30% for phase 1 and a further 20% for phase 2. For other users, a 30% reduction was given for consumer broadband Internet charges.	www.skmm.gov.my/link_file/what_we_do/Research/Industry%20studies/IR_Broadband%20Access.pdf
80	Malaysian Communica-tions and Multimedia Commission	Industry Performance Reports 2007	2007	Malaysia	A review of industry performance and government policy.	The strategy for nationwide broadband implementation to achieve 50% household penetration by 2010 was proposed. ICT development in the country is acknowledged as an enabler of sustaining national economic growth and achieving international competitiveness.	The number of broadband subscribers in Malaysia increased by 53% to 1.4 million in 2007. ICT industry revenue contributed 6% and 7.6% to the country's GDP and GNP respectively. Growth is supported by revenue from overseas operations, which contributed 18% to ICT aggregate revenue in 2007.	www.skmm.gov.my/link_file/what_we_do/Research/IPR07.pdf

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
81	Telecom Regulatory Authority of India (TRAI)	Draft Recommenda-tions on Growth of Broadband	2007	India	This report is an overview of broadband technologies and deployment in India.	Slow growth of broadband is a serious concern, in spite of good growth potential. Deep analysis of all impediments to growth is required, and discussion of various options to boost broadband penetration.	Availability of broadband services at affordable tariffs can have a significant impact on GDP and attract new investment, as well as generate more employment and raise productivity.	www.trai.gov.in/trai/upload/PressReleases/495/recommendation17sep07.pdf
82	CISCO	Brazil Extends Broadband Technology to a Tiny Municipality to Promote Benefits of a Digital City	2007	Brazil	A short overview of solutions for extending broadband coverage to a small rural town, to demonstrate the power of the Internet.	The challenge for the Brazilian public sector is to extend telecom coverage to diverse geographic regions, coordinate efforts local and central government efforts and motivate service providers to modernize infrastructure without a projected return on investment.	A broadband mesh network was deployed in the town of Tiradentes. Plans were created to extend broadband to all 5,600 municipalities throughout Brazil.	www.cisco.com/web/about/ac79/docs/wp/Govt_of_Brazil_CS_1016b.pdf
83	University of Rhode Island; University of North Carolina—Greensboro, United States	Drivers of the Broadband Industry in China and India: What Can We Learn?	2007	China, India	This study is based on a comparative analysis.	The telecommunication networks of India and China are among the largest in the world. This paper offers a model of broadband diffusion in a developing economy. It compares and contrasts the building blocks of the model in the context of China and India.	In China, the government has influenced demand and supply of broadband through its entrenchment in the economy. In India, competition and the country's emergence as the global capital of offshore outsourcing have triggered broadband growth.	www.ptc.org/past_events/ptc07/program/papers/M21_NirKsheti.pdf
84	InfoDev	Recognition of Broadband for Economic Development	2006	Global	An overview of case studies and of empirical research on broadband's economic impact. From the US and other countries, and at a regional community level, there is confirmation that there is a substantial quantifiable impact.	With broadband as a relatively new phenomenon, there was a limited amount of empirical research. But all research studies demonstrate that broadband deployment results in very substantial benefits to an economy.	For the UK economy, by 2015, the productivity benefits of broadband could be as much as 2.5%, resulting in an annual increase to the UK's GDP of GBP 21.9 billion.	http://infodev-study.oplan.org/the-study/folder.2006-02-02.6117616300/3-2-recognition-of-broadband-for-economic-development

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
85	Illuminas Global LLC.	Net impact Canada: Small and medium-sized enterprises	2006	Canada	The study is based on a research model developed by Cisco Systems and Illuminas, which conducted the research in partnership with Cisco Canada and info-Canda. It examines the effects of ICT upon SMEs, in contrast with large businesses.	The study focused primarily on enterprises with fewer than 100 employees. Comparisons are made to previous Net Impact Canada studies to show how the Canadian SME's approach to using ICT has changed over time.	80% of Canadian small businesses reported increased speed in information processing, and nearly 75% reported increased availability of information through ICT to support decision-making.	www.netimpactstudy.com/ca/pdf/20070102_ni_canada_small_med_business.pdf
86	Atkins Management Consultants	Benefits of Broadband and the Broadband Wales Programme to the Welsh Economy	2006	South Wales, United Kingdom	The methodology underlying this calculation of the net benefit of broadband in Wales is based on the equation: Net benefit = private sector benefits + public benefits – costs.	The analysis aimed to quantify the benefits arising from the adoption of broadband in Wales and the benefits attributable to the Broadband Wales Programme.	The net benefit of broadband to the Welsh economy over the period 2000 to 2015 was estimated to be at least GBP 1,387 million.	www.gwynedd.gov.uk/upload/public/attachments/925/Broadband_benefits_report.pdf
87	InfoDev	Case Studies on the Economic Impact of Broadband	2006	United States, Canada	These case studies use comparative analysis in an input-output model.	The paper demonstrates the economic impact of broadband deployment at national, regional and local levels and the role of local open access networks. It also deals with the impact of broadband deployment and adoption on the issues of social benefit and inclusion.	The economic performance was compared of two towns in Iowa. Cedar Falls had a citywide municipal hybrid fibre/coaxial broadband network; in Waterloo, incumbent cable and telecom carriers provided services, but not including FTTB. By the end of 2003, Cedar Falls had 130 firms employing more than 5,000, while Waterloo had only 10 such businesses.	http://infodev-study.oplan.org/the-study/2-economic-and-social-development/2-2-case-studies-on-economic-impact-of-broadband
88	MIT Futures Communica-tions Program	Measuring Broadband's Economic Impact	2006	United States	This study (for the US Department of Commerce, Economic Development Administration) is an analysis of business activity indicators, demographic indicators and controls, geographic controls, and broadband metrics.	The results of the study support the view that broadband access enhances economic growth and performance, and that the assumed economic impacts of broadband are real and measurable.	Broadband related employment added about 1-1.4% to the job growth rate in 1998-2002. Broadband added about 0.5-1.2% to growth rate of business establishments from 1998-2002. In 2000, housing rents were 6% higher in areas where broadband was available.	http://cfp.mit.edu/publications/CFP_Papers/Measuring_bb_econ_impact-final.pdf

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89	IEEE Mexico Council	Telecommunica-tions Convergence, Competitive-ness and Development of Broadband Internet working Technologies and Services: Impacts, Challenges and Proposals for Mexican Market Evolution	2006	Mexico	This document contains an overview of the broadband service network in Mexico,	The Mexican market shows potential for growth due to significant pent-up demand for connectivity and the expectation of improvement in the macroeconomic climate.	Convergent networks require new capital investments, but they typically result in lower cost networks for the operators. These economic impacts must be part of the “basic service” price.	http://ieeexplore.ieee.org/iel5/4381469/4381470/04381490.pdf?arnumber=4381490
90	Applied Economic Studies, First Legal Advisors	Broadband and Economic Development: A Municipal Case Study from Florida	2005	Florida, United States	An econometric model is employed to compare economic growth in Lake County, Florida, with other similar Florida counties.	An extensive, fibre-optic broadband network was deployed throughout Lake County — a multimillion-dollar project in a relatively small community. The study postulates that broadband infrastructure can be a significant contributor to economic growth.	Lake County experienced a doubling in economic growth relative to its Florida peer counties after offering its municipally owned broadband network widely to public and private entities.	www.aestudies.com/library/econdev.pdf
91	Rural Development Institute, Brandon University; Dalhousie University, Strategic Networks Group	Industry Canada: Broadband Economic Impact Study	2005	Canada	This report provides comparative statistics on broadband’s impact in two small Canadian communities — Churchill in Manitoba, and Parrsboro in Nova Scotia.	The return on investment of broadband provision in Churchill and Parrsboro has been positive and respondents strongly support future investments in broadening access to ICT and broadband.	In Churchill, the impacts were USD 769, 000 revenues generated online by businesses using broadband, against a USD 4,200 decrease in revenue resulting from lack of broadband. In Parrsboro, USD 58,000 was gained from Internet sales and by businesses using broadband.	www2.brandonu.ca/organizations/rdi/Publications/ICT/IndustryCanadaEconomicImpactFinalRpt-August2005.pdf

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
92	University of Bradford, United Kingdom; SustainIT	Sustainable Broadband? The Economic, Environmental and Social Impacts of Cornwall's actnow Project	2005	Cornwall, United Kingdom	An online survey assessed broadband's economic, environmental and social impacts in the county of Cornwall.	Broadband generally benefitted enterprises, individuals, the Cornish economy, society and the natural environment by, for example, extending market reach and impact, making working practices more efficient, enabling staff to work flexibly, and substituting for physical travel.	A large majority of respondents said broadband has positive effects on business performance (91%), relationships with customers (87%), the job satisfaction and skills of staff (74%), and a fall in telephone (80%) and mail/printing (76%) costs.	www.ukceed.org/files/downloads/actnow_full.doc
93	TeleNomic Research, LLC (for Office of Advocacy)	Broadband Use by Rural Small Businesses	2005	United States	Numerous studies and examples are cited showing the benefits of broadband services comparing urban and rural usage, and depicting the availability of broadband services by population density.	This research explores two ideas. First, that broadband services provide tangible benefits to the overall economy; second, that rural deployment lags urban deployment.	For every one million dollars of broadband investment, eighteen new jobs are created in the economy	www.sba.gov/advo/research/rs269tot.pdf
94	ACIL Tasman Pty Ltd	Economic Impacts of Broadband Adoption in Victoria	2004	Victoria, Australia	The methodologies used in the study were a literature review; review of broadband availability and adoption in the state of Victoria (a calibration of the take up curves to 2003), and sectoral productivity estimates.	The report explores and quantifies the economic importance of broadband Internet access to the economy in Victoria, particularly in relation to productivity, gross state product (GSP) and jobs.	The average annual growth in the number of jobs in Victoria resulting from broadband adoption was 0.5% over 2004-2015. The average annual contribution of broadband to GSP growth over the projection period is 0.82%.	www.mmv.vic.gov.au/Assets/42/1/EconomicImpactsofBroadbandREPORTFINAL2004.pdf
95	The Allen Consulting Group, with Ericsson	True Broadband: Exploring the Economic Impacts	2003	Australia	The study combines the application of an economic model, with qualitative and quantitative inputs from a range of relevant sources.	This study evaluates, in detail, the economic impact of a broadband network in Australia. It also examines the impact for industries within the Australian state of Queensland.	By 2018-2019, Queensland's economy would benefit from broadband through an increase in real output or gross state product (GSP) by AUD 854 million per annum; additional employment equivalent to 1,155 new jobs, and an increase in annual aggregate consumption by around AUD 499 million.	www.citynet.nl/upload/ERN01_Final_Report_2_Broadbandproductivity_1.pdf

	INSTITUTION AUTHORS	TITLE	YEAR	FOCUS	APPROACH	SUMMARY	KEY FINDINGS	LINK
96	Access Economics (for the Australian Government)	The Economic Impact of an Accelerated Rollout of Broadband in Hospitals	2003	Australia	The economic impact was determined by (1) calculating the impact if broadband were rolled out immediately; (2) deducting the impact generated from broadband already in place, including the costs and benefits from existing ISDN health applications, and (3) estimating the impact of alternative rates of broadband roll-out.	The report examines the impact of accelerated rollout of broadband connecting major hospitals and specialist medical centres. E-health applications, including for psychiatry and radiology, have a strong track record of efficiently delivering clinically-effective health services to rural and regional areas.	A carefully planned, extensive broadband network connecting major healthcare facilities has the potential to generate net economic benefits to Australia by enhancing the delivery of health services.	www.dbcde.gov.au/__data/assets/pdf_file/0003/48351/Broadband_in_Hospitals.pdf
97	European Commission; Forum for European e-Public Services	e-Government best practices and their impact	2003	Europe	This is a Power Point presentation of e-government goals, with aspects of best practice in Europe.	E-governance through broadband networks and ICT is a tool to reduce costs and improve efficient management for citizens in local municipalities.	An example broadband project for municipal governance is Liverpool Direct, which yielded cost reductions that allowed a tax cut of about 3%.	www.erdf.edu.pl/downloads/wwwupload/Projekty%20ICT-%20Marc%20RIBES.ppt
98	Centre d'études et de recherches internatio-nales (Sciences Po), France	South Korea: new model of a new economy?	2003	Republic of Korea	This study highlights multiple examples of the broadband Internet as a key factor in social and economic transformation of the Republic of Korea.	"New economy" is a synonym of broadband Internet access in the Republic of Korea. In 2003 it was already one of the best-connected countries in the world.	The broadband network's deployment and penetration had a huge impact on the dynamic growth of the electronics sector in the Republic of Korea. Production increased ten-fold between 1990 and 2000, from a worth of KRW 15.2 trillion to KRW 150.2 trillion.	www.ceri-sciencespo.com/publica/etude/etude98.pdf
99	Strategic Networks Group (for the Department of Trade and Industry, United Kingdom)	Economic Impact Study of the South Dundas Township Fibre Network	2003	Ontario, Canada	Data was collected from the local business community, to identify and assess changes, compile information on the direct effects of broadband in the local economy, and assess their economic impact.	The study assessed the return on investment in broadband. The township of South Dundas invested CAD 750,000 in 2000 to build a fibre-optic network. The goal was to provide broadband connectivity to South Dundas and promote local economic development.	Between June 2001 and April 2003, the broadband network created 62.5 new jobs in the town, and was responsible for CAD 2.8 million in commercial /industrial expansion and CAD 140, 000 in increased revenues and lower costs.	www.bis.gov.uk/files/file13262.pdf

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100	The British Chambers of Commerce	Business Broadband: A state of the nation survey into the penetration and impact of broadband on British business	2003	United Kingdom	In this survey 3,973 responses were received from businesses of all sizes and sectors	This survey is a state of the nation look into the penetration and impact of broadband on British business.	Businesses perceived the benefits of broadband to be more effective communication (60.8 % of respondents); improved productivity (46.4 %); reduced costs (45.3 %); more efficient procurement (26.2 %), and increased sales (13.4 %).	www.cisco.com/cisco/web/UK/news/pdfs/Broadband_Survey.pdf
101	CSE Freedom Works Foundations	State Economies Can Benefit from Broadband Deployment	2003	United States	This is an input-output analysis with a study of the legal background and economic benefits related to broadband deployment.	Broadband deployment is the next step in creating the new networked economy. In addition to wider access to providers of goods and services, consumers will have easy access to information and many new services.	Combining the direct and spill-over job estimates, a total of 1.2 million new jobs would be created if broadband technologies were deployed to residential customers across the United States.	www.heartland.org/customz/semod_policybot/pdf/14457.pdf
102	The Broadband Industry Group, CEBR	The Economic Impact of a Competitive Market for Broadband	2003	United Kingdom	The benefits of broadband were translated into input for UKMOD, CEBR's UK macroeconomic model, to understand the potential impact on the UK economy.	This report represents the first attempt to quantify rigorously the benefits of broadband to the UK economy.	By 2015 the productivity benefits of broadband could result in the UK's GDP being up to GBP 21.9 billion higher than it would otherwise have been.	www.ist-bread.org/pdf/CEBR%20Report%20on%20BB.pdf
103	Criterion Economics LLC	The Effect of Ubiquitous Broadband Adoption on Investment, Jobs, and the US Economy	2003	United States	This analysis estimates the impact of universal residential broadband adoption on consumers and on investment, employment, and economic growth. It begins by estimating the value to consumers— the "consumers surplus" — of universal broadband adoption.	Unleashing the full potential of broadband communications could generate hundreds of billions of dollars per year in consumer value.	The cumulative increase in capital expenditures associated with ubiquitous adoption of broadband would result in a cumulative increase in GDP of USD 179.7 billion and sustain an additional 61,000 jobs per year.	www.newmillenniumresearch.org/archive/bbstudyreport_091703.pdf
104	TeleNomic Research LLC	Building a Nationwide Broadband Network: Speeding Job Growth	2002	United States	This study is an analysis of policies related to broadband and broadband's effects on job creation.	This study investigates the economic benefits of building a nationwide broadband network and quantifies the job gains that this will have on the US economy.	Building and using a robust, nationwide network will expand US employment by an estimated 1.2 million new and permanent jobs.	www.lus.org/uploads/BuildingaNationwideBroadbandNetwork.pdf

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105	University of Technology in Lodz, Poland, Faculty of Marketing and Economy	ICT network development impact on e-Commerce	2002	Europe	This paper is based on an input-output analysis of the broadband infrastructure possibilities in Europe and its impact on e –commerce.	ICT development has a direct impact on e-commerce growth, and broadband enhances its impact.	Broadband network access allows a better quality of service; the reduction of time lags for goods and services; the assurance of connection stability and security; creating brand awareness, and establishing and managing customer relations.	http://mikro.univ.szczecin.pl/bp/pdf/5/17.pdf
106	University of California; The Brookings Institution; Momentum Research Group.	The Net Impact Study: The Projected Economic Benefits of the Internet in the United States, United Kingdom, France and Germany	2002	United States, United Kingdom, France, Germany	The study provides a comparative analysis.	The study provides data, collected at the company level, to estimate the impact of the Internet to date and to project what impact it might have in future; also to estimate the impact on the productivity growth rate in the economies of the countries studied.	Organizations in the United States, United Kingdom, France and Germany have achieved cumulative cost savings of USD 163.5 billion, with the majority occurring since 1998. US organizations expect to realize more than USD 5 trillion in cost savings once all Internet business solutions have been fully implemented by 2010.	www.netimpactstudy.com/NetImpact_Study_Report.pdf
107	Criterion Economics LLC	The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access	2001	United States	The study conjectures the demand function for high-speed access once broadband has diffused throughout the US. It also examines eventual specific benefits and calculates the consumer surplus associated with each source of benefit.	Broadband Internet access in all forms — ADSL, cable modems, and wireless services — will bring enormous benefits to the US economy. Many of the impacts cannot be foreseen in 2001, but are already on the horizon.	Widespread deployment of broadband could contribute up to an extra USD 500 billion annually to the GDP of the United States.	www.att.com/public_affairs/broadband_policy/BrookingsStudy.pdf

4 CONTENT, CREATIVITY AND CAPACITY BUILDING

4.1 INTRODUCTION: BUILDING INCLUSIVE KNOWLEDGE SOCIETIES

The World Summit on the Information Society (WSIS), held in 2003 and 2005, showed that innovations in information and communication technologies (ICT) should, as broadband Internet access, provide vast new opportunities for the creation, preservation, dissemination and use of information. But technical connectivity and infrastructure can only serve development when combined with content and users. The close connection between infrastructure and content is an essential factor in enabling broadband Internet access to be sustainable, and able to contribute to the building of inclusive "Knowledge Societies."

In this regard, the concept of pluralistic Knowledge Societies appears to be more appropriate, rather than that of an "Information Society," which may be associated particularly with the idea of technological innovation. The Knowledge Societies concept is rooted in the framework established by the Universal Declaration of Human Rights of 1948, which enshrines the right of all to express ideas and interests, and also implies a right to access information in an open and inclusive environment.

In 2005, the United Nations Educational, Scientific and Cultural Organization (UNESCO) published a report "Towards Knowledge Societies"[1], which analysed the opportunities emerging from the transformation of information and communication, the challenges in terms of equity and inclusiveness, and an approach to building societies in which knowledge is the primary resource for individual development, social engagement and economic growth.

The four key principles for development of inclusive Knowledge Societies are[2]:

- Freedom of expression
- Universal access to information and knowledge
- Respect for cultural and linguistic diversity, and
- Quality education for all.

Currently, the vast opportunities provided by technical development, including broadband, are not accessible to everyone and there are various reasons for this. UNESCO's "Recommendation

1 http://unesdoc.unesco.org/images/0014/001418/141843e.pdf

2 http://unesdoc.unesco.org/images/0012/001295/129531e.pdf

concerning the Promotion and Use of Multilingualism and Universal Access to Cyberspace" (2003)[3] states that the major elements needed to overcome this issue are as follows:

- Development of multilingual content and systems
- Facilitating access to networks and services
- Development of public domain content, and
- Equitable balance between the interests of rights-holders and the public interest.

4.1.1 THE INFORMATION FOR ALL PROGRAMME

The *Information For All Programme* (IFAP) is an inter-governmental programme of UNESCO established in 2001 to provide a framework of international cooperation and partnership aimed at fostering Knowledge Societies. In particular, IFAP seeks to assist UNESCO Member States in the elaboration and implementation of national information policies and knowledge strategies.

Through its policy-oriented interventions, IFAP supports the role of ICT as drivers for development and key enablers for all citizens — women and men alike — to fully exercise their human rights and responsibilities and participate in Knowledge Societies.

Broadband has a clear role in supporting the achievement of this goal. Broadband not only facilitates technical access and connectivity to networks, but also enables the delivery of services that support the acquisition of key literacy skills that users require to gather, use and create information, new content, and services, as well as to participate in a range of knowledge-based activities. Broadband also offers increased possibilities for richer audio-visual content that can support participation of oral cultures, sign languages and non-literate persons, a majority of whom are women.

At the same time, paradoxically, while broadband is part of the solution to increasing accessibility to networks, inequitable roll-out of broadband may contribute to the digital divide. IFAP, through publications such as its "National Information Society Policy: A Template" and its online *Information Society Observatory*, seeks to provide resources that assist policy-makers in grappling with these dichotomies.

Box 4.1 Info-ethical considerations of broadband

The Information For All Programme (IFAP) of UNESCO has identified five priority areas for action, namely information for development, information literacy, information preservation, information ethics and information accessibility. IFAP focuses on identifying policy gaps in these areas, developing knowledge resources to mitigate them, stimulating policy discussion in international fora and building multi-stakeholder partnerships to address the programme's priorities.

Broadband affects each of these priority areas. Inequities in the cost and availability of broadband services have profound implications for information accessibility and participation and exercise of human rights in Knowledge Societies. Broadband enabled networks also contribute to the viability, development and pervasiveness of technologies such as grid computing, mesh networks, digital identity management and location based services.

While clearly beneficial, these technologies, when inappropriately applied, may aggravate discrimination or invasion of privacy, or present info-ethics challenges. It is important that policy-makers, deployers and users of these technologies be conscious of potential societal impacts and their implications for the creation of inclusive, just, Knowledge Societies.

Source: UNESCO: "Ethical Implications of Emerging Technologies: A survey" (http://unesdoc.unesco.org/images/0014/001499/149992E.pdf).

3 http://portal.unesco.org/en/ev.php-URL_ID=17717&URL_DO=DO_TOPIC&URL_SECTION=201.html

4.2 FREEDOM OF EXPRESSION

Freedom of expression is central to building strong democracies, contributing to good governance, promoting civic participation and the rule of law, and encouraging human development and security. The principle of freedom of expression must apply not only to traditional societies, but also to Knowledge Societies enabled by the Internet.

With the development of the broadband Internet, there is a need to continually expand and adapt policies and regulatory frameworks, and to explore the relationships between freedom of expression and other key values and rights. In this context, more efforts need to be made to promote wider citizen involvement and corporate responsibility in Internet governance.

Special attention should be given to ensuring that women's organizations and networks are brought on board, in order to further promote freedom of information and to foster awareness of its relevance for the rights of women, among other stakeholders. Representatives of the Internet industry, governments and civil society should work together to protect freedom of expression as a fundamental human right.

Some of the specific problem areas that must be considered are:[4]

- Digital rights, tied to freedom of expression, privacy and data protection
- Technical measures for controlling Internet flows, such as content filtering
- Fraud, child protection, human trafficking (especially of women and children), decency, libel, and control of hate speech
- Network regulation, including particularly regulation of Internet service providers, and
- Security concerns, ranging from cybercrime and controlling viruses, to protecting national security.

Individual privacy should be considered as a corollary of the fundamental human right of freedom of expression. Multi-stakeholder governance of the Internet should aim at protecting users' right to inform, while enabling them to control their personal data.

In particular, the increasing popularity of social networking applications raises new challenges to both privacy protection and freedom of expression. These challenges, given social networking's transnational diffusion, lie in the disparity between existing legal frameworks and the new realities of the virtual domain.

4.2.1 PROTECTIVE REGULATION – NET NEUTRALITY

Internet use can be shaped and reinforced through the design of technologies, policies and practices. An example of this is the use of regulatory mechanisms to transfer the responsibility for monitoring traffic to Internet service providers (ISPs): a practice that is currently being used in some countries to identify illicit content shared online.

The regulation of businesses in this sector, including the assignment of social responsibility, is becoming a key element affecting access to the Internet as governments intervene in various ways to

4 These and other issues were featured in a UNESCO report "Freedom of Connection – Freedom of Expression: The Changing Legal and Regulatory Ecology Shaping the Internet" (2010)

impose national laws and policies. There is also much discussion of how this might affect freedom of expression, since the Internet is such an important means of communication.

In this context, the concept of "net neutrality," a technical aspect of Internet regulation, has been used in debates over the need to regulate the right to connection. Although there is not a globally accepted definition of net neutrality, in general the term has been used to describe operators (backbone operators and ISPs) not favouring any type of content or traffic transferred through their networks, regardless of the amount that content providers pay for their connection. The opposite practice to net neutrality would be to give priority to certain types of traffic (such as video) that might be more sensitive to delays in the network.

As digital media evolve and use of the Internet intensifies enormously, the need for ever greater bandwidth has made the net neutrality debate more prominent, particularly in relation to who should pay for the use of networks — operators or service providers. Net neutrality (also described as a "single-tier Internet") is seen by many as an approach to managing existing bandwidth fairly as demand begins to exceed supply, rather than risking an increase in inequality by offering different speeds to different customers.

Although net neutrality has often been viewed as a North American debate, it is becoming an important global policy issue. Net neutrality regulation is seen by some countries and policy experts as a viable approach to encourage ISPs to invest in broadband infrastructure, while taking account of the principle of inclusiveness and of social priorities.

4.3 UNIVERSAL ACCESS TO INFORMATION AND KNOWLEDGE

In building Knowledge Societies, it is essential to ensure that the principles of inclusiveness, pluralism, equity, openness and participation are taken into consideration. All of those principles must be equally applicable to all members of society.

The debate around the right to Internet access is growing in governments around the world, and countries are beginning to formally recognize this right. In June 2009, the French Constitutional Council ruled that the freedom to access "public online communication services" is a basic human right[5]. In the same year the Spanish government announced that its citizens would have the legal right to buy broadband Internet access at 1 Mbit/s, starting in 2011. In July 2010, Finland became the first country in the world to pronounce broadband Internet access as a fundamental human right. Costa Rica's constitutional court ruled in September 2010 that the Internet was also a fundamental right for its citizens, and mandated the government to provide universal access for all[6]. Estonia[7] and Greece[8] were amongst the first countries to stipulate that the national government has legal obligations to provide access to electronic information and services for citizens.

5 Decision 2009-580 DC: www.conseil-constitutionnel.fr/conseil-constitutionnel/english/case-law/case-law.25743.html

6 Costa Rican constitutional court ruling-2010-012790 (in Spanish): http://200.91.68.20/scij/busqueda/jurisprudencia/jur_repartidor.asp?param1=XYZ&param2=1&nValor1=1&nValor2=483874&strTipM=T&lResultado=1

7 Estonia's Public Information Act: http://unpan1.un.org/intradoc/groups/public/documents/un-dpadm/unpan039520.pdf

8 Article 5A.2 from the Greek Constitution: *www.nis.gr/npimages/docs/Constitution_EN.pdf*

4.3.1 INCLUSIVENESS OF ACCESS – BROADBAND AS AN EQUALIZER

In the above context it can be easily argued that every member of society should have access to a high-speed, high-capacity broadband connection to the Internet. This includes people in urban or in remote areas, men and women, young girls and boys, the elderly, people with various types of disabilities, and those with different cultural, linguistic or ethnic backgrounds. If this principle is applied, all will have equal opportunities to become participants and contributors in Knowledge Societies, particularly benefiting from new economic, educational, health, employment and social opportunities.

Moreover, universal access to broadband will increase the development of local content, and contribute to the burgeoning of local ICT economies and enterprises. Continuously expanding networks — based on broadband Internet and other ICT advances — will stimulate new forms of human association of unprecedented scale and flexibility, spanning cities, nations and cultures.

Very importantly, broadband connectivity can significantly increase the independence of women and men with disabilities, so their needs should be taken into account in designing and implementing Internet infrastructure at all levels (backbone, distribution, user facilities and access devices).

Box 4.2 Making ICT accessible to people with disabilities in the United States

In 2010, the United States Senate passed by unanimous vote the "Twenty-first Century Communications and Video Accessibility Act" (S. 3304), which is a significant step forward in making ICT accessible to people with disabilities.

The legislation will ensure full access by such users as those who are deaf, hard of hearing, late deafened and deaf-blind, to evolving high speed broadband, wireless, and other Internet Protocol technologies. In particular, it stipulates that accessibility features be preserved when materials are offered online, that telephones used over the Internet must be compatible with hearing aids, and that television programmes must be captioned when delivered over the Internet.

The Act will help to eliminate discrimination based on disability, and enhance broadband accessibility in public and private places, thus reducing the digital divide for people with disabilities.

Source: Coalition of Organizations for Accessible Technology (www.coataccess.org/node/9777)

The importance of the impact of broadband on women's lives should also be taken into account. Broadband is a unique means for preparing the groundwork for the empowerment of women, as it connects them to a wide range of resources used to enhance family life, improve health outcomes, bolster education, and pursue economic opportunities. Women are essential stakeholders and key resources in discussions about broadband going forward, including decision-making processes. However, in societies that impose strict social and gender roles, women (especially rural women) are often not able to enjoy or benefit from advances in Internet technology, which can clearly provide them with greater social and economic freedom and improved access to opportunities. Gender equality must be seen as a necessary condition for the achievement of development objectives, as well as being a fundamental human right.

Young girls and boys represent a particularly important broadband user group, as their great gift for assimilating technologies provides added benefits for empowering them to contribute to the application of these technologies to development, not only as users but also as promoters and innovators. On the other hand, it is important that older citizens, with their special needs and also their underused potential to contribute to social goals, should not be left out of the broadband revolution.

The recent rapid growth in smartphones and other advanced mobile devices has partly been fuelled by the "app" concept of distributing small, specialized software applications to mobile devices. App-based services, such as news updates, navigation tools and games, have unleashed a new demand for mobile devices as well as stimulated creativity and local adaptability on a previously unseen scale. At the same time, as mobile devices are increasingly becoming an important factor in political processes, governance and democratization, ordinary citizens use them to report news, expose wrongdoing, mobilize opinion and monitor elections and government. When planning for inclusiveness of access, the links between broadband and mobile technologies should be fully exploited. In an initial approach, mobile devices can be connected to the Internet through broadband hubs, while as technology develops, the potential of mobile broadband is likely to become more and more a reality in developing countries.

Box 4.3 Harnessing mobiles' potential for development

Here are some of the areas in UNESCO's fields of competence where mobile communication technology can play a major role in development, facilitated by smartphones and broadband:

m-Learning: M-Learning can bring quality education and innovation to learners and teachers facing geographical isolation or social marginalization. For example, the public-private Text2Teach programme in the Philippines enables teachers and students to access more than 900 multimedia educational materials such as video, pictures, text or audio files, by requesting them via SMS.

m-Science: Many different research activities share the same need for accurate and timely field data, giving mobile devices the potential to dramatically improve collection of data over wide geographic areas. At the same time, new software that runs on smartphones, connected to grid computing solutions, can approximate in seconds scientific calculations that previously would have taken hours. These solutions are not dreams for the future, but are increasingly being deployed on the ground, for example through compact microscopes that interface with cameras in mobile phones, or nanosensor-based detectors for airborne chemicals that plug into smartphones.

m-Culture: Mobile technology can be applied to the creation and dissemination of cultural works and to the development of culture in general. For example, disadvantaged communities can be empowered to enhance livelihoods and local development through mobile applications to promote their artistic and craft work, or through mobile guides to museums and other historical and cultural sites.

m-Media: The media in most developing countries have lagged in taking advantage of mobile technology opportunities which have proved effective in industrialized countries. Examples of these opportunities are:

- production of innovative mobile-adapted content, e.g. educational games, breaking news, and videos on development issues
- voice-based wikis or repositories for the delivery of spoken content on mobiles, and
- diffusion of local video content on mobile devices, ultimately moving with broadband to digital broadcasting of live mobile television.

Source: UNESCO

4.3.2 DIGITAL PRESERVATION AND ACCESS TO HERITAGE

Our cultural treasures such as manuscripts and art collections, as well as information about historical sites, are increasingly becoming available in high-quality digital format. Original works of art are also being created digitally nowadays. Preservation of this heritage in digital form can provide high-resolution access for vast numbers of people, and enable better protection and preservation of cultural treasures.

In addition, digital records and media are an increasingly important source of knowledge today, including new forms of information such as websites, blogs and social network content. These have immense economic and cultural value, yet their preservation is in danger.

Box 4.4 Memory of the World Programme (MoW)

UNESCO launched the *Memory of the World* (MoW) Programme in 1992 to promote the preservation of valuable archive holdings and library collections all over the world and to ensure their wide dissemination.

The MoW Register lists documentary heritage items (e.g. manuscripts, historical archives, photographs, audio-visual works) which have been recommended by the International Advisory Committee, and endorsed by the Director-General of UNESCO, as having outstanding universal value. There are currently 193 items in the Register from 84 Member States and four organizations.

Regional and national MoW committees are a crucial part of the programme's strategy of identifying documentary heritage, raising awareness, preservation, promoting access and building cooperative structures and relationships. The formation of a national MoW committee in every country is encouraged as a strategic goal; and when they have the capacity to do so, national committees are encouraged to set up their national MoW registers.

Digital preservation of the works is encouraged, and about a dozen of the Register entries are now available in the World Digital Library (see Box 4.5).

Source: UNESCO

The realization of the growing importance of the digital documentary heritage, and of the risks of losing it, led UNESCO to prepare in 2003 its Charter on the Preservation of the Digital Heritage. The Charter recommends the development of "strategies and policies to preserve the digital heritage... taking into account the level of urgency, local circumstances, available means and future projections." However, a survey in 2009 revealed that few governments in either developed or developing countries had elaborated or established a strategy for preservation of, and permanent access to, digital heritage.

What is needed is a way to ensure preservation of, and access to, digital heritage, thereby contributing to the building of Knowledge Societies while protecting property rights. This requires consideration of a range of legal, technological, social, financial, political and human issues, and in particular:

- *Technology:* hardware and software obsolescence; changing file formats; chemical decay; harvesting/migration/transfer of data; data integrity, etc.
- *Legal aspects:* rights management; out-of-print works; orphan works; protection of both privacy and access, etc.
- Poor awareness, infrastructure, financial or human resources to ensure the contribution of digital documentary heritage to national development, particularly in developing countries.

Since digital preservation is a resource-intensive activity, its successful implementation requires a range of partnerships. These include heritage/stewardship institutions, publishers, IT developers, creators and owners of documentary heritage, social networking media and third-party hosting services, among others. There is a need to share responsibility and to ensure good governance and transparency if reliable and sustainable access to digital information, including privately owned information, is to be assured.

Box 4.5 The World Digital Library (WDL)

WDL is an online resource that has been developed to provide free, multilingual access to documentary heritage held in institutions around the world, aiming at a wide audience ranging from students and researchers to the general public. The content is contributed by partner institutions in the language of origin and is accessed through an interactive interface in seven languages: Arabic, Chinese, English, French, Portuguese, Russian, and Spanish. Furthermore, voice-enabled browsing permits easy access by people with visual disabilities, as well others interested in this tool, such as language students. WDL provides speedy, reliable delivery of content and complies with the W3C Web Content Accessibility Guidelines WCAG 2.0. Each item can be viewed using state-of-the-art zoom features.

The impact of WDL has already been considerable. Within 20 months of its launch in 2009, 13.2 million visitors had accessed the site. Users have come from all around the world; the highest numbers have been from Spain, the United States, Mexico, Brazil, Argentina, China, France, the Russian Federation, Portugal, and Colombia, with the Spanish language interface being the most often consulted. By December 2010, more than 2.7 million links had been made to the WDL from other websites.

Source: UNESCO

4.3.3 OPEN ACCESS

Scholarly information is both a researcher's most important output and a key resource for progress and innovation. Increased access to, and sharing of, research results also leads to opportunities for equitable economic and social development and intercultural dialogue.

Open Access (OA) to scientific information is the provision of free access to peer-reviewed, scholarly and research information for all. OA allows researchers to gain access to previously restricted knowledge and new knowledge as it is being produced. To this end, rights holders grant a worldwide irrevocable right to access, copy, distribute, transmit, and make derivative works in any format for any lawful activities, with proper attribution to the original author.

There are two major approaches to OA — open access journals and open access repositories — which are often referred to as the "gold route" and the "green route" to OA respectively. Today, there are over 6,000 open access journals[9] and over 1,200 institutional repositories.[10] Over 150 research institutions and funding agencies require the application of OA to their research results.[11] Despite these developments, only 20% of scientific journal articles are available thus far through open access.[12] Nevertheless, OA is changing the scholarly publishing world, and it is emerging as one of the democratizing forces in making knowledge accessible. The Scientific Electronic Library Online is one example of OA (see Box 4.6).

There is yet another approach to providing access to scientific information, as adopted by Research4Life[13] (R4L), which provides free or low-cost online access to academic and professional peer-reviewed content in developing countries. This is a public-private partnership of World Health Organization (WHO), Food and Agriculture Organization (FAO), and United Nations Environment Programme (UNEP). Collectively, R4L provides online access to about 8,100 journal titles from over 150 publishers, for more than 5,000 participating institutions.

9 http://www.doaj.org/

10 http://repositories.webometrics.info

11 http://roarmap.eprints.org/

12 http://www.plosone.org/article/info:doi/10.1371/journal.pone.0011273

13 http://www.research4life.org/

It is essential that OA research information be shared in electronic format via networked digital repositories and journals. An inclusive broadband network has the capacity to provide equal access to research literature and thereby stimulate further research and development on a global scale.

Box 4.6 The Scientific Electronic Library Online (SciELO)

SciELO is a technology and a service model from the South for open access to scientific information. Started in 1997 as a one-year pilot project funded by FAPESP (the State of São Paulo Research Foundation) with the cooperation of BIREME (Biblioteca Regional de Medicina) of the Pan-American Health Organization (PAHO) and the World Health Organization (WHO) to evaluate the feasibility of improving the quality and impact of journals published in Brazil, SciELO has established itself as a major OA meta-publisher for the South. It is a unique OA journal publishing platform and indexing agency. Currently, SciELO provides 15 national and two thematic open access collections that include over 600 journal titles containing about 200,000 articles. More than 10.5 million downloads are made every month by users around the world.

Multilingualism is a central feature of SciELO, as journals are available in English, Spanish and Portuguese. SciELO has helped the journals in the collections to considerably improve their impact. For example, Brazilian journals indexed in Web of Science and SciELO improved their impact factor by 240% between 1997 and 2008. SciELO offers personalized services to users, allowing them to build their own collections, share them, and receive alerts about new items. The average cost of publishing an article in SciELO is less than USD 100 (excluding the editorial process).

Source: Packer, A.L. (2009): "The SciELO Open Access: A Gold Way from the South" Canadian Journal of Higher Education, 39 (3), 111-126

4.3.4 FREE AND OPEN SOURCE SOFTWARE (FOSS)

The World Summit on the Information Society recognized the importance of the issue of use of software, mostly in relation to the crucial role that it plays in access to information and knowledge. The summit stressed the possibilities offered by different software models (including proprietary, open-source and free software) to improve competition, access by users, diversity of choice, and empowerment of users to develop solutions which best meet their requirements.

Free and open-source software (FOSS) is made available along with its source code and generally at no cost. Users can adapt the software to their needs, and redistribute both the original and the modified version. FOSS provides a mechanism for the participation of voluntary communities of specialists in the development and distribution of software, for building capacities for software development in developing countries, and for enabling entrepreneurs in those countries to create livelihoods in this sector.

Since the source code of FOSS products is available to all, institutions and specialists in developing countries can readily adapt them to local needs, including local languages and cultures. Despite the freely available nature of FOSS, however, there still is a significant gender divide with regard to women as users and as content developers. The inequalities between women's and men's access and participation in all aspects of the development of FOSS should be urgently addressed.

Access to broadband networks is essential to accelerate international technical collaboration on FOSS development, and in turn FOSS products are becoming increasingly important in creating inclusive broadband Internet infrastructure.

Box 4.7 Schools in Kerala benefit from FOSS and broadband

In the Indian State of Kerala, *IT@School* is an ongoing educational initiative, started by the State government in 2001 with a view to introducing ICT training in more than 2,600 secondary schools, and to integrating ICT in the curriculum.

In 2005, a satellite broadcast channel entitled "Virtual Classroom Technology Educational Channel for Rural Schools" was introduced, and receive-only terminals were installed at selected schools, enabling basic communication between experts and students. In addition to the satellite receivers, a GNU/Linux based FOSS system was applied, allowing the initiative to expand in scale and scope towards a broader integration of ICT into the education system.

In 2009, broadband Internet connectivity was rolled out via a local cable network to more than 96% of the schools, connecting 1.6 million students including those in inaccessible areas. The early adoption of FOSS led to the creation of a local FOSS content repository and training of 40,000 teachers, which stimulated the broad deployment of innovative local technology solutions.

IT@School, which is now an "ICT-enabled Education" initiative rather than just focused on ICT training, is looking to expand further through the provision of web services for both students and teacher training. Thus, although Internet access was not an initial part of the project design, building experience with ICT, and in particular with FOSS, helped to justify investment in broadband and also to ensure that the content and users would be able to take advantage of the Internet.

Sources: Society For Promotion of Alternative Computing and Employment, Kerala (www.space-kerala.org/files/Story%20of%20SPACE%20and%20IT@School.pdf)
IT@School, India (www.itschool.gov.in/index.php)

4.4 RESPECT FOR CULTURAL AND LINGUISTIC DIVERSITY

"Cultural diversity is not simply an asset to be preserved but a resource to be promoted ... including in areas relatively distant from culture in the narrow sense," says UNESCO's "Global Report on Cultural Diversity" (UNESCO, 2009).[14] Cultural and linguistic diversity is not only an essential feature of human existence, but protecting it is also a force for social cohesion, promoting mutual understanding, knowledge, reconciliation, and peace. It is thus a critical element for ensuring social, economic and political stability around the world.

Languages are among the first and foremost instruments for attaining educational, cultural and political autonomy. Language allows for the transmission of information and knowledge from one generation to another and it is instrumental in disseminating cultures and traditions among various ethnic groups in highly diverse geographical areas.

With the advent of ICT and broadband, new opportunities have emerged to create, preserve, use, and share content in digital formats that is culturally and linguistically diverse, much faster and more widely. If the required resources are made available and the necessary measures taken to adopt broadband, the resulting alleviation of language barriers will promote human interaction, as well as the creation of, and access to, educational, cultural and scientific content in digital formats.

4.4.1 THE IMPORTANCE OF A MULTILINGUAL INTERNET

Respecting cultural diversity entails respecting multilingualism online. A language divide exists on the Internet, and is a significant driver of the digital divide. One can reach and communicate with 82.6% of all the Internet users in the world with just ten languages — English, Chinese, Spanish, Japanese,

14 http://unesdoc.unesco.org/images/0018/001847/184755e.pdf

Portuguese, German, Arabic, French, Russian and Korean,[15] but there is much less online content for the remaining population of existing and potential users.

It is estimated that, if nothing is done, half of the 6,000-plus languages spoken today will disappear by the end of this century.[16] With the disappearance of unwritten and undocumented languages, humanity would lose not only cultural assets, but also important ancestral knowledge embedded, in particular, in indigenous languages. Even among the world's written languages, many are not represented online, or only marginally so. In principle, the Internet is open to all languages of the world when certain technical conditions, including broadband access, are met, and when the necessary human and financial resources are in place. Now we need to put that into practice.

Multilingualism on the Internet fulfils the dual function of facilitating communication between individuals of different cultures and contributing to the survival of endangered languages.[17] It plays a significant role in communication and cultural exchange among the various linguistic communities. In building multilingualism on the Internet, it is essential to ensure that the principles of openness, inclusiveness, freedom and diversity are taken into consideration.

Box 4.8 Multilingualism in user-generated content

In 2008, 91.3% of total web content was disseminated in just seven languages, with English content counting for 68.4% and the next most accessible language at only 5.9% (this was Japanese, but second place is now reported by some to be Chinese).

During the last decade, there have been numerous attempts to measure languages used on other Internet communication modes, such as e-mail and chat often used by social media networks, and currently available statistics indicate that the number of languages on social networks poorly reflects linguistic diversity worldwide. For instance, Wikipedia was available in 264 languages in 2009, including all Wikipedia versions with one or more articles in addition to the main page; in February 2011, only 13 new languages had appeared on Wikipedia, reaching in total 277 languages.

On Twitter, English is the dominant language — more than 60% — followed by Portuguese (11%), Japanese (6%) and Spanish (4 %). However, the number of languages actually used on Twitter is very high, as any language whose script is supported by Unicode can be used for tweets. The initiative entitled "Indigenous Tweets" showed that by April 2011, there had been tweets in 70 indigenous and minority languages, and it is expected that this number will keep growing.

Sources: http://en.wikipedia.org/wiki/Wikipedia:Multilingual_statistics
http://stats.wikimedia.org/EN/Sitemap.htm
http://www.viralblog.com/research/twitter-facts-figures/ (March 2011)
http://indigenoustweets.com/
http://www.scientificpsychic.com/blogentries/internationalization-of-web-pages.html (May 2008)

4.5 QUALITY EDUCATION FOR ALL

About 17% of the world's adults — 796 million people — still lack basic literacy skills. Nearly two-thirds of these are women. The quality of education remains very low in many countries. Millions of children are emerging from primary school with reading, writing and numeracy skills that are far below expected levels.

ICT, and notably the Internet, have already shown that they can significantly contribute to achieving the goal of "Education for All," which is one of the key elements in creating Knowledge Societies (see section 4.1). The emergence of the Internet, and particularly broadband, presents an enormous

15 http://www.internetworldstats.com/languages.htm
16 http://www.unesco.org/new/en/unesco/themes/languages-and-multilingualism/endangered-languages/
17 http://unesdoc.unesco.org/images/0018/001852/185202E.pdf

opportunity to further harness ICT globally for deepening and creating knowledge through education, and for education to promote a culture of tolerance, peace-building and understanding in our increasingly interconnected world.

However, developing countries face particular challenges in achieving the goals of Education for All, including insufficient budgets, a lack of skilled resources, high drop-out rates and gender discrimination in access to education. In terms of the opportunities that broadband Internet access can provide, a better understanding is required in several areas: the disparities in Internet access between urban and rural areas and how these might be overcome; how best to support the readiness of teaching professionals to use ICT in the educational process, and how to ensure the availability of quality content in local languages.

Technological advances such as broadband will cause educational practices to evolve. The challenge is ensuring that e-learning is fit for purpose, so that the quality educational process is enhanced. Key issues include the extent to which distance learning can complement or replace certain traditional educational processes. Underlying the use of ICT in education are the challenges of addressing ICT and media literacy, and the gender imbalance in access to education and to ICT.

A further challenge lies in understanding whether the Internet is changing women's and men's ways of individual and cooperative study. Through virtual networks of peers, learners are harnessing the potential of ICT, creating stimulating learning environments for themselves. Such movements are, in some cases, challenging traditional educational paradigms. Broadband applications with a basic educational function are also evolving outside traditional educational practices and authority; for example, YouTube contains tutorials created by young people themselves on how to play music, using a combination of video streams of amateur performances and free software.

Box 4.9 Teachers count

The lack of qualified teachers is a significant obstacle for achieving the goals of Education for All, so it is vital to attract qualified people into the teaching profession, retain them and provide them with the necessary skills and support. Another 1.9 million teachers have to be recruited and trained by 2015, more than half of them in sub-Saharan Africa. (Source: "EFA Global Monitoring Report 2011")

The emergence of global broadband may contribute to addressing this issue. Broadband can facilitate access to education for a large number of trainee and in-service teachers, allowing them to develop their professional skills and obtain certification of their achievements. These teachers and their students, as the broadband users of the 21st century, should be able to creatively develop, disseminate and use the educational content of the future. In order to ensure that teachers have the appropriate ICT skills, UNESCO has, together with private-sector and civil society partners, developed an *ICT-Competency Framework for Teachers,* which is designed to assist policy planners and teacher training providers in identifying and imparting the appropriate ICT skills.

Source: UNESCO

4.5.1 OPEN EDUCATIONAL RESOURCES

Open Educational Resources (OERs) are learning materials that have been released under an open-content licence such as Creative Commons,[18] or that are in the public domain permitting their free use by others. OERs allow teachers to freely use and customize training materials to best suit the learning needs of their students.

18 http://creativecommons.org/

Broadband Internet connectivity has a significant positive effect on the use and creation of OERs to improve the quality of education, as well as facilitate knowledge sharing and capacity building. Tangible benefits for teachers and learners include:

- Increasing the availability of free, quality learning materials
- Being able to perform more comprehensive reviews of training materials most relevant to learning needs, and
- Development of a diversity of learning programmes that allow for asynchronous, personalized, self-paced and life-long learning.

4.6 CONCLUSION

The global roll-out of broadband offers vast potential for development, for example by enhancing learning opportunities, facilitating the exchange of scientific information and increasing access to content that is linguistically and culturally diverse.

But for this to happen, human activity must transform information into knowledge which can support individual, social and economic development, including institutional and political transformation. Capacity building is essential to this process, and can in turn be facilitated by broadband access and applications.

Attention must also be paid to creating a level playing field for users, content providers and network developers alike. This implies the adoption of policy frameworks which minimize the risk that unequal broadband access might create new knowledge divides between developed and developing countries, and between privileged and disadvantaged populations.

Taking account of these concerns, some of the major principles for a balanced, effective, innovative, open and inclusive design of a broadband Internet can be summarized as follows:

- Everyone should have access to the Internet and benefit equally from broadband, with particular concern for impoverished, isolated and other disadvantaged populations.
- Access by women, young girls and boys, and older people must be addressed.
- Freedom of expression and other individual rights, such as privacy and security, must be guaranteed in Knowledge Societies enabled by broadband Internet access.
- Universal access to quality multilingual content should be ensured, including content created at the grass-roots level in user-friendly formats and local languages.
- The capacities of local content creators should be improved and the necessary local access infrastructure developed.
- The potential of broadband in achieving Education for All is a high priority goal, not only because of its immediate potential to better people's lives, but also because those with access to broadband in their education will become the drivers of new waves of Knowledge Society development.
- Full attention should be given to the preservation of, and continued future access to, the vast amounts of digital information, which will transit through the future broadband system.

5 WHAT CAN BROADBAND DELIVER?

Worldwide, the number of Internet users has reached at least 25% of the population, or more than one-and-a-half billion people, according to ITU statistics[1]. With high speed broadband connections increasing too, the long-term prospects for the digital economy are very positive. Unlike the e-commerce environment of old however, the new digital universe incorporates innovative services with a profound social impact, such as e-education, e-health, financial services and e-government. And increasingly, these are being delivered through mobile devices.

Where large areas are covered by high-speed broadband networks, government organizations and businesses are using them to more efficiently and effectively to deliver products and services to their customers. This could eventually lead to much cheaper broadband access for most people.

Underlying trends are developing that will shape the future of this market and influence the nature of strategic investments. It will be the video-based applications, linked to communications (as distinct from, for example, entertainment) that are going to make the difference.

5.1 THE RISE OF THE DIGITAL ECONOMY

Millions of organizations are becoming part of the digital economy and most of these are adding digital elements and strategies to their existing business models. However, a wide range of new companies are building dedicated Internet businesses, or are emerging specifically to service this new industry. There are especially good opportunities for Internet service providers (ISPs) and content/service/media companies to merge and take more of a leadership role in this market.

The emergence of the next generation of Internet technologies and applications led to the coining of the term “Web 2.0”, to indicate that the Internet now has more capabilities than ever before (see Box 5.1). Internet media companies are just some of the leaders taking advantage of this with the introduction of new services and applications.

1 ITU statistics on Internet penetration and ICT in general can be found at www.itu.int/ITU-D/ict/statistics/

Box 5.1 Examples of Web 2.0 developments

- Instant Messaging (IM)
- New traffic patterns, such as peer-to-peer (P2P)
- Wikis, i.e. sites where users build up a source of content by adding and editing text
- Really Simple Syndication (RSS) – for syndicating web articles, such as online news
- Blogs, social networking and user-generated content (UGC)
- New business models, such as pay-per-click advertising
- VoIP, online videoconferencing, telepresence technologies.

5.1.1 DIGITAL ECONOMY – KEY DEVELOPMENTS

One of the most significant developments worldwide over the past ten years that has assisted in the growth of e-commerce and the digital economy as a whole is the introduction of secure online payment systems. This has supported the growth of some of the most popular online services and content, such as music and video downloads or gaming. Overall the most common activities online are not necessarily paid for directly, as listed in Box 5.2. Nevertheless, there is clearly a huge potential market as broadband access spreads.

Box 5.2 Most popular online activities worldwide

- Web searching and finding information for personal use
- E-mail
- Accessing news and sports information
- Accessing financial/credit information
- Social networking.

Source: "Number of Mobile Devices Accessing the Internet Expected to Surpass One Billion by 2013", IDC, 2009, www.idc.com/getdoc.jsp?containerId=prUS22110509

5.2 CLOUD COMPUTING

The term "cloud computing" describes the shift towards providing data processing, communications and software services to a customer's location from a variety of places in the online "cloud", rather than them being accessed on a user's own hard drive or local network. Cloud computing is dynamically scalable and users need not have knowledge of, expertise in, or control over the technology infrastructure in the cloud that supports them.

Types of cloud computing include the "enterprise cloud", in which, typically, one or more company-owned regional data centres are networked together to provide centralized resources as well as redundant services in the event of outages. The "hosted cloud" is similar, in that the service provider places all elements into its single cloud. A significant difference is that the hosted service provider will try to offer as many capabilities as possible in a multi-tenant configuration and often in a virtual configuration.

Embracing cloud computing offers potential benefits, not only from a service point of view, but also savings in the costs of hardware, software, premises and personnel for organizations, corporations and government departments.

According to the Open Computing Alliance (OCA), "*the direct cost benefit over existing systems stems from the commercial opportunity to pay for use as needed, rather than pay for a system designed to meet peak usage where much computing capacity can stand idle for much of the time*". There are indirect cost benefits as well, in particular increased workplace efficiency, leading to greater productivity.

A forecast by market analysts International Data Corporation (IDC)[2] sees 52 countries benefiting from cloud computing services, with the addition of around USD 800 billion in net new business revenues, between 2009 and 2013. Analysts Gartner Inc.[3] forecast that the cloud computing market will be worth around USD 150 billion in 2013.

The possibilities for cloud computing architecture keep growing – for example, it is now also being considered for use in distributing mobile applications.

5.2.1 CLOUD COMPUTING AND NATIONAL BROADBAND NETWORKS

Open networks are those that give all service providers equal access to interconnect with certain functions of the basic network of a telecommunications carrier. Add cloud computing to the concept of open networks and you have a great application for a broadband network on a national scale.

In Australia, for example, several information technology (IT) management companies have already indicated an interest in the business opportunities of running cloud computing over the new National Broadband Network (NBN) that is in development.

While cloud computing can be classified as an IT service, it will also require rigorous telecommunication standards in order to be delivered over national broadband networks in such a way that users can be sure that the various services will work on their equipment. Discussions need to be started on this issue in standards organizations such as ITU, the International Organization for Standardization (ISO) and the Internet Engineering Task Force (IETF). As with the national network itself, there needs to be a common architecture for the various services that will evolve.

5.3 E-COMMERCE

Nowadays, hundreds of billions of dollars are spent shopping online by individual consumers worldwide. While estimates vary considerably, the volume of business-to-business (B2B) e-commerce far exceeds that of business-to-consumer (B2C) e-commerce and is already worth trillions of dollars globally. In 2012, according to IDC[4], over 1 billion online consumers will spend USD 1.2 trillion in B2C transactions; online B2B spending is forecast to be ten times higher, reaching USD 12.4 trillion in 2012.

2 "Aid to Recovery: the Economic Impact of it, Software, and the Microsoft Ecosystem on the Global Economy", IDC (2009) www.intertic.org/Policy%20Papers/IDC.pdf

3 "Forecast: Sizing the Cloud; Understanding the Opportunities in Cloud Services, Gartner Research (2009) www.gartner.com/DisplayDocument?id=914826

4 "Number of Mobile Devices Accessing the Internet Expected to Surpass One Billion by 2013", IDC (2009) www.idc.com/getdoc.jsp?containerId=prUS22110509

There is speculation that e-commerce may be maturing in developed markets, particularly in the United States. While there is still growth ahead for the sector, overall worldwide growth rates may drop to around 10% per year, rather than the more than 20% recorded in recent years. Despite this, some of the developing markets, such as the Asia-Pacific region, show signs of strong growth ahead.

The Organisation for Economic Co-operation and Development (OECD) has found that the number of people buying goods and services over the Internet continues to rise.[5] In a report issued in 2009, it said that, in the OECD area, the percentage of adults buying online increased from 26.9% in 2004, to 35% in 2008. However, there was considerable variation among countries: more than 50% of adults in Japan and several European countries ordered goods or services on the Internet in 2008, while in several other OECD countries, fewer than 10% did so.

While e-commerce transactions continue to gain in popularity, it is important to note that security issues and concerns continue to hinder the Internet economy.

A report released by McAfee [6] in June 2009 estimated that data theft and cybercrime cost businesses worldwide up to USD 1 trillion in 2008. The projection used data from research by Purdue University's Center for Education and Research in Information Assurance and Security, which conducted a survey of around 800 chief information officers in companies across the United States, United Kingdom, Germany, Japan, China, India, Brazil and Dubai (UAE), and discovered that respondents lost data and intellectual property worth around USD 4.6 billion and spent USD 600 million repairing the damage after security breaches.

5.3.1 ONLINE ADVERTISING

The Internet has become an important platform for advertising and the market continues to grow (see Table 5.1). Media services agency ZenithOptimedia has identified the United Kingdom, Denmark, Norway and Sweden as some of the key countries to watch in Europe, for example, and predicts that online advertising will eventually account for around 20% of all advertising in these markets[7].

Table 5.1 Worldwide online advertising spending – 2007-2010

Year	Spending (USD billion)
2007	41
2008	50
2009	55
2010 (estimate)	60

5 "Background report on empowering e-comsumers" OECD (2009) www.oecd.org/dataoecd/44/13/44047583.pdf

6 "Businesses Lose More Than $1 Trillion in Intellectual Property Due to Data Theft and Cybercrime", McAfee (2009) www.mcafee.com/us/about/press/corporate/2009/20090129_063500_j.html

7 "Global Ad Market to Accelerate in 2008 Despite Credit Squeeze", Zenith (2007) www.zenithoptimedia.com/gff/pdf/Adspend%20forecasts%20December%202007.pdf, p6

5.3.2 MARKETING AS A PROVIDER OF BROADBAND CONTENT

A new model is emerging in which customers can give permission for Internet-based companies to use data that allows tailor-made services to be provided. Trust is very important for this permission-based marketing, with the provision of data being controlled by the customer (using encryption technologies), rather than being collected secretly by retailers.

This extremely powerful concept of trust-based communications could also lead to a large number of free services being offered by advertisers via broadband, in order to establish relationships with customers. These services could include free electronic magazines, movies, or messaging, and so on.

5.4 LOOKING AHEAD: THE POTENTIAL OF E-COMMERCE IN CHINA

Becoming the country with the world's largest population of Internet users in 2008 was a huge milestone for China, and it raised the stakes for Chinese and foreign companies battling for market share. The Internet carries only about 5% of advertising spending in China, compared with 10% in the United States, for instance. But this is bound to change if China's economy continues to grow and its young people increasingly choose the Internet over traditional forms of accessing entertainment and other services. Over the next five years, it is estimated that the number of Internet users in China will rise at a compound annual rate of 18.5%, while by comparison, in the United States it will grow at only 2.2%. By 2012, that would give China nearly 590 million Internet users.

After a slow start, there is now increasingly rapid development of Internet businesses in China as more and more of the population gains access to the Internet[8]. The e-commerce of large enterprises has expanded from online information release, purchase and sales, to integrated online web design, manufacture and management between upstream and downstream enterprises. Small and medium-sized businesses have strengthened their awareness of the application of e-commerce, and the number using it is steadily increasing.

Box 5.3 China facts and figures for e-commerce

Some 8% of the Chinese population shopped online in 2009, compared with 3% in 2006. E-commerce adoption is estimated to jump to 19% of the population by 2012.

An additional 8% of Internet users in China conduct primary product research through e-commerce sites, even though they do not necessarily purchase online. This suggests that besides hosting transactions, e-commerce platforms have emerged as important clearing houses for product information and prices.

The value of B2C and C2C online transactions was USD 37 billion in 2009 and is projected to surpass USD 100 billion in 2012.

Online retailing is expanding quickly, and the market is being gradually regulated. According to a government sample survey, over 50% of big enterprises have established an e-commerce system; over 30% of small and medium-sized companies find their product suppliers through the Internet; 24% of them are engaged in marketing via the Internet, and there are over 100 million online buyers in China.

8 "25th Statistical Survey Report on the Internet Development in China" China Internet Network Information Center (CNNIC) (2010) www.cnnic.net.cn/uploadfiles/pdf/2010/3/15/142705.pdf

In 2009 the trade volume of e-commerce in China surpassed RMB 3.6 trillion, a 48.5% increase over 2008. Within this, the consumer-to-consumer (C2C) e-commerce market hit RMB 234 billion in 2009, an almost 100% increase over 2008. Specialized e-commerce services are taking shape. Supporting systems, such as digital authentication, e-payment and logistics, are being gradually formed. The first e-commerce regulation "Interim measures on administration of Internet-based goods and service transactions" was introduced in June 2010.

The majority of China's e-commerce websites are based in Beijing, Shanghai and Guangdong, which are also where the Internet and e-commerce have been developing fastest. There were over 2.8 million websites in China by the end of 2008, an increase of over 90% from 2007 and the most rapid growth since 2000.

C2C transactions are far more developed in China than B2C sales. However, a few Chinese companies have already built strong B2C operations, most of them focusing on the distinct needs of a specific service. Online travel agency Ctrip.com International, for instance, is a purely B2C platform, with USD 233 million in revenue in 2008.

The volume of China's online B2B transactions jumped 65.9% year-on-year to RMB 2.1 trillion (USD 292 billion) in 2007. In 2008 this increased by 14% to RMB 2.4 trillion (USD 351 billion). Alibaba.com, the Hong Kong-listed online B2B giant, maintained its leading position and generated RMB 3 billion (USD 415 million) in revenue in 2008, an annual increase of 39% over 2007 following an increase of 65.4% over 2006.

As more and more small and medium-sized enterprises are using online B2B transactions to reduce costs, revenues drawn from online B2B operations are expected to jump to RMB 13.8 billion (USD 1.8 billion) in 2011.

Explosive growth in Chinese Internet use is driving a sharp rise in profits at online companies. Sohu was the official Internet portal for the Beijing Olympics in 2008. Its advertising revenue in the first quarter of that year was USD 34.8 million. Brand advertising revenue rose 40.9%, while non-advertising revenue, including for online game and wireless value-added services, rose by a huge 570%.

Table 5.2 Breakdown of China's e-commerce by popular online service - 2008

Activity	Internet users (millions)	Use rate	Annual growth
Online shopping	74	24.8%	60.9%
Online selling	11	3.7%	–
Online payment	52	17.6%	57.6%
Travel reservation	17	5.6%	–

(Based on CNNIC data)

Sina, China's largest web news portal, saw advertising revenue climb 51% to USD 47.8 million in the first quarter of 2008, while non-advertising revenue grew 20% to USD 23.5 million. Mobile value-added service revenue rose 19%. Web 2.0 product lines were also successful, with the launch of SINA Space and SINA TV. Sina has a strategic partnership with Google to offer web searches and advertising, and it has a strategic alliance with China Telecom to support a video-sharing platform.

5.4.1 CHINA'S GOVERNMENT E-COMMERCE PROJECTS

The Ministry of Information Industry (MII) has been working hard to accelerate the growth of e-commerce in China by presenting a series of model projects to guide development. Seventeen have been approved, including the Jinyao e-commerce network, the Capital e-commerce project, the Shanghai municipal e-commerce project, the China Telecom Hunan e-commerce project, the Chinese Postal Service e-commerce system and the Wuhan Changjiang Data Communications Company's e-commerce platform project.

MII has also been pushing the development of infrastructure capable of supporting this growing industry. Plans have involved the development of relevant laws, policies, technical standards and advanced entrepreneurial abilities:

- **Government Online Project** – launched in 1999, is aimed at encouraging government departments to open websites to share information with the general public.
- **Enterprise Online Project** – an effort by MII to move Chinese enterprises into the Internet age.
- **Family Online Project** – it is hoped that the provision of high-speed broadband access will trigger home shopping, home entertainment, distance education, online stock buying and selling, and online ticket booking, among other services.

5.4.2 CHINA'S E-PAYMENT SYSTEMS

While many of China's shopping websites can take orders and accept payment online, most shoppers order online but pay offline. At the start of 2005, around 25% of all payments for B2C online purchases were made as payment upon delivery. However, under the "Golden Card" project, Chinese banks started to integrate their networks. This began at a local level, but a national hub was built to connect the local networks in various cities. Companies such as Cyber Beijing support online payment for e-commerce companies in exchange for a transaction fee. Such programmes are helping make online payment more widely available.

Pay-as-you-go (prepaid cards)

The pay-as-you-go payment model is credited for part of the success of China's top three websites, Sina.com, Sohu.com and NetEase.com. For online games, companies sell prepaid cards in convenience stores, similar to prepaid phone cards.

Pay-as-you-go systems are popular in China, where the average consumer cannot always afford electronic equipment. With a prepaid card, someone can go to an Internet cafe and pay under USD 1 an hour to have use of a computer with access to an online game, for example.

Alipay

Alipay is part of the Alibaba Group of Internet businesses, based in China. Alipay, launched in 2004, works like an escrow service. When a buyer and seller agree on a price, the buyer transfers funds to

Alipay, which releases the money to the seller when the item is delivered. The service is supported by four banks: Industrial and Commercial Bank of China, China Construction Bank, Agricultural Bank of China, and China Merchants Bank. The system has been used on Alibaba's consumer auction site, Taobao.com, since early 2005.

In late 2007, Alipay started to offer Chinese consumers the opportunity to pay online for goods from abroad denominated in any of 12 major foreign currencies, and pay for them in yuan. Alipay offered the service in partnership with Bank of China Ltd and Industrial & Commercial Bank of China Ltd. The latter bank also joined with online game developer and operator NetDragon Websoft to introduce the Peony NetDragon Credit Card at all the bank's branches across China in April 2008. As well as offering basic credit card functions, the card offers a system for holders to send payments to their online game accounts.

5.5 E-PAYMENTS AND E-BANKING

The adoption of broadband is stimulated by e-commerce, and an important element of e-commerce transactions is the online system for electronic payments for goods and services, using credit cards or debit cards. PayPal has established itself as the most advanced e-payment system outside the banks. Payment systems using mobile phones (m-payments) constitute another fast-growing market (see section 5.7 below).

Alternative payment systems are attracting attention as consumer demand grows for payment methods other than credit cards. This is especially important in some of the developing markets where credit cards and bank accounts are scarce. Security concerns are also continuing to cause consumers to be reluctant about releasing credit card information over the Internet directly to a retailer.

As the complexities and security issues surrounding e-payments increase, some online retailers are using outsourced payment processing companies to manage their e-payment solutions. This may also lead to a growth in alternative payment methods, which can include:

- Bank transfers – a real-time payment can be made from the consumer's bank account to the online retailer. This also reduces the likelihood of the purchase being fraudulent, as consumers must identify themselves to their banks before making payments. In 2009 the US company CashEdge, for example, launched a service called POPmoney (POP stands for 'Pay-other-People') which lets banks offer payment services using online and mobile applications. Bank customers can make an electronic payment by using the e-mail address or mobile phone number of the recipient to be paid.
- Cash payments – these are becoming popular in some developing markets such as Brazil. From the retailers' website a consumer prints out a transaction voucher which includes a unique barcode. The consumer presents the voucher and cash at the required bank, which then makes an electronic funds transfer to the retailer.
- Pay-by-phone – consumers can purchase goods and have the amount added to their phone bills.
- M-payments – financial transactions via mobile phones are set to soar in the coming years (see section 5.7).

Meanwhile, though, security issues continue to tarnish the e-payment industry. For example, a report[9] from CyberSource entitled "UK 2011 Online Fraud Report" found that, on average, the percentage of annual online revenue that businesses in the United Kingdom expected to lose to payment fraud in 2010 dropped from 1.8% to 1.6%. For 2011, however, over a third of businesses are expecting to see the percentage of web revenue lost to fraud grow year-on-year.

As e-commerce continues to grow, the total losses from online payment fraud are expected to rise at a rate of about 20% a year, resulting in billions of dollars in losses.

5.5.1 INTERNET BANKING

Internet banking (also known e-banking) is becoming more popular worldwide, especially as broadband Internet access spreads. A 2007 study by the OECD found that around 30% of people in OECD countries used online banking services, including around 50% of users in Nordic countries. A 2008 study by Forrester Research[10] found that Internet banking has been a huge success in the Netherlands, with around 68% of Dutch consumers banking online. Forrester found this to be the highest adoption level in Europe, and predicted that, by 2013, Internet banking would be used by 81% of consumers in that country.

Figures released in mid-2008 by UK Payment Administration Ltd found that the number of adults using online banking in the United Kingdom had increased by 505% over the previous seven years. In China, online banking grew to 58 million users in 2008, representing a usage rate of 19.3% and growth of 45% from the 40 million in 2007. By 2006, around 44% of all Internet users in the United States were doing at least some of their banking online, according to the Pew Internet & American Life Project. This was a rise of around 47% over 2002 levels.

However, security concerns also persist for this Internet sector and a study by the University of Michigan[11] found that 75% of the online banking sites surveyed had at least one design flaw that could make customers vulnerable to cyber attacks. The study was conducted in 2006 and while the University of Michigan acknowledges that, since then, some financial institutions may have resolved the problems, it is generally considered that there is still room for improvement.

In 2006 the PCI (Payment Card Industry) Data Security Standard was launched, which represents a common set of industry requirements for the safe handling of sensitive information through policies, procedures, network architecture and software design. The large players, such as Visa and MasterCard, are supporters of the PCI standard and the PCI Security Standards Council [www.pcisecuritystandards.org] encourages all online merchants to adopt it.

Improved bank security measures, such as the introduction of home chip and pin devices, are also helping to combat this problem.

9 http://forms.cybersource.com/forms/FraudReport2011UKUKCYBSwebjan2011

10 Dutch Online Banking Forecast: 2008 to 2013", Forrester Research (2008) www.forrester.com/rb/Research/dutch_online_banking_forecast_2008_to_2013/q/id/42188/t/2

11 "Security Flaws in Online Banking Sites Found to be Widespread", Michigan University (2008) www.ns.umich.edu/htdocs/releases/story.php?id=6652

5.6 M-COMMERCE

M-commerce (mobile e-commerce) incorporates a range of mobile-driven applications, such as payments for parking and theatre tickets (m-payments). M-commerce is a broad field, incorporating a large variety of services and business models. It is potentially important for a wide range of industries, including telecommunications, IT, finance, retail and the media, as well as for end-users. It will work best in those areas where it can emphasize the core virtue of mobile networks – convenience.

The major elements of m-commerce are m-payments and m-banking. A particular focus is financial services in developing markets, where mobile phones are being viewed as an opportunity to reach the masses that would not otherwise use financial services. Mobile money services will be driven primarily by the operators, which can charge service fees to complement existing short message service (SMS) and voice revenues, while simultaneously increasing customer loyalty and the number of transactions on the network.

Over recent years new models have emerged around the world, especially regarding the processing of payments. These include:

- Subscription based services – users are charged a regular fee for unlimited access to products
- Consolidation of bills – customers' m-transactions are integrated into their usual mobile bills
- Co-ordination of merchant fees – merchant charges are grouped together as a single transaction
- Direct debit – charges are taken directly from a user's bank account upon authorization.

Japan and the Republic of Korea were among the first to see the appearance of low-cost models for providers of content to process payments, and the mobile content market is flourishing in those countries, alongside m-commerce (see Box 5.4). Most of the proceeds flow to the content providers; however, in the rest of the world, mobile operators seeking to have a much larger share of the profits.

5.6.1 M-COMMERCE AND NEAR FIELD COMMUNICATIONS

Near-field communication (NFC) is a wireless technology that permits data to be transferred between devices that are up to about 10 centimetres apart. It combines a smartcard and a reader into a single device, and is compatible with existing contactless payment infrastructure.

Box 5.4 Examples of NFC applications

- contactless transactions such as payment and transit ticketing
- simple and fast data transfers
- calendar synchronization
- electronic business cards
- access to online digital content

The prime usage of NFC is in mobile phones. At the 2008 Mobile World Congress in Barcelona, a panel forecast that NFC could be used in as many as 20% of mobile transactions in the following few years – if the necessary infrastructure were to be rolled out successfully.

An NFC-enabled phone provides several benefits to consumers, such as the capability to view transactions and data on the phone display and to buy items directly at any time. An NFC phone can also be used to access services by simply touching the phone against a poster or other display embedded with an RFID chip (see Box 5.5).

Box 5.5 The development of m-commerce and near field communications in Japan

Japanese consumers spend the equivalent of hundreds of millions of US dollars million each year using their mobiles to make payments, including prepaid travel tickets. This can be partly attributed to the success of Sony's "FeliCa" contactless payments standard, using using radio-frequency identification (RFID) technology, that has been widely adopted in Japan for electronic money cards and by banks and mobile phone companies.

KDDI announced in late 2003 that it planned to use FeliCa software in its 3G mobile phones. In early 2004, NTT DoCoMo announced that it would conduct a trial of the i-Mode FeliCa preview service, using the contactless IC chip technology developed by Sony Corporation. The trial included public transport tolls, electronic money, personal identification and other services. Commercial operation of the service commenced in 2004.

A series of mobile phones for the NTT DoCoMo service became the world's first with embedded computer chips that could be used for electronic cash simply by waving them in front of reception devices. To add cash, the phone is placed in a special slot at participating convenience stores and other outlets and the user puts yen bills into the machine. The purchase is deducted from the embedded chip using RFID. The handsets are equipped to use Sony's Edy e-money system. NTT DoCoMo sees these services as a means of retaining customers, as subscribers are less likely to switch to a different mobile operator if their existing mobile phone also serves as an electronic wallet.

Tokyo-based Rakuten, an Internet auction business, and NTT DoCoMo started a joint venture in late 2005. Rakuten has some 5.3 million goods on its auction site "Flea Market". Rakuten claims around 17.3 million users, but they mainly do their shopping from personal computers, with only about 10% using mobile phones. The joint venture features an auction system that allows customers to use their camera phones to take pictures of articles and put them up for auction. A mobile phone payment system called Osaifu Keitai ("mobile wallet") is available for goods bought on mobile phone auctions.

In early 2006 NTT DoCoMo unveiled a new service called DCMX allowing customers to use their handsets to pay for goods and services such as groceries and taxis. By December 2006, it had about one million subscribers. The company said it aimed to have 10 million subscribers by 2011. The DCMX credit service was expected to generate annual sales of up to JPY100 billion by 2009.

According to the GSM Association, around 40% of operators worldwide are exploring contactless m-payment systems. Visiongain[12] predicted that there would be around 450 million NFC phones shipped in 2012 (based on a forecast of two billion mobile handsets shipped overall in 2012).

A 2009 report[13] released by analysts Juniper Research forecast that mobile payments using NFC would be worth around USD 30 billion in 2012. Driving this growth would be NFC use in mobile marketing – particularly retail applications, such as coupons and smart posters which enable consumers to obtain product information or discounts. Juniper has also forecast that one in five smartphones will feature NFC capabilities by 2014.[14]

12 "M-Payments 2007-2012: Commerce and Banking in the Mobile World", Visiongain (2007) www.visiongain.com/Report/263/M-Payments-2007-2012-Commerce-and-banking-in-the-mobile-world

13 "NFC Payments to Exceed $30bn by 2012, Supported by Revenues from Mobile Coupons and Smart Posters, Juniper Research (2009) www.juniperresearch.com/viewpressrelease.php?pr=154

14 www.juniperresearch.com/viewpressrelease.php?pr=239

5.7 M-PAYMENTS

A study by Arthur D Little released in late 2009[15] estimated that the value of worldwide mobile payment transactions reached around USD 29 billion in 2008. A study[16] by Gartner found around 43 million consumers worldwide used m-payment services in 2008, with the Asia-Pacific region accounting for approximately 85% of the world total. The study said that in 2009 there were around 74 million m-payment users globally, and it forecast that by 2012 around 190 million consumers will be making mobile payments worldwide (see Table 5.3).

Table 5.3 Number of consumers worldwide using m-payment services – 2008-2012

Year	Number of consumers (millions)
2008	43
2009	74
2010 (estimate)	95
2011 (estimate)	130
2012 (estimate)	190

(based on Gartner, 2010)

Developing countries are likely to be major growth areas for m-payments. A particularly successful example is the M-PESA system in Kenya (see Box 5.6).

The gross transaction values of m-payments worldwide have been predicted to rise as high as USD 300 billion in 2013 (see Table 5.4). A report[17] by Juniper Research in 2010 forecast that, in the ticketing segment alone, the annual number of mobile payments for travel, theatres, sports events and so on will reach a global total of almost 15 billion by 2014.

Regionally, Europe and the Far East are expected to represent around 60% of the gross transaction value by 2013. In Western Europe, SMS is the most popular mobile application for purchasing digital goods; in contrast, in Asia (particularly Japan) consumers tend to use the mobile web to make purchases.

15 www.adlittle.com/i-eu-press-releases05.html?&no_cache=1&view=195

16 "Gartner Says Number of Mobile Payment Users Worldwide to Increase 70 Percent in 2009, Gartner Research (2009) www.gartner.com/it/page.jsp?id=995812

17 "Mobile Ticketing Applications and Markets, 2009-2014" Juniper Research (2010) www.juniperresearch.com/reports/mobile_ticketing_applications_and_markets

Table 5.4 Worldwide transaction value of m-payments	
Year	**Gross transaction value (USD billion)**
2008	29
2012 (estimate)	250
2013 (estimate)	300

(based on Arthur D. Little, 2009)

The study by Arthur D Little also forecast that the m-payment transaction volume in developed markets would grow by 56% each year and would account for around 35% of the total transaction volume of payments in 2012. The emerging markets would grow even faster, with a prediction that m-payments would grow by 76% per year and represent 65% of the total transaction volume in 2012.

5.7.1 INTERNATIONAL MONEY TRANSFER SERVICES

International remittances are generally person-to-person and of relatively low value. They allow people to send and receive money worldwide, primarily through a global network of agents who use multi-currency money transfer processing systems.

The key is that the services are relatively cheap. In developing countries in particular, a mobile banking transaction fee (the cost of an SMS) of USD 0.50 is seen as inexpensive compared with the fees charged by the official banking system (up to USD 25 per transaction) that make it uneconomical to send small amounts of money.

The global nature of the telecommunication market provides new avenues for international transfers. For example, minutes of call time can be added to an account and these minutes then exchanged for cash in another country.

5.7.2 CAN M-PAYMENT SERVICES BE PROFITABLE IN DEVELOPING COUNTRIES?

There is a keen interest in m-payment and m-banking among mobile operators in developing countries as one way of generating new revenue streams in an environment where the average revenue per user (ARPU) in the voice market has fallen below USD 5 per month in many cases. The revenues are indeed growing in this sector, but can it also be profitable – thus adding to funds that might be used to support broadband?

The often quoted pioneer success story in this sector is M-PESA in Kenya, introduced by Vodafone's Safaricom network in 2007. It allows SMS-based money transfers, irrespective of whether the recipient is another M-PESA customer or not. Users can also deposit cash into the M-PESA account and withdraw it through a network of thousands of authorized dealers such as shops and petrol stations, or at one of 120 "PesaPoint" ATMs throughout Kenya (with hundreds more planned), without the use of an ATM card. The service does not require the user to have a bank account, nor is there a minimum amount per transaction.

Box 5.6 The M-PESA success story

Kenya's leading mobile operator Safaricom applied for a banking licence in 2006 and launched a mobile payment service called M-PESA in early 2007, allowing customers to transfer money, and deposit or withdraw funds using their mobile phones. The service uses Safaricom's airtime distribution outlets and other authorized agents. A user need not have a bank account, nor is there a minimum amount per transaction. In 2009 over six million Kenyans accessed M-PESA.

The majority of transactions are between KES 2,000 and KES 5,000 (approximately USD 27 to USD 67). The average M-PESA user currently sends transactions totaling USD 33 per month through the system; that equates to USD 400 per year, compared to the average m-payment transaction volume per user worldwide of USD 674 per year.

Based on the figures mentioned above (in section 5.7) of 43 million m-payment users worldwide in 2008 generating a total transaction volume of USD 29 billion, Kenya had more than 10% of the world's m-payment users and represented close to 10% of the world's total transaction volume. That is huge for a country that represents 0.5% of the world's population and 0.05% of the world's economic output.

M-payment is already a multi-billion dollar business in terms of volume. But transaction fees in Kenya are around 1% of the transaction value, and the average user pays the operator about USD 4 per year That is not much on which to make a profit, and Safaricom has indeed stated that M-PESA by itself is not yet profitable. But it is growing fast and already makes up at least 4% of the operator's total revenues.

This direct revenue is not the only benefit for the operator: Safaricom has found that the voice ARPU of M-PESA users is 25% higher than non-M-PESA users, simply because they can keep their phone accounts topped up more conveniently and therefore more regularly, and consequently call and text more. Taking this into account, m-payment and m-banking can indeed be a key component in a strategy for a mobile operator in an emerging market to increase ARPU, and ultimately to improve profitability as well.

5.7.3 MICRO-PAYMENTS

Micro-payments are generally regarded as payments of less than USD 5 and represent a remarkable business opportunity since they involve a huge number of daily transactions. Unlike larger payments, they do not require strict verification mechanisms, which therefore makes it possible to reduce connection times and authentication costs considerably.

Most micro-payments take place on the fixed network (essentially for electronic content), but there is extremely high potential in this area for mobile networks. For example, in Latin America the micro-payment sector has been particularly active in recent years (see Box 5.7).

5.7.4 STANDARDIZED INFRASTRUCTURE REQUIRED

Mobile and financial organizations can see the value of working together to define a standard technical infrastructure which will enable interoperable and secure contactless mobile payments. While many organizations have initiated work related to standardizing such infrastructure (including ETSI, GSMA, Mobile Payment Forum, Mobey Forum, NFC Forum, Open Mobile Alliance, etc.), the m-payment sector still lacks cohesive technology standards.

5.8 M-BANKING

Mobile banking found its initial success in the developing world where financial services are scarce (see Box 5.7). The sector was also stimulated by the high charges which banks demanded for conventional money transactions. In coming years, however, much of the growth in this area will come from mature markets with the use of broadband and as consumers turn to mobile phones as an adjunct to popular online banking services.

Box 5.7 Mobile financial services reduce poverty in Latin America

A study funded in 2009 by Fundación Telefónica indicates that increased access (up by 10%) to financial services for the people of Latin America has reduced social inequality indices by 0.6 points, and that an increase in private credit, which is also up by 10%, has reduced the poverty ratio by 3**%.** Countries such as Brazil, Mexico and Peru have begun to launch mobile financial service initiatives with excellent results.

The study found that this change in financial distribution, together with the entry of new players, must have a stable, standardized framework to which the telecommunication operators, financial institutions and joint initiatives adapt. It concluded that mobile phones and their extraordinary penetration of Latin American society are becoming a key tool for financial growth and development in the region, since they offer a rapid, efficient and safe way for people to carry out financial transactions and use their banks in areas where the traditional financial sector does not meet their needs.

The study was prepared by Asesores Financieros Internacionales and the Inter-American Development Bank, under the management of the Spanish economist Emilio Ontiveros, and involved over one hundred experts from Argentina, Brazil, Chile, Colombia, Ecuador, the United States, Peru and Spain. The authors urge telecommunication operators to collaborate with financial institutions and to work more closely with public authorities to drive coordinated reform of the legislative framework and promote the use of mobile financial services. In addition, national and supranational authorities coordinate a vision for developing public policies, regulation and tax regimes in order to promote the use of mobile telephony and access to financial services.

Source: www.fundacion.telefonica.com/en/prensa/noticias/noticia.php?prog=debateyconocimiento&noticia=30_06_2009_esp.htm

A 2009 prediction[18] by Berg Insight saw the world number of m-banking services reach 915 million by 2014, up from only 20 million in 2008. M-banking is most advanced in some parts of Asia, accounting for roughly 65% of the worldwide user base. But such services are increasingly offered in North America and Europe, and the Middle East, Latin America and Africa are also expected to benefit.

The overall growth of this sector can be attributed to a number of factors, including the shift towards consumers viewing their mobile phones as a trusted device, increasing familiarity with using online services for banking and the increasing penetration of mobile devices. Despite this, many users still have security and privacy concerns regarding mobile transactions. A survey[19] conducted in the United States by Harris Interactive in March 2008 found that many consumers were still wary of m-commerce for this reason. A further survey[20] by ABI Research in late 2008 found that 71% of respondents in the United States said security concerns prevented them from using the mobile phone for financial transactions.

18 "Worldwide Installed Base of Smart Electricity Meters Will Reach 302.5 Million Units in 2015", Berg Insight (2010) www.berginsight.com/News.aspx?s_m=1&m_m=6

19 "Consumers Increasingly Embrace Mobile Phone Commerce With Banking and Buying On-The-Go", Harris Interactive (2008) www.harrisinteractive.com/vault/Harris_Interactive_News_2008_03_12.pdf

20 "Surveys Find Security Concerns Remain Biggest Barrier to Mobile Transactions in 2009", ABI Research (2009) www.abiresearch.com/eblasts/archives/analystinsider_template.jsp?id=158

5.9. E-GOVERNMENT

In the late 1990s and early 2000s, governments around the world started to appreciate the benefits of information and communication technologies for improving operations and cutting costs. Since that time there has been substantial investment in developing e-government systems, particularly web-based services. In addition to websites providing information, many governments now offer applications online, including the ability to file tax returns, fill out official forms, and so on.

To date, e-government applications have been primarily web-based; however there are also examples of governments using other electronic tools and mobile devices. Around the world, a large number of government agencies have established SMS facilities, for example, which allow citizens to contact emergency services, make general enquiries or provide feedback.

5.9.1 BENEFITS OF E-GOVERNMENT

While one of the primary aims of e-government is to improve customer services for citizens, applications can also assist in improving processes and communications between government departments. For citizens, web portals offering one-stop services can reduce time and confusion when dealing with a number of departments. Such services can also be accessed 24 hours a day.

Interactions between government, business and industry can also be improved via e-government applications and the increased transparency of such services can help to prevent corruption. In addition, streamlining services can lead to cost-cutting and less waste of public resources.

Countries where there are still only small numbers of consumers connected to the Internet are exploring and implementing e-government kiosks. These allow citizens to access e-government services at a shared location, such as a local post office.

In 2008, the Brookings Institution[21] found that, worldwide, around 50% of government websites now offer services that can be completely executed online. This was up from 28% in 2007.

5.9.2 BARRIERS TO E-GOVERNMENT

The barriers in the way of implementing e-government include such issues as scalability and the need to protect private data. In addition, it is important that governments ensure that their websites are kept up to date, have a consistent design across ministries and are accessible to all users, including people with disabilities.

An OECD report released in November 2009 found that the economic downturn was leading some countries to boost their e-government strategies in order to improve efficiency. Among the countries raising budgets for this purpose were Germany, Japan, Mexico, Netherlands, Slovak Republic, Switzerland and the United States. In contrast, countries such as Austria, Hungary, Iceland and the United Kingdom reduced budgets in 2009, while others made no change.

21 "Improving Technology Utilization in Electronic Government around the World, 2008" Brookings Institution (2008) www.brookings.edu/~/media/Files/rc/reports/2008/0817_egovernment_west/0817_egovernment_west.pdf

Box 5.8 Cloud computing and e-government

In terms of government use, cloud services may be particularly useful. In Japan, for example, it was announced in May 2009 that there are plans to create (in stages up to 2015) a massive cloud computing infrastructure to support all of the central government's IT systems. It will enable various ministries to collaborate, integrate hardware and create platforms for shared functions. By consolidating current data centres, the cloud will eliminate the need for individual ministries to maintain their own IT systems, and allow each ministry to use only computer resources as necessary through the cloud platform.

5.10 E-HEALTH

E-health may also be known by such terms as tele-health, telemedicine, m-health, or personal health systems. This field of development also corresponds to the organizational or administrative convergence of healthcare and social care through the use of assistive technologies and those that, for instance, support elderly people at home. It is likely to become a major component of services delivered via broadband.

With the increased use of modern medical technologies such as computer tomography, spending on ICT in healthcare is on the rise. Despite the economic downturn, Gartner predicted that ICT-based healthcare spending would still grow by 2.2% worldwide in 2009[22].

A mid-2009 report[23] by Pike and Fischer forecast that, in the United States alone, annual revenues for telemedicine devices and services would reach almost USD 3.6 billion within the following five years. This would be driven by the continuing deployment of wireless broadband and smartphone devices, which would enable mobile services companies to capture a large share of the market.

Stimulus packages will also assist in the growth, particularly the USD 20 billion allocated for health information technology in the United States, which includes a specific focus on electronic medical records and telemedicine.

5.10.1 MASSIVE COSTS OF HEALTHCARE

In countries worldwide, a significant portion of GDP is spent on healthcare, and costs are rising further (see Box 5.9). According to the World Bank (see Table 5.6), global health spending in 2002 was USD 3.2 trillion or around 10% of global GDP. Today, it is estimated that around USD 5.5 trillion is spent worldwide[24].

The growth in world population implies commensurate increases in healthcare spending across all regions. In high and middle-income countries, the challenge comes mainly from aging populations with increased incidence of chronic conditions. In the United Kingdom, for example, approximately 30% of people are known to have one or more chronic ailments, and this is expected to grow to 36% by 2025. And in terms of funding by taxpayers in that country, between 1950 and 2050 the ratio of people who are below 65 to those older (the "potential support ratio") will have fallen from 12:1 to 2:1[25].

22 "Worldwide Vertical Market IT Spending Will Be Flat in 2009", Gartner Research (2009) www.gartner.com/it/page.jsp?id=893512

23 "Telemedicine and the Economic Stimulus: Broadband Opportunities in a Swelling Market", Pike & Fischer (2009) www.broadbandadvisoryservices.com/researchReportsBriefsInd.asp?repId=723

24 The Boston Consulting Group (2011)

25 IPTS Report 'Personal Health Systems and Remote Patient Monitoring', European Commission (2009)

Box 5.9 Selected healthcare spending statistics

- US health care spending is expected to reach USD 4.2 trillion in 2016, the equivalent of 20% of GDP (up from around USD 2.3 trillion in 2007)
- Healthcare spending in China is forecast to grow to USD 323 billion by 2025
- Healthcare spending accounts for around 10.9% of the GDP in Switzerland, 10.7% in Germany, 9.7% in Canada and 9.5% in France
- Healthcare spending in the United Arab Emirates is around 2.5% of GDP
- Health spending is rising faster than incomes in most developed countries
- According to the University of Washington's Institute for Health Metrics and Evaluation, spending on global health aid for poor countries quadrupled from around USD 5.6 billion in 1990 to USD 21.8 billion in 2007.

(From various industry sources)

Table 5.5 Projected regional increases in total healthcare spending, 2020 – 2050

Region	Increase in health care spending
Europe and Central Asia	14%
East Asia and Pacific	37%
South Asia	45%
Latin America and Caribbean	47%
Sub-Saharan Africa	52%
Middle East and North Africa	62%

(Based on World Bank, 2006)

Part of the healthcare challenge can be alleviated by reducing demand through improving lifestyles so people stay healthy longer. Better treatments will also help. But that still leaves the bulk of the challenge to be answered. There is a need to work out how health and social care can be managed much more efficiently whilst still improving the quality of delivery.

Cost savings through the use of e-health are expected to be between 10% and 20% of total healthcare costs, while maintaining a good quality of service.

Box 5.10 Advantages of e-health	
Improved services	• Optimization of technical facilities in hospitals and clinics for faster, more comprehensive diagnosis. • Local medical staff can consult specialists anywhere in the world. Specialist hospitals can spread their expertise more widely. • Patient and doctor journeys are minimized. • People in remote areas can gain access to medical services that were previously unavailable. • Care customization – a range of processes within the clinic or at home that can be tailored to specific ailments and circumstances.
Improved response times	• Rapid medical intervention if abnormal vital parameters are detected. The care team is automatically alerted for an immediate response.
Cost savings	• Reduced hospital costs. • Improved workflow efficiency: the entire patient-related process – from admission to hospital to billing for treatment – can be monitored at all times. • Data management systems: providing for a centrally administered medical record for the entire life of the patient, which can be accessed at any time by authorized physicians and the patients themselves. This helps avoid unnecessary examinations, repeated consultations and inappropriate treatment; it is also one of the keys to greater citizen engagement in self-care and wellbeing.
Training and education	• Students can watch an operation being performed thousands of kilometres away.
Improved quality of life	• Seniors may be able to stay in their own homes longer with in-home monitoring and treatment. This may include dispensing medication, monitoring exercise, sleep, blood pressure, glucose levels, and managing nurse visits. Emergency response can also be offered. • Services can be extended outside the home by providing mobile connectivity via 3G to allow user location tracking. Within the home, short-range connectivity can deliver data to home hubs or gateways. • Improved preventive care and quality of life. The focus is not just on managing a single task (e.g. measuring blood pressure at a certain time) but on creating an interactive communication channel among patients with the same condition, medical staff, family and friends. This also helps to prevent isolation and exclusion by maintaining a social network, contributing to a better quality of life.

5.10.2 E-HEALTH – COMPELLING APPLICATIONS ON BROADBAND

Many governments are recognizing that healthcare is one of the last paper-based sectors of the economy in terms of administration. And while many healthcare institutions have their own computerized systems, they are mostly not integrated with other systems in the sector. There are

important technical challenges to be overcome in ensuring the interoperability of data systems. But broadband networks could not only supply the infrastructure for a national e-health framework – they can also be a catalyst for the standardization and integration of the various widely dispersed computerized systems that are currently used within the sector.

An equally important element of e-health is that it will give the citizen a more proactive role. This shift in policy focus could transform the industry, with patients taking far greater control of their own healthcare. There will be opportunities for personalized healthcare management, with caregivers and patients integrated into the process.

Box 5.11 Savings from healthcare through broadband

Studies quoted in a June 2010 report* from Access Economics Pty Limited say that in a two-year Italian trial of 927 e-health consultations for residents of rural communities, 600 visits to physicians were saved, as well as 122 hospital admissions, yielding savings of EUR 20,400 and reduced travel costs to patients of EUR 3,700. In another study, the European Union found that two hospitals in a remote part of Sweden reduced their costs by 35% per medical scan by sending images to Spain for diagnosis, saving over EUR 800,000 a year. Patients also benefited by an average 50% reduction in waiting times for an appointment.

*"Financial and externality impacts of high-speed broadband for telehealth" June 2010

5.10.2.1 National broadband policies are essential

E-health is one of the most compelling applications to take advantage of high-speed broadband networks. In countries with a clear policy for an advanced broadband infrastructure, e-health allows citizens to enjoy advances in medical technology and services, at more affordable costs.

Like other important applications, e-health must be delivered at a consistently high quality of service (QoS), regardless of the particular telecommunication or broadband service provider. This is technically possible; the question is whether QoS requirements need to be taken into account when designing a network, or can they be left to those who will provide the services?

The healthcare sector comprises many providers that need to be able to interact with each other in a reliable environment, such as a collaborative services network (CSN). The current approach tends to use, for instance, a mix of regional, local and in some cases national patient databases. The challenge is not only the technical integration of such repositories, but also establishing regulations about the extent to which the data must be shared, or at least encouraging providers to do so. A national broadband network offers the unique opportunity for transformation of isolated and inefficient systems.

Healthcare is provided under many different schemes globally. Regardless of whether it is publicly or privately funded in a particular country (or is a combination of both), national broadband infrastructure can make a contribution to the development of healthcare policy that is of fundamental importance. In this respect, it will be essential for governments to take the leadership role, as none of the individual sub-sectors within the healthcare ecosystem have the power to instigate this initiative. Once an overall network plan has been established, each sub-sector can organize its own participation within that collaborative network, as it would be a distributed model and therefore could be organized according to a modular process.

It is, of course, also critical that government departments in charge of healthcare make their requirements known to those designing the networks, so that a proper discussion can take place to map out a plan for the future.

5.10.2.2 Aged care services at home

Aged care services are at the forefront of developments for in-home technologies using broadband. It is estimated that there are currently around 550 million senior citizens worldwide. The elderly outnumber children in countries such as Japan, Bulgaria, Germany, Greece, Italy, and Spain. In China alone, more than 160 million people are seniors, or more than 12% of the population[26]. This demographic shift in many countries implies challenges for the future funding of pensions and specialist care facilities.

A key component of solutions will be homecare services. Video-based broadband connections allow people to stay at home and still have access to medical staff at monitoring hubs that provide services ranging from automated analysis of data from personal health systems, to advice from qualified nurses on call throughout the day.

These layered response systems can alleviate demand for expensive clinical staff and significantly ease the anxiety levels experienced by family carers. The nurses maintain contact with people who need medical assistance and other medical specialists can be brought in as required via video link. An example is "Nurse Gudrun"– a Swedish-based broadband-enabled video support service for elderly people. Certain diagnostic facilities such as heart rate, blood pressure and urine samples are linked to the broadband service, and other diagnostic tools can be implemented through these links.

Companies developing solutions for at-home aged care include Intel, General Electric (GE), Philips Electronics, Honeywell, Bosch, and many technology start-ups. Intel and GE, for example, have partnered together and plan to spend USD 250 million in the next few years on product development. According to a study[27] by Aging in Place Technology Watch, the US technology market for this type of at-home care is forecast to grow to USD 20 billion by 2020.

Because those who most need these technologies might be the least comfortable using complex interfaces, companies need to make these intuitive. For example, some systems operate via the television with simple set-top boxes. In addition, software to make computers more accessible is available for people with disabilities.

5.10.2.3 Video consultation and health monitoring

Another growing e-health area is the monitoring of patients – from pregnant women to people with mental health problems. Parks Associates forecasts that by 2012, around 7.2 million consumers will use home health monitoring solutions in North America and major countries in Western Europe[28]. This compares with half a million in 2008.

26 www.chinadaily.com.cn/thinktank/2011-01/10/content_11815933.htm

27 "2010 Technology Market Overview Report", Aging in Place Technology Watch (2010) www.ageinplacetech.com/page/2010-technology-market-overview-report

28 "e-Health Opportunities for Global Service Providers", Parks Associates (2008) www.parksassociates.com/coms2/summary_0256-9604_ITM

The general social benefits of health monitoring should also not be ignored. Housebound people can feel less isolated, and carers are better supported. These new broadband communication technologies will be tremendously helpful to the millions of carers around the world, whose contributions often pass unnoticed but who are, themselves, under great pressure and are often forced to withdraw from employment and other economic activity.

5.10.2.4 Internet already a popular source for health information

In 2008, according to Comscore,[29] the number of visitors to health-related websites grew at a rate four times faster than overall Internet use. The Internet contains an enormous amount of health-related information; however many consumers are concerned about the accuracy and reliability of the information found online and would like to be able to communicate with a medical practitioner directly. This is why reputable full-service e-health providers need to be developed in order to provide quality healthcare assistance.

Overall, however, if governments are to maintain a high level of healthcare policy management, it is important that the national healthcare system, regulated to meet standards of quality provision, is the primary place where people find advice and interaction with their healthcare providers.

5.10.2.5 Privacy a key concern

Privacy is another issue that is often raised – and may be best addressed by making all systems require participants to "opt in," with clear rules regarding authority to access personal information. The challenge here is not technological but legislative. Many countries have specific laws regarding patients' rights to privacy and data protection, but there are complexities in the way that general directives may be interpreted by national and local governments.

Concerns about privacy may also be motivated by a wide range of secondary issues, including liability protection in litigious societies, market defensiveness, restriction of patients' ability to change doctors, debates about information ownership, the nature of patient/doctor relationships, and privacy legislation that restricts information to be stored outside areas of national jurisdiction.

In general, however, consumers seem to be increasingly willing to disclose personal information, or to be monitored, where this is understood to have a beneficial impact on health and care outcomes.

5.10.2.6 Accountability and transparency

With the shift towards e-health, medical practitioners might be concerned that excessively automated systems could be over-simplified and therefore not capable of properly reflecting the nuanced experience of professionals when making diagnoses and planning treatments. However, currently used paper-based – and even computerized – processes of management seldom have common standards, meaning that not all available information can be used effectively. E-health systems can provide the level of coherence and transparency required of the healthcare process.

29 "Online Health Information Category Grows at Rate Four Times Faster than Total Internet", Comscore (2008) www.comscore.com/Press_Events/Press_Releases/2008/09/Top_Internet_Healths_Sites

Box 5.12 Examples of e-health in practice

- **2010**
  The GPS-tracking Personal Emergency Response System from MobileHelp enables the user, when away from home, to simply press a button to send a map of his or her location to a control centre.
- **2009**
  TeleMedic's lightweight VitalLink system for monitoring vital signs supports mobile medical data transmissions. It was first successfully tested over Iridium's global satellite network, which is used if a wireless network is not available. Telemedicine can reach users in remote areas where there are no terrestrial wireless networks, as well as at sea or in the air. VitalLink is designed as a communication gateway between medical devices and IT systems. It provides healthcare workers with remote access, integration of client records and an audit trail of successful or attempted access to any part of the system.
- **2009**
  The Croatian government wanted to offer its citizens a more efficient health information system. A solution was developed with the goal of integrating healthcare processes, information management and business workflows. Connecting 2,400 primary healthcare teams in the 20 counties and the capital, Zagreb, the Healthcare Networking Information System provides electronic reporting and booking, updates patient records, and digitizes prescriptions and referrals, so they can be sent to pharmacies, hospitals and laboratories without the need for print-outs. Ericsson was chosen to supply and implement the system. Ericsson has also studied this e-health system from a CO2 emissions reduction perspective.
- **2008**
  IBM Research brought together mobile phones and 'presence' technology combined with health records to provide people with information on how to aid others in critical medical situations. It combines IBM Research capabilities and the IBM WebSphere Presence Server.
- **2007**
  Cisco offers a series of high-definition video-conferencing services called Telepresence. Included are video pods (similar to automatic photo booths) where patients can be connected to doctors just by signing in at the booth at the appointed time. Heartbeat, blood pressure and body temperature can be monitored by sensors the patient puts on while under instruction by the doctor on the video screen.
- **2005**
  The US Department of Health and Human Services awarded an USD 18.6 billion dollar contract to four consortiums, made up of healthcare IT vendors, management services firms and healthcare providers. Their goal was to develop prototypes for a national health information highway over which digitalized patient medical records could be shared securely.
- **2004**
  The World Health Organization (WHO) used a wide range of information from formal and informal sources to track suspected or rumoured outbreaks of disease. The Internet is a key information source as reports of many initial outbreaks often originate in online news sources and blogs. In order to be quickly alerted to these reports, WHO worked with Health Canada to develop the Global Public Health Intelligence Network II (GPHIN II).
- **2001**
  A team from France's IRCAD (Institute for Research into Cancer of the Digestive System), led by Professor Jacques Marescaux, carried out remotely from New York an operation on a patient in France. This procedure was first of its kind, and the result of a partnership between IRCAD, the France Télécom group and Computer Motion. The successful operation was made possible by high-speed fibre-optic services and sophisticated surgical robots, which reduced the time delay that would have hindered such projects in the past.

5.10.2.7 There simply is no alternative to e-health

The alternative to not embracing e-health is to accept a significantly inferior healthcare service in the future. A World Health Organization (WHO) report[30] has revealed an estimated shortage of almost 4.3 million doctors, midwives, nurses and support workers worldwide. The shortage is most severe in the poorest countries, especially in sub-Saharan Africa.

There is no doubt that e-health has the capacity to totally transform national healthcare systems, but that society will need time to make the adjustment. Training is vital, and not just of medical professionals. Equally important is the training of other carers, volunteers, and the patients themselves.

Box 5.12 gives examples of just some of the thousands of e-health projects from around the world that have been initiated during the past ten years.

5.10.3 RECENT DEVELOPMENTS

5.10.3.1 Digital Health Initiative (DHI)

In September 2009, Ericsson announced it would become a founding member of the Digital He@lth Advisory board, along with the Commonwealth Business Council, Pfizer and the African Business Round Table. Led by the United Nations Office for Partnerships, the DHI will consist of multiple stakeholders with health and technology expertise.

In line with the Millennium Developments Goals, DHI initiatives include promoting telemedicine to improve the delivery of health and education to remote areas, and to collect and collate health-related data such as birth and deaths, laboratory results and the monitoring and control of disease.

5.10.3.2 Smartphone applications to assist healthcare industry

Smartphones are likely to play an expanding role in delivering healthcare advice, as well as in the exchange of data between doctor and patient. One important aspect of this growth is the boom in the number of "apps" that are being created for everything from providing information on specific medicines, to allowing users to test their own eyesight.

Datamonitor expects that Apple's decision to allow third-party developers to create applications for the iPhone, for example, will result in the development of many new healthcare related applications[31]. In particular, apps for electronic health records and for supporting clinical decisions may assist in increasing physicians' use of broadband.

5.10.3.3 Training of healthcare professionals

Modern telepresence technologies are being used more and more in the training of medical staff. In addition, e-education has been used for a number of years to help train rural and remote healthcare

30 "Scaling up, saving lives", World Health Organization & Global Health Workforce Alliance (2008) www.who.int/workforcealliance/documents/Global_Health%20FINAL%20REPORT.pdf

31 "Doctor + iPhone = Better Healthcare (Analyst Opinion)", Datamonitor Research Store (2008) www.datamonitor.com/store/Product/doctor_iphone_better_healthcare_analyst_opinion?productid=BFTC1933

professionals, primarily via radio. Nowadays, medical staff in remote areas are increasingly using the Internet and interactive multimedia applications.

5.10.3.4 Internet media companies become involved

The large Internet media companies appear keen to be part of the future of e-health. Microsoft, for instance, launched a personal health platform named Health Vault in 2007. In early 2008, Google launched a service to store medical records, via an initial project with a clinic located in Cleveland in the United States. These services are still in their formative stages but indicate the types of facilities that may be expected to gain traction with the growth in source data from personal health systems.

Progress towards interoperable personal health records (PHR) came a step closer in 2008 with the endorsement of a PHR standard by Google and Microsoft Known as the "Common Framework for Networked Personal Health Information" and developed in the United States.

5.10.3.5 Developing the evidence base

In the United Kingdom, the National Health Service (NHS) has "Whole System Demonstrator" projects that are on course to report findings in 2011. Their objectives are to provide, for both the healthcare and social care sectors, evidence to demonstrate the true value of remote patient monitoring and assistive technologies. The trials are taking place in three areas of England: rural (Cornwall), inner city (Newham in London) and urban (Kent), each with 1000 participants and a matching control group, and with academically-led and peer-reviewed analysis of the results.

This complex study[32] includes measures of the clinical and economic effects on general physicians' practices, reductions in hospital admissions (or re-admissions) and reductions in anxiety levels and financial burdens experienced by family carers. This evidence base will inform policy development and is seen as a necessary precursor to widespread adoption of a full range of assistive technologies.

Data are also available from the United States via projects undertaken by the Veterans Association and by the Centre for Connected Health, demonstrating the underlying economic and clinical justifications for e-health initiatives[33].

The European Commission has funded several studies[34] in this field, including a multi-country report on the growth of remote monitoring technologies and personal health systems. These reports also document the many non-technological reasons that inhibit the introduction of e-health services, and concerns about the adequacy of the underlying broadband infrastructure in some countries.

5.10.4 ESTONIA'S E-HEALTH EVOLUTION

A demographic crisis is looming across much of Eastern Europe. Eurostat data forecasts that the population of most Eastern European EU nations will shrink by up to 30% by 2060. The remaining population would be characterized by a high median age and an increased proportion of elderly citizens dependent on the working population for care and support. Implications of this scenario include a decreased tax revenue base and increased healthcare costs. One solution is to increase the effectiveness and efficiency of existing health care systems through the wider use of ICT.

32 "Whole System Demonstrator (Newham)", NHS (2010) www.newhampct.nhs.uk/services/telecare/

33 "MiCare", Department of Defense, USA (2008) www.micare.va.gov/Portal/Index.aspx

34 "Personal Health Systems", European Commission (2010) www.ec.europa.eu/information_society/activities/health/research/fp7phs/index_en.htm

The Estonian Digital Health Information System aims to increase efficiencies in the healthcare process. Initiated in 2008 with development scheduled to continue until 2013, the system is designed to facilitate quality healthcare services, guarantee patients' rights and protect public health. It is comprised of an online patient portal, digital imaging and digital prescriptions, which provide benefits such as allowing patients to make and cancel medical appointments, as well as rapid access to patient records by healthcare providers.

Participation by healthcare professionals is mandatory. Patients are authenticated by their electronic national identity cards, each of which is embedded with a microchip housing a digital signature certificate. Issued to all Estonian nationals over the age of 15, these cards are already used for authentication in using other e-services.

The Estonian Digital Health Information System was made possible due to cooperation among government departments, regulatory change, cultural change and technological change. An evolution rather than a revolution, it builds on previous developments in both the public and private sectors, such as the digitization and networking of government departments and records, as well as widespread adoption of broadband by the general population.

5.10.5 URGENT RETHINK NEEDED ABOUT E-HEALTH DELIVERY

Healthcare might progress in various ways, but one thing is certain: low cost connectivity and bandwidth will be key enablers of future developments. It is also important for broadband infrastructure and service developments to proceed in tandem. If the services are not made available, businesses and citizens might question why so much capacity is needed. However, a major barrier lies in the fact that healthcare administration systems are often not suited to the delivery of e-health services.

Estimates of the savings to be gained from using coherent e-health systems vary from 15% to 25% of total national healthcare budgets. And yet, hundreds of billions of e-health dollars are spent on proprietary administrative systems in hospitals and elsewhere, while the world is moving towards web-based services aimed at the delivery of e-health directly to patients.

A key reason for the delays in implementing e-health is that its benefits cover society as a whole and do not necessarily have immediate positive consequences for the commercial aspects of healthcare. Leadership is needed to develop a trans-sectoral approach to these problems, so that the multiplier effects that broadband infrastructure has to offer are fully explored.

5.10.5.1 Redefining services

One of the most important changes that governments can make is to officially recognize that e-health consultations, by video for example, can be classified as medical consultations for accounting purposes. Currently only face-to-face consultations are usually accepted in this way. In some countries, this simple issue is blocking implementation of a large number of new e-health consultancy services.

In addition, remote patient monitoring systems that gather patients' vital signs such as blood pressure and heart rate are being deployed but principally using narrowband or dial-up services, because these appear to be cheaper. This is why it is important that the decision-makers within the healthcare system are aware of what the broadband possibilities are for taking advantage of efficiencies while delivering more and better services.

In another interesting development, in the United States and Japan in particular, there is now an enormous demand for e-health services from the affluent "worried well". This cohort is currently spending billions on health services, indicating clearly that there is a commercial demand for such types of e-health. By deregulating issues such as the definition of a medical "consultation," governments can allow private industry to develop these new services. Clearly, government has a role to ensure protect citizens from inappropriate or dangerous products, but not to stop developments of innovative technologies.

5.10.5.2 E-health strengthens the business case for broadband

Some have argued against the need for a fibre-to-the-home (FTTH)-based national broadband network, saying the capacity provided might not immediately be needed. But using broadband for e-health strengthens the business case for the building of such infrastructure – if up to 25% of an national broadband network is going to be used for healthcare (as has been estimated), that would put the infrastructure investment on a sound economic footing. Both the telecommunication and health sectors can profit enormously from the introduction of e-health.

5.10.6 E-HEALTH: SUPPLY AND DEMAND

As broadband networks spread, it appears that ubiquitous e-health services might not be too far away. But although there has been a huge increase in digital healthcare services over the last decade, particularly in hospitals, the wider development of these services has not generally advanced beyond pilots and small-scale projects.

Among the likely reasons for this are:

- In general, insufficient connection between healthcare policy and awareness of how ICT and broadband can be used to implement that policy
- The diversity of healthcare business models and the relative maturity (and regulatory priorities) of different national and regional markets reduces the potential for scale economies and consequent affordability
- Funding mechanisms do not generally cover the cost of e-health applications
- Many, non-compatible, private and public systems are being used
- Lack of affordable and ubiquitous high quality broadband access
- Lack of interoperable systems.

The development of e-health requires both "supply-push" and "demand-pull". Most of those involved in healthcare delivery understand the benefits of e-health and most health economists clearly see the cost savings that can be made, once a proper e-health system is in place.

Gaining acceptance from the profession requires clinical and administrative evidence from relevant pilot projects – of which there are many. At the same time many consumers' expectations are rising through their everyday experience of smart systems in other sectors.

Both supply and demand in e-health are inhibited by the current immaturity of broadband infrastructure. The countries which are making the most progress are those whose governments are putting trans-sector policies in place directed towards using national broadband networks for e-health applications.

5.11 E-EDUCATION

Remote education services via radio were launched decades ago to provide teaching for children in remote parts of Australia and Canada, for example. Broadcasting has also played an important part. The Open University, founded in the United Kingdom in 1969, broadcast lectures on television from 1971. Nowadays, the term e-education, also known as tele-education or distance learning, refers to the delivery of training or teaching using mainly the Internet or intranets. It can include web-based seminars, live instruction in classroom settings, online forums, and virtual training programmes.

Box 5.13 Advantages of e-education

- Low-cost way to train workforces
- E-learning allows employees to quickly learn new skills
- Conglomerates can use e-learning to ensure all business units receive the same training
- E-learning gives students in rural areas or developing markets better access to resources
- Wireless technologies allow educators to reach even further into remote areas via radio, satellite, and Wi-Fi signal distribution
- E-learning can be fun, leading to improved motivation to study
- Connecting schools globally enables students from around the world to share their experiences.

5.11.1 THE E-EDUCATION MARKET

According to a report released by market analysts Ambient Insight in February 2010, the global e-learning market was valued at around USD 30 billion, and was forecast to reach USD 46.9 billion by 2014[35]. In the current economic environment, e-learning growth could be curtailed as companies rein in non-essential spending. But another school of thought believes this environment will lead to a growth in e-learning as enterprises and educational institutions cut back on instructor-led training and use cheaper online methods instead.

A survey[36] by Bersin and Associates in 2009 found that spending on training (including offline and online) by the corporate market in the United States declined by 11% in 2008 compared to 2007. While instructor-led training remained popular, accounting for 67% of all training hours, online learning actually decreased from 30% of training hours in 2007 to only 24% in 2008. In contrast, a study[37] by the Distance Education and Training Council in the United States found that around eight million citizens are currently enrolled in distance learning programmes and enrolments in online courses are increasing by around 25% per year.

35 www.ambientinsight.com/Resources/Documents/AmbientInsight_2009_2014_WWeLearningMarket_ExecutiveOverview.pdf

36 "The Corporate Learning Factbook 2009: Benchmarks, Trends and Analysis of the US Corporate Training Market", Bersin & Associates (2009) www.bersin.com/Store/Details.aspx?Docid=10337850

37 "Is Distance Education for You?", Distance Education and Training Council (2009) www.detc.org/downloads/publications/Is%20Distance%20Education%20for%20You%207-08.pdf

The United States is the single largest market for e-learning, estimated to be worth around USD 14-17 billion in 2008. Europe and Japan have much smaller markets, but significant growth is expected in Asia particularly.

E-learning has become big business for application service providers (ASPs). Universities, companies and institutions often use ASPs rather than develop and run training courses in-house. Open-source solutions are also emerging, such as Moodle, an e-learning platform designed for scaled use by learning-oriented groups, schools and colleges.

5.11.2 RECENT TRENDS AND DEVELOPMENTS

5.11.2.1 Telepresence and e-education

There are several examples of telepresence and education emerging around the world. Cisco TelePresence, for instance, creates a virtual experience over a converged network, delivering real-time face-to-face interactions, using advanced visual, audio, and collaboration technologies. It combines high-definition audio quality, interactive technologies and a specially-designed environment that approximates to the feeling of actually being in the same room as participants in separate locations.

The high cost of a base line unit is likely to be prohibitive for home or even small business use. However, institutions can make use of the technology. In 2009, for example, the University of Missouri in the United States launched a Cisco TelePresence system to be used for communication between campuses and with a view to offering instructional training.

Another example comes from Australia where the federal government is working with the telecommunications company Telstra to deploy a telepresence system across more than 20 government offices. The network would span thousands of kilometres and reach across the country. It will help the federal government reduce the cost of travel, improve productivity and lower the impact of carbon emissions. It will also provide highly secure, life-size high-definition video facilities, used for inter-jurisdictional meetings, including the Council of Australian Governments (COAG) and Ministerial Council meetings.

5.11.2.2 Off-Net video technology

Off-net video refers to content streamed from an intranet out onto the Internet for wider dissemination. The medical field is a prime mover in this area of technology. In major healthcare institutions, video is increasingly becoming an essential element for improved patient care, as well as training of medics and collaboration through the provision of tutorials and demonstration of procedures online.

While it sounds quite similar to videoconferencing, an off-net video application has notable advantages. The quality of service is always maintained, even when the network is congested; the video is always high quality, and timeliness of video packet delivery is ensured. In a medical application, high resolution and clarity is paramount. Videoconferencing does not provide this level of resolution.

Another advantage of off-net video technology is that it can be used to train multiple students at the same time, who each receive high-quality, close-up images, either live or previously recorded. Consider an arthroscopic procedure on a patient's knee: it is not practical or realistic for ten medical

students to stand in an observation gallery and expect that they would be able to see the operation clearly. The only way to observe what is going on is through a feed from a fibre-optic video camera. Hence, distributing high quality video is for both collaborative and educational purposes.

Additional applications for video off-net are diverse, wherever clarity and high resolution are essential for accurate and effective two-way communication.

5.11.2.3 E-learning and open source

Gartner[38] has detected a trend for higher education institutions to move towards open source e-learning platforms such as Moodle or Sakai. This is based partially on the perception that open source is cheaper and does not require a licensing fee. Higher education institutions also appear to like the features and functions offered by these products, according to Gartner.

5.11.2.4 Virtual worlds for education

Some institutions are experimenting with using virtual worlds for education and training purposes. For example, Dartmouth College in the United States developed a virtual world that could be used to train emergency response teams. Participants were able to immerse themselves in situations that also called for them to interact with others. Also in the United States, Harvard University has developed "River City," where users must deal with and identify the source of a disease outbreak in a simulated world.

5.11.2.5 Crowdsourcing

User-generated content websites, such as Facebook and YouTube, are where users share personal information for social purposes. However, sites such as Wikipedia have also demonstrated that pooling user-generated information can create a useful resource based on collective knowledge.

There is a growing understanding that bringing enthusiasts and specialists together in an online environment creates a powerful assembly of untapped knowledge, talent and creativity. These developments could be considered as an example of a more informal method of online learning that is emerging through social media tools.

Enterprises are beginning to use this external labour source in order to help create products, predict markets, share resources and knowledge, organize data, and so on. Some crowdsourcing sites offer financial incentives to encourage participation; one example is Innocentive, which offers financial rewards to scientists who work on research and development projects.

5.11.2.6 iTunes U

A new type of "university", iTunes U, launched in May 2007. The theory is that every university in the world – many of them benefiting from significant public funding – can share all their course lessons, lectures, language classes and laboratory demonstrations with everyone. The service is accessed through iTunes, where the user enters any search term and relevant content is delivered from all the partner universities. This content can then be downloaded onto desktop computers or mobile devices.

38 "Gartner Higher Education e-Learning Survey 2007", Gartner Research (2008) www.gartner.com/DisplayDocument?doc_cd=155547

5.11.2.7 Mobile devices beginning to be used in e-education

Mobile devices are becoming more common as e-education tools. In late 2009, for example, a partnership between Ericsson and the Indira Gandhi National Open University (IGNOU) was formed to allow 2.5 million students from India and 34 other countries to download IGNOU course contents to their mobile phones via a 3G network that Ericsson plans to build. Students can also receive SMS alerts on their mobile phones.

5.11.3 CASE STUDY: AUSTRALIA

Australia is a world leader in its trans-sectoral approach to e-education, using digital technologies. The use of ICT within educational environments is set to increase dramatically between 2010 and 2015 as high-speed broadband becomes widely available to schools and other learning institutions through the country's National Broadband Network (NBN) and Digital Education Revolution initiatives. This is thanks to a technology mix of fibre-optics, terrestrial wireless and satellite solutions.

Simultaneously, the capability of Internet services devoted to e-education purposes is set to increase enormously over the next decade. Australia, with its large land mass and relatively small population is an ideal market for remote education services. Rural and distance education in Australia is likely to have a disproportionately high dependence on satellite solutions. The broadcast (point to multipoint) nature of education services is most efficiently served over satellite, especially in remote areas that would be prohibitively expensive to serve via terrestrial solutions.

Box 5.14 Australia to provide broadband and computers for all senior school students

In 2007 the Australian federal government announced the National Secondary School Computer Fund, which aims to see all school students in years 9-12 with access to their own school computers by the end of 2011. This initiative, combined with at least 100 Mbit/s connections to all schools in the country, is going to open up avenues that could revolutionize Australia's education system.

The size of the project and its trans-sectoral approach also create a range of business opportunities. It allows for a standardization of hardware and software, which will then open the way to an enormous explosion in e-education innovation. There is already a very healthy education software and content market, eager to take their current developments a step forward. Aside from the benefits to Australian students, the initiative could open up export opportunities as well.

5.11.3.1 Interactive and personalised education system

A successful implementation of Australia's plans will allow for a truly new approach to education that is individual for each student. Students will be able to set the pace and the subjects studied, within the context of the education system. This will be beneficial for fast learners, as well as for children who have learning difficulties and who can be supported with specialized services. Management of both these groups is problematic under the current system – it is difficult to cater for them in a cost-effective way.

Teachers will not only be able to coach students in a more individual environment: when it does not have to be restricted to school-based structures, the education system will be able to go global, with students tapping into knowledge and expertise from all over the world.

5.11.3.2 Professional development

One of the most critical issues will be to ensure that the education system is capable of leading this revolutionary change. This will necessitate very significant professional development. Often a great deal of attention and money goes into the technology but very few resources, if any, are available to ensure that those who will have to make it work are equipped to implement and guide that process. Teachers and other staff will need significant support – without this, despite the enormous investment by the government, the project could fail.

Teaching as a profession will also change radically, as not all teachers will need to be school-based. For example, teachers who leave the formal system when they start their own families could be easily retained within a far more flexible work structure complemented by e-education.

5.11.3.3 E-education infrastructure initiatives

The bulk of e-education infrastructure initiatives in Australia are implemented with public funding for services often hosted by Telstra, the country's largest telecommunications provider. Infrastructure developments commonly focus on the provision of fibre-based broadband connections to primary and secondary schools. Tertiary education institutions typically already have fibre connections, but more remote institutions are seeking to improve the cost of their fibre and DSL based connections which are often relatively expensive.

Through the Digital Education Revolution project, the Australian government is investing AUD 2 billion over seven years (2008-2014) to provide for initiatives that include:

- Investing AUD 2.3 billion in the National Secondary School Computer Fund (see Box 5.14), which gives grants to schools to assist them to provide for new or upgraded ICT for secondary students in years 9-12. The aim of the Fund is to achieve a 1-to-1 computer-to-student ratio by the end of 2011
- The Fibre Connections to Schools initiative, a contribution of up to AUD 100 million to support the development of fibre-to-the-premises (FTTP) broadband connections to Australian schools
- Collaboration with states and territories to ensure that teachers have access to training in the use of ICT that enables them to enrich student learning
- AUD 32.6 million over two years to supply students and teachers with online tools and resources to support the national curriculum, including specialist subjects such as languages
- Supporting systemic change to increase the level of ICT proficiency among teachers and school leaders across Australia to embed the use of ICT in teaching and learning
- More than AUD 16 million in funding for four projects that will help teachers and school leaders to better use ICT in the classroom
- Development of online learning and access tools that enable parents to participate in their children's education.

The Australian government has also committed AUD 81.9 million over three years to fund the Vocational Education Broadband Network, which will create a single high-speed broadband network for the post-secondary and training and further education (TAFE) sector, similar to the network currently serving universities.

5.11.4 DEVELOPMENTS IN AFRICA

The education aspect of the Internet is particularly important to developing markets such as Africa. The markets in northern Africa and South Africa are the most advanced. However, the topic is high on the agenda across the continent, as demonstrated at the "eLearning Africa 2007" event, held in Kenya, Egypt and Ethiopia [www.elearning-africa.com/]. Some of the other initiatives taking place in Africa are listed in Box 5.15.

Box 5.15 Examples of e-education initiatives in Africa and beyond

Morocco: A pilot interactive teacher training project was completed in 1998. Using very small aperture terminal (VSAT) technology, broadcasts in quality video, data and audio were possible and became operational through 15 learning centres in 1999. The project combines the use of television, telecommunications and computers to remote classroom situations, where computers and feedback terminals have been supplied. Since 1999, Morocco has also implemented an ICT plan focused on e-learning by developing student training programmes and connecting over 1,000 schools and colleges to the Internet. Today over 40% of tertiary education institutions offer e-learning courses;

Botswana: The ThutoNet programme is important to the entire Maitlamo initiative (Botswana's national ICT master plan). ThutoNet will provide all schools in Botswana with computers and access to the Internet. Teachers will also be trained on how to use ICT as a classroom tool and formal ICT education will be introduced into the school curriculum to help prepare the nation's children for success in the digital age. Locally produced educational software will be developed to assist with e-learning and ensure local content and subject relevance;

Algeria: Djaweb (Algeria Telecom's ISP division) launched an e-learning service based on prepaid cards in March 2006. Conducted in partnership with Thomson NETg and Microsoft, the service provides content via the Internet for 4,000 training programmes in ICT and skills development. In March 2007, Algeria's national library launched a bilingual e-learning platform called DZCampus in cooperation with two local companies specialised in interactive training and communication;

Kenya, Uganda and Rwanda: Under a project by the Millennium Villages Project (Sub-Saharan Africa), Millennium Promise, and the Earth Institute at Columbia University, community health workers are using m-Learning modules on their mobile phones. Reproductive health and care for newborns are two of the subjects on which information can be downloaded from a central database. The mobile networks are provided by Ericsson, MTN and Zain (now Airtel), and offer the privacy, quality of service and interoperability required for this learning application.

Global education for girls: Evolving from the Millennium Villages Project, the Earth Institute, Ericsson and Millennium Promise have launched a global effort to promote universal access and quality in secondary education in developing countries, with an emphasis on girls' education. This will be achieved by coordinating scholarships and using ICT to enhance the quality of the education and to connect school children worldwide.

India: Ericsson has partnered with the Indira Gandhi National Open University (IGNOU), which has a student base of about 2.5 million learners, 59 regional centres, 2,250 learner support centres, 52 overseas centres, and nearly 37,000 academic counselors. Text messages are sent automatically to students when courses are updated, and RSS feeds from websites for each course are sent to students on their mobile phones.

Mauritius/India: Launched in February 2009, the Pan African e-Network Project is an initiative of the President of the Republic of India, which aims to connect 53 African countries through satellite, fibre-optics and wireless links, with each participating country connected to a Continental Hub Earth Station. The Pan African Online Services Network will provide tele-education and telemedicine to the 53 States. The services will be provided by seven Universities (two in India and five in Africa) and eight hospitals (three in India and five in Africa). Mauritius is one of the three countries short-listed for the setting up of the Continental Hub Earth Station.

5.11.5 DIGITAL EDUCATION APPROACHING REALITY

The concept of digital education is approaching reality with the development of broadband networks.

E-schools will undoubtedly have the capacity to become the basis of a national e-education system, by being able to connect to the rest of the community while providing a one-to-one education service to students wherever they are, most likely outside the physical school environment. Education providers will be able to independently develop their own e-learning facilities and provide personal, interactive education services.

Developments in public and private digital education will complement each other and, to a certain extent, overlap and thus compete with each other. This could stimulate improvements in the overall quality of education.

It will be interesting to see how the design and architecture of these education networks will evolve. Systems linking thousands of schools and other educational institutions will be different from the national infrastructure that will connect millions of homes. The interconnection of both will be important, not just from a technical perspective, but also concerning the interoperability of applications and management between schools and homes. This will create a whole new set of market dynamics that will lead to innovative new developments in education that cannot yet be imagined.

In the end, as many government and industry leaders have said, investing in education is the soundest economic investment one can make. Economic capital has moved towards knowledge and a trans-sectoral approach to e-education is building up that required knowledge capital and spreading it throughout society, while helping to provide every child with an equal opportunity for education.

Box 5.16 Uruguay connects all its children

In 2006, the Uruguayan government decided to equip every single pupil and teacher in its public education system with a laptop computer. By September 2009 it had met that goal by distributing 380,000 computers through the "Plan Ceibal." The aim of this initiative is to promote equal access to ICT and the Internet, in order to reduce the digital divide that deepens social and economic inequalities in Uruguay. The project benefits children's families too, as they can use their laptops at home.

In addition, a Ceibal Portal has been created online (www.ceibal.edu.uy), with contents for learning and games, as well as a virtual campus with courses for teachers and advice for children, parents and the community.

Since the start of Plan Ceibal, Internet penetration in Uruguay has doubled from approximately 20% to 40%. The Plan provides connectivity to 89% of the nation's schools, which serve 99% of school enrollment. It also provides connectivity in 250 public places and in other public and private educational institutions.

5.12 E-SCIENCE

E-science refers to a worldwide development to bridge the gap between scientists in various domains through advances in information and communication networks. The common goal is to make the most efficient use of the very fast developing ICT infrastructure in all fields of science and research.

The following three areas of action can be distinguished:

- A "virtual laboratory" uses software (middleware) to provide generic e-science services and generic application-domain oriented services. Examples of generic e-services are workflow management, metadata management and knowledge extraction, content access and browsing, reasoning technologies, and security services. Examples of generic application-domain oriented services are found in such areas as informatics for biology, medicine and food science.
- The computational science field is concerned with constructing mathematical models and numerical techniques and using powerful computers to analyse and solve complex scientific and engineering problems. The vision is to advance innovative, interdisciplinary research where complex multi-scale, multi-domain problems in science and engineering are solved on distributed systems, integrating sophisticated numerical methods, computation, data, networks, and novel devices (see 5.12.2 below).
- The third line of action is the human and digital interface with end users, including various facilities for visualization.

Prototype services need to be further developed, both to provide better support for the research areas for which they were created and to broaden their scope to include other research areas. In order to provide the scientific community with stable and reliable products, research activities need to be complemented by software engineering development and operational support.

5.12.1 CITIZENS' E-SCIENCE

Widespread multinational collaboration can lead to developments that would not happen – or at least not as fast – when science is done by a tiny few, separated from each other by time, space and language. The result of joint collaboration can often be more than the sum of individual contributions, and ordinary citizens have their part to play, as well as specialist researchers.

In an open broadband environment, supercomputing can be brought within the reach of people at home. These end-users can go online to participate in virtual laboratories, and collaborate over high-performance distributed computing that connects many thousands of personal computers into a grid.

Already, for example, NASA, in the United States, is using the power of over a million amateur astronomers scattered all over the planet. Another early project, SETI@home, began in 1999 to use the spare capacity on volunteers' home computers in order to analyse radio signals from Space in a search for extra-terrestrial intelligence (or SETI). It is said to have more than 5 million participants worldwide.

No matter how advanced a particular organization might be, none of them alone can ever hope to employ all of the truly talented and innovative people in its field. But on a national or worldwide scale, an e-science initiative, combined with open broadband networks, can help harness the talents and computing resources of hundreds of millions of people. The amount of research and innovation that could result from this dynamic field of interaction is potentially enormous.

Box 5.17 Netherlands supports an e-science network

The government of the Netherlands has declared that the underlying infrastructure of the country's GigaPort project – SURFnet – will be seen as an integral part of national infrastructure and be regulated and funded accordingly.

GigaPort consists of two interrelated projects, GigaPort-Network (managed by SURFnet, the Netherlands' research and education network) and GigaPort-Applications (managed by Telematica Institute). Within the context of GigaPort-Network, a highly advanced research communications network is being developed with super-fast connections across the Netherlands and Europe and to North America and Asia. GigaPort-Applications offers the Dutch academic and business community the opportunity to carry out large-scale research into new applications for the next generation of the digital highway.

5.12.2 INTERNATIONAL COLLABORATION THROUGH THE GRID

There is already a significant amount of international collaboration taking place in e-science. Grid computing is another way of exploiting distributed resources. Rather than using data centres, this method harnesses a huge grid of machines, each of which might only be as powerful as an ordinary home computer. Grid computing is well-suited to solving resource-intensive problems in science, engineering and commerce.

For example, 80,000 central processing unit (CPU) cores are shared within Enabling Grids for E-sciencE (EGEE), one of the largest systems in the world. More than 10,000 users in 140 institutions in 50 countries together produce a reliable and scalable computing resource that is available to the European and global research community. The four Large Hadron Collider experiments at CERN (Europe's central organization for nuclear research located near Geneva on the French-Swiss border) send more than 150,000 tasks a day to the EGEE infrastructure, generating hundreds of terabytes of data a year.

This grid was also used to help ITU's Regional Radio Conference in 2006 to establish a new frequency plan for introducing digital broadcasting in the VHF and UHF bands. The complex calculations required major computing capability within a very tight schedule. ITU's Radiocommunication Sector deployed a distributed system of 100 high-speed computers capable of running 200 parallel jobs. To complement the local cluster and provide additional flexibility and reliability, it agreed with CERN to use resources from the EGEE grid infrastructure.

5.12.2.1 Towards ubiquitous access to knowledge

Harvey Newman is the architect and one of the principal builders of the global optical network that will collect the data for the Large Hadron Collider at CERN. In 2008 he wrote:

> *"Network applications involving access to, and sharing of large volumes of binary data as the basis of information, and ultimately as a basis of knowledge, are highly developed, but are not so visible in the world of entertainment and social networking as they are in the realm of research. But soon, corporations will learn to follow in the footsteps of the research community to handle and benefit from the knowledge implicit in such datasets, whether for healthcare or for other business processes, or for new forms of education, that complement web-page and video (more traditional) content.*
>
> *Even in the days when the walls of your home are live displays (the walls themselves, as extensions of current OLED developments, not just screens), it will be the knowledge behind the images, and the ways they are used to inform and educate, as well as entertain, that will matter most."*

The possibilities are profound. Developments could include hybrid optical networks that will send light paths across heterogeneous network boundaries. And there is no reason why, if the issues of authorization and authentication are solved, these optical hybrid networks could not be available almost universally. TCP/IP would be used much less than now, less electrical energy would be needed and – for the first time – the infrastructure would exist on which the world's knowledge could truly be delivered ubiquitously.

5.13 SMART GRIDS

Our prosperity and way of life depend upon efficient and affordable energy – but, according to the NUS Consulting Group, prices are rising (see Table 5.6). Based on current forecasts, the world will invest trillions of dollars in new (conventional) electricity grids.

These investments are simply needed to meet expected growth in demand. However, the World Energy Council notes that the production and use of electricity accounts for around 40% of greenhouse-gas emissions, making the industry the single largest polluter. This has led to a focus on developing smart grids that make use of broadband to manage energy demand.

Smart Grids will allow utilities to much better control their networks, limit electricity loss, prevent outages, and provide customers with real-time information and tools (such as smart meters) to better manage their own energy use. Smart grids also help to more easily integrate renewable energy resources, such as solar and wind power, into the grid, and enable energy generated in homes, schools and businesses to be stored and shared. ITU set up a focus group on the topic of smart grids in May 2010.[39]

39 Details of the Focus Group are at www.itu.int/en/ITU-T/focusgroups/smart/Pages/Default.aspx

Table 5.6 Overall electricity price rises in selected countries:2003-2008	
Country	**Electricity price increase 2003-2008**
Australia	34%
Belgium	31%
Canada	15%
Finland	46%
France	27%
Germany	68%
Italy	35+%
The Netherlands	63%
South Africa	23%
Spain	36%
Sweden	75%
United Kingdom	140%
United States	23%

(Based on NUS Consulting Group, 2008)

At the same time, broadband over power line (BPL) technologies allow data to be carried on a conductor that is also used to transmit electricity. BPL, fibre-optic, wireless and mobile systems can all be used to link a smart grid backbone to customers' premises – and such networks also offer opportunities to sell excess capacity (on a wholesale level) to telecommunication and Internet service providers.

Box 5.18 Definition of a smart grid

- A smart grid can be compared with a modern IP-based broadband telecommunications network. It is an intelligent, managed, controlled, and ultimately self-healing IP overlay on top of the existing electric distribution network, capable of closely matching supply with demand while improving efficiency and reliability.
- BPL technologies, sensors and control devices, combined with integrated high-speed communications and advanced analytic software, provide utilities with status reports and other information. A smart grid also offers smart meter features which allow users and power companies to easily access information about usage, supply and real-time price, thus enabling better management of energy usage.
- Smart grids can also manage the effective use of diverse and highly dispersed sources of power generation, including renewables. Excess capacity can also be used to deliver voice, data and video broadband services to homes and businesses.

In addition, utilities will be able to reduce their carbon emissions, which will offer interesting opportunities on the carbon trading market. Perhaps this reason alone will see a rapid deployment of smart grids around the world.

Box 5.19 Evolution of smart grids

With the deregulation of telecommunication markets, many utility companies around the world became successfully involved in telecommunications, especially those that made their infrastructure and/or their excess telecommunication capacity available on a wholesale basis.

The development of broadband over power line (BPL) from narrowband power line communication (PLC) technology gave utilities an opportunity to explore new markets. However, delays in standardization and the relatively high cost of hardware – and the fact that moving further into the broadband access market was completely outside their core business – put a virtual stop to new deployments during 2006/07.

But with global warming finally hitting the political agenda and the fact that generation and the use of electricity accounts for a large percentage of all carbon emissions, serious reasons now exist for the utilities to revisit their total operational plans.

5.13.1 THE GLOBAL SMART GRID MARKET

In 2000, the Telegestore project in Italy launched as the first in the world to connect millions of homes to a power grid with smart meters and power line communication. It was completed in 2005. The construction of smart grids continues today, with some countries assigning funds from economic stimulus packages to the development of smart grids and smart meter projects. Examples of these investments include Australia (AUD 100 million) and Germany (EUR 100 million). And as part of its push toward greener and more efficient technology, the US government has spent about USD 3.4 billion of stimulus money on smart-grid projects, with utilities and others contributing another USD 4.7 billion[40].

France, the Russian Federation, and Hong Kong, China, are also considered to be leading markets in terms of smart grid development or smart meter deployment, and many others, such as Brazil, the United Kingdom, China, Sweden and Japan, are moving in this direction.

One of the catalysts for change has been that more and more governments and utility companies around the world are recognising the mounting problems presented by energy and environmental concerns. These concerns include:

- limitations on energy generation, while usage is skyrocketing
- decades-old networks are under greater stress
- utility workforces are aging and there is a resource squeeze
- increased use of alternative energy sources in their networks
- wastage of energy and the resulting high penalties, and
- the likelihood of carbon trading.

A 2008 report from Edison Electric Institute (EEI) and the Electric Power Research Institute (EPRI) predicted that a reduction in power consumption of between 7% and 11% could be reached over the next 20 years if major steps are taken to improve efficiency, including smart grids. Some US studies have suggested that savings of between 10% and 25% in electricity demand are achievable.

40 http://politicalticker.blogs.cnn.com/2009/10/27/obama-unveils-3-4-billion-in-smart-grid-energy-awards/

In 2009 the smart grid market was valued at around USD 20 billion and a forecast by Morgan Stanley sees an 8% compound annual growth rate through to 2030, at which time the market could be worth around USD 100 billion.

According to a report from Pike Research, governments and utilities are expected to ramp up their investments in smart grids, spending a total of USD 200 billion worldwide from 2008 through 2015. Technologies to automate the grid are expected to win around 84% of that money. Smart metering systems to track and analyse the usage of electricity, gas, and water will grab 14%, while systems to provide power to electric cars will garner the remaining 2%.

Box 5.20 Smart grid applications

For utilities companies:

- Outage identification and reporting
- Automated electric and water meter reading (AMR)
- Demand response management
- Video surveillance through BPL-enabled video cameras placed on the power grid
- Street light management
- Solar power system that integrates energy storage technologies, load measurement and control devices and renewable energy sources
- Line sag detection, to remotely sense when distribution lines drop to hazardous heights.

For consumers:

- Home energy management including consumer empowerment with greater transparency and choice
- Internet access and standard ISP service
- Voice over IP telephone service
- Security and intelligent home service through an always on, monitored wireless system.

So far, development of the smart grid has been hurt not just by technical and financial limitations, but also by a lack of vision and common standards, and by outdated regulations. An example of efforts being undertaken to tackle this is work by the National Institute of Standards and Technology (NIST), an agency of the US Department of Commerce. It is developing interoperability standards for smart grids and will address areas such as adapting IP and wireless networks, pricing models, security, and access to data for third parties.

If created, a worldwide and universally accepted set of standards would allow vendors to ship equipment ready to be plugged in to smart grid networks, and help drive down prices for consumers.

5.13.2 AUSTRALIA AND THE UNITED STATES – TWO LEADING MARKETS

The governments of Australia and the United States have both committed significant stimulus funds towards the development of smart grids. A non-profit alliance known as Smart Grid Australia initially requested AUD 50 million for demonstration projects and the government responded with the provision of AUD 100 million across 2009-10 for what they call the National Energy Efficiency Initiative to develop an innovative energy network. Combining broadband with intelligent grid technology and smart meters in homes, this project would enable greater energy efficiency and

better integration of renewable energy sources. Funding was provided to a consortium of state and local governments, public and private energy companies and other private-sector investors for the large scale demonstration of integrated smart grid technologies.

In the United States, utilities are rapidly developing smart grids as part of the need to improve the efficiency of energy production and use. Clean energy is also seen as a platform for rebuilding the American economy and smart grids are viewed as critical to a sustainable energy future.

In February 2009, the US Congress passed the American Recovery and Reinvestment Act, which, among other projects, targeted the development of smart grids. Thousands of applications for funding were received and in October 2009 the government allocated approximately USD 3.4 billion in matching grants. The successful recipients include 100 private companies, utilities, manufacturers, cities and other partners. With matching funding, the total project value will be over USD 8 billion.

Of the allocations, around USD 1 billion will be used to enable consumers to save energy and cut utility bills through the installation of smart meters and customer systems. Another USD 2 billion is allocated to integrating different components of a smart grid, including smart meters, smart thermostats and appliances, synchrophasors, automated substations, plug-in hybrid electric vehicles, renewable energy sources, and so on. Approximately USD 400 million is allocated to making electricity distribution and transmission more efficient through grid modernisation. A further USD 25 million goes to fostering a smart grid manufacturing industry. The awards will benefit consumers in 49 states.

The funding, combined with private investment, aims to achieve the deployment of more than 40 million smart meters over the next few years. Other targets include more than one million in-home displays, 170,000 smart thermostats and 175,000 other load control devices to enable consumers to reduce their energy use. Funding would also help expand the market for smart domestic appliances.

5.13.3 SMART METERS

At the end of 2009 there were estimated to be around 80 million smart meter units installed worldwide and this is expected to increase sharply, reaching some 230 million by 2015. Italy is the leader in this area, with around 30 million units already installed.

Of the total the cost of upgrading smart grids, 70% is associated with the physical replacement of meters in homes. But new meters will last for at least ten years, and they are gateway products that enable home-owners to link to other applications. Further upgrades simply become a matter of updating software, rather than replacing the whole meter.

This is all the more reason to opt for an open standard, which will allow customers and utilities to add plug-and-play devices to the smart grid connection in the home or on the utilities' infrastructure. Already, many new energy saving and reliability improvement applications are becoming available and this will increase. Interoperability should be a key element.

Box 5.21 Europe's meter standardization makes progress

The increasingly liberalized electricity market in Europe is behind the need for standardization in smart metering. Although several European standards have been established, the European Commission has called for a more comprehensive set of open standards covering models from all utilities.

In early 2009 the European Commission began funding the OPEN Meter Project, a collaborative research project to develop a set of open and public standards for smart multi-metering services, supporting electricity, gas, water and heat metering. These will be based on existing industry standards where practicable, including those established for broadband over power line (BPL) and metering for electricity and other utilities. The project is coordinated with the European standardization organizations CEN, CENELEC and ETSI.

The project is aimed at removing possible barriers to the wider adoption of smart metering in Europe, by ensuring that products and systems based on the new standards are interoperable and supported by most stakeholders, including meter manufacturers, utilities, and research institutes.

In June 2009 the project reported on a number of regulatory aspects of smart metering (both on a European and national levels), and in August 2009 it reported on suitable BPL and wireless technologies for smart metering (including GPRS, 3G, Wi-Fi and TETRA). The project is expected to run until June 2011.

5.13.4 UTILITIES NEED TO BE MODERNIZED

The electricity generation industry tends to be heavily regulated. For utility companies to build smart grids in such an environment, encouragement by the regulator is required. This will necessitate regulators taking account of social effects as well as economic concerns, along with the need to act quickly to obtain the full benefits of smart grids at a time when older infrastructure is increasingly under stress.

Politicians need to lead the way in this important area, with a clear and far-sighted vision for the future. If, in renewing old infrastructure, the old types of equipment are used again, taxpayers, industry and society as a whole will lose the opportunity to benefit from greater efficiency and a cleaner environment.

In addition, a limited, narrowband communications system will not support the real-time information flows that are involved in a smart grid deployment. It will not have the capacity to support communication between the utility and the plethora of increasingly intelligent appliances that we can expect to see in coming years.

5.13.4.1 A trans-sectoral approach

The current regulatory environment tends to reward a utility company's entire capital investment in infrastructure. However, the utility receives no reward if it opts to partner with a telecommunication firm, requiring operational expenses but negating the need for capital up front. This encourages a "silo" approach, in which different, separate, communication networks are built in parallel.

At the same time, regulations that stimulate vertically-integrated telecommunication companies do not supply an economically viable reason for electricity companies to use these networks for their smart grid requirements.

The smart grid is dependent on service-oriented networks (SON) for its functionality, but ultimately it is simply a communications system overlay on an existing electric grid. There are ways to achieve the desired levels of efficiency and control with reliable communication networks that already exist. Policy should aim to provide utilities with an array of smart grid communication options, including both commercial networks and private networks.

5.13.4.2 Using electricity infrastructure to roll out broadband

Sharing infrastructure makes a lot of sense. It reinforces the business model for providing universal high-speed broadband, as the cost of infrastructure is one of the most critical elements in any national broadband plan. This makes it all the more crucial for smart electricity infrastructure to play its part in the expansion of broadband.

There is certainly no uniform approach to smart grids, but a significant number of electricity utilities understand the strategic benefits associated with a combined smart grid/broadband roll-out. The fact that these two developments are happening at the same time is certainly viewed by visionaries within both industries as a unique source of synergy.

The more strategically oriented utilities do not consider this to be just an opportunity to make money by leasing the use of their poles. They understand the negotiating power they have to secure the best possible communications deal for their smart grid requirements.

5.13.5 SMART GRIDS – POTENTIALLY DISRUPTIVE BUSINESS MODELS

Most of the discussion that is taking place in relation to smart grids assumes linear developments moving forward. However, the reality is that a rather disruptive development could take place that could undermine the current business models for the energy industry.

Smart grids and home automation information will create a whole range of new applications. To this add new storage technologies for distributed energy in neighbourhoods, cars, shopping centres, etc., and a whole new set of business dynamics will emerge.

Many people in the telecommunications industry underestimated the impact of the Internet. That should be a lesson for the electricity industry. If it does not show leadership, then others who are able to see the enormous opportunities ahead will do it for them. New models will emerge that could, in some instances, actually result in free energy being offered along similar lines to some of the models that now provide free Internet access. In other words, the monetary benefits may be derived elsewhere – energy, like the Internet, is a facilitating utility that will allow innovative organizations to add their own models.

An early example can be seen in a suburb, Hoogkerk, in the city of Groningen in the north of the Netherlands. Here 25 homes will be virtually connected with each other in a smart grid where energy can be shared among the participants. The project is funded by the European Union and managed by energy expert KEMA. The houses will be equipped with photovoltaic panels, combined heat and power microsystems, home energy networks, and so on. Also linked into this network will be the solar panels at the KEMA plant in Groningen, as well as a local wind farm. Intelligent communication and energy systems will manage the electricity flow within this smart suburb. Combined, these homes could also operate as an energy generator and could sell energy to the grid, and for this purpose lithium-ion batteries will be installed in every participating home.

When enough of these smart suburbs exist, it is feasible to link storage facilities to them and, combined, they could at least overcome the challenge of peak demand, which is one of the most costly elements of electricity production. Fewer polluting power stations would be required and eventually, distributed generation could even become the major source of energy production. Another scenario is that local companies could use their rooftops to generate energy and through local smart grids could make that available to neighbouring homes and businesses.

The explosion in renewable energy activities, in particular at consumer levels, is beginning to create the foundation for new, distributed energy generation business models. A whole new industry could be built around this – from energy brokers, system integrators and smart service providers, to software companies and device manufacturers. As energy prices soar, a climate is being created for these new disruptive businesses to emerge.

5.13.6 KEY ALLIANCES

5.13.6.1 Cisco Smart Grid Ecosystem

Cisco is creating the Cisco Smart Grid Ecosystem to help accelerate the adoption of the Internet protocol (IP) for utility communication networks. The members of the ecosystem include system integrators, technology vendors, power and utility integrators, service providers, and other vendors representing various elements of the smart grid infrastructure. In addition, a Smart Grid Technical Advisory Board was formed, made up of utility and energy companies from around the world.

The company is already working with Canadian utility ENMAX to help accelerate the deployment of Cisco Smart Grid and related energy management technologies. They are also providing security services to utilities and participating in the ZigBee Alliance to help standardize IP-based communications within the energy industry.

5.13.6.2 IBM's Intelligent Utility Network Coalition

The IIUN Coalition was created by IBM as a group of companies working together to accelerate the development of common standards, technology solutions and processes for smart utility grids. In 2011, it includes 13 utilities from North America, Europe and the Asia-Pacific region[41].

An Intelligent Utility Network, or IUN, is an information architecture and infrastructure that enables the continuous automated monitoring of a utility's assets and operations, as well as customer electricity usage, and uses this on-demand information to improve services, reliability and efficiency.

5.13.6.3 IPSO Alliance

The IP for Smart Objects (IPSO) Alliance was formed by a group of leading technology vendors, as well as end users. Its goal is to promote IP as the networking technology best suited for connecting sensor- and actuator-equipped "smart" objects and delivering information gathered by those objects.

Smart objects transmit information about their condition or environment to locations where the information can be analysed, correlated with other data and acted upon. Applications range from automated and energy-efficient buildings and factory equipment maintenance, to hospital patient monitoring and safety and compliance assurance.

The IPSO Alliance will perform interoperability tests, document the use of new IP-based technologies, conduct marketing activities and serve as an information repository for users seeking to understand the role of IP in networks of physical objects.

41 www-03.ibm.com/press/us/en/pressrelease/34006.wss

5.13.7 SMART GRIDS FOR THE DEVELOPING WORLD

Despite progress towards the development of smart grids, the reality is that in many developing countries there are few traditional electricity distribution networks. For example, in Africa three-quarters of the population does not have access to electricity[42]. However, with renewable energy it is possible to build affordable, locally distributed smart micro grids. New storage technologies for distributed energy in villages, around hospitals, schools and shopping centres will create a whole new set of opportunities for developing countries.

The following example provides an approach which is also highly relevant to developing nations. Two new power stations developed by Horizon Power in remote Western Australia at Marble Bar and Nullagine use innovative new technology to generate energy provided by the sun. The projects employ solar and diesel generation, combined with a flywheel energy storage system to ensure reliability and quality of power supply. It will also maximize utilisation of solar energy. The solar energy systems will generate over 1 GWh of renewable electricity per year, using sunlight to supply over 60% of the towns' daytime energy demand. This will save 35-40% of the diesel fuel used now, as well as 1,100 tons of greenhouse gas emissions every year.

In the developing world, new initiatives will be driven by the urgent need for electricity, while in the developed world, high energy prices and government policies aimed at reducing use of fossil fuels are creating a business climate for new technologies and businesses to emerge. This means that there is a clear synergy between the developments and all countries can work together to achieve their common goals.

5.13.8 SMART GRIDS AND CLIMATE CHANGE

Finally, the benefits of smart grids go beyond providing power and communications. They also help to reduce greenhouse-gas emissions and so tackle climate change, as part of other ICT solutions (see Box 5.26).

Governments are becoming far more proactive in the field of climate change, and these policies are stimulating the development of smart grids. Also, there is now overwhelming evidence that, taking the wider climate-change issues on board, the economic benefits of smart grids far outweigh the costs involved.

According to the World Energy Council, electricity generation is the single largest contributor to global CO_2 emissions – roughly twice as much as transport. But it also offers the greatest potential for reducing such emissions in the short and medium term.

Major innovations and advanced technologies available today can radically transform the ability of consumers and enterprises to find, produce, deliver, and use energy in a more cost-effective, resource efficient and environmentally sustainable way. Alternative energy sources such as solar, wind, hydrogen fuel cells and clean batteries, as well as mobile battery or hydrogen powered cars, will become the distributed sources of energy in the future and will require the current analogue grid to become IP enabled, much like the telephone and Internet industries have developed. Smart grids or network intelligence are a way to reduce CO_2 emissions and connect the distributed and clean generation sources.

42 "Underpowered: the State of the Power Sector in Sub-Saharan Africa", World Bank (2008) www.eu-africa-infrastructure-tf.net/attachments/library/aicd-background-paper-6-power-sect-summary-en.pdf

Smart grids or network intelligence enables real-time operational intelligence, connectivity and surveillance further down into the grid and across the electricity supply chain. This approach leverages network automation and analytics, in conjunction with grid data devices such as smart meters, to provide further benefits to both utilities and consumers. Sensors and automated monitoring mean fewer outages and faster restoration. Optimized transmission of power can shorten transmission paths and reduce losses, which lowers overall generation needs – all of which amounts to lower greenhouse-gas emissions.

5.13.8.1 Carbon trading and next-generation grids

Demand for electricity has soared in recent decades, and this is set to continue (see Table 5.7). But with the environmental problems the world is facing, many countries are reviewing the type of new power stations they build. While alternative energy is now being taken more seriously, the reality is that it will not account for more than 10-15% of total energy production over the next 5 to 10 years. However, rising carbon taxes will make alternative energies more commercially viable.

As a major polluter, the electricity industry will come under increasing pressure to financially address this issue, as governments impose carbon taxes or other measures. Perhaps the issue of smart grids will be solved by such carbon trading, provided that a broadband-based system is used so that reduction of emissions can be maximized.

The electricity industry is in the unique position of being able to reduce its carbon emissions, so its costs can be traded. There will be plenty of industries that will need to increase their electricity use and the utilities are in an ideal spot to profit from this. Against this background, it would be a grave mistake to build smart grids upon old, narrowband technology. Next-generation networks are needed. And extra capacity on a broadband-based smart grid can be used to recoup some of the investment.

Table 5.7 Worldwide electricity consumption,1973-2030

Year	TWh
1973	6,100
1980	8,000
1990	12,000
2000	15,000
2010 (estimate)	21,000
2020 (estimate)	27,000
2030 (estimate)	32,000

(Source: IEA)

5.14 SMART BUILDINGS, COMMUNITIES AND CITIES

The challenges the world faces mean that we must look at every opportunity to build smarter communities. These should incorporate integrated, carbon neutral, advanced communication networks, linked to a new generation of social services such as e-government, e-health and e-education.

Around the world there are many smart city developments taking place, with multiplier effects provided by broadband infrastructure. Broadband technologies are also leading to intelligent home networks that can assist in controlling indoor climates and monitoring energy. Taking these concepts further leads to the development of smart buildings, smart communities and smart cities.

Box 5.22 A new smart city in Abu Dhabi

Abu Dhabi obtains 60% of its national income from oil. But it is creating the new Masdar City as a carbon neutral community based on renewable resources. Masdar City will accommodate 40,000 people and provide work for another 50,000 commuters. Over USD 24 billion over 8 years will be invested to create a community that includes intelligent buildings that generate wind and solar energy. This energy will also fuel a public transport system that excludes cars from the new city.

Because of the desert environment, 78% of all energy will come from photovoltaic rooftop panels. The other 22% will be provided by five other renewable sources. Through building design alone, 70% of energy savings are expected to be realized. All waste will be recycled into energy.

The city will be built in four phases and each one of them will have its own mini smart grid. The grids will be interconnected during the course of the project. The city will also host a university and R&D institute dedicated to the new sciences that are involved in its establishment, and it aims to become a supplier of scientists in this field.

5.14.1 BUILDING SMART CITIES TO EASE STRESS ON RESOURCES

More than half of the world's population now lives in cities, and over the last century, cities that hold more than one million people have increased from 20 to 450. These metropolises are under stress. In many cases, their infrastructure systems for managing water, energy, food supply, transport, communications, economic and social structures are faltering. Cities are also major producers of CO_2 emissions.

At the same time, cities are centres of knowledge, innovation and social and economic interaction. They contain a vast pool of human capital that can be tapped into for solutions. And cities are often in a better position than national governments to investigate horizontal, trans-sectoral approaches to address shared problems.

5.14.1.1 Using people power

All over the world people are eager to cooperate to save energy, water and other resources. It is crucial to harness this people power and link it to sound smart city management policies and strategies.

Cities need to set up trans-sectoral teams for all the core problem areas: population growth, transport, communications, water, energy and economic activities. These teams should be developed from the grassroots level, with strategic leadership from the top.

And, rather than allowing governments, energy and water companies, transport systems and telecommunication providers to provide services to passive citizens, it would be more constructive to help citizens themselves to become involved in actively taking charge.

Around the world, various local initiatives are already taking place, working towards the development of smart communities – some dating back to the 1960s. But they have not yet been given the mainstream status that could lead to a true transformation of our cities. What is needed is for the smart city concept and its many elements to be better communicated to ordinary citizens. Very significant information and communication processes need to be put in place to support these communities as they work to transform themselves.

5.14.2 KEY COMPONENTS OF SMART CITIES

5.14.2.1 Smart grids and broadband

Smart grids form one of the bases of smart cities. There has been global under-investment in utility infrastructure, and upgrades are urgently required.

Meanwhile, telecommunication networks are undergoing extraordinary changes with investment in IP-based next-generation networks (NGN) and fibre-optic national broadband networks, in order to meet burgeoning consumer demand for high-bandwidth applications. This infrastructure can be used for a range of smart community applications, including healthcare, education, and transport.

5.14.2.2 Smart buildings

In many cities around the world, high density living is the norm and attention is now turning towards making this style of living more sustainable. Technological innovations include water harvesting and reuse, solar power collection and energy efficient appliances, including for heating and cooling.

Smart homes are equipped with devices that possess the integrated intelligence required to manage and exchange data through broadband networks. As well as enhancing lifestyles with entertainment and communication applications, home automation systems also now offer security protection and facilities for teleworking. Even the current demand for simple applications has prompted broadband service providers to include home networking products in their installation packages.

Increasingly, smart homes and other buildings are also able to achieve zero net energy emissions. Carbon emissions generated from fossil fuel power stations are balanced by the amount of on-site renewable energy production. The equation can also include carbon emissions generated in the construction of the building.

5.14.2.3 Smart roads and transport

Investing in intelligent infrastructure allows for road managers to be more aware of how the network is being used, and how it can be used more efficiently. ITU has been very active in supporting work in this field, through its support for intelligent transport systems and vehicles.[43]

43 See ITU's Focus Group on this topic, at: www.itu.int/en/ITU-T/focusgroups/carcom/Pages/Default.aspx

Some examples that are already in use include:

- Electronic tolling: improving traffic flow, safety and emissions by vehicles not needing to stop to pay a toll, and incorporating interoperability between toll roads.
- Variable message and lane-use signs: improving traffic flow across the system, responding to emergencies and hazards, and alerting drivers ahead of an incident.
- CCTV cameras: allowing the arterial road network to be monitored and managed.
- Telematics: using GPS systems and vehicle-generated data to inform traffic management centres about problems and send data on real-time traffic conditions back to the vehicles.
- Radio interrupt: allowing critical safety announcements to interrupt AM/FM radio.
- Transport scheduling and regulation of heavy goods vehicles.

Intelligent transport systems (ITS) encompass a range of wireless and wired communications-based information technologies that can be integrated into the infrastructure and individual vehicles. ITS systems include the software and hardware for new electronic vehicle-to-vehicle and vehicle-to-infrastructure communication systems.

For example, a state-of-the-art road and vehicle system recommends to drivers the best roads to use, advises what their estimated travel time will be, alerts them to traffic hazards ahead, warns them when they stray out of their lane or get too close to the vehicle ahead, suggests where to buy the cheapest fuel, and tells them where to park.

Current ITS technologies use dedicated short-range communications (DSRC) to transfer data between in-vehicle mobile radio units and roadside units. Arrangements to facilitate the use of ITS have been developed internationally in the 5850-5925 MHz band (the 5.9 GHz band).

ITS increases the safety and efficiency of transport networks – from public bus, tram and train transport, to rail and road freight, and private and commercial road transport.

5.14.3 EXAMPLES OF SMART COMMUNITIES

India

Bangalore– Intelligent Urbanisation

In 2009 Cisco launched an initiative dubbed Intelligent Urbanisation in Bangalore, India. A pilot programme in conjunction with the state of Karnataka will see a blueprint developed for an intelligent, smart and sustainable city. It will focus on solutions for public safety, security, transport, buildings, energy, healthcare and education.

China

Shanghai Satellite Cities

In Shanghai, the government is building nine new satellite cities which could house more than one million people by 2020. It is incorporating smart city concepts into its plans and using companies such as Siemens to implement the technology. Examples include state-of-the-art technology incorporated into Pudong Airport, such as building automation, alarm equipment, information systems, control systems for baggage transfer, and energy supply facilities.

As demand for electricity increases, a new power plant is being developed that would use Chinese coal; however technology will be implemented to reduce polluting emissions. A more efficient waste water treatment facility is another initiative.

World Expo 2010

The theme of the World Expo held in Shanghai, China, from 1 May to 31 October 2010 was "Better City – Better Life". Among its central themes was the use of ICT to improve public safety and people's lifestyles and employment opportunities. ITU celebrated World Telecommunication and Information Society Day on 17 May at the Shanghai event, focusing on the same theme as the Expo, and drawing attention to the need to expand communications and connectivity to all.

Europe

Madrid – urban energy management

In 2009, Madrid, Spain, launched a project known as Urban Energy Management, initially in one apartment complex but with a view to expanding to other buildings. The project has two key features:

- In each apartment, a smart meter known as a Home Energy Controller uses monitoring devices and the building's broadband infrastructure to enable each resident to manage consumption of electricity, gas and water by establishing limits and receiving energy-related alerts via a high-definition touch screen.
- The Urban Energy Controller is used by building managers and appropriate authorities to monitor and manage energy use across different buildings and urban areas and provide a wider community view of energy consumption. Examples of the types of information it can provide include real-time graphs displaying energy; comparison data, such as historical versus current usage, and energy consumption alarms based on defined limits for shared buildings.

The scheme is the beginning of a project that aims to incorporate such innovations as heating and cooling using geothermal and solar panel technologies. With the management and control systems, it is estimated that these innovations could deliver huge energy savings.

Stockholm – government leadership promotes growth

The Stockholm government established a company called Stokab to build an open-access fibre-optic network. It connects competing service providers with government and business customers.

A new urban district – Stockholm Royal Seaport – is also being developed in the east of the city. Modern architecture and environmental thinking is combining to create a vibrant waterfront district for sustainable living, business and recreation. A former brownfield industrial area of 236 hectares is being transformed, and will focus on sustainable transport solutions, efficient building processes, energy conservation and energy efficiency. It has a target of cutting carbon emissions to below 1.5 tons per person per year by 2020, and to be free of fossil fuels by 2030. Broadband will be a key enabler of services in this development, and Fortum, Ericsson, Electrolux and NCC are among the companies developing solutions for the project.

Stockholm also manages KISTA Science City, housing more than 1,400 companies, plus a support programme for start-up and early-stage companies. In 2009, Stockholm was named intelligent community of the year by the Intelligent Communities Forum (see 5.14.5).

Box 5.23 A smart transport system in Seoul

In May 2009, the city of Seoul, capital of the Republic of Korea, launched a web-based service called Personal Travel Assistant (PTA). Using web-enabled devices, it allows users to access real-time travel information such as cost, travel time (real-time traffic congestion is taken into consideration) and the carbon impact associated with the mode of transport selected. Other cities such as Amsterdam are reportedly planning to pilot a PTA service in the future.

Source: Connected Urban Development

5.14.4 BENCHMARKING STUDIES IN EUROPE

In 2007 a team of scientists in Europe benchmarked cities with populations of less than 500,000 against a smart city model. The model ranks cities against set criteria including economy, population, governance, mobility, environment and living standards. The team included scientists from the Technical University of Vienna in conjunction with the University of Ljubljana and the Technical University of Delft.

The result of the study[44] found that the smart middle-sized cities in Europe were located in Finland, Denmark, Austria, Germany and Benelux.

5.14.5 INTELLIGENT COMMUNITIES FORUM

The Intelligent Communities Forum (ICF)[45] studies the economic and social development of intelligent communities. In particular it aims to:

- Identify and explain the emergence of the broadband economy and its impact at the local level;
- Research and share best practice by communities in adapting to the changing economic environment and positioning their citizens and businesses to prosper;
- Celebrate the achievements of communities that have overcome challenges to claim a place in the economy of the 21st century.

As part of its research work, the ICF identified the top seven intelligent communities around the world in 2010:

1. Arlington County, Virginia, United States – Using broadband, the government and private sector provide free connectivity to all county offices and the public school system through a service branded I-NET. Arlington's Department of Technology Services offers a growing array of web-based government services to county employees, who use mobile and online tools to speed onsite inspections, resolution of citizen complaints and emergency response.
2. Dublin, Ohio, United States – Following telecommunications deregulation in 1996, Dublin began installing a network of underground conduits to encourage deployment of broadband by private carriers. By 2003, Dublin had built and lit its own fibre network, called DubLink, to connect city facilities and replace telephone services. The Central Ohio Research Network (CORN) allows schools, businesses and institutions to explore experimental technologies through Internet2, where the next generation of commercial networking technologies are taking shape.

44 See www.smart-cities.eu.

45 www.intelligentcommunity.org

3. Dundee, Scotland, United Kingdom – The i3 Group has made Dundee the second UK community where it will deploy a fibre network through the sewer system, which substantially cuts costs of deployment. “Dare to be Digital” is a successful contest held for students from throughout the UK and, increasingly, around the world.
4. Eindhoven, Netherlands – The city developed a number of projects via its public-private collaboration called Brainport. These include an outsourced IT management system for schools; a remote home healthcare programme called Viedome, and a campaign called Technific that promotes e-education. “Digital City Eindhoven” attracts a half-million visitors monthly to an online social media tool that encourages people to learn more about the region.
5. Ottawa, Ontario, Canada – By 2008, through a project funded by the city, broadband passed 100% of all homes, businesses, government offices and educational facilities. In a survey of rural business owners, 75% said that access to broadband had improved their sales and profitability and 15% said that they would be forced to relocate if broadband access were not available.
6. Suwon, South Korea – The city decided to develop its own government network despite South Korea's impressive broadband infrastructure. It was able to trim nearly a quarter-of a million US dollars from its operating costs by eliminating leased lines, and using conduit already installed for the transport management system kept construction costs to a minimum. Control of its own network allowed Suwon to massively boost connection speeds from 32 Mbit/s to 1 Gbit/s.
7. Tallinn, Estonia – The city has provided computers in schools and deployed widespread Wi-Fi as well at nearly 700 public access kiosks. Tallinn has also developed a large-scale digital skills training programme, extensive e-government services and an award-winning smart ID card system.

All of these communities have one thing in common – strong leadership. In most cases a forward looking government began to implement technology and broadband initiatives at least 10 years ago, and these communities are now reaping the rewards with strong broadband infrastructure based on fibre-optics. It is also worth noting that many projects were conducted through public-private partnerships.

5.15 ENVIRONMENTAL MONITORING AND EMERGENCY RESPONSE

5.15.1 COLLECTING AND SHARING DATA

The increasing availability and power of ICT underpins the collection, sharing and analysis of vital data on the environment. For example:

- Satellite and direct sensor technology provide the ability to record and store massive amounts of information with increasing resolution and geographic coverage;
- Geographic information systems allow for the visualization and interpretation of the datasets to be made available through these observation systems;
- Increasingly fast microprocessors provide computational power that can be used to model complex environmental processes.

When combined with broadband networks, these technologies and techniques lead to very rapid communication, processing and storage capabilities. And this vast and growing amount of data is not only able to be shared; it can also be worked on intensively through the combined power of many computers, distributed remotely in a grid. (See also section 5.12 on e-science.)

The role of ICT in climate monitoring, for example, is clearly shown in the World Meteorological Organization's World Weather Watch (WWW) system, which comprises three integrated core components: the Global Observing System (GOS) provides observations of the atmosphere and the Earth's surface (including oceans) from the globe and from outer Space. GOS uses remote sensing equipment placed on satellites, aircraft and radiosondes to relay data to control centres. Combined with communication networks and the Global Data Processing System (GDPS) – thousands of linked computers – WWW processes an enormous volume of meteorological data and generates warnings and forecasts.

But for countries to participate fully in such monitoring or in collaborative international research activities –linked to the environment or to any other topic – improved broadband network resources need to be made available, most probably based on fibre-optic solutions.

5.15.2 WEATHER INFORMATION FOR ALL AROUND LAKE VICTORIA

The "Weather Info for All" project – a partnership between Ericsson, the World Meteorological Organization, the World Bank, mobile operators Zain and MTN, and the Earth Institute – aims to roll out up to 5000 automatic weather observation stations throughout Africa.

Reusing infrastructure at new and existing mobile network sites, the stations will dramatically improve information that is crucial to predicting and coping with climate change. The initiative also seeks to distribute weather information by mobile phone, and it will provide emergency alerts.

Initial deployment is focused on the area around Lake Victoria in Kenya, Tanzania and Uganda. The first 19 stations established there have already doubled the region's weather-monitoring capacity and more will be added.

Box 5.24 UNESCO helps with tsunami warning system

The several tsunami early-warning systems that are currently in place or being developed are examples of Earth observing and data recording systems that can make excellent use of broadband. The Intergovernmental Oceanographic Commission (IOC) of UNESCO was established in 1960 and has coordinated the Pacific Tsunami Warning System since 1965. After the devastating Indian Ocean tsunami on 26 December 2004, the IOC received a mandate to help countries in the region establish the Indian Ocean Tsunami Early Warning System. IOC also began coordinating the establishment of similar systems in the Mediterranean and north-east Atlantic Ocean and the Caribbean.

Tsunami warning systems draw on sensor systems developed for weather observation (ocean buoys) and earthquake detection (seismic sensors) to feed into real-time analysis and detection systems. They continuously collect, distribute and interpret all available seismic and sea-level data that relates to tsunami and other ocean hazards. They issue timely warnings for their areas of operation and exchange data with other national and international centres.

5.15.3 EMERGENCY COMMUNICATIONS

Broadband networks are essential in the gathering and transmission of data that monitors environmental conditions to anticipate natural disasters such as floods, famines, or the threat of a tsunami (see Box 5.24). Broadband also provides a platform for efficient and reliable communications for public safety before, during, and in the immediate aftermath of disasters and emergencies.

Because terrestrial communication networks are vulnerable to disasters, broadband wireless provides a highly cost-effective and reliable alternative for humanitarian teams to communicate with each other or the outside world, to provide a fully coordinated response, and to provide facilities for services such as telemedicine for the victims.

In 2005, for example, ITU sent solar-powered satellite terminals to help establish links in the Kashmir region of Pakistan, after a massive earthquake struck the region. As well as communications for rescuers, the terminals provided broadband links for doctors at a major hospital to help medical teams at the scene of the disaster.

Wireless and satellite broadband communication systems can be moved to a disaster site and deployed rapidly. In addition, a number of routes to different satellite connections can be easily accommodated: this flexibility ensures that it is easy to allocate appropriate bandwidth to meet demand and address the issue of congestion.

This is made more possible by the increase in Ka-band capacity that is capable of providing high-performance broadcast and data communication services, including broadband Internet access to remote and rural areas that are underserved by terrestrial networks. Solutions can be scaled to cover different scenarios following a disaster, from the failure of a single communication node, to total network failure.

Box 5.25 ITU sends emergency communication systems to earthquake-stricken regions

Within the first 24 hours of the extremely strong earthquake that struck Haiti in January 2010, ITU sent 40 satellite terminals that were deployed in Port-au-Prince. Sixty additional units, with broadband capabilities, were sent a few days later, along with a team of experts to help restore telecommunication networks. ITU and its partners also set up a Qualcomm Deployable Base Station – a complete high-speed mobile network for wireless communications. Subsequently, more satellite terminals mounted on motor vehicles for on-the-move communications were installed. All of this equipment was used by humanitarian aid agencies, government authorities, and the local population.

Through a new partnership announced on 11 February 2010, ITU also set up wireless systems based on Wi-fi and WiMAX technologies in over 100 hot spots around the disaster zone to provide broadband and voice connectivity to internally displaced people, as well as to aid workers and local authorities. Some 10 WiMAX base stations and 40 customer premises equipment devices were delivered to Haiti following the signing of a cooperation agreement between ITU and Singapore-based smart-Bridges Solutions.

Before the earthquake, about 35 per cent of Haiti's 9 million people had mobile phones, and 11 per cent had Internet access. But connectivity was severely reduced by the collapse of terrestrial networks. ITU is working with the Government of Haiti, telecommunication operators and regional organizations, not only to help restore services, but also to build state-of-the-art broadband infrastructure to enable the country to develop its shattered economy.

More recently, ITU sent satellite communication equipment to areas of northeastern Japan that, on 11 March 2011, were devastated by a huge earthquake measuring 9.0 on the Richter scale – the strongest ever recorded in the country in modern times – followed by a devastating tsunami that swept away communities.

Broadband communications also play a critical role in boosting a country's preparedness to deal with natural disasters and emergencies. They allow for reliable data-gathering and alerts, and help make sure that civic authorities, businesses and individuals are fully ready for, and get early warning of, any impending threat. In addition to providing emergency support where existing systems are overloaded or out of service, mobile broadband technologies can also provide reliable early-warning systems, particularly when the normal infrastructure cannot cope.

In the immediate aftermath of disasters, vehicles fitted with advanced satellite broadband systems provide the ideal degree of mobility required to quickly deliver and install secure, easy-to-deploy and cost-effective access to bandwidth in the affected zones (see Box 5.25). The rapid availability of mobile broadband is not just important in supporting the emergency services, but is also critical in helping local communities return to normality as quickly as possible. During the recovery phase, broadband mobile communications are key to restoring normal services as part of broader reconstruction and rehabilitation efforts.

5.16 BROADBAND AND CLIMATE CHANGE

The ICT sector is responsible for approximately 2% of global CO_2 emissions today, yet can be instrumental in helping to reduce the other 98% of emissions from more high carbon-emitting sectors such as transport and energy utilities. This is outlined in a report "SMART2020 – Enabling the low-carbon economy in the information age" released by the Global e-Sustainability Initiative (GeSI) in 2008.[46] Formed in 2001, GeSI is a partner of ITU, as well as of the United Nations Environment Programme (UNEP), and the World Business Council of Sustainable Development (WBCSD).

ITU has been very active in this field,[47] and the GeSI report was introduced at one of a series of ITU seminars on ICT and climate change. ITU also launched the Dynamic Coalition on Internet and Climate Change[48] in 2007 as an open body committed to moderating the environmental impact of the Internet, to seeking new ways to embrace its power to cut greenhouse-gas emissions worldwide, and to enabling transformation in line with the objectives set and to be set under the United Nations Framework Convention on Climate Change (UNFCCC). There is also an ITU study group[49] that has responsibility for the issue of climate change, especially with respect to technical standardization.

In fact, according to GeSI, "SMART" stands for "*standardize*," – the first necessity for ICT. Next comes "*monitor*" energy consumption and emissions across the economy in real time, providing the data needed to optimize for energy efficiency. Network tools can be developed that allow "*accountability*" for energy consumption and emissions. This information can be used to "*rethink*" how we should live, work and play in a low carbon economy. Ultimately it will be a set of technologies and architectures working coherently together that will enable the "*transformation*" of the economy as a whole.

46 GeSI "SMART2020" (2008) at http://gesi.org/ReportsPublications/Smart2020/tabid/192/Default.aspx

47 See www.itu.int/themes/climate/index.html

48 See www.itu.int/themes/climate/dc/index.html

49 Study Group 5 of ITU's Telecommunication Standardization Sector.
See www.itu.int/ITU-T/studygroups/com05/index.asp

Box 5.26 ICT solutions for combating climate change

Any plan for reducing carbon emissions should include an evaluation of the emissions from ICT itself, which needs to optimize at all levels. But at the same time, using key ICT systems to their full potential could see as much as 5.8 billion tons of CO2 emissions eliminated by 2020, according to an estimate by IDC. This requires core technologies to be used in energy generation and distribution; transport; buildings, and industry.

ICT will play a key role in dealing with global warming and saving energy. By making processes and systems more efficient, savings will start to occur naturally. Furthermore, by giving the end-users more control there will be an increase in energy efficiency.

Once utilities, for example, are able to provide decentralisation (with end-users increasingly taking charge of their own energy management) a large number of energy-efficient devices and management tools will flood the market. These will be popular. Not only is there a great willingness to address environmental issues we all face, but energy prices are going to rise and customers will be looking for products and services that will allow them to maintain the lifestyle they want, within their budget.

Already we are seeing that environmental awareness is proving to be a major driver for the greening of the ICT industry. Data centres are among the industry leaders in this effort – for altruistic motives and because they are major users of electricity.

Broadband will also be a major contributor in addressing environmental concerns. Teleworking can be increasingly promoted. E-health and e-education can be delivered worldwide. Many services that previously required hardware products can today be supplied over broadband as software-based applications. Many energy-saving applications can be delivered and managed via broadband networks.

With combined human effort directed towards a much more environmentally friendly world, massive changes can be expected over the next five years and beyond – and the ICT industry will take a leadership role in this process. While ICT is not the solution to all these problems, there will be no solution without ICT.

The fact that broadband infrastructure is being deployed all over the world lays the foundation for a dramatic increase in transformative ICT solutions that will pave the way for a low carbon economy. The energy sector is just one of the major areas in which broadband can have an impact on reducing greenhouse-gas emissions (see section 5.13.8). Future service delivery in health, education, energy, transport and content distribution will rely on ICT. This makes it even more important that countries should plan for 21st century broadband infrastructure that supports access to these solutions.

By 2020 there could be 50 billion connected devices, and the number of mobile subscriptions is expected to reach six billion. Machine-to-machine connectivity will allow for real time information to be exchanged, dematerialisation, and support for low-carbon lifestyles. With the right type of policy and investment framework, the adoption of these solutions can be accelerated, and the resources saved can be used to accelerate further carbon reductions. A global climate agenda that includes ICT and broadband would enable faster CO_2 reductions, support new green jobs, productivity and economic development.

6 HOW BROADBAND CAN BE DEPLOYED

6.1 CREATING INFRASTRUCTURE FOR THE 21ST CENTURY

The last few decades have witnessed a true revolution in communication technology. This has created enormous social and economic opportunities for all nations — whatever their current state of economic or technological development. At the same time, it vastly complicates the question of how to assess a nation's existing communications infrastructure and determine how to most efficiently improve it.

Box 6.1 Key issues in the deployment of broadband

When seeking to take advantage of the many benefits of broadband in particular, several key tasks should be kept in mind:

- **Creation of a common vision**: all stakeholders should work together to define a common vision appropriate to their national environment, with the aim of ensuring that conditions are in place for a competitive broadband-based ecosystem to also flourish worldwide.
- **Raising awareness of the benefits of broadband**: the social and economic benefits of broadband should be publicized among decision makers and the general public.
- **Engaging with private investors**: it is likely that most investment in broadband will come from the private sector, so policy-makers need to engage with industry and investors in order turn vision into reality.
- **Innovative public investment**: for areas where private investments are not feasible, public authorities and private entities should find innovative ways of cooperation to achieve widespread access to, and usage of, broadband.
- **Role of public authorities**: public authorities could play a key role in abolishing existing barriers and factors that hinder widespread adoption of broadband, as well as barriers to investment. Governments could also use tax policy to give long-term incentives to broadband investments and use e-government to create more demand. Especially important in the short term is consideration of how to meet the increasing demand for radio-frequency spectrum for mobile broadband.

There are several key issues that policy-makers must confront as they devise a path from the current state of infrastructure deployment to the goal of ubiquitous broadband connectivity. These include the issue of public or private investment, regulation, and spectrum management, and are examined in Chapter 7 of this report.

The purpose of this chapter is to identify key factors that governments, businesses, citizens, and others can use to assess the current state of a nation's physical communication infrastructure and to identify a technological path for expansion and improvement.

The broadband market is very innovative and is quickly evolving in various ways, depending on each market's situation. Consequently "one size does not fit all" when it comes to broadband deployment. The best solution has to be analysed case-by-case, taking into account (among other factors) the social, economic, geographic, political, market and administrative situations of each country. However, the following points should be taken into consideration when considering broadband deployment:

The revolution in communication technology is ongoing.

Today, a state-of-the-art network might be a ubiquitous broadband Internet protocol-based network delivered via fibre to the premises, complemented by a fourth-generation (4G) wireless cellular network for mobile or nomadic communications. But there can be no assurance that this will be true in twenty, or even ten years from now. In order to make progress, some decisions must be made now to invest in particular types of infrastructure; however, interested parties should always remain alert to new technologies and look for ways to take advantage of them.

Infrastructure policy should be adaptively focused on larger goals, not directed towards a specific, predetermined technology mix.

In its broader context, this report emphasizes the importance of trans-sectoral thinking. That is, looking at infrastructure as serving goals that cross typical silos of governmental, economic, and social activity, in order to achieve the goals of all of those sectors more efficiently. Similarly, an important criterion for any particular element of the physical communication infrastructure will be its ability to meet multiple social and economic goals, and to take advantage of potential technical developments in other infrastructure elements.

Legacy infrastructure (or lack thereof) constitutes both a constraint and an opportunity. A less-developed nation with scant existing infrastructure will obviously have more work to do to achieve a 21st century communications environment than will a developed nation with near ubiquitous telephone, broadband, cable television, and wireless services. At the same time, the less-developed nation will be able to work on a clean slate from a technological perspective, and will have fewer established players to contend with, whether public or private. Because each nation's situation is unique, each will likely have a unique path towards bringing its infrastructure up to 21st-century levels. Policy-makers should carefully assess both the opportunities and constraints presented by their nation's existing communications ecosystem.

Infrastructure goals are separate from, but related to, questions of public ownership of facilities and the role of competition in spurring private investment.

Consensus that a nation would benefit from deployment of an advanced physical communication infrastructure does not mean that there will be consensus on how it should be owned, funded, and managed. It is critical to analyse from the nation's unique circumstances the best way to attract the investment needed from private and/or government sources to build and operate a modern system. A nation with a reasonably robust privately-owned communication infrastructure might be able to

achieve its expansion by managing the incentives offered to those private entities. A nation with a publicly owned infrastructure may be able to reach agreement on upgrading it via normal political processes. On the other hand, nations without an existing robust infrastructure will need to determine what mix of private and public investment will be appropriate. For such nations, it may be unrealistic to rely entirely on private investment to deploy the infrastructure the nation needs. However, it is beyond the scope of this report to propose any particular role for public versus private ownership. Policy-makers in each nation must assess what mix makes most sense in their nation's individual situation.

Barriers to access must be removed as far as possible.

The benefits for businesses and citizens of access to a robust communication ecosystem are enormous. It follows, sadly, that anyone who can erect a barrier to such access can extract fees from those who need to communicate. Precisely because a 21st century communications infrastructure must be ubiquitous to achieve maximum value, the opportunities for charging unreasonable prices should not be allowed — such as high rents for the use of utility poles or access to buildings. There are legitimate interests that need to be accommodated with respect to the need to recoup investment costs in deployment of infrastructure, but policy-makers must be vigilant and aim to reduce barriers as far as possible.

With these broad considerations in mind, experience from many different nations permits the identification of certain specific characteristics that any infrastructure should have in order to provide a meaningful chance of achieving the full technical, social, and economic benefits of a robust communications ecosystem. These include the following:

- When it comes to bandwidth, more is better. We appear to be only at the beginning of discovering ways to use communication facilities, from two-way video distribution to cloud computing, to the creation of vast arrays of mobile networked devices. The most robust landline infrastructure for delivery of large and growing quantities of data today, and for the foreseeable future, is optical fibre. Policy-makers should give preference to functionalities, however, rather than to a particular technology. Fibre could be a long-term goal, while various technologies can permit very high data transmission rates over copper wire or coaxial cable. The wired infrastructure must be complemented by a rapidly evolving wireless infrastructure as technology develops.
- Preserving flexibility and innovation at the network's edges is absolutely essential to a healthy communications ecosystem. By its nature, much communication infrastructure — fibre or wires on poles (or buried in the ground), large antennas to send and receive wireless data, expensive switching and routing gear — is long-lived and can be very expensive to modify. In contrast, devices that attach to (and in some sense become part of) that infrastructure — wireless phones, small computers, and the endlessly varied software that runs on them — are relatively cheap and easy to replace and modify. Similarly, new applications and content are rapidly developed and deployed. These technical realities create a situation in which edge devices and applications naturally evolve rapidly in response both to global technological trends and highly localized market needs. It is simply impossible to reap the benefits of a 21st century communication infrastructure without permitting that evolution to occur and be disseminated throughout the network. It follows that nations must avoid policies permitting or requiring restrictions on the attachment and use of edge devices beyond those absolutely necessary to protect the core infrastructure from harm

- The physical network is distinct from the services and functions that travel across it. The physical infrastructure used to upload and download e-mail, images or video is very different from the typically edge-based servers and software that enable those functions to occur. The fundamental economic and technical characteristics of providing such applications differ in critical ways from the economic and technical characteristics of providing the physical network. If applications become "built in" to the network, it might be more difficult for the natural evolution of increased functionality to occur in some cases. Therefore, policy-makers should be cautious in considering the degree to which the network operator — that is, the supplier of the physical infrastructure — should be directly involved in providing services or functionalities that use and depend upon that infrastructure.
- Interconnection among networks must be robust, reasonably priced and efficient. Policy-makers are challenged today with a complex network of networks in both the horizontal (geographic) dimension and the vertical (service) dimension. The customer can access many diverse and competing services, which may come from multiple providers across a single connection at the same time. Moreover, many services are delivered to the local access network across several transit networks. A robust communication ecosystem will have multiple networks serving overlapping needs. These will include public landline networks for data, video, voice and other uses; public wireless networks serving the same needs; a number of private networks deployed by large organizations to meet the needs of their constituents, and a variety of networks from other nations seeking to exchange information. Moreover, higher service layer logical networks use lower layer physical networks to provide end-to-end services and applications. A sound communications policy will strongly support robust and efficient interconnection among networks.

Box 6.2 From IPv4 to IPv6

A crucial aspect of broadband connectivity is the ability to connect to end-user devices and the dramatically growing world of machine-to-machine communications. All this needs an enormous supply of Internet addresses — but these are beginning to run out.

Currently, the vast majority of links use version 4 of the Internet protocol, or IPv4, which was defined in 1981 for a much smaller network. The protocol provides 32-bit addresses each consisting of four groups of numbers. This yields a maximum of some 4.3 billion unique addresses. Various ways to try and overcome the shortage have been devised, such as network address translation (NAT). This allows many computers on a private network to use just one public IP address to connect to the Internet. However, the best long-term answer is seen as the deployment of a new version of the Internet protocol, IPv6. Using 128-bit addresses, IPv6 generates a total number that is so huge it yields trillions of addresses for every person on Earth, and for the Internet of things.

Although it was defined a decade or so ago, the new version of the Internet protocol is still in the early stages of deployment. Only in February 2008 were the first computers using IPv6 linked through Internet master servers without needing IPv4 technology. However, an IPv6-only website cannot reach the IPv4 Internet, and "dual stack" equipment that can cope with both protocols will be needed, since the IPv4 Internet is likely to continue to exist. The challenge is to manage the transition so that the Internet does not fragment, while maintaining services and expansion. As IPv4 addresses become scarce, a market could develop in which any spare addresses are sold. This favours those who were able to join the Internet early, and could have an impact on developing countries that are just starting to go online.

There have been many discussions of the technical, administrative and coordination issues that the migration to IPv6 entails, but much more work remains to be done. In addition, there are immediate costs associated with deployment of IPv6, whereas many benefits are long-term and depend on a critical mass of actors adopting it. Migration to IPv6 requires planning and co-ordination over several years, and this means that increased awareness of the issues is needed among all players, including governments.

6.2 ELEMENTS OF A ROBUST INFRASTRUCTURE

The remainder of this chapter focuses in more detail on the network technologies that are likely to be a part of any nation's 21st century communication infrastructure, and highlights some policy considerations relevant to those particular technologies.

With due regard for continuing evolution in technology, it is safe to say that a modern communication infrastructure will consist of at least the following:

A robust fibre-optic infrastructure
This should link all major population centres and all major government, industrial/commercial, and health and educational centres. It must also provide interconnection to the global communication infrastructure.

Local high-bandwidth connections
These should be made from local hubs to individual homes and businesses; most likely all-fibre or wireless for greenfield developments, and deep fibre to copper, coaxial cable, or wireless tails for brownfield developments.

A robust broadband wireless infrastructure
This should cover all (or nearly all) of a nation's population, as well as all major roads linking population and industrial centres for mobile and nomadic services.

6.2.1 OPTICAL FIBRE NETWORK LINKING MAJOR HUBS:

- This should be a high capacity network with diversity, including both redundant fibres and, where possible, alternative routes.
- Although bandwidth should be available for other applications, this network should support now-standard TCP/IP communications at very high transmission rates. Other interconnection means, such as all-optical network interconnection (wavelength), are also becoming increasingly important.
- Optical fibre-based infrastructure should be future proof and should be able to accommodate emerging services and network mechanisms such as next-generation networks (NGN) and future networks (FN).
- There should be encouragement to make the most of the latest high-speed optical transport network (OTN) technologies. Based on these, 10 Gbit/s OTN and 10 G Ethernet standards are already available. Work on optical transport technology at 40 Gbit/s and 100 Gbit/s is under way with close collaboration between Study group 15 of the Standardization Sector of ITU (ITU-T) and the 802.3 Working Group of the Institute of Electrical and Electronics Engineers (IEEE), and even higher bit-rate transport technologies are emerging.
- This network should be extended to second- and lower-tier locations (towns and villages) as soon as practicable.
- The deployment of optical fibre should be coordinated with other infrastructure projects such as the construction or repair of roads, electrical grids, railways, and oil or gas pipelines.
- Once it is decided to install the network along a particular route, it is relatively cheap to deploy multiple redundant fibres rather than only a few. This should be done, even if many of the fibres will remain fallow for some time.

- Major government institutions and departments should be encouraged or required to use this infrastructure for their internal communications.
- Countries must be linked to the global infrastructure by high-capacity fibre links via diverse routes. This connectivity can be a major challenge and costs can be high for island nations or less developed countries that are land-locked and might not have direct access to submarine cables. The pricing of this connectivity in a global economy warrants particular attention from policy-makers.

6.2.2 LOCAL HIGH-BANDWIDTH CONNECTIONS TO INDIVIDUAL PREMISES:

- In areas where high-bandwidth connections to individual premises do not yet exist, it is likely that fibre or wireless links (either terrestrial or, in remote or low-density areas, satellite) will provide the most robust connectivity, so network providers (public or private) should be encouraged or required to deploy fibre or wireless in such circumstances.[1, 2] Where coaxial cable or twisted pair connections exist, network providers should be encouraged or required to make the best use of them by means of technologies such as DOCSIS 3.0[3] or high-speed DSL[4], until aggregate demand drives an economic conversion to optical fibre. For cable, twisted pair or terrestrial wireless, aggregation onto fibre will likely be needed deep into the network to connect to the access technology, in order to support the capacity demands for broadband services.
- Access to the Internet protocol (IP) backbone from individual premises should be low-latency (<100 ms). The exception may be in low-density or remote areas where satellite connectivity is the only viable choice economically.
- A minimum target bandwidth/throughput for connections to individual homes and small businesses should be 4 Mbit/s downstream and 1 Mbit/s upstream, with a road map to much higher speeds over the next decade.
- A minimum target bandwidth/throughput for connections to larger businesses and institutions (schools, business parks, health centres, universities, government agencies, etc) should be 100 Mbit/s symmetrical connectivity.
- Local hubs should be linked together to minimize latency on local-to-local connections and to provide redundancy/survivability if a particular hub's direct upstream link is compromised.
- As with intercity/backbone fibre infrastructure, fibre deployment should be coordinated with projects such as road construction and repair and the deployment of other infrastructure such as power grids, gas pipelines, etc.
- There should be encouragement to use economical methods to deploy high-speed optical access to individual premises, such as through passive optical networks (PON)(G-PON) specified by Rec. ITU-T G.984 series (984.1-984.7), 10 G-PON specified by Rec. ITU-T G.987 series (987, 987.1 and 987.2), as well as point-to-point Ethernet-based optical access systems (100 M point-to-point specified by G.985 and 1G point-to-point specified by G.986).

1 www.ftthcouncil.eu/home/latest_news/top_5_downloads_on_ftth/?cid=37&nid=427&catid=8, Fibre to the Home Council Europe, FTTH Business Guide2010, and FTTH Handbook 2010

2 www.broadband.gov/plan/broadband-working-reports-technical-papers.html, FCC Working Paper, The Broadband Availability Gap, Chapter 4, Network Economics, March 2010

3 www.cablelabs.com/cablemodem/primer/, DOCSIS Project Primer, Cable Labs, 2010

4 Adtran "Defining Broadband Speeds: Estimating Capacity in Access Network Architectures." Submissions for the FCC Record - GN Docket No. 09-51, (4 January 2010) at 8

6.2.3 ROBUST BROADBAND WIRELESS INFRASTRUCTURE

A robust broadband wireless infrastructure is critical to support ubiquitous communications in the modern world. The wireless infrastructure simultaneously supports a number of distinct infrastructure needs for mobile, nomadic and even fixed communications, and should be considered from these distinct perspectives:

- The wireless infrastructure will be a heterogeneous mix of wide area and in-building networks using different frequencies and different technologies optimized to provide communications from dense urban areas to the most rural areas, and for both indoor and outdoor communications.
- It supports truly **mobile** communications while in a car, train, or airplane. Only wireless can serve this market
- It supports **nomadic** use of wireless-enabled devices, such as netbook computers and other devices, including basic functions such as voice communications, e-mail and web browsing. In most cases, at individual premises the owner is likely to create a wireless network via WiFi as one use of a wired broadband connection.
- It functions as a (perhaps temporary) **substitute** for a fibre link to particular premises where fibre has not yet been deployed, and can act as a back-up if the fixed connection becomes compromised.
- It supports general social purposes, such a broadband communications for first responders to emergencies.
- The role of wireless infrastructure will probably be very different in urban versus rural areas, and will change over time. For example, limitations on the total availability of radio-frequency spectrum with the ability to penetrate walls, combined with the population density of urban areas, suggests that wireless will play a more limited and complementary role in providing fixed broadband connectivity in towns as compared with the countryside. In rural areas, advanced wireless solutions (including 4G technology) will frequently be the most economic choice if there is no existing wired broadband infrastructure.[5] But in many rural areas, an initial infrastructure that primarily relies on wireless connectivity could evolve into a more fibre-rich approach.
- A robust wireless infrastructure must be able to meet rapidly increasing demand, given that, depending on the market situation, wireless broadband traffic is growing at a much greater rate than wired broadband traffic.
- Every wireless infrastructure site needs a high-speed backhaul link to a switching/routing device that is itself linked to the Internet backbone or other relevant wired network. This backhaul will require fibre or very high-speed microwave to provide higher performance wireless services to end users.
- As the density of wireless devices to be served in an area increases, it becomes necessary to re-use spectrum by deploying smaller “cells” or by adopting “spatial division” techniques to achieve spectrum efficiencies. As cell density increases, the required density of fibre in the area increases as well.

5 www.broadband.gov/plan/broadband-working-reports-technical -papers.html, op cit

- On a case-by-case basis, efficiencies might be achieved by co-locating wireless cells with institutional locations (such as schools, hospitals, public buildings) that have direct fibre connectivity. From these, fibre links could then be extended to other cells.
- In countries where a terrestrial wireless infrastructure cannot cost effectively serve 100% of the country, possibly because of rugged terrain or low population density, satellite services should be part of the total solution in order to provide true ubiquity of broadband communications. Satellite can also provide excellent back-up capabilities if terrestrial networks fail due to natural disasters. The Global Broadband Satellite Initiative provides planning and technical information about this use of satellites.[6]
- The role of wireless versus landline broadband infrastructure is likely to vary greatly among nations with different levels of existing development.
- It is easier to build a single cell tower serving a town than it is to run fibre (or coaxial or copper wire) to all premises in the town.
- Wireless devices typically have much greater functionality than typical wired handsets, and offer mobility too. Building a wired network to support voice and low-bandwidth connectivity is hard to justify if such a network does not already exist.
- Less developed nations will likely have much more unused spectrum available immediately for two-way broadband connectivity. In contrast, developed nations will have to accommodate more existing users of spectrum, such as multiple television and radio broadcasters, public safety agencies, and so on.
- The ability of wireless signals to penetrate walls — an important aspect of reliance on wireless connectivity — will vary significantly with the physical nature of the built environment. For example, in colder climates, reduced window areas and thicker walls will constrain performance. So it is critical to maintain flexibility in technology choices in order to accommodate local conditions.
- As noted above, in extremely rural or remote areas, the only practicable wireless infrastructure may be satellite-based rather than terrestrial.[7]

6.3 ASSESSING THE STATUS OF INFRASTRUCTURE

Given that the objective is a robust broadband communications infrastructure as described above, a key task for policy-makers is to assess what infrastructure is currently in place, in order to identify what steps need to be taken. Key measurements would include:

- Mapping existing infrastructure: Where has fibre already been laid? Where are major routing/switching hubs? What wireless cell sites already exist, what regions are within their "footprint," and how much bandwidth connects them back to the core network?
- What portion of the population (individuals, households, small and large businesses and institutions) currently has a functioning fixed broadband connection? What are the geographic, demographic, economic and educational characteristics of the connected and unconnected?

6 Global Broadband Satellite Infrastructure Imitative: http://67.228.58.85/dyn4000/itso/tpl1_itso.cfm?location=&id=325&link_src=HPL&lang=english

7 www.broadband.gov/plan/broadband-working-reports-technica-papers.html, op cit

- What portion of the population is located in an area in which mobile broadband wireless connectivity is available, and what are their characteristics?
- Which population centres are linked to a nationwide broadband backbone network and which are not?
- How many points of connection, and at what bandwidth, link a nation with the networks of other nations and the world at large?

Based on these measurements, policy-makers will need to make estimates (using appropriate economic models) of the additional investment needed to meet national infrastructure and connectivity goals, i.e. a gap analysis. Both the amount and nature of these investments will be highly dependent on local conditions. For example, connecting every home in a densely populated community located on flat, sandy terrain would be vastly less expensive than connecting a low-density community built on a lava bed.

It is likely that each nation will discover that there are ways in which its communications infrastructure falls short of the objective of ubiquitous availability of broadband. The question will then become what public policy steps should be undertaken to bridge the gap between current reality and the objective of ubiquity.

In estimating the distance between the current and the target infrastructure levels, the economic analysis must be based on a realistic assessment of the costs of technology and the corresponding construction and installation, in order to provide significant breakthroughs in costs. This needs to be done both in today's terms and as technology evolves, e.g. as optical packet switching technology.[8]

Box 6.3 Cost models for broadband infrastructure

In the National Broadband Plan unveiled in March 2010 by the Federal Communications Commission, in the United States, a detailed analysis* was provided of how a public-private trans-sectoral partnership for the creation and funding of such a network could meet the need for accessibility, reliability and affordability of public safety communications, while saving the nation approximately USD 18 billion or more in capital and operating expenditures over a 10-year period.

Smart grids present another very large opportunity for trans-sectoral economic benefits. Japan spends more than USD 200 billion on electricity each year and the United States spends over USD 400 billion. So, broadband-enabled smart grids that provide even a small percentage of savings on electricity can justify considerable investment in associated telecommunications infrastructure. The challenge is analysing what is the most cost-effective way to provide the communications infrastructure to support smart grids. Australia is one country has done this type of trans-sectoral analysis for a smart grid, based on plans to deploy a nationwide broadband infrastructure with fibre and wireless access.**

* www.broadband.gov/plan/broadband-working-reports-technical-papers.html "A Broadband Network Cost Model: A Basis for Public Funding Essential to Bringing Nationwide Interoperable Communications to America's First Responders," FCC Working Paper for "The National Broadband Plan: Connecting America".

** www.smartgridaustralia.com.au, "Requirements for Leveraging NBN Infrastructure for Smart Grid Applications and Specifically Smart Metering," June 2010

8 www.intunenetoworks.com/home/tune-i/tune-in-new-wave

6.4 OPTIONS FOR NEXT-GENERATION FTTH AND FTTB NETWORKS

The various large-scale — even national — networks for fibre-to-the-home (FTTH) or fibre-to-the building (FTTB) that are now being built around the world have been designed with quite different business and service models in mind. As a consequence, the ability of these networks to carry utility communications differs enormously.

The various models can be summarized as follows:

6.4 1 VERTICALLY-INTEGRATED CARRIER

Typically, these networks are completely built, operated and owned by a single carrier, and often all retail services are provided by this carrier. The focus was originally on providing high-speed Internet access, with optional voice over Internet protocol (VoIP) telephony. More recently it has included video distribution for broadcast television (IPTV) and video-on-demand.

The dominance of the carrier in this model is often reinforced by using very simple optical modems at the end-user premises, and by providing a "home gateway" which is the focus for delivering the carrier's retail services (especially video entertainment). With such an approach it becomes difficult to separate out different services, and for a regulator to impose unbundling of wholesale services. Changing carriers might become difficult for the end user as all communication services are affected, and the high cost of providing the fibre network means that there might be few, or no, alternatives available.

Vertically-integrated carriers sometimes enjoy a virtual monopoly in providing telecommunication and entertainment services in a region; however they also typically bear the full costs, risks and complexity of building and operating the fibre network. Furthermore, certain services, such as telephony and television broadcasting, are often highly regulated. Also, as services are carried through common IP switching/routing equipment, cyber-attacks against the switching equipment could disrupt all telecommunication services carried through the network.

As well as residential FTTH and FTTB services, these carriers could theoretically use the same fibre infrastructure to support services to businesses, and to "non-premises" locations such as street cabinets for traffic lights, or pole-top security cameras. The carrier is free to shape and price these services, and could treat them as entirely separate from their residential services.

The majority of FTTH or FTTB services in the United States are of the vertically integrated type.

6.4.2 WHOLESALE ACTIVE CARRIER

Wholesale (or "open access") active carriers provide switched FTTH connectivity only, and sign up a range of retail service providers to offer the actual service packages of Internet access, video and telephony. Indeed, the wholesale open access carriers are often barred from offering retail services. However, in return, they are typically assigned a monopoly for a region, and might receive subsidies from the government.

These open access services can deliver multiple, logically separate streams of Ethernet connectivity to each building. Using standardized "carrier Ethernet" virtual connections, multiple services are provided in parallel (independently and simultaneously) without any interference or security consequences. Each Ethernet stream can connect to a different retail service provider, and it thus

becomes possible to implement Ethernet streams for specific purposes. For example, legacy telephony is a special case which can be carried over an Ethernet stream.

This network capability makes it possible to dedicate an Ethernet stream to a home area network (HAN): the local network within the user's premises dedicated to utility services (e.g. smart metering of electricity and water supplies). Within the home or business, the HAN can be created using a range of wireless and wired technologies.

All communications on the HAN are exclusively controlled by the utility services. It is possible that Internet service providers could be established to offer utility-related services, such as home automation, or electric vehicle charging. These services would only access the HAN via a standardized and secure energy gateway.

While services are carried through common Ethernet switching/routing equipment, the implementation of carrier Ethernet standards to achieve virtual sessions means that IP packets are carried transparently and so cyber-attacks are blocked inside the fibre access network. (However, attacks on the service providers and utilities routers and servers are possible.)

As well as residential FTTH services, a wholesale active operator can use the same fibre cable infrastructure to support wholesale services for retail service providers to sell to businesses, and to "non-premises" locations such as security cameras. These services could be valuable for utilities in providing connections to infrastructure (e.g. transformers, pumps and sensors), and for providing alternative, back-up connections to key infrastructure centres such as zone substations or gas storage facilities.

Examples of the wholesale active carrier system are the FTTH networks being built in Sweden and Australia.

6.4.3 WHOLESALE PASSIVE CARRIER

Wholesale (or "open access") passive carriers only provide the use of passive fibre cables, and make arrangements with wholesale or retail active service providers to deliver the actual services to consumers. Typically, wholesale open access carriers are not permitted to offer retail services themselves, but are usually assigned a monopoly for a region and may receive public subsidies.

Some of these open access services deploy several discrete fibres to each home. These fibres must then be "lit" by various wholesale or retail active operators. This makes it possible to dedicate one of the fibres to support the HAN; however, this would require the HAN operator to provide an optical modem in every home and the switches and backhaul at the network end of the fibre. This would be a very costly approach. More likely is that a wholesale active operator lights the fibre, and, using carrier Ethernet standards, offers virtual connections for HAN connectivity. As there may be several wholesale active operators, the arrangement for HAN connectivity might be that all premises have at least one fibre from a "default" operator, or that all wholesale active operators are required to carry HAN connectivity.

As with wholesale active carriers, cyber-attacks are blocked inside the fibre access network. In addition, the wholesale passive carrier can, in a similar way, provide not only residential FTTH services, but also use the same fibre-optic links to offer services to businesses and "non-premise" locations, possibly through a retail service provider.

Examples of the wholesale passive carrier system are the FTTH networks being built in Singapore and New Zealand. In Singapore, the government has further required that the wholesale rates of the next-generation national broadband network are regulated and available to all on a non-discriminatory basis.

6.5 WIRELESS BROADBAND INFRASTRUCTURE

A significant part of rural areas, especially in developing countries, will, for the foreseeable future, have to rely on wireless systems to access broadband services. While the same rigour needs to be applied to network architecture and design as is applied to the areas to be served by fibre-optic networks, wireless solutions can be deployed relatively quickly. So it makes sense to start in these underserved areas with wireless broadband infrastructure, as part of a balanced overall national plan.

However, it is not easy to provide profitable services in sparsely populated localities, so government incentives may be required to stimulate the provision of wireless broadband. Such a government assisted roll-out would also allow a country to start considering open networks and wholesale services. New business concepts introduced in that way could also lead to voluntary changes towards a telecommunication environment that will become more competitive and better suited for the provisioning of trans-sectoral services.

6.5.1 MOBILE BROADBAND

Mobile broadband is developing rapidly. According to ITU statistics, at the end of 2010 the world total of mobile broadband subscriptions reached 940 million, and is expected to top 1 billion in 2011 — up from 73 million in 2005. One key reason for growth in mobile broadband is that operators are offering competitive and affordable data packages. This development is complemented and supported by new technologies such as High-Speed Packet Access (HSPA), which are bringing more efficiency to networks.

Still, mass-market penetration will be difficult in many markets because of a general lack of radio-frequency spectrum available to push all this traffic through. Also, the next upgrade of the technology to, for example, long-term evolution (LTE), is essential to handle increasing traffic loads. But mass markets are already developing in industrialized countries — specifically Japan, Sweden, Finland, Portugal, Austria and the Republic of Korea — and are likely to emerge in most countries over the coming years.

Looking at the developments that are becoming available through HSPA, we see that carriers are opening up their mobile networks to broadband access. Previously, operators tried to limit access though their proprietary portals, often charging content providers 60% of their content revenues for the privilege of using the portals. This strategy has failed, as (apart from SMS), mobile data services never accounted for more than 3-5% of mobile revenues.

However, spurred by the popularity of smartphones such the iPhone, carriers are now having to make basic mobile broadband access available to their users. We are now seeing the mobile data market developing along the following lines:

- Messaging (SMS, MMS and mobile e-mail)
- Wireless broadband (access via phones, netbooks and other devices)
- Mobile broadband (access via mobile handsets).

While “on-deck” (through proprietary portals) mobile data usage remains strong, “off-deck” access to both mobile-specific and ordinary Internet sites is also growing rapidly — although much of the content is provided via large content publishers such as Google, Yahoo, and so on. The same content publishers are now establishing separate off-deck mobile sites in order to extend and enhance their online activities, as well as to generate mobile advertising revenues.

It can be expected that mobile revenues will soon come mostly from data. This depends, however, on business models changing to offer low-cost mobile data services as the norm. The mobile industry is also developing its own triple- and quadruple-play models, where voice (fixed and mobile), data and video are bundled. To facilitate this, the industry is focusing on 3.5G technologies such as HSPA. Furthermore, they are also linking fixed and mobile together on the IP Multimedia Subsystem (IMS), allowing for fixed-mobile convergence and mobile television and video services.

6.5.2 MOBILE’S NEED FOR FIBRE

Driven by developments in smartphones, and in particular the applications that are possible with these devices, operators have been pushed to upgrade their networks in order to cater for the extra capacity needed for these new services. Backhaul demand thus created by mobile broadband applications could lead to a rather rapid upgrade to LTE networks, for example (see section 6.5.4 below). Capacity demand on such networks could be anything from 300 Mbit/s to 1 Gbit/s per cell site.

The problem for mobile operators in saturated markets is that the service revenue predictions for the next few years are looking rather flat, while at the same time they are being forced to continue to invest more and more in their networks, more mobile base stations and, importantly, in fibre-based backbones. For them, national fibre-optic networks (especially open networks based on wholesale) cannot come quickly enough. It would be an advantage for them to use these networks on a utilities basis, rather than one that is based on the premium rates charged by vertically-integrated fixed operators. Therefore, they have an incentive to become involved in any large-scale fibre-optic infrastructure developments.

6.5.3 THE SPECTRUM ISSUE

Around the world the mobile industry is calling for the allocation of more radio-frequency spectrum — often in competition with other potential users. There is good evidence that more spectrum is required in order to make the most of all the new opportunities that mobile and wireless broadband technology have to offer.

Many regulators have looked at the issues and opportunities, and have come up with innovative spectrum plans that take into account the social and economic benefits of the nation, as well as the commercial interest of the spectrum buyers (see Chapter 7). Important policy aspects are a more efficient use of spectrum, e.g. through re-farming to new technologies via technology- and services-neutral licensing, and re-allocation of spectrum employed for various government services that is rarely or inefficiently used.

Some regulators are now also looking at opportunities in areas such as ultra-wideband (UWB) and “white space” (unused spectrum). And increasingly sophisticated software-based wireless devices are making it possible to consider cognitive radio systems, where either a network or a wireless node changes its transmission or reception parameters to communicate efficiently, avoiding interference

with licensed or unlicensed users. This development is, however, not yet ready for mass-market deployment.

These are some of the solutions that will need to be considered as part of the picture of spectrum allocation for wireless broadband. In the meantime, spectrum allocation needs to be coordinated among the various regions of the globe, in order to ensure interoperability and promote the use of standardized equipment that lowers deployment costs.

6.5.4 TOWARDS THE FOURTH GENERATION (4G)

A number of technologies are competing on the road towards more advanced wireless broadband. Although WiMAX is a 3G technology, Mobile WiMAX, as well as LTE, are both regarded as pre-4G technologies. In LTE's favour is the fact that it allows operators a smooth migration from both legacy 3G Partnership Project (3GPP) and non-3GPP systems. In the meantime, while we wait for mass-market 4G technologies, operators continue to deploy the 3.5G technology, HSPA.

In October 2010, following the assessment of six candidate technologies for IMT-Advanced, ITU's Radiocommunication Sector (ITU-R) selected LTE-Advanced and WirelessMAN-Advanced as true 4G technologies. The two successfully met all the criteria established by ITU-R for the first release of IMT-Advanced. They will now move into the final stage of the IMT-Advanced process, which provides for the development in early 2012 of an ITU-R Recommendation specifying detailed technical standards.

HSPA

According the Global mobile Suppliers Association (GSA), most operators now entering the mobile broadband market launch with High Speed Packet Access (HSPA) technology. It says that, by the end of April 2011, there was a total of 398 commercial HSPA operators in 160 countries, with more than two-thirds of them supporting download speeds of at least 7.2 Mbit/s. As regards the next step of HSPA Evolution (HSPA+), GSA predicted that there would be 150 commercial networks worldwide by the end of 2011.[9]

The Association also reported that there were 342 million HSPA subscribers around the world at the end of 2010. A global ecosystem for the technology is apparently becoming firmly established, with several thousand devices now available, including more than a hundred with HSPA+ capability. In addition, the production of dual-mode equipment that can handle both HSPA and LTE has been announced.

LTE

In December 2009, Ericsson and TeliaSonera launched the world's first and largest commercial Long-Term Evolution (LTE) network. The deployment was ahead of schedule and provided LTE coverage to central Stockholm, the capital of Sweden. TeliaSonera subscribers are able to access the Ericsson network using Samsung LTE dongles.

In the United States, Ericsson and Alcatel-Lucent were chosen by the country's largest operators — Verizon and AT&T — to supply LTE infrastructure. AT&T is set to begin deploying its LTE network in 2011. Verizon opened its network (covering 110 million people in 38 metropolitan areas) in December 2010, with full nationwide coverage scheduled for 2013. This is an especially significant development in favour of the 3GPP suite of technologies in the United States, given the historical

9 See www.gsacom.com/news/statistics.php4

split among technologies deployed by wireless operators (CDMA, LTE, HSPA, GSM, and WiMAX are all in active use in the United States today).

It has been forecast that by 2013 there will be over 70 million subscribers to LTE services worldwide, and that this could grow to 380 million by 2015.

WiMAX

Proponents of Mobile WiMAX say that it is competitive with the 3G or 3.5G systems which are currently being deployed and achieving commercial success. WiMAX base-station deployment densities would be similar to those of 3G, and propagation would be roughly similar, depending on the frequencies used.

In early 2010 there were around 10 million WiMAX subscribers worldwide and this is forecast by Juniper Research to reach 50 million by 2014.[10] Juniper also forecasts that WiMAX broadband services will generate USD 15 billion in revenues by 2014.

6.5.5 GROWTH OF MOBILE BROADBAND DATA SERVICES

It has been suggested that in 2010, revenue from mobile data services probably accounts for over 10% of overall global revenues from telecommunications. In 2009, according to analysts BuddeComm, mobile content and services (excluding messaging services) reached around USD 85 billion in revenues. SMS/MMS/mobile e-mail and so on reached around USD 150 billion, and revenues from mobile applications came to around USD 4 billion. This resulted in a combined total of USD 239 billion – the equivalent of approximately 25% of total mobile revenue for 2009.

Other analysts have made the following predictions regarding the mobile data market:

- Ericsson said that mobile data traffic surpassed mobile voice traffic for the first time in December 2009. It found that data traffic grew globally by 280% during both 2008 and 2009, and forecast it would double annually over the next five years.
- A 2010 Pyramid Research report[11] forecast that the US communications market would reach USD 406 billion in 2014, as mobile data revenue climbs from USD 36 billion in 2008 to USD 94 billion in 2014, surpassing fixed voice (PSTN + VoIP) revenue.
- In 2011 Analysys Mason[12] predicted that mobile data traffic will be the biggest driver of growth in the global telecommunications market, jumping from USD 1.8 trillion in 2009 to USD 2.4 trillion in 2014.
- A 2010 report[13] from Gartner Inc forecast that worldwide revenues from mobile applications would reach USD 6.2 billion in 2010, and by 2013 this market will be worth around USD 30 billion.

Wireless broadband is very well suited for the delivery of data. By 2015, mobile content could be worth in excess of USD 1 trillion worldwide, with voice comprising only a 10% share of the market. It is therefore a good strategy for mobile operators to expand broadband coverage to reach as many new customers as possible.

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10 Juniper Research "WiMAX broadband: markets, Opportunities & Forecasts, 2009-2014" (www.juniperresearch.com/reports/WiMAX_broadband)

11 Pyramid Research "USA Intelligence Report" (2010)

12 Analysys Mason "Worldwide telecoms market forecast 2010–2014" (www.analysysmason.com/Research/Content/Reports/RDIG0_Worldwide_forecast/)

13 See: www.gartner.com/it/page.jsp?id=1282413

Box 6.4 Australia plans to reach all premises

In Australia, a study in May 2010 advised the government on how best to implement its National Broadband Plan, through examining the whole-of-life costs of fibre-optic, wireless and satellite connectivity, especially to the final ten per cent of premises to be covered in less-densely populated areas. According to the results of the Implementation Study, "the government's objectives for the National Broadband Network can be implemented within the AUD-43-billion estimate of capital expenditure by deploying fibre to 93% [of premises], fixed-wireless from the 94th to 97th percentiles and satellite to the final 3% of premises." Satellite services will continue to be essential in serving the lowest-density areas due to the prohibitive cost of deploying terrestrial technologies."

See: www.dbcde.gov.au/broadband/national_broadband_network/national_broadband_network_implementation_study

6.5.6 SATELLITE SERVICES

Satellite services are ideally suited to providing instant infrastructure for broadband, especially in more remote and rural areas — as well as after natural disasters or other emergencies. While the cost of deploying fibre may increase incrementally for the final percentage of premises to be connected, the cost of a satellite solution remains constant. In the case of Australia, for example, a study found that it would be most cost-effective to provide broadband via satellite for the final 3% of premises that cannot be served economically in other ways (see Box 6.4).

Very small Earth station terminals (VSATs) can be installed in the most rugged and remote terrains within a matter of days, allowing new users to immediately take advantage of broadband services. Fibre-optic or terrestrial wireless links can be substituted if and when the cost is justified by the density and volume of demand.

Today's satellite solutions fall behind fibre and wireless technologies in terms of latency and mass throughput, and cost per delivered bit; however, they are advanced in terms of reliability, speed of deployment and security. Also, the next generation of satellites is under procurement and will deliver transmission speeds of 100 Gbit/s, thus potentially competing with other types of broadband connectivity at lower speeds.

6.6 EXAMPLES OF INFRASTRUCTURE DEPLOYMENT AND NATIONAL POLICY

Around the world, governments and industry are deploying broadband infrastructure within the context of national policy to expand this facility as far as possible among the population. This section offers just a few examples; many more case studies are expected to be made available at the online resource of the Broadband Commission for Digital Development.

6.6.1 JORDAN

The Hashemite Arab Kingdom of Jordan sees expansion of broadband networks as a social development tool, and in 2002 the government launched the "Connecting Jordanians Initiative". The need for a broadband fibre-optic network was determined to be a major requirement for the success of the initiative. Accordingly, the Ministry of Information and Communications Technology established a National Broadband Network (NBN) Programme.[14] This is a fibre-optic broadband

14 Ministry of Information and Communications Technology, Jordan, www.moict.gov.jo/MoICT_NBN.aspx

network connecting government bodies, and has the objective of contributing to education, and social and economic development.

The scope of the NBN Programme includes:

- University Broadband Network — connecting eight public universities at nine sites (operational since 2004).
- School Broadband Network, aims to connect 3300 schools, 100 "knowledge stations", 17 public community colleges and 12 learning resource centres. By 2009, 227 schools in Amman and 56 schools in Aqaba had been connected, and some 660 schools across Jordan were to be connected by the end of 2010. In partnership with the private sector, the government plans to provide every school student with a computer.
- Secure Government Network — This was launched in 2007 and 42 government entities in Amman have been connected. There are plans to connect the system with online payment services, so that citizens can pay fees over the Internet.
- Medical Entities Network — Launched in 2008, the network connects four medical facilities in Amman, with 67 more to be connected in the northern area.

The NBN Programme will be completed in cooperation with the private sector, and already has made use of the infrastructure of other utilities. For example, pole rental agreements were signed with the Electricity Distribution Company (Edco) and the Irbid District Electricity Company (Ideco) to install aerial fibre cables on their poles in the companies' coverage areas. Similarly, agreements were concluded with VTEL Holdings and with NEU Venture Groups Ltd on renting fibre-optic cabling plastic pipe along the Amman–Aqaba route. In addition, an agreement was signed with the carrier Batelco Jordan on utilization of the NBN.

Box 6.5 The EU's Digital Agenda for Europe aims to boost broadband

Policies have been developed for broadband which will be progressively implemented by European Union Member States. They are a good example of how the obstacles to broadband deployment have been identified and plans made to tackle them at a regional level.

The broadband policy is part of the EU's action plan for ICT — *the Digital Agenda for Europe* — endorsed by the 27 Member States. This aims to deliver sustainable economic and social benefits by creating a digital single market across the EU, based on fast and ultra-fast Internet connectivity and interoperable applications. It identifies seven problem areas in which action at the European level could have the most impact: fragmented digital markets; lack of interoperability; rising cybercrime and low trust in networks; lack of investment in networks; insufficient research and innovation; lack of digital literacy and skills, and missed opportunities in addressing societal challenges. The agenda sets out specific actions to be taken by the European Commission and by Member States to address each of the problem areas.

The *Digital Agenda* includes three specific broadband targets: (a) by 2013, provide basic broadband coverage for all EU citizens; (b) by 2020, make fast broadband coverage at 30 Mbit/s available to all EU citizens, with (c) at least half of European households subscribing to broadband access at 100 Mbit/s.

To push the process forward the European Commission adopted in September 2010 a broadband package consisting of three complementary measures:

- A common framework for actions at EU and Member State level, with a focus on attracting capital for investment in new infrastructure
- A proposal for a Decision establishing the first radio spectrum policy to accelerate deployment of wireless broadband by ensuring that sufficient spectrum is made available by 2013.
- A Commission Recommendation on regulated access to Next Generation Access (NGA) networks, setting out a common regulatory approach and providing regulatory clarity for market players.

Details of the Digital Agenda for Europe, including its broadband aspects, can be found at:
http://ec.europa.eu/information_society/digital-agenda/index_en.htm

6.6.2 SWEDEN

In 1999, Sweden was the first country in Europe to develop a broadband policy, with the government aiming to provide broadband in rural and remote areas where there was no market incentive to do so. For the period 2009 to 2013, the government has committed some SEK 4.4 billion in grants to municipalities and operators to develop broadband infrastructure (particularly fibre) in areas where none exists.[15] Subsidies have been developed through such methods as tax reductions for access installations and funding to local authorities that establish operator-neutral networks. Government funding is limited to 50% of the costs, with operators and municipalities providing the balance.

A highly successful example of a Swedish municipality's support of broadband can be seen in the capital, Stockholm. In the mid-1990s, the Stockholm government established a company called Stokab to build an open-access fibre-optic network. This network is now over 4,500 km long and connects competing service providers with government and business customers. The city has a broadband penetration rate of close to 100%, and Stokab also provides FTTP access to over 95,000 low-income households in public housing (see also Chapter 5, section 5.13.3).

6.6.3 LITHUANIA

Broadband development in Lithuania was assisted by a broadband strategy for the period 2005-2010, adopted in 2002.[16] The strategy aimed to promote competition in the Internet access market through public and private capital investments, as well as enable national social and economic growth to reduce social exclusion.

During 2008, deployment was completed of a publicly funded rural fibre-optic backbone network, the Rural Area Information Technology Broadband Network (RAIN). All operators can access the network on a wholesale basis only.

During December 2009, a financial agreement was concluded for the second phase of the RAIN project, designed to financially assist public institutions in connecting to the network and also in building the necessary infrastructure for private companies to provide broadband internet service in rural and remote areas. The second phase of the RAIN project is expected to be implemented over 40 months, when approximately 98% of rural areas will have broadband access.

6.6.4 ANGOLA

The government of Angola has a plan to bundle all State-owned backbone infrastructure into a separate company which would then offer access to service providers on a neutral wholesale basis.[17] An Inter-ministerial Commission for the Coordination of Multi-Sectoral Telecommunications has been formed to coordinate a USD 500-million national fibre-optic roll-out by Angola Telecom (AT), with fibre and microwave deployments by other entities such as the Transport Ministry (following the railway lines), the Electricity Ministry (following the power lines) and the Water Ministry, in a bid to avoid duplication of efforts.

15 Ministry of Enterprise, Energy and Communications, Sweden, www.sweden.gov.se/sb/d/12103/a/134543

16 Ministry of Transport and Communications, Lithuania, www.transp.lt/en

17 Ministry of Telecommunications and Information Technology, Angola, www.mtti.gov.ao/default.aspx (in Portuguese)

Prior to this, a multi-sector hub project had already been initiated, under which a satellite-based national backbone network with thousands of nodes will benefit service providers and institutions across various sectors of the economy, including telecommunications, media, energy, health, education, transportation, water, fisheries, finance, justice, and defence.

As part of the project, telecommunication service providers and the ministries responsible for each sector were asked to identify the demand for capacity, as a basis for the technical network design and costing. It is also intended to harmonize the various technologies used in the various projects: fibre-optics for the major cities, microwave for second-tier population centres, and satellite and wireless systems for rural and remote areas.

Separate companies have already been established for satellite and international fibre-optic connections. Angola Cable was established in June 2009 as a public-private partnership between AT and private operators, in order to jointly manage the country's connections to international fibre-optic cables. The joint venture, in which AT owns 51%, will invest USD 90 million and expects to be fully operational in 2011. Previously, AT had been allowed to monopolize the SAT-3/WASC international fibre link to Europe, which led to high prices for international bandwidth.

The incumbent is also a partner in the WACS consortium. In addition, the Main One submarine cable, connecting countries in West Africa, is expected to land in Angola (see Box 6.6).

Box 6.6 International links improve Africa's connectivity

A key indicator for broadband development in Africa is the deployment of basic infrastructure, such as international submarine fibre-optic cables. Many African governments have co-sponsored new cables of this type along the continent's east and west coasts, with the aim of improving broadband connectivity. Examples include The East African Marine System (TEAMS), which became operational in mid-2009, and the East African Submarine System (EASSy), in 2010. The West Africa Cable System (WACS) landed in South Africa in April 2011 and is expected to be launched commercially in early 2012.

While EASSy experienced some delays, TEAMS is an example of a successful public-private partnership that got off the ground relatively quickly. Other privately funded initiatives have been launched to compete with these cables, such as the SEACOM cable along the east coast of Africa (launched in mid-2009), and the Glo-1 (2009), Main One and ACE cables in the west (both in 2010).

In parallel, governments, through their national telecommunication companies, are rolling out national fibre backbone networks to take the new bandwidth from the coast to population centres in the interior. This has also been matched by privately funded parallel initiatives. Meanwhile, satellite links continue to play an important role in connecting Africa's rural and remote areas that are beyond the reach of national fibre or microwave infrastructure.

One of the international links within Africa that will carry connectivity away from the coast is the 4,000-km long East Africa Backhaul System (EABS). It is an overland fibre ring that will link cities in Kenya, Tanzania, Uganda, Rwanda and Burundi to the various international submarine fibre-optic cables in the region. The ring structure will provide redundancy in case of network cuts. The project is an encouraging example of participation by partners from the public and private sectors: Telkom Kenya and KDN in Kenya, Uganda Telecom and MTN in Uganda, Rwandatel and MTN in Rwanda, Onatel and Telecel in Burundi, and TTCL in Tanzania.

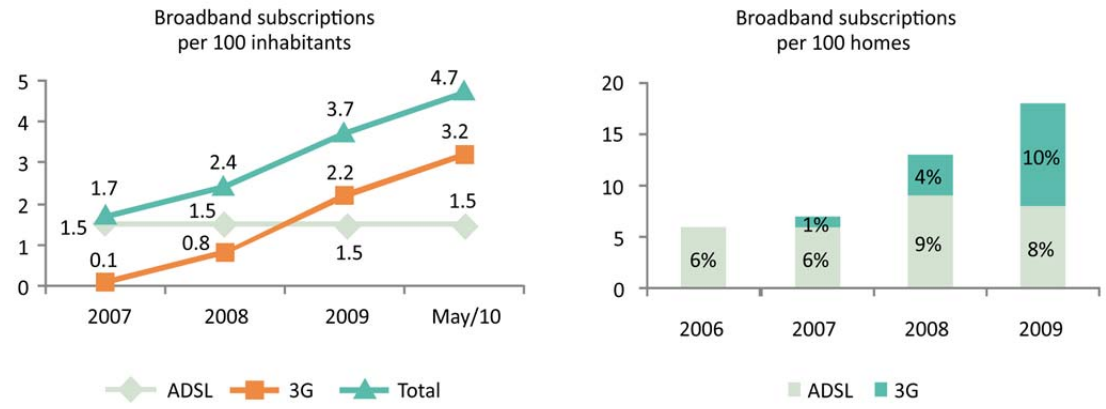
Announced by the World Bank and the African Development Bank (AfDB) in 2009, the Central African backbone (CAB) is a USD-215-million ten-year programme to support countries in central Africa in developing fibre-optic telecommunication backbone infrastructure. The programme aims to raise an additional USD 98 million from the private sector. Cameroon, Chad and the Central African Republic are participating in the initial phase of the programme. A further eight countries are also eligible to participate in the CAB: Niger, Nigeria, Gabon, the Democratic Republic of the Congo, Republic of the Congo, Sao Tome and Principe, Equatorial Guinea, and Sudan.

6.6.5 MOROCCO

Morocco is an example of very rapid and wide adoption of broadband services, based on affordable prices for consumers despite the incumbent Maroc Telecom maintaining a dominant share of the market. Within two years of its introduction in 2003, digital subscriber line (DSL) Internet access had almost entirely replaced dial-up and leased lines. Within four years, more than 40% of Morocco's 1.3 million fixed lines were using a DSL broadband service. In mid-2010, a basic 1 Mbit/s DSL connection with unlimited downloads cost only USD 11 per month, 20 Mbit/s cost USD 88. Speeds below 1 Mbit/s are no longer available.

As elsewhere, the market in Morocco is now moving towards mobile broadband (see Figure 6.1). In 2007, the first 3G services were made available, and by March 2010, 3G had acquired a 65% share of the broadband market. By 2009, 18% of homes had a broadband subscription, and as of May 2010, the penetration rate for broadband was 4.7% of the Moroccan population.

Figure 6.1 Mobile broadband development in Morocco



Source: Michael Minges, Crafting a Broadband Strategy for Developing Countries an Evidence-Based, Case Study Approach, Telecommunications Management Group, Inc.

The shift towards mobile broadband services is expected to continue, since the copper fixed-line network reaches only around 20% of the country's households, while the mobile networks already provide more than 95% population coverage. To accommodate the increasing amount of Internet traffic, Maroc Telecom is upgrading its international connectivity and its fibre-optic national backbone network.

The coming few years are likely to see increased competition from new entrants who are already achieving success in the both the mobile and fixed markets. Meanwhile, the Moroccan government launched a MAD 5.2 billion "Maroc Numeric 2013" initiative in October 2009. It aims to have one in three Moroccan families use broadband Internet access by 2013, and 400 community computer centres will be built in low-income districts and remote areas.

6.6.6 MALAYSIA

Malaysia's Ministry of Energy, Communications and Multimedia (MECM) announced in 2004 that it was developing a National Broadband Plan for Malaysia. The government and telecommunication industry work closely on this initiative, which has the following broad goals:

- To increase national competitiveness by having advanced communications infrastructure and high speed networks that can increase productivity
- To improve the delivery of public services to individuals and businesses
- To improve socio-economic conditions by providing access to advanced applications that raise the quality of life
- To improve communications between urban and rural areas, in order to develop community integration.

It is expected that educational establishments will be the leading public-sector users of broadband over the life of the National Broadband Plan. While the demand for broadband from government offices, judicial sites (such as courts) and health institutions was expected to develop more slowly, they were nevertheless identified in the plan as among the key users.

In early 2010, the regulator, the Malaysian Communications and Multimedia Commission (MCMC)[18] said it aimed to have broadband connections to 3.2 million homes in Malaysia by the end of the year, which it saw as adding one per cent to GDP and 135,000 new jobs. According to MCMC, at the start of 2010 there were 16.9 million Internet users in Malaysia, 30.4 million mobile phone subscribers, and 1.8 million households owned a computer.

The plans for a national broadband network started to take firm shape in 2008 when an agreement was signed between the Malaysian government and Telekom Malaysia to build what was to become known as the High Speed Broadband (HSBB) network at an estimated cost of MYR 11.3 billion (some USD 3.3 billion), with the government contributing MYR 2.4 billion of the project and Telekom Malaysia paying the rest. The project is expected to take 10 years with the initial phase to cover major cities and towns, and linking up 1.3 million premises in high population density areas by 2012. This was expected to boost the country's broadband household penetration rate to 50% in 2010, as targeted by the government.

Under the agreement, Telekom Malaysia has control over access to the network until 2015. The prices and terms for access to the network are subject to approval by the regulator MCMC, to ensure pricing levels are fair for consumers and rival ISPs that lease capacity from Telekom Malaysia. The government has issued assurances that it will ensure open access to Telekom Malaysia's infrastructure.

Telekom Malaysia launched its HSBB retail service in Kuala Lumpur in March 2010. The operator said that the network was delivering bandwidth at access speeds of 10 Mbit/s and above.

18 Malaysian Communications and Multimedia Commission, www.skmm.gov.my/index.php?c=public&v=main

Box 6.7 Making an IMPACT on cybersecurity

The dark side of broadband access to the Internet is the increased opportunity it gives for criminals to spread malicious content and to attack individuals, organizations and even governments. In May 2007, ITU launched the Global Cybersecurity Agenda (GCA) as a framework for cooperation and response to threats against cybersecurity. As part of efforts to achieve this global system of defence, ITU signed a Memorandum of Understanding in September 2008 with the International Multilateral Partnership Against Cyber-Threats (IMPACT), instituted in May that year and which has its headquarters at Cyberjaya, near Kuala Lumpur, Malaysia. The IMPACT headquarters were formally opened on 20 March 2009.

IMPACT is an alliance of governments, industry leaders and cybersecurity experts, working together to enhance the global community's capacity to prevent, defend against and respond to attacks. IMPACT provides technical support and facilities from its Global Response Centre. They include a Network Early-Warning System (NEWS) to identify threats and advise on how to respond. Another resource is the Electronically Secure Collaborative Application Platform for Experts (ESCAPE), where resources from around the world can be pooled safely and experts can work together, using a growing database of knowledge on cybersecurity issues.

At the regional or national level, the establishment of computer incident response teams (CIRTs) is fundamental in protecting cybersecurity. CIRTs serve as trusted, central coordination points of contact within a country, and play a key role in coordinating an international response to threats. ITU and IMPACT have created a strategy for setting up CIRTs where they do not yet exist, using a programme called "CIRT Lite". This provides incident management services and access to constantly updated security alerts, as well as the ability to exchange information and to consult experts at IMPACT.

The various online toolkits and other materials related to cybersecurity that are being developed by ITU will eventually be integrated into the ITU-IMPACT collaboration, in order to provide Member States with a consolidated set of products and services. And interactive sessions on these tools are included in ITU's Regional Cybersecurity Forums, so that participants can familiarize themselves with ways to protect their nations' networks and critical infrastructure.

6.6.7 BRAZIL

Demand for broadband in Brazil is expected to soar, and the government has been drawing up plans to spread access across the vast country in one of the world's largest infrastructure projects.[19] Up to now, two major factors have inhibited the growth of broadband: shortage of fixed-line infrastructure and broadband prices, which are too high for the Brazilian socio-economic environment. Nevertheless, there has been steady growth in mobile broadband, which reached a penetration rate of 4.47% by 2009. The figure was even higher for fixed broadband, which had a penetration rate of around 6% by 2009.

The preferred broadband technology is ADSL. Since 2005, however, the proportion of ADSL subscribers has been decreasing in favour of cable broadband clients, largely due to the growing popularity of triple-play solutions. Wireless and satellite connections remain an important option for the more remote areas of the country. However, about four out of five of Brazil's broadband subscribers are concentrated in the coastal band from Rio Grande do Sul to Espírito Santo and Minas Gerais. The remaining subscribers are scattered across the vast centre-west, north, and north-eastern areas. The Brazilian government has launched plans to address this issue (see Box 6.8).

Telebrasil, an association of telecommunication operators, estimates that Brazil will have to invest BRL 215 billion over the eight years from 2010 in order to create a universal broadband network capable of meeting the escalating demand.

In 2009, the Brazilian government began to consider using the infrastructure of domestic oil firm Petrobrás and of power companies Eletrobrás and Furnas Centrais Eletricas (Furnas) to operate a broadband network linking Brasilia, São Paulo, Rio de Janeiro, and Belo Horizonte. In January 2010,

19 Ministry of Communications, Brazil, www.mc.gov.br/; Brazil's regulator ANATEL, www.anatel.gov.br/

the government won the legal right to use an existing fibre-optic network formerly administered by electricity firm Eletronet (a subsidiary of Eletrobrás), and about 17,000 km long. The government's idea is to create a network connecting public databases at federal, state, and municipal level, and to serve schools, city halls, police, public banks, and other bodies.

The Brazilian government, however, has stressed that it does not want to take the place of private enterprise. Rather, it will step in where needed, while at the same time inviting private companies to note the country's huge potential broadband market and take advantage of this promising investment opportunity.

In 2009, mobile companies Vivo and Claro and fixed-line operator Embratel deployed a shared 4,500 km fibre-optic network, operational in 2010 and covering the southern states of Paraná, Rio Grande do Sul, and Santa Catarina.

Box 6.8 Creating digital inclusion in Brazil

The Brazilian government has been active in developing programmes aimed at making broadband access available to people in lower income brackets. The e-Government Citizens' Support Service (Governo Eletrônico, Serviço de Atendimento ao Cidadão, or GESAC) was set up in early 2002 for the purpose of increasing social inclusion by promoting digital inclusion.

GESAC uses wireless technologies, such as satellite and WiMAX, to roll out broadband to poorly served areas. It operates a network of community telecentres that offer Internet access free of charge. Through GESAC, the government aims to ensure that all of Brazil's 5,565 municipalities have at least one broadband access point.

In early 2008, the Communications Ministry announced a tender for contracts to provide broadband access in areas where such infrastructure did not exist. The winning bidder was the Conecta Brasil Cidadão Consortium, headed by Embratel. The consortium agreed to provide satellite broadband access to 12,000 remote points in 4,214 cities throughout Brazil. All points will offer free Internet access, with speeds of between 256 Kbit/s and 8 Mbit/s.

In early 2008, a "Broadband in Schools" programme was launched through a partnership involving the federal government, the regulator ANATEL and several telecommunication operators. The project aims to connect 56,865 state schools nationwide, benefiting 37.1 million pupils, or 84% of the Brazilian student population.

6.6.8 UNITED STATES

In March 2010, the national telecommunications regulator, the Federal Communications Commission (FCC), released a series of proposals called the "National Broadband Plan" with the aim of ensuring that all citizens in the United States have access to broadband capability (see www.broadband.gov/).

The National Broadband Plan recommends freeing up 500 MHz of radio-frequency spectrum for broadband use by 2020, shifting universal service funds away from support of landline telephony in favour of broadband, and connecting 100 million households with speeds of 100 Mbit/s or better by 2020. Another goal is for every American community to have affordable access to at least 1 Gbit/s broadband at "anchor institutions" such as schools and hospitals.

Because the FCC does not have the authority to allocate US Treasury funds to various investments or to engage in some of the more creative plans for spectrum policy, certain aspects of the National Broadband Plan will require approval from the US Congress. For example, broadband may require more funding that will mean an outlay from Congress. The plan for television broadcasters to return spectrum in return for a share of the proceeds at auction would also require Congressional approval.

Meanwhile, the National Broadband Plan outlines various policy measures the government can take to stimulate the expansion of broadband.

6.6.9 NEW ZEALAND

New Zealand is embarking on a series of major telecommunications policy initiatives, aimed at accelerating the deployment of ultra-fast broadband to its businesses, citizens and social services institutions.[20]

These initiatives comprise:

- **Ultra-fast Broadband Initiative** (UFB), a NZD 1.5-billion government investment programme to establish public-private partnerships for the construction of fibre-to-the-premises (FTTP) access networks connecting 75% of New Zealanders.
- **Rural Broadband Initiative** (RBI), a NZD 300-million government funding programme to improve the availability of fibre backhaul links in less-urbanised parts of New Zealand, and to provide the country's schools with reliable, ultra-fast connectivity.
- **Complementary Measures Work Programme**, a series of measures to streamline and coordinate telecommunication infrastructure deployments and associated processes, and to aggregate demand for enhanced broadband networks.

Over the past quarter-century, the policy environment for telecommunications in New Zealand has been characterized by innovative approaches. Like many other countries, New Zealand has moved from government-owned monopolies to a more competitive market, which was liberalized at an early stage. New entrants have been able to secure significant market share from the incumbent, Telecom New Zealand (TelecomNZ), and there has been extensive roll-out of infrastructure. The growth in broadband has been among the highest in OECD countries in recent years.

Successive governments have sought to support investment and drive efficiency in the sector, with significant benefits seen for the wider economy and society as a whole. In particular, broadband is viewed as an enabling tool for greater productivity, and for the delivery of important services to all citizens.

6.6.10 SINGAPORE

Singapore is a highly developed ICT nation, with a more than 100% penetration rate for mobile phones and with the great majority of households having at least one mode of broadband access. The Infocomm Development Authority of Singapore (IDA)[21] aims to make the country into a global communications and ICT hub, with broadband as an essential element. Its programme of integrated development involves nurturing a competitive telecommunications market and conducive business environment for both local and international companies.

Singapore's Next Generation Nationwide Broadband Network (Next Gen NBN) is a "fibre-to-anywhere" project under the country's *Intelligent Nation 2015* (iN2015) ICT master plan, launched in 2006 and being carried out by IDA. Government and industry together aim to design, build and operate the network to every home, office and institution in the country.

Various strategic options were considered for putting into place the Next Gen NBN, but, with a fully liberalised telecommunications market since April 2000, IDA considered that reliance on market

20 See: ITU/Mikan Consulting Ltd, "Toward Universal Broadband Access in New Zealand" (2010)

21 See Infocomm Development Authority of Singapore "Building Singapore's Next Generation Nationwide Broadband Network: Towards a Next Generation Connected Nation" (www.ida.gov.sg)

forces and the private sector was the best option. However, it was also important that the infrastructure would be operated in an effective open-access manner, to ensure that the operators had sufficient business incentive to provide competitive access and prices to downstream operators, and to develop and deploy the services needed in Singapore.

The Next Gen NBN operators were selected through an open Request for Proposal or RFP process, so that the government achieved the best value for money. In a year-long competitive dialogue with 12 pre-qualified consortia, IDA posed detailed and challenging questions on the structure and requirements for the RFP. This allowed the government to better understand the industry's view on key RFP parameters and helped to resolve many issues.

In the three-layer open-access industry structure envisaged in the RFP, the Next Gen NBN has a structurally separated network company, or NetCo, and an operating company, or OpCo. The NetCo is responsible for the design, build and operation of the passive infrastructure of the Next Gen NBN, including optical fibre. The OpCo is responsible for the design, build and operation of the active infrastructure, including the routers, switches and access network equipment. IDA imposed structural separation on the NetCo to ensure that the downstream operators would have unencumbered access to the passive infrastructure. It also meant that there were limits placed on the extent of ownership and shareholding of this entity by downstream operators. On the other hand, the government decided to allow downstream retail service providers to retain full shareholding in the OpCo, on condition that the OpCo be operationally separated from these downstream providers.

In September 2008, the government selected the OpenNet Consortium as the NetCo, and in April 2009 selected Nucleus Connect as the OpCo. These two companies are working together on a coordinated nationwide roll-out of the network. Under the terms of the broadband deployment, OpenNet will waive all installation charges for home and building owners when the network first reaches their area. In addition, in line with the concept of a universal service obligation for fibre connectivity that comes into effect in 2013, the NetCo and the OpCo are required to meet any reasonable request for next-generation services within stipulated service activation periods. Besides connectivity to homes and businesses, IDA also requires OpenNet and Nucleus Connect to provide network connectivity to outdoor locations.

With deployment starting in August 2009, the Next Gen NBN was on track to cover 60% of homes and businesses in Singapore by 2010, and 95% of all homes and businesses by the middle of 2012. This is ahead of the government's initial target of nationwide roll-out by 2015. The Next Gen NBN OpCo started commercial operation from the end of August 2010. Since then, competitively-priced fibre broadband plans, with speeds starting from 100 Mbit/s, have been available to businesses and consumers.

6.6.11 AUSTRALIA

The Australian government announced in April 2009 that it would establish a government owned company, NBN Co Limited, to build and operate a National Broadband Network (NBN). The company will invest up to AUD 43 billion to fund deployment of the network, which is expected to take place over eight years, during which up to 250,000 km of access network and backhaul fibre will be rolled out across the country.

The government's objective is to provide access to high-speed broadband to all Australian premises, by connecting 93% of Australian homes, schools and businesses with FTTP technology providing

broadband speeds of up to 100 Mbit/s. All remaining premises will be served by a combination of next-generation wireless and satellite technologies, providing peak speeds of at least 12 Mb/s.

The NBN will be a national, wholesale-only open access broadband network. NBN Co Limited will offer a uniform national wholesale price – the same for households and businesses, regardless of whether they are in urban, rural or remote areas.

The establishment of the NBN and the provision of wholesale services nationally will result in significant changes to the structure of Australia's telecommunications industry. In support of this, Telstra (Australia's incumbent telecommunications operator) and NBN Co Limited are negotiating the use of Telstra's existing infrastructure by NBN Co, and the progressive migration of customers to the new FTTP network. The Australian government has agreed in principle to a number of institutional, regulatory and funding changes to the delivery of universal service obligations and other public interest services. This will ensure that essential communication services are protected and will assist the structural reform of the industry.

Construction of the NBN in Australia is well underway. As of November 2010, 3500 km out of 6000 km of backbone fibre-optic cable has been deployed to link 100 regional locations in mainland Australia. Also, three communities in Tasmania have been connected by NBN FTTP technology and are now receiving high-speed broadband services on this new network. The construction of a series of test sites on the mainland has begun, as a precursor to the total national deployment. NBN Co has appointed a range of service and equipment providers and is in the process of finalising its planning to implement the government's policy for superfast broadband to be available to all.

7 POLICY AND REGULATORY ISSUES

7.1 WHAT WILL IT TAKE TO BRING BROADBAND TO THE MASSES?

In many countries, today's broadband "missing link" is the regulatory framework. Regulators have before them an unprecedented opportunity to accelerate the adoption of broadband, but addressing this challenge requires new thinking and an end to "business as usual".

Using broadband, service providers are now offering the multiple play of voice, Internet and broadcasting services, starting in developed countries and spreading to the developing world. Wireless broadband technologies offer the prospect of faster roll-out of services, as well as portability and mobility.

Many broadband technologies can also be deployed incrementally as demand develops, rather than requiring expensive network-wide upgrades. A full range of players, large and small, private and public, can now harness the power of technological advances to become service providers, thus helping to close the broadband divide that exists between developing and developed countries, and between rural and urban areas.

All of these market and technological developments are exerting pressure on current regulatory frameworks. Broadband regulation requires a new vision of reduced regulatory burdens, innovative incentives, and coordinated efforts by all links in the broadband value chain to unleash commercial deployment opportunities. Regulations can be carefully tailored to open the door to both large and small-scale broadband providers.

Broadband-promoting regulators can aim to make local communities and non-governmental organizations aware of the technologies and broadband provisioning opportunities they could seize, and also coordinate with other government and public institutions (such as universities, schools and health centres) to drive demand for broadband-enabled health, education and government services. At the same time, regulators can strive to revise outdated regulatory frameworks designed for an earlier era.

Promotion of competition, innovation and growth can be achieved by identifying adaptive and targeted regulations, or through envisaging a framework that has varying degrees of regulation (heavy to light touch) according to the different layers of the market (from infrastructure to applications and services). This is a critical exercise to ensure a healthy development of the sector,

while meeting social goals. Time-tested regulatory principles, such as transparency and open competition, should be applied to new technologies, and the promotion of wireless broadband in particular will require flexible and innovative spectrum management practices.

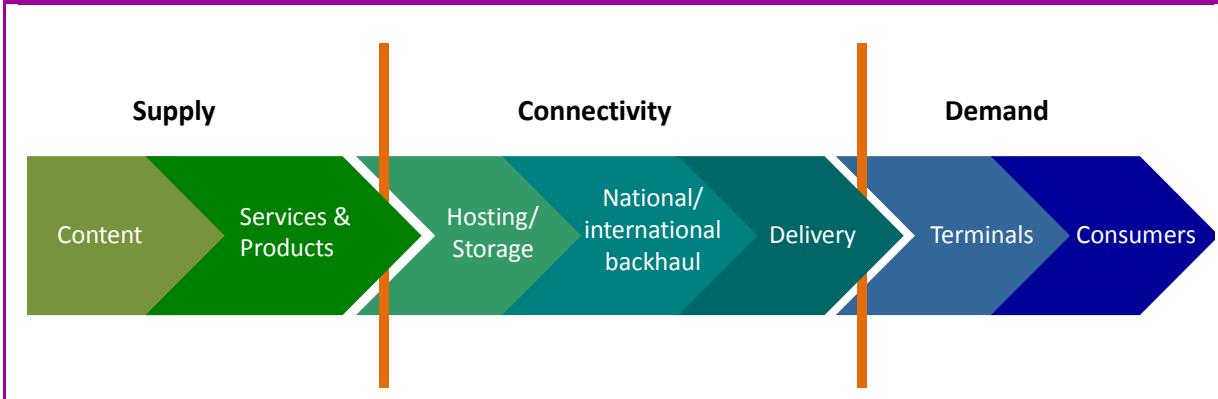
Of course, broadband also poses new challenges. The rapid rise of voice over Internet protocol (VoIP) service providers has introduced a new business model that might not be covered by existing regulations designed for older types of business. There is also the scourge of spam to deal with, as well as other issues of cybersecurity.

7.2 KEY ISSUES IN PROMOTING BROADBAND IN DEVELOPING COUNTRIES

In many developing countries, the fundamental problem is that there is an array of constraints upon adoption of broadband all along the value chain (see Figure 7.1). There are impediments in the supply of online content, broadband services and products, as well as barriers to widespread connectivity. Finally, there is currently limited demand for broadband in many developing countries. However, once more broadband networks are deployed, it is likely that consumer demand (in terms of content and volume) in the developing world will rise considerably. The main difference from the developed world might remain in the prices that consumers are willing or able to pay for broadband services and content.

All these aspects depend, of course, on the level of development of each broadband market. They are evolving rapidly and can differ from month to month. Emerging markets also need time to adapt to local situations.

Figure 7.1 A simplified broadband value chain



In terms of **supply**, the key constraints on deployment of broadband services and products that might be found in developing countries are:

- Insufficient compelling content, especially in local languages;
- Little or no incentive for fixed-line incumbents to offer broadband access technologies (particularly if they risk cannibalizing Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN) revenue streams);
- Competing demands for investment of operators' capital (in developing countries operators often believe they can generate a better return by deploying non-broadband networks);

- Lack of market competition to encourage operators to develop and commercially deploy broadband services, and
- Lack of a regulatory framework designed to encourage broadband deployment by large-scale incumbents, or to sponsor market entry by potential broadband competitors, which might include public institutions (e.g. universities) or local, community-based providers.

In terms of **connectivity**, the key constraints on adoption could be:

- Lack of hosting/storage facilities within many developing countries, which means that much content must be stored abroad, straining international connectivity;
- Limited international connectivity, which affects the data rates available, the quality of services and the cost of bandwidth;
- Lack of backbone connectivity in many areas – and where backbone networks exist, they are owned by incumbents that control the cost and quality of leased lines available to competitors, and
- Concern on the part of large-scale network operators over the commercial viability of deploying broadband networks in rural or remote areas, where the costs of network operation and service provision might make services unaffordable for consumers.

In terms of **demand**, the key constraints often found in developing countries are:

- Lack of consumer demand, resulting from limited consumer purchasing power;
- Lack of consumer awareness, coupled with a lack of coordination by key stakeholders who could raise that awareness;
- Excessive pricing of broadband and services, especially compared to average incomes;
- Greater priority given to mobile voice communications than data services, and
- Limited availability of affordable end-user devices.

Many of these factors, of course, are not unique to developing countries. But they may prove more significant there than in developed countries, where consumers are more likely to be able to pay for broadband services and products at price points that more accurately reflect the underlying costs of provision. However, regulators can play an important role in minimizing the impact of these factors or in creating appropriate solutions.

7.3 PROVIDING INCENTIVES FOR NETWORK INVESTMENT

Regardless of the stage of network development, generating investment in ubiquitous high-speed IP-based networks has risen up the priority list for regulators around the world.

The more developed economies have substantial backbone capacity, and their relatively high levels of telephone subscriptions allow for a greater focus on the promotion of service-based competition. However, even these countries anticipate congestion problems with the expected growth of higher-speed services. They are focusing increasingly on spreading fibre-optics throughout their networks. Where it is not economically viable to extend fibre all the way to the customer, they rely on other high-speed access technologies.

Many developing economies still lack the high-speed IP backbones and international bandwidth capacity required to offer broadband connectivity. So they are focusing on enhancing investment and

competition in core networks and international submarine and overland cable connections.[1] For access networks, their primary focus is on wireless broadband technologies. The primary role of most regulators in developing countries, however, has to be creating an environment conducive for network investment where little or no telecommunication infrastructure exists. In this respect, satellite and wireless technologies in general might provide a rapid way of achieving broadband connectivity.

The common challenge all regulators face is how to attract the large-scale investment required to advance networks to the next stage of development, in terms of improved speed and coverage.[2] Investors seek to recover their costs and make a return on investment that is commensurate with the risks and opportunity costs involved. From a regulatory perspective, network development is essentially tied to issues of universal access and closing the digital divide. Addressing this involves creating a virtuous cycle of increasing market demand, which then justifies investment in networks and equipment, which in turn fuels demand.

Box 7.1 How can regulators attract investment in broadband?

The steps could include:

- Lowering investment barriers that prohibit or hinder capital flows from one country to another; reducing regulatory barriers (e.g., high licence fees) that discourage capital investment and market growth
- Actively encouraging the sharing of essential facilities such as cable landing stations, local switching centres or fibre backbone networks
- Adopting rules to provide for infrastructure sharing, particularly involving "passive" sharing of towers, ducts, rights-of-way and other support facilities
- Overhauling and streamlining cross-agency processes to create "one-stop shopping" for various network-related authorizations (including land management, port access, environmental, and safety permits)
- Adding innovative spectrum management mechanisms that promote increased sharing and efficiency in the use of radio-frequency spectrum
- Amending regulatory frameworks to eliminate discriminatory rules that favour one company or industry over another in a converged services market, and
- Ensuring that government policies and rules maximize the ability of incumbents and market entrants to choose from a variety of business plans and long-term strategies, including resale, wholesale and niche markets.

7.3.1 OPTIMIZING OPEN MARKET ENTRY

Market liberalization remains the most effective mechanism to encourage greater investment in telecommunication networks. Experience shows that liberalization through the licensing or authorization of new operators will yield greater benefits than incentives or obligation-driven approaches targeted at only a monopoly or duopoly.

It is clear, however, that after market liberalization, the incumbents in many developing countries continue to be in a position to invest significantly more in network deployment than many new entrants, especially in marginal areas. So the incumbent can often be the most important (and often the largest) source of funds for telecommunication investment in the longer term. In contrast, in

1 See, e.g., Mark Williams, Broadband for Africa: Policy for Promoting the Development of Backbone Networks, InfoDev - World Bank 2009; Telecommunications Regulatory Authority of Lebanon, Broadband Licensing Plan (issued for consultation), May 2009.

2 These challenges are further discussed in the ITU GSR discussion papers, "Impact of effective regulation on investment: an investor's perspective" and "Effective regulation: the 'stimulus plan' for the ICT sector."

developed economies that have established a high degree of competitive intensity in their markets, alternative operators have very similar levels of capital outlays for new network investment.

Due to the costs of network deployment – especially of broadband access technologies – there have been suggestions that inefficient duplication of networks could be avoided by creating a "super" network operator that would provide wholesale network access to retail service providers. In effect, this could amount to a transition to service-based competition rather than network-based competition, which in some cases might be the more efficient model. However, implementation raises significant competitive concerns. "Super" network status would allow incumbents to retain complete control over infrastructure and, by extension, over the development of competition. Therefore, to be effective, a "super" network scheme needs a very strong regulator that can ensure that multiple service providers have equitable access to the network.

One alternative is for governments to fund the construction of such comprehensive networks directly, and to oversee access to them by both incumbents and new service providers. Such an approach was used successfully in Singapore when, in 1997, the government funded the roll-out of one of the world's first nationwide broadband networks. This backbone network is accessible by the incumbent and new operators, including the cable television operator. Today, the Singapore government continues to support the development of the new all-fibre Next Generation Nationwide Broadband Network with grants of up to SGD 1 billion available to its industry partners, in order to future-proof the country's connectivity needs. This new network also gives the government an opportunity to rethink the policy and regulatory framework for next-generation networks, in order to ensure a competitive ICT marketplace (see Chapter 6, section 6.6.10).

A more practical alternative in many countries may be offered by infrastructure sharing. For example, allowing mobile operators to roam onto each other's second- and third-generation (2G and 3G) networks in rural areas could save significant network costs while enabling greater coverage. In some places competitors have also started sharing the bulk of their wireless access network facilities in non-rural areas: one example is Telstra's and Hutchison's shared 3G network in Australia. Similarly, France has allowed infrastructure sharing among 2G operators in order to reach unserved rural areas. Such roaming and infrastructure-sharing arrangements could also apply to new broadband wireless networks.

Fibre-optic backbones can boost the capacity of digital subscriber line (DSL) networks. Extending fibre to rural areas can also facilitate Internet backhaul for wireless broadband technologies. Again, rather than resorting to a "super" fibre backbone operator, regulators can promote synergies among different kinds of utilities or projects that employ internal communication links. Energy and transport infrastructure projects, for instance, could be encouraged to deploy fibre too. Telecommunication operators could then access these facilities to augment their networks (see also section 7.8 on infrastructure sharing).

In addition, countries are introducing new regulatory tools to encourage network investment by smaller market players. Ireland, for example, has found that rather than imposing national broadband roll-out and coverage obligations on large-scale operators, it can achieve greater success by allowing wireless broadband providers to enter small local service areas. This has led to a significant rise in new broadband subscribers in non-urban areas[3].

3 ITU "Trends in Telecommunication Reform 2006: Regulating in the Broadband World".

7.3.2 COMPETITION FOR CONNECTIVITY

Attracting investment depends on establishing a regulatory framework allowing investors to enter the market and compete on a fair basis. Competition at the physical infrastructure layer of networks has proved to be a valuable means of driving market penetration of services. For instance, mobile service providers routinely compete on the basis of the geographic coverage of their networks – first for voice and now for Internet services. Competition can lead to new ways to expand coverage, both in network design and in generating usage to justify investment.

Today's diversification of access technologies demonstrates that not only is competition among providers of the same service beneficial, but inter-modal competition is also driving improved access to higher-speed networks and services. At a basic level, this includes competition between PSTN and mobile networks for voice traffic. It also includes competition between services integrated in the networks and applications which are run over the Internet, increasing the tension between the legacy telephony market and the IP-empowered network model.

7.3.3 THE ROLE OF FOREIGN OWNERSHIP

New market entry and subsequent investment, including in broadband access networks, is likely to be supported if there are no restrictions on foreign ownership of licenses. This is particularly true in developing countries, where capital availability may be limited. Foreign ownership brings the possibility of incremental capital funding, as well as international best practice.

Increasingly, governments and regulators seek to attract foreign ownership, rather than restrict it on the premise of national security, cultural protection and domestic economic development.

Besides allowing foreign ownership, governments can also seek funds to upgrade networks from international lending agencies, or by tapping into global capital markets

7.3.4 ADDRESSING PERSISTENT GAPS IN THE MARKET

Even with competition and good use of public resources such as radio-frequency spectrum and rights of way, the cost of making substantial advances in connectivity can remain a significant barrier to rapid private-sector investment.[4] Also, competition might even weaken some means of reaching universal service objectives. In the past, incumbents' internal cross-subsidies from certain services allowed the below-cost provision of standard telephony in rural and low-income areas. Competition may eventually drive coverage beyond the more profitable areas. A clear regulatory plan should however, take account of the tendency of some operators to "cherry pick" only the most attractive markets.

Regulators therefore have to identify where competition is unlikely to be an effective driver of increased penetration of broadband. They have to consider how to address bottlenecks, and whether

4 In the case of fibre networks, the amounts are particularly large. The US Federal Communications Commission's estimate of the cost of extending high-speed access to all Americans is between USD 20 billion to USD 350 billion. (See David Hatch, "Cost of Expanded Broadband Service Could Reach $350B Wednesday," Telecommunications, 30 September 2009). In its study of the costs of fibre deployment in the UK carried out for the Broadband Stakeholders Group, Analysys Mason found that deploying FTTC nationally would cost about GBP 5.1 billion and almost five times this (GBP 24–28 billion) for FTTH, depending on whether it was GPON or PTP. See Broadband Stakeholders Group, "The costs of deploying fibre-based next-generation broadband infrastructure" (8 September 2008) Ref: 12726-371.

(and if so, where) aggregation and consolidation of networks and services may be necessary to provide a robust revenue base for substantial levels of investment. A common approach to the loss of internal cross-subsidies is to institute universal access charges that supply a fund that may be used for reverse subsidy auctions. Other geographic-focused solutions include region-specific approaches to licensing, exemptions from licence and spectrum fees, encouraging partnerships among operators, and coupling profitable areas with under-served rural areas in licences.

Universal service funds (USF) raise particular challenges for regulators (see also section 7.9). The political dimension and, in many cases, the scale of such funds necessitates additional supervision, sometimes through the creation of cross-sector participants' committees and sometimes involving politicians. Ensuring that the application of funds is consistent with the rest of the regulatory regime and does not distort investment incentives is also important. Changing definitions of services can raise concerns about which entities should be required to contribute to a fund. Also, the impact of convergence may change the ranks of entities required to contribute.[5]

7.3.5 THE GOVERNMENT'S ROLE

Telecommunication reform in most countries has reduced the direct role of government in the sector, through policies of liberalization and privatization. Independent regulatory authorities have been established, and investment risks have been better aligned with decisions about network operation and service provision. In a number of countries, however, governments have remained significantly invested in the sector as a part (or whole) owner of the national operator. But the importance of high-speed networks to national economic policies is leading to increasing government financial investment and public-private partnership arrangements, often organized through economic stimulus funding.[6]

One of the most ambitious of these is the Australian government's AUD-43-billion plan to build and operate a National Broadband Network using a mix of fibre, wireless and satellite technologies, and, subject to Parliament's approval, to subsequently privatize a large portion of the network. Both the Japanese and Republic of Korea governments have provided substantial subsidies, with significant results.[7] Other countries have seen significant initiatives at the municipal level, including Norway and Sweden.[8] In Europe, most of such projects are led by municipalities and power utilities. [9]

Decisions by national or municipal governments to invest public money in telecommunication networks may boost connectivity significantly, but they also raise significant regulatory issues. Where

5 For instance, if universal access charges are levied on licensees or telecommunication service providers, questions may arise regarding whether an ISP should require a licence or is a telecommunication service provider, which could depend on whether it has its own equipment and infrastructure connecting to the Internet or is merely a reseller, and even then whether it should be required to contribute to the universal access fund. This becomes more complex and contentious when services are provided in the form of applications from sources other than the provider of access connection (such as VoIP providers or MVNOs).

6 See ITU "Confronting the Crisis: ICT Stimulus Plans for Economic Growth," October 2009, available at www.itu.int/osg/csd/emerging_trends/crisis/index.html, and OECD "The Role of Communication Infrastructure Investment in Economic Recovery", March 2009.

7 The Japanese Government offers tax benefits for operators introducing broadband access networks, including corporate tax redemptions and depreciation and amortization tax benefits for fixed assets. It also offers broadband access providers guarantees for their debts and low interest financing by the Development Bank of Japan.

8 The municipal Stokab network in Stockholm in Sweden lays fibre and allows network providers to connect their servers for a fee (see Chapter 6, section 6.6.2).

9 According to the research firm IDATE, 56% of FTTH/B projects in June 2009 were led by municipal authorities or power utilities (IDATE for FTTH Council Europe).

government funding is provided in a multi-operator market, there are significant risks of adverse competitive effects on private operators. This may create distortions in competition and dampen incentives to invest in the private providers.

For this reason, the European Commission published guidelines on how restrictions on state aid should apply to rapid deployment of broadband networks. The Commission has categorized:

- "White areas," where broadband is not currently available and there are no plans by private investors to roll out such infrastructure in the near future, in which case government aid will generally be permitted;
- "Black areas," where at least two broadband network providers are present and there is facilities-based competition, making government aid for deploying additional broadband networks unnecessary and potentially anti-competitive, and
- "Grey areas," where a broadband operator is present and further analysis is needed to assess market conditions and determine whether government aid would help or hurt.

The Commission required various safeguards to avoid potential adverse consequences, including ensuring that public aid is only provided:

- Where, in the absence of private investment, a public service network is necessary to ensure universal coverage;
- Compensation is granted only to deploy the network in the unprofitable areas, and
- The network is open to all service providers. [10]

The European approach, then, focuses on targeting public funds to expand broadband, while maintaining competitive dynamics in the market.

7.4 COMPETITION AND INDUSTRY REGULATION

This section explores how regulators can address various issues that arise as broadband markets evolve and mature, in the context of existing and allied telecommunication markets, such as voice telephony.

7.4.1 BACKBONE AND INTERNATIONAL CONNECTIVITY ISSUES

Multiple network bottlenecks can occur in the provision of broadband services, caused both by incumbents and new market entrants. These bottlenecks often stem from a lack of needed infrastructure, or from monopoly ownership of infrastructure by a single operator – typically, the incumbent.

There are two main options available to regulators to avoid the adverse consequences of monopoly control of backbone infrastructure:

1. Impose a tighter regulatory framework on owners of bottleneck facilities to ensure that other operators can access such backbone infrastructure at an appropriate price, and/or
2. Encourage existing or new licensees to deploy alternative infrastructure.

10 See European Commission "Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks".

Regulatory intervention is often required where the costs and timelines associated with duplicating bottleneck facilities would be so excessive as not to be commercially viable. Some countries allow local broadband providers to connect directly with international backbone networks, rather than terminating traffic through an incumbent's international gateway. But in many developing countries the incumbent still controls access to international network infrastructure and is able to use this to impose excessive prices on other operators.

However, regulators are increasingly stepping in to ensure that new entrants gain fair and competitive access to existing backbone infrastructure. In addition, regulators are finding that reliance on international connectivity can be reduced by developing Internet Exchange Points (IXPs) and local caching, which the government can actively encourage or establish[11]. It is also necessary to encourage the construction of supporting backbone networks, especially if the intent is to deploy infrastructure into rural areas.

Box 7.2 Ways of stimulating the development of broadband infrastructure

To encourage licensees to deploy infrastructure, especially in areas previously not served by networks, there are several approaches for governments and regulators to consider:

- Facilitating access to existing communication infrastructure used for other activities (for example, railway signaling or pipeline monitoring) which can be made available to licensed telecommunication operators.
- Ensuring and facilitating access to government land, including railways, electrical grids and road networks. Governments can streamline and standardize the application process for access to rights of way and pole attachments, and ensure just and reasonable fee structures.
- Ensuring that broadband networks are incorporated into new infrastructure developments. Governments can include network conduits in road projects or incorporate cable arrays in new electrical grids.
- Creating broadband alliances to pool financial and other resources and to enhance negotiating power with network vendors. For example, the Wireless Broadband Alliance gives operators in the United States, the United Kingdom and the Asia-Pacific region benefits of scale in areas such as services, influencing development and adoption of technology standards, and negotiating international roaming agreements.

7.4.2 FUNDING BROADBAND DEPLOYMENT

Policies to expand infrastructure into more economically marginal areas are based on the recognition that without such access, the digital divide will continue and could grow – both between developing and developed nations and between urban and rural areas. Regulators play a critical role in seeking to reduce this divide through the promotion of broadband access.

The first step is to develop regulatory regimes that are conducive to investment and supportive of commercially viable broadband network deployment. Regulators should also focus on removing unnecessary regulatory burdens and encourage market demand for broadband deployment, allowing market forces to promote access wherever possible. This can include facilitating market entry by small enterprises and micro-entrepreneurs, as well as non-governmental organizations (NGOs), local governments, and institutions such as libraries. In addition, regulators can encourage large-scale operators to deploy broadband networks in areas viewed as not commercially viable, in return for access to potentially more profitable business activities or other incentives.

11 The role of regulators in promoting IXPs is explored in the ITU-IDRC report "Via Africa: Creating local and regional IXPs to save money and bandwidth", available at www.itu.int/ITU-D/treg/

It may also be necessary, however, for regulators to establish mechanisms to fund network deployments, especially if there is evidence that regulatory incentives and lower-cost network alternatives will not be enough in certain areas. This shortfall between market-based measures and universal access is termed the "true access gap". In any given area, when all inefficiencies have been removed from the market and the true access gap remains, only then might government intervention be necessary. This intervention can take the form of targeted and limited subsidies to spur the deployment of broadband networks to areas and populations that would otherwise not be reached.

Regulators have several ways to address the true access gap, including:

- Licensing special rural operators to deploy broadband networks in defined locations. Licensees can be selected through bidding for the minimum subsidy required to achieve specified targets. By this method, regulators can accelerate the diffusion of new technologies from urban to rural areas.
- Funding local community initiatives to provide broadband access. Many universal access fund programmes take a top-down approach, by identifying communities for which targeted subsidies will be made available. But a bottom-up approach could also be used, allowing communities themselves to apply for funds to deploy their own broadband networks. This can help ensure local community involvement in, and demand for, broadband access.
- Giving direct and indirect financial support in return for the deployment of broadband networks. Governments can provide tax exemptions to operators that roll out infrastructure in rural areas. Where this is insufficient to attract commercial operators, governments could offer full or partial subsidies, or loans at preferential rates.
- Requiring operators to deploy broadband access networks. This can be tied to funding mechanisms that are drawn from government revenues or contributions made by all operators at either a flat-rate or a percentage of revenues. The operator responsible for the provision of universal broadband access in any given area would receive financial incentives or payments for each new broadband line installed. But it could also be given the freedom to determine in which specific locations it would deploy such infrastructure.

In many parts of developing countries (and in some areas of developed ones), deployment of broadband by large-scale network operators – even those employing wireless architectures – might only be commercially viable if an incentive framework is incorporated into the licensing approach, coupled with government funding and initiatives that generate customer demand.

One approach is to use regulatory incentives to support and promote broadband network deployment by large-scale operators. Another approach is to encourage small-scale players to serve local communities by removing regulatory burdens that often apply to large-scale operators.

7.4.3 ENFORCING COMPETITION IN THE BROADBAND MARKET

To foster competition and investment in the market for broadband services, it is necessary to establish a regulatory framework that prevents anti-competitive behaviour by operators (see Box 7.3). Regulators need to monitor dominant operators, which can be defined as those that are capable of acting unilaterally in the market (such as on pricing or provisioning terms). Such regulation need not be excessively restrictive; it just needs to be effective in preventing constraints on the development of market competition.

Box 7.3 Anti-competitive behaviours

Examples of potential business conduct by dominant operators that regulators can consider preventing include:

- Refusal to supply (grant network access)
- Predatory pricing (providing services at less than cost)
- Mandatory product bundling (requiring end users to take products in which the operator is not dominant, in order to access products in which the operator is dominant)
- Price discrimination (applying different prices and terms and conditions to favour or disadvantage particular customers), and
- Cross-subsidization (using profits generated in one service market, in which an operator is dominant, to subsidize its operations in a competitive market).

In response, obligations typically applied to dominant operators include:

- Placing appropriate access obligations on incumbent operators at appropriate terms and conditions, and
- Obligations to ensure that tariff structures comply with regulatory requirements, including appropriate price controls.

In general, developing broadband markets should be subject to *ex ante* rather than *ex post* regulation – which tends to be work better only when there is no dominant carrier.

Regulations can be minimized and carefully tailored to address key concerns: preventing anti-competitive business conduct; ensuring compliance with licence commitments, and protecting end users. Strict price regulation, for example, can be replaced by a general price cap regime, with the goal of ending price regulation when the market is genuinely competitive. At the same time, market development of new services could also hasten the end of price regulation. For example, the rise of new offerings for VoIP, which is usually not price-regulated, may force dominant operators to lower prices to retain market share.

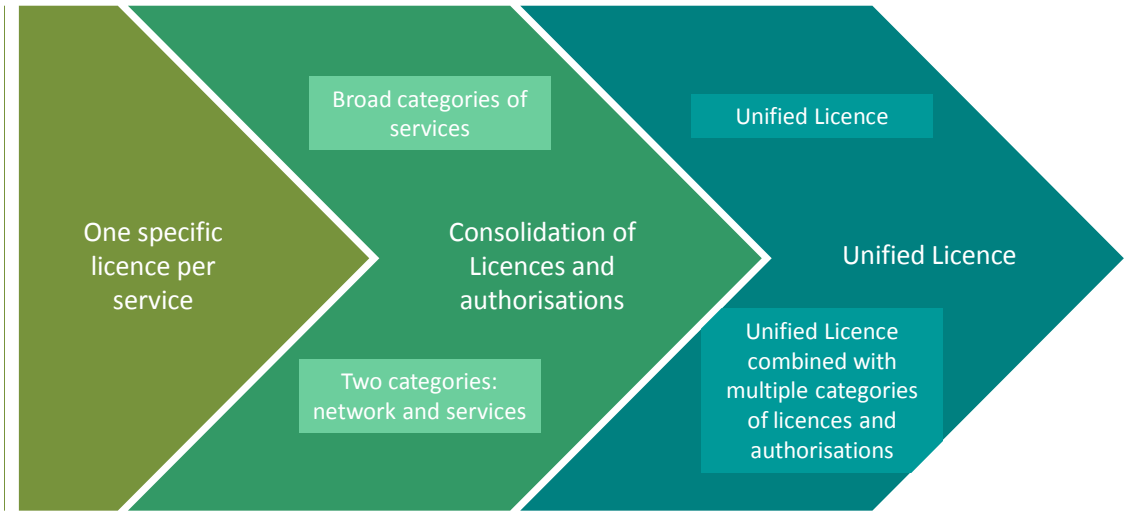
7.5 BROADBAND LICENSING

With the advent of convergence in telecommunications and broadcasting, many countries have been simplifying their regulations to support the development of convergent and innovative services that involve broadband. The reform of licensing regimes has resulted in two main trends. The first consists of the simplification of licences that traditionally have been established for individual services, which generally means that a single telecommunication operator must hold as many licences as the different services it provides. Simplification involves the consolidation of different services into a generic categorization, or bringing together all services under what is often called a unified licence (as illustrated in Figure 7.2).

The second trend consists of the reduction or elimination of the administrative and formal procedures for entering the market. This involves modifying the general authorization category to allow more services to be provided, in most cases only requiring registration or a simple notification (see Figure 7.3).

Finally, some countries have opted to completely eliminate the need for of licences, or even the requirement to notify or register with the regulator.

Figure 7.2 Convergence brings simplification of licences



Usually, both trends are combined in order to achieve greater simplification and flexibility. It is important to minimize inconsistencies between new and existing rules. Also, licensing reforms are most effective if the guiding principles of technology neutrality and flexibility are applied to the rights and obligations of operators, as well as to the other essential elements of the regulatory framework, including interconnection, numbering, universal service and use of the radio-frequency spectrum.

Figure 7.3 Models for reduction of administrative requirements

7.5.1 CONSISTENT LICENSING AND AUTHORIZATION FRAMEWORKS

The deployment of broadband can be expedited through relaxing the licensing conditions for large-scale broadband access providers and by establishing a consistent licensing framework that is clearly targeted to achieve a set of defined policy objectives. In addition, regulators are increasingly using general authorizations in lieu of onerous licensing regulations in order to ease market entry.[12]

While licences — or at least general authorizations — are usually required for large-scale broadband infrastructure operators, regulators are increasingly lightening such requirements for operators and service providers in small, remote and rural areas. Facilitating broadband market entry in these areas

12 ITU "Trends in Telecommunication Reform 2006: Regulating in the Broadband World"

allows providers to test their broadband business models on a small scale. Some may later decide to commit to more large-scale deployment. Thus, regulators can replace licensing requirements for commercial community broadband providers by a general authorization or registration framework, just as some countries have already established "open entry" policies for Internet service providers (ISPs).

Box 7.4 Best practice in broadband licensing

Where licences are distributed, it is important to:

- Have an efficient administrative process that is transparent and consistently applied, together with minimal administrative requirements
- Ensure that any terms and conditions included in licences are not financially punitive and allow operators to achieve sufficient financial return over the life cycle of their investments
- Ensure that licensing fees are commensurate with the required activities of the licensee; that is, if the licensee is expected to deploy substantial broadband access infrastructure, fees should be reduced to reflect this high level of investment, rather than treating operators as providers of government revenues
- Require regulators to establish and enforce appropriate monitoring mechanisms to ensure that licensees meet their commitments or specific conditions of license agreements, and
- Recognize that re-negotiating licence commitments increases the risk associated with network investment to promote broadband access deployment and adoption.

Where broadband access will be used exclusively for public services, such as in health facilities or schools, regulators may question whether licensing should apply at all. It is also particularly important that licence fees for very small broadband providers be kept as low as possible, if not eliminated altogether. Licensing obligations that may apply to large-scale operators, such as deployment and coverage obligations or contributions to universal access funds, can be minimized or eliminated in a regulatory framework targeted at community broadband providers.

In rural areas too, a case can be made for allowing resale of broadband services without any licensing requirements. For example, broadband subscribers in a rural area could be allowed to use their connections to set up public kiosks and resell the service. The customers of these kiosks might not otherwise be able to afford the service at all. In this way, additional economic activity would be generated through increasing broadband access.

It is important to note that reducing or eliminating licensing requirements is not synonymous with ceasing to regulate service providers. In some countries, for example, telecommunication licensing is not widely used as a regulatory instrument. Instead, regulatory rules are enacted through universally applicable regulatory codes, decisions or orders. Even with open-entry or simple notification policies, local commercial broadband providers could still be subject to government oversight in areas such as consumer protection. Again, they could be treated like ISPs, which often come under general business regulations that apply to commercial entities.

7.5.2 USING LICENSING TO ENCOURAGE BROADBAND DEPLOYMENT

Regulators can use licensing frameworks to provide incentives for network deployment by large-scale operators, especially in the early stages of market liberalization. This often works particularly well with respect to the deployment of broadband access technologies[13]. The intent of this approach should be to encourage operators to deploy networks that might otherwise not be considered

13 ITU "Trends in Telecommunication Reform 2004: Licensing in an era of convergence"

commercially viable. The incentives can either be rewards for meeting licence commitments or (where they can be enforced) financial penalties for failing to meet agreed commitments, or even the revoking of a licence.

Box 7.5 Broadband licensing incentives

Licensing incentives could take several forms, such as:

- Extension of licence periods
- Access to other operators' infrastructure
- Allowing the provision of other, more lucrative services under the same licence
- Access to universal access/service funds
- Reduced licence fees
- Tax incentives, including reduction of taxes and duties for both operators and end users, and
- Financial penalties for failing to meet licence commitments

Reducing the burden of taxes and duties on equipment can also lower costs for end users, encouraging wider adoption and usage. In many developing countries, a substantial portion of the total cost of mobile telephony, for example, stems from taxes and duties. Reducing or abolishing these would allow more people to afford services.

To date, most incentive mechanisms have been applied only to traditional local telephony (PSTN) services, but there is no reason why they could not also be applied to encourage deployment of broadband networks, especially if they were available to all industry players.

Using exclusivity periods as an incentive mechanism, however, poses the danger of "crowding out" potentially more efficient new entrants and new investment sources. As long as licensing frameworks are appropriate, market liberalization generally will yield greater benefits than the exclusivity approach (often coupled with build-out obligations) adopted in many markets – both developing and developed.

On the other hand, almost all regulators take the view that at least certain dimensions of the market require the number of sector participants to be limited, and the best way to control that is through licensing. It is generally recognized that the potential for competition to produce ubiquitous coverage is constrained by the large cost of rolling out networks. So, in the mobile sector, there are arguments for restricting entry to the market because (aside from issues of spectrum requirements and interference risks) an industry structure with a smaller number of players could substantially reduce the cost of serving subscribers.[14]

Similar arguments could apply in the wire-line sector, particularly when it comes to installing fibre-optic networks. With large-capacity facilities such as fibre, it makes little sense to create redundant network infrastructure, except to provide backup for security purposes. There is a tendency towards "natural monopoly" thinking among regulators for passive (and sometimes active) network infrastructure in a given geographic area – and, in some countries, even nationally. Fibre networks are increasingly regarded as crucial national infrastructure, with economies of scale that may require a single supplier to aggregate traffic and ensure efficiency. This thinking emphasizes the substantial

14 McKinsey & Co have estimated potential cost reductions of between 20% and 30% if the number of mobile providers in a country is reduced, for example, from five to three. See Sören Buttkereit, Luis Enreiquez, Ferry Grijpink, Suraj Moraje, Wim Torfs and Tanja Vaheri-Delmulle, "Mobile broadband for the masses: Regulatory levers to make it happen," McKinsey & Company (February 2009).

trans-sectoral benefits that a society can expect to gain from having ubiquitous high-speed connectivity. And these spill-over effects are not usually priced into operators' business plans.

7.5.3 TECHNOLOGY NEUTRALITY

Broadband regulation should be technologically neutral, and licensing and authorization regimes should reflect this. Increasingly, licensing focuses on encouraging the construction of (and investment in) broadband networks, rather than defining the specific method of delivering services. This principle is especially relevant to spectrum licensing for broadband wireless services, but it can also apply to wire-line deployment, giving licensees the flexibility to use copper, fibre-optic or hybrid networks.

Technology- and service-neutral licences and authorizations also enable broadband providers to offer a full range of services in rural areas (including multiple play), increasing revenue stream options. In Venezuela, for example, rural licences allow operators to offer mobile and multimedia services in addition to fixed access, long-distance and international services. India and Uganda allow operators to provide both fixed and mobile services under the same licence, leading to increased competition and more subscribers, as well as lower prices for consumers. Hong Kong, China, has issued unified licences for broadband wireless access providers, allowing them to adapt to technological developments.

Pure technology neutrality in licensing may be quite difficult to achieve, however. For example, some wireless technologies and services are reliant on, and standardized for, specific radio frequencies. But regulators are increasingly providing licensees with the maximum flexibility possible to select which technologies they wish to adopt, within approved standards and international frameworks.

Such flexibility may encourage broadband deployment in marginal areas and developing countries by allowing licensees to select the delivery technology that most minimizes costs and accelerates financial return. Operators can customize the components of their network infrastructure to suit the particular service offerings and technical requirements of their business plans. This will allow them to leverage whatever existing economies of scale they have been able to achieve in other, possibly adjacent, markets. Such flexibility is a hallmark of India's unified access service licensing framework, which gives operators a choice of using either GSM or CDMA technology within their assigned spectrum blocks.

Some countries specify the use of particular technologies (often made by specific companies) as a tool for industry development or trade policy. But mandating use of a specific technology within a defined spectrum block – or for particular kind of service – may not result in the most efficient allocation of spectrum or the most rapid deployment of that service.

Of course, technical standards and international radio frequency allocations are very important. Employing a common technical standard provides many advantages, including:

- Economies of scale (both in terms of network and end-user equipment)
- Commitments and support from large-scale vendors
- More consistent road maps for product evolution and development
- More interoperability
- Reduced consumer switching costs, and
- International roaming capabilities.

Standards also provide agreed best practice that can drive more efficient usage of spectrum and energy – two particularly important elements in resource-scarce areas. These advantages have often accelerated deployment of telecommunication services above and beyond what could have been expected if technologies had remained fragmented.

Nevertheless, accepting the benefits of standardization does not mean that regulators should specify which standards should be used in any specific spectrum allocation or service. Nor does it necessarily mean that regulators should limit operators' technology selections to internationally standardized technologies. The regulatory framework could provide licensees with the flexibility to select the appropriate technology for their circumstances in order to encourage the deployment of broadband.

7.6 OPTIMIZING THE USE OF RADIO-FREQUENCY SPECTRUM

If the experience of the mobile sector's growth in voice services over the last 10-15 years offers any indication, competition in mobile broadband may be expected to reduce prices and increase market penetration and usage. Mobile broadband is enjoying very high growth,[15] driven by the development of data services and Internet-capable devices, as well as multiplexing and other improvements in spectrum efficiency.[16] Radio-frequency spectrum is a valuable, and in many places crucial, means of extending networks to users. It can make access to broadband feasible in places where the cost of laying wire-line infrastructure is not economically viable. It also enables mobility.

Countries worldwide are releasing larger amounts of radio spectrum as they reallocate it for new purposes. Many regulators have taken steps to make more spectrum available for narrowband and broadband connectivity. With the distribution of spectrum that can carry 3G or 4G mobile services (e.g. Worldwide Interoperability for Microwave Access, or WiMAX, and Long Term Evolution, or LTE),[17] along with unlicensed WiFi use, the last ten years have seen a huge shift towards wireless communications. Making available more spectrum where it is needed, particularly in lower frequency ranges that allow for higher quality of service over longer distances, can facilitate mobile broadband growth. However, good spectrum policy means licensing spectrum on a technology-neutral basis, allowing market players to decide what technologies to employ as developments occur.

And at the same time, it is important not to neglect the current and future spectrum needs of many existing services such as those via satellite, as these provide critical (secure and highly reliable) infrastructure for constant broadband services, as well as emergency and disaster response. While sharing of frequencies is important, this should never be done at the expense of creating a risk of harmful interference that could have an impact on emergency and other critical services, as well as reducing service quality in general. Indiscriminate reallocation of frequencies could result in reduced

15 According to the Allot Communications Global Mobile Broadband Traffic Report, "Mobile data bandwidth usage continued its phenomenal rise with 73% growth during the second half of 2010. Video streaming continues to drive this growth as it remains the fastest growing application type, accounting for 37% of mobile bandwidth." Report available at www.allot.com/MobileTrends_Report_H2_2010.html

16 The importance of devices in leading this usage growth is illustrated by the large amount of mobile traffic accounted for by the iPhone, although studies also find that the usability of websites by mobile devices remains limited. See Nielsen Norman Group Report "Usability of Mobile Websites" (2009). Available at www.nngroup.com/reports/mobile/

17 Telefonica announced on 1 October 2009 that it would be deploying LTE equipment in Spain, the United Kingdom, Germany and the Czech Republic in Europe, and Brazil and Argentina in Latin America. "Telefonica Announces Wide-Spread Trials of LTE Networks," Cellular News (30 September 2009).

options for inhabitants of rural areas, and special attention should be given to helping developing countries in addressing optimal policies in this field.

7.6.1 EVOLUTION OF SPECTRUM ASSIGNMENTS

Significant amounts of spectrum that are expected to be useful for telecommunication purposes are being freed up through the digitization of broadcasting. The spectrum made available from this process – the so-called "digital dividend" – includes the 700/800 MHz bands that are expected to be useful for broadband Internet access. However, the process is complex and the cost of replacing equipment is high. Such plans may also create tension between broadcasters and telecommunication regulators that often have authority over spectrum management.

Radio spectrum is not a blank slate on which regulators can design perfect assignments and allocations. Various government departments (including the military), institutions and companies typically already hold rights to use substantial blocks of useful spectrum. Furthermore, in many countries spectrum is still managed under a "command and control" approach as a legacy of earlier government monopolization of spectrum-dependent uses.

Proposals for decentralized methods of management have ranged from treating spectrum under a tradable property rights regime,[18] allowing "open access" to certain spectrum blocks, [19] and creating spectrum "commons"[20] of unlicensed frequency ranges available for use by all. These new paradigms of spectrum distribution have not been adopted universally, but various initiatives are allowing market forces to influence the allocation and assignment of spectrum.

The most important liberalization steps are to adopt technology- and service-neutral licensing. Another equally important step is to adopt internationally harmonized plans for spectrum bands, in order to facilitate the usage of equipment from many markets and provide economies of scale.

Box 7.6 Liberalizing spectrum distribution

Liberalization of spectrum assignments has included:

- Initial public offerings by governments, approving rights to use frequencies for certain periods
- Relaxation of controls over transfers and consolidations of licensees (and thus indirectly spectrum rights)
- Steps to permit secondary trading of spectrum rights (including sale, buy-back, leasing and mortgage schemes)
- Allowing licensees to aggregate spectrum to meet their needs and, inversely, to transfer spectrum rights to other entities when they expect to make more profitable use of it, [21] and
- Using spectrum on a commons (typically unlicensed) basis.

Typically, unlicensed use involves limiting the transmission power of radio devices to protect against risk of interference. Such low-power devices, however, may proliferate if the "Internet of things" grows as expected. That could have the effect of sparking demand for more unlicensed spectrum. [22] It may also elevate the radio-magnetic "noise floor," prompting interference concerns for licensed users.

18 See Robert Coase, "The Federal Communications Commission," Journal of Law and Economics, vol. 2 (October 1959)

19 See Eli Noam, "Beyond Auctions: Open Spectrum Access", at www.citi.columbia.edu/elinoam/articles/beyond_auctions.htm

20 See Gerald R. Faulhaber and David Farber, "Spectrum Management: Property Rights, Markets, and the Commons"

21 New Zealand and the UK have taken the most significant steps towards spectrum trading.

22 See Richard Thanki, "The economic value generated by current and future allocations of unlicensed spectrum," Perspective, (8 September 2009), a study supported by funding from Microsoft.

7.6.2 SPECTRUM PRICING

The challenge regulators face is to make spectrum available in a manner that ensures its optimal exploitation.[23] In addition to allocation and assignment, optimal use is significantly influenced by pricing. This may serve various purposes, including:

- Advancing fiscal and political goals
- Ensuring a fair return on private use of a public asset through charging economic rents, and
- Rationing a scarce resource to ensure its efficient use.[24]

Spectrum pricing mechanisms have not been developed in many countries, partly due to the complex economic and technical analysis involved. Pricing methods often depend on perceived demand for spectrum, potential congestion in a given band, and political or social pressures. Prices can be determined by auctions, setting fixed charges (whether one-time or recurring), or setting revenue-sharing obligations. Another method is "administrative incentive pricing," in which the price is based on a calculation of the opportunity cost value of the spectrum. Tailored pricing mechanisms can reduce economic barriers to efficient spectrum usage.

The frequencies and bandwidth that an operator is allowed to use have a significant impact on its costs, the distances it can serve, and the capacity of its network. Capacity is likely to increase in importance as a competitive factor in the provision of wireless broadband. The pressure of broadband usage on capacity and the need to manage mobile network traffic are intensifying the debate today about wireless "network neutrality" in the United States, for instance. It will be important for regulators to ensure that their allocation and assignment methods and associated pricing do not hinder the potential of broadband, but rather facilitate the efficient use of a valuable resource.

7.6.3 DEMAND EXCEEDS SUPPLY

The growth of broadband services over wireless networks is putting enormous pressure on all kinds of limited resources, including rights of way, ducts, numbering resources or (especially) access to radio-frequency spectrum. Since the launch of the first mobile broadband network in 2001, no fewer than 130 countries had launched commercial IMT-2000 (3G) services by the end of 2009 (see Box 7.7, left). Mobile WiMAX services were expanding and services were available in 76 countries.

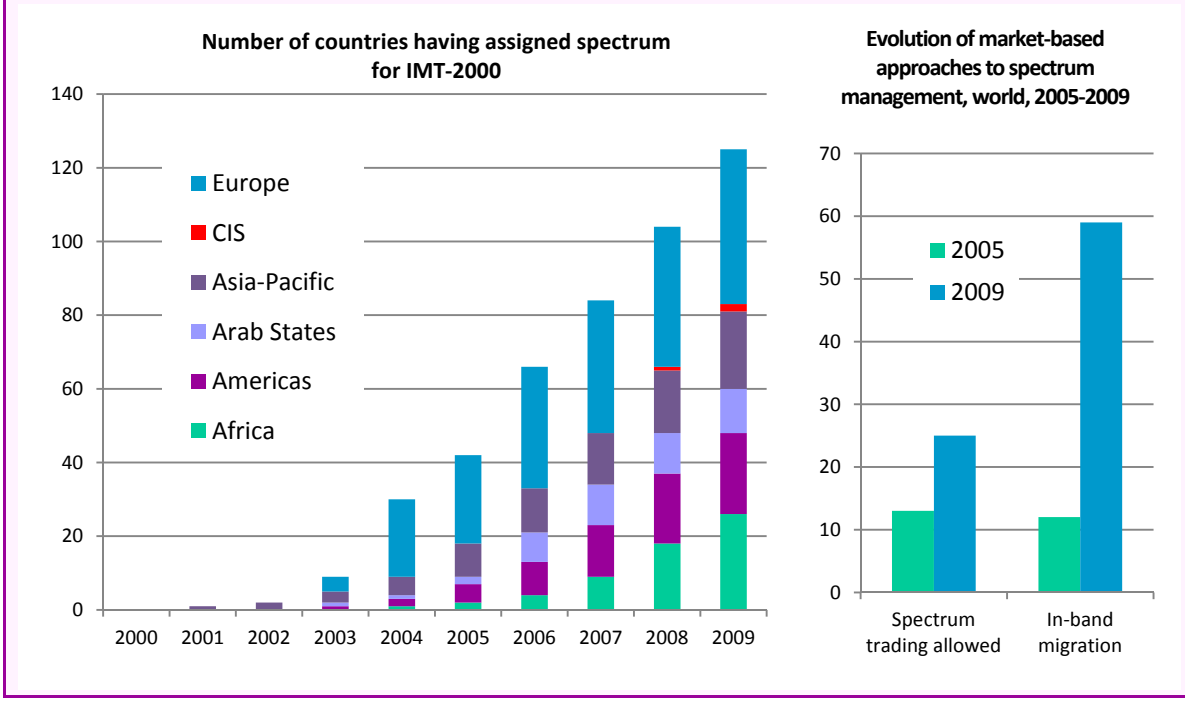
Anticipating consumers' demand, operators in developed countries are already asking regulators to reallocate hundreds of Megahertz of spectrum, all to accommodate new broadband, IMT-Advanced (or 4G) technologies. In many countries, there is no longer any "low-hanging fruit" in terms of spectrum that can easily be re-allocated for 4G. Difficult decisions remain as to whether and which older industries – and which government services and operations – may have to be relocated or forced to share spectrum in order to make way for the huge bandwidth that 4G seems to require.

23 In part this means ensuring the spectrum is offered in sufficiently large contiguous blocks (e.g. 10-12 MHz) to reduce costs and improve efficiency.

24 See a discussion of these matters in the Lebanese TRA's "Draft Opinion for Determining Spectrum Right to Use Fees," at www.tra.gov.lb/Draft-Opinion-for-Determining-Spectrum-Right-To-Use-Fees.

Box 7.7 Spectrum distribution

Technological progress and market transformation have placed an increasing strain on the traditional methods of spectrum allocation. As liberalization, deregulation and privatization have swept over the ICT sector as a whole, the regulatory approach to spectrum management is on the brink of major changes.



Source: ITU World Telecommunication/ICT Regulatory Database

Spectrum should not be licensed to a specific generation of technology; however, different amounts permit different services. In certain cases, regulators have delayed in allocating spectrum that can serve 3G, and in licensing network operators and service providers. It is interesting to note, however, that some developing countries that have not yet allocated 3G spectrum seem to be taking the opportunity to optimize their spectrum use and leapfrog directly to bandwidth that can deploy 4G services.[25]

At the time of the first 3G spectrum auctions, a perceived scarcity of spectrum raised prices for 3G mobile licences in some places to above USD 100 per inhabitant.[26] This might be repeated in the allocation of spectrum for 4G, as "digital dividend" spectrum (in the 700/800 MHz bands) might be viewed as resolving some of the anticipated scarcity issues for advanced mobile broadband services. It is possible, however, that the digital dividend will not be released solely for mobile broadband services: broadcasters and governments are also interested in this liberated spectrum.

In response to the growing complexity of spectrum needs and the variety of players in the market, several regulators have adopted an approach focused on deregulation and greater reliance on market forces in spectrum management. Many countries have now started assigning spectrum through competitive mechanisms, such as spectrum auctions. And while most countries still retain centralized control over spectrum, a growing number of regulators are introducing market-based

25 ITU World Telecommunication Regulatory database on the ICT Eye, see: www.itu.int/icteye

26 World Bank, contribution to the ITU "Confronting the Crisis" report, 2009, at www.itu.int/osg/csd/emerging_trends/crisis/index/html

mechanisms such as in-band migration, spectrum sharing and trading in order to distribute spectrum access (see Box 7.7, right). Traditionally, regulators have granted licences for exclusive rights to certain spectrum bands. Many countries have also allocated spectrum bands for licence-exempt use, effectively allowing more freedom for market players to manage spectrum among themselves.[27]

7.7 PROMOTING OPEN NETWORKS

7.7.1 ENABLING NEW TECHNOLOGIES

The rise of broadband networks also means the rise of new applications and services, including Internet protocol television (IPTV) and mobile broadcasting. This gives rise to the need for regulatory frameworks designed for an environment in which multiple services share a single network. Where the legacy telecommunication network *is* this single network, and is currently regulated only for telecommunication services, regulators need to begin addressing new issues, such as how to protect minors and dealing with intellectual property rights.

7.7.2 VOIP — A PRIME EXAMPLE OF A BROADBAND SERVICE

Voice over Internet protocol (VoIP) is an excellent example of a new technology that takes advantage of the growth of broadband networks. Over the last decade, VoIP services have revolutionized the economics of voice services in telecommunications.

The main regulatory issues related to VoIP involve whether to regulate it as a substitute for PSTN telephony, and whether VoIP regulation should differ from that of traditional telephone services and broadband providers. Regulators may want to ensure a "level playing field" between existing operators and new VoIP market entrants in the areas of universal service, access to emergency services, and numbering portability. At the same time, however, many regulators are anxious to avoid disproportionate regulatory interventions that could stifle innovation, dissuade entry by new competitors, or dampen investment in new services and networks (see Box 7.8).

Questions of whether and how to apply and interpret pro-competition policy for the VoIP market remain largely unresolved. Regulators have to define whether VoIP is a service, a technology or an application, as well as redefine competition between relevant markets and how far services can be substituted for one another. Then, regulators can begin to target anti-competitive practices by new market entrants, as well as by incumbents seeking to maximize returns on their network investments. The ability of regulators to regulate effectively in this area has major implications for investment, innovation and a country's long-term competitiveness.

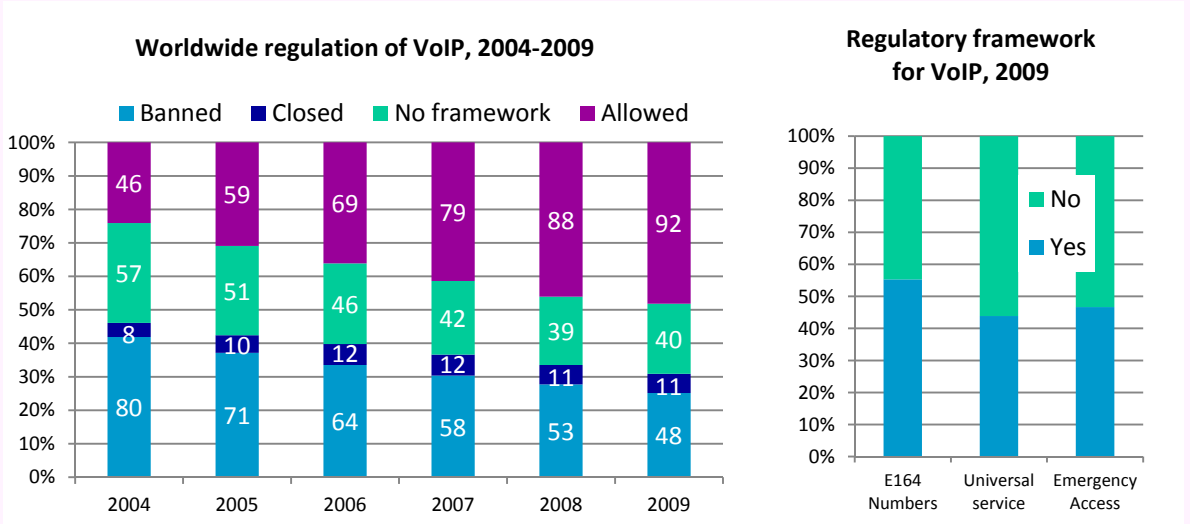
So, what would a comprehensive regulatory framework for VoIP providers look like? It is not necessary to design a completely new regulatory regime to accommodate VoIP. In fact, while the transition to IP is ongoing, regulatory regimes for PSTN and IP-based networks are likely to co-exist for some time yet. Regulators must decide which regulations and requirements are important to retain, transfer or replace during the transition. Last but not least, regulators need to respond in flexible and measured ways to address and resolve these issues, pointing the way toward bringing all of the benefits of IP-based voice services to consumers.

27 ITU "Radio Spectrum Management for a Converged World", ITU New Initiatives Series, 2004

Box 7.8 Regulation of VoIP

Progress in VoIP adoption and legalization is closely connected with market liberalization. In 2004, VoIP was explicitly legalized in 46 countries (see figure above, left) — mainly in Europe, North America and the Asia-Pacific region. VoIP was also broadly permitted in another 57 countries — for example, countries where there was no explicit regulatory framework or licensing for VoIP. Between these two categories, just over half of all countries permitted VoIP in 2004. By mid-2009, the proportion of countries where VoIP was tolerated had risen to two-thirds, with 92 countries having legalized VoIP and a further 39 countries tolerating it. Meanwhile, the number of countries where VoIP was banned shrank from 80 in 2004 to 49 in 2009, or about a quarter of all countries for which data exist.

The regulation of VoIP is an ongoing process that requires regular attention as new issues emerge. VoIP regulations differ widely from country to country. The requirement to provide access to emergency services is a key consideration, as are universal service obligations and numbering allocations. More than half of all countries responding to an ITU survey question on numbering indicated that they had allocated normal telephone (E164) numbers to VoIP providers (see Figure above, right).



Source: ITU World Telecommunication/ICT Regulatory Database

7.7.3 POLICING THE OPEN FUNCTIONING OF THE MARKET

As market competition has developed, so has the sophistication of understanding barriers to, and problems in, promoting competition and the regulations tailored to address those problems. Still, regulators face major challenges in keeping multi-operator markets open. The challenges of policing open markets include defining and analysing the markets in which the level of competition is to be assessed. Of particular importance is identifying dominance or significant market power. As experience with anti-competitive behaviour has grown, countries have legislated against specific activities carried out by providers that have been identified as dominant. This often takes the form of *ex post* remedies.

Abuses of market power, of course, can only be addressed after they have occurred. They can be so serious, and so difficult and slow to prove, that the remedy often comes too late. For this reason, legislation typically also provides for regulations that will prevent such abuses from occurring in the first place. This involves placing *ex ante* obligations or restrictions on dominant providers, such as:

- Requiring dominant players to provide a minimum interconnection offer
- Controlling their wholesale prices and other conditions offered to competing providers

- Requiring them to make their facilities available to other providers, and
- Where there is inadequate competition at the retail level, controlling their retail prices and quality of service.

Thus, regulators face considerable challenges in determining the balance between *ex ante* and *ex post* regulation. New entrants often press for greater *ex ante* regulation of incumbent operators, who in turn may argue that matters should be dealt with more by *ex post* regulation. Licences are, in effect, another form of *ex ante* regulation and risk restricting competition in a market before it has even got started. Occasionally – in some African and Caribbean mobile markets, for example – very rapid changes in market structure challenge regulators' abilities to keep up as new entrants quickly overtake incumbents.

The flexibility to change regulations where they no longer match the facts on the ground is, then, just as important as getting it right the first time.[28] In the European Union and increasingly elsewhere, regulators are duty-bound to ensure that the obligations and remedies they impose are specific, relevant and proportionate to the problems they are designed to address.[29]

7.7.4 PREVENTING MARKET FORECLOSURE DUE TO DOMINANCE

An essential part of both the *ex ante* and *ex post* approaches to regulation involves identifying which providers are dominant and which are not. Dominance is often defined as a level of market power enabling a provider to behave to an appreciable extent independently of competitors and customers. Such power can include the ability to close down markets and undermine the benefits of open competition. The use of dominance as a threshold trigger for various regulatory obligations is useful for various reasons:

- It means that lighter regulatory treatment can be applied where dominance does not exist, thus placing the emphasis on market forces to drive service improvements and lower prices;
- It focuses on dominance as the underlying source of competition problems, and
- Once dominance is established, regulatory obligations can be applied automatically without extensive further consideration.

The benefits of using a dominance test include the now fairly extensive jurisprudence available internationally regarding the meaning and application of such tests. Furthermore, dominance focuses competitive analysis on the precise potential for market failure that regulation has to address. It requires detailed fact-gathering and complex economic analysis.[30]

In turn, competition policy and law have developed methodologies for identifying what markets authorities ought to look at when considering whether a service provider has reached a position of

28 Section 30(1) of the Solomon Islands Telecommunications Act 2009, for example, requires the Telecommunications Commission to refrain from regulating "where it reasonably anticipates that the presence of effective competition in a telecommunications market are sufficient" and ensure that regulation, "including each obligation therein, is proportionate to its purpose."

29 The principle that regulatory remedies should be specific, relevant and proportional to the problems they address is prevalent in laws and to a significant degree in regulatory practice in many developed nations. See, e.g. the European Framework Directive (2002/21/EC, of 7 March 2002), on a common regulatory framework for electronic communications networks and services. The principle is increasingly being introduced in developing countries, but many regulators continue to apply blanket regulation in areas where it is no longer necessary, such as applying tight retail price controls in a competitive mobile sector.

30 An example of a regulator carrying out a dominance analysis can be found at www.ofcom.org.uk/consult/condocs/wbamp/wholesalebroadbandreview/paper3/.

dominance. Experience in developed markets has yielded a well-known method, commonly known as the "Small but Significant Non-Transitory Increase in Price" (SSNIP) or "hypothetical monopoly" test. This test originated from broad competition law and policy, where it was necessary to identify what segment of the country's entire economy was being considered.[31]

In many countries, however, lack of economic and legal resources and the information available to analyse such factors presents a huge challenge for regulators. In countries where these resources are extremely limited, there may be little choice but to use somewhat blunt regulatory instruments.

The regulator might, for instance, apply more symmetric regulation on operators, involving less distinction between dominant and non-dominant providers. It might focus on non-discriminatory interconnection negotiations rather than requiring the incumbent to publish a reference interconnection offer. The regulator might also apply infrastructure access obligations on the basis of a simplified "essential facilities" test. Where there is a severe lack of cost information, it might regulate prices solely or principally according to international benchmarks.[32]

7.7.5 MANDATING OPENNESS

In some cases, such as for network interconnection, or access to infrastructure and wholesale services, regulation has been applied to bring about the desired result. In others, such as open source software, "creative commons" licensing and social networking websites, the open systems have emerged without prescriptive or coercive regulation.

For business reasons, many companies have endorsed openness to some degree in their business models, without any strong regulatory coercion, often in order to generate further or linked sales and sometimes to disrupt prevailing monopolies (see Box 7.9).

The challenge regulators face is to identify where openness is particularly valuable and, if it does not arise voluntarily, whether and how intervention might be needed to mandate it. When considering taking such steps, it is critical for regulators to weigh carefully:

- The benefits of competition and innovation that are anticipated
- The operational effects on the functional integrity of the infrastructure, equipment, product, service or process which is to be opened
- The impact on investment incentives and property rights, and whether the wider distribution of control (e.g. over customer relationships) reduces margins, making investment less attractive.

31 The test seeks to define a relevant market in a defined geographical area such that a hypothetical profit-maximizing service provider, not subject to price regulation, which is the only present and future producer or provider of products or services for the relevant market in that area, could impose a small but significant and non-transitory increase in price (SSNIP), assuming the terms of provision of all other products are held constant. The test is repeated until the market boundary is set. It requires an analysis of whether consumers of a particular product or service would be likely to switch to readily available substitutes in the short term – and at a negligible cost – in response to a hypothetical SSNIP in the range of 55 to 10% that is applied to the products or services under consideration. An example of a regulator carrying out this test can be found at www.ofcom.org.uk/consult/condocs/wbamp /wholesalebroadbandreview/paper2/.

32 The new Solomon Islands Telecommunications Act effectively creates a presumption that benchmarks will be used instead of hampering the regulatory process with attempts to produce, examine and argue over cost information. See Solomon Islands Telecommunications Act 2009.

Box 7.9 The business case for openness

Businesses have chosen open systems at many of the IP-network layers:

- At the content layer, huge amounts of content are made freely available online by institutions and individuals. Many content providers — newspapers, for example — have embraced open provision of their proprietary information on the Internet. Now there are signs, however, that their dissatisfaction with the current Internet advertising business model is leading to increased charging for content.
- At the computer operating system and applications layers, Sun Microsystems and IBM have embraced open source software. The Linux operating system and the Mozilla Firefox browser have become widespread in the mainstream computer market, and Google Android is increasingly deployed on mobile devices.
- Both the manner of Internet traffic exchange and the logical layer of the Internet itself may be described as relatively open. However, there are limits to such openness due to firewalls, network address translation, proprietary protocols in the middle of the network, ISP liability, government controls, traffic prioritization, and virtual private networks.*
- At the layer of network wholesale services, there could be benefits for a national network operator opening its network for use by other providers — even competitors — because such open use would increase usage and therefore maximize network capacity.**
- At the layer of physical network infrastructure, tower companies and voluntary infrastructure management arrangements are often open to adding the equipment of new network operators.

* Network address translation, whereby a number of private IP addresses are hidden behind a public IP address, is a method for dealing with the exhaustion of IPv4 address space. It prevents end-to-end connectivity and thus reduces the openness of the Internet architecture. Address constraints are expected to be addressed with the introduction of IPv6.

** Some have argued that return on investment in new fibre access networks is significantly more affected by take-up rates than by revenue per subscriber, that opening the network to use by many competing service providers is likely to produce a greater variety of attractive services with better pricing that drive take up, and that therefore higher returns on investment are likely from embracing network openness. See www.fiberevolution.com/

7.7.6 ANTICIPATED BENEFITS OF COMPETITION AND INNOVATION

The significant benefits of mandating openness are generally recognized in the context of significant market power over core services, such as in interconnection, or access to wholesale services and essential facilities. Some countries are pushing infrastructure openness even further. For example, in the United Kingdom, BT Openreach has committed itself to functional separation and to offering access to, and use of, its network on the basis of "equivalence of inputs". BT separated its network asset ownership arrangements and structured its group governance structure to protect against discriminatory behaviour at the network wholesale services layer.

This example of functional separation – along with initiatives in Australia, Italy, New Zealand and Singapore, among other countries – exemplifies a powerful application of openness policy, implemented at the network infrastructure level. In Singapore, it has ensured effective open access to the all-fibre next-generation NBN by requiring full structural separation of the passive infrastructure business, based on the belief that this will drive a more competitive market.

Requiring openness for customer premises and equipment has had benefits universally, prying apart equipment from service offerings and unbundling components that could be subject to market competition. In the United States, for example, the decision of the US Court of Appeals of the D.C. Circuit in the 1956 *Hush-a-Phone* case[33] – and the subsequent 1968 *Carterphone*[34] decision of the US

33 238 F.2d 266, Hush-A-Phone Corporation and Harry C. Tuttle v. United States of America and Federal Communications Commission, American Telephone and Telegraph Company et al., and United States Independent Telephone Association, Intervenors, No. 13175, United States Court of Appeals District of Columbia Circuit. Available at www.cavebear.com/archive/ialc/hush-a-phone.htm.

34 Available at www.uiowa.edu/~cyberlaw/FCCOps/1968/13F2-420.html.

Federal Communications Commission (FCC) – presaged separate regulation of networks and services from terminal devices. The FCC ended AT&T's control over terminal devices and, by requiring AT&T to connect any compliant devices with its network, opened up a vibrant market in end-user devices.

Now that most countries have adopted similar arrangements, devices are treated as consumer products and, other than some type-approval concerns and consumer protection activities, have not been at the forefront of regulatory policy. Today, devices are clearly an important driver of telecommunication traffic, a generator of revenues and a factor in capturing and defending market share. Competition over the development of such devices is fierce, and they can spark a positive feedback loop that drives broadband network development and generation of third-party applications.

7.7.7 OPERATIONAL AND TECHNICAL REALITIES

Openness often involves a reduction in proprietary control over content, applications, networks and infrastructure. Openness also has significant operational implications for networks. Proposed net neutrality rules in the United States (concerning non-discriminatory management of traffic across networks) have provoked intense debate, especially in the mobile sector, where operators argue that bandwidth constraints and difficulties in managing hand-offs among different cells make more careful traffic management necessary.

Likewise, functional separation involves major changes in how the network is managed. The technique has been criticized for undermining the operational link between retail services and the networks that support them, diminishing the impact of market forces on network management decisions.[35]

Determining whether and how to mandate openness involves parsing a complex blend of policy goals and operational and technical issues. For example, some policy advocates have suggested embedding the horizontal layered architecture of the Internet as a broadly applicable principle in regulation, in order to guarantee its openness at each level and encourage innovation.[36] The physical, logical and content layers should be kept separate from (and transparent to) one another, with each layer's problems solved at that layer's level. An example of this would be that an ISP should not be held responsible for unlawful online content provided by a third party, since the ISP merely provides access to the Internet.[37]

This has been criticized by others as misconstruing the historical development of the Internet, of freezing the evolution of network design, of undermining technology neutrality, and of missing the benefit of the Internet's inherent openness to its own continual change and improvement, which critics argue should be allowed to evolve with less, not greater, regulatory control.

35 For an introduction to functional separation, see Malcolm Webb, "The Emergence of Functional Separation" in ITU "Trends in Telecommunication Reform: Six Degrees of Sharing" (2008).

36 See Lawrence B. Solum and Minn Chung, "The Layers Principle: Internet Architecture and the Law," Research Paper 55, June 2003, University of San Diego Law School. Available at http://ssrn.com/abstract=416263. Also, Richard S. Whitt, "A Horizontal Leap Forward: Formulating a New Communications Public Policy Framework Based on the Network Layers Model", Federal Communications Law Journal 2004, 587 [Vol. 56], and Rob Frieden, "Adjusting the Horizontal and Vertical in Telecommunications Regulation: A Comparison of the Traditional and a New Layered Approach", Federal Communications Law Journal 2003, 207 [Vol. 56].

37 A commonly cited case occurred in 2002 when the French courts held Yahoo responsible for allowing customers to access auction sites selling online Nazi memorabilia. More recent examples concern responsibility of ISPs for peer-to-peer file sharing of content in violation of copyright laws, or the permissibility of discrimination by ISPs against traffic that consumes high bandwidth.

The debate over network neutrality touches upon many operational necessities of network management, including optimizing quality of service (QoS), technical requirements for applications and services, managing traffic and congestion, dealing with harmful traffic (e.g. viruses and spam), blocking unlawful content (child pornography, for example) and management of intellectual property (see Box 7.10).

In some places, rapidly rising volumes of broadband traffic on mobile networks are putting severe stress on traffic management systems for mobile broadband networks.[38] Similarly, video content now represents about a third of all consumer Internet traffic, and not counting peer-to-peer video sharing. All forms of video transmission combined are expected to increase to over 90% of traffic by 2013.[39] This acceleration of bandwidth-hungry transmissions intensifies arguments about the way network operators manage traffic flows over intelligent networks that deliver a range of services at once. There are increasing concerns that "throttling" traffic that has low tolerance for latency – such as real-time audio or video – may render transmissions worthless to the recipient.

In some countries, ISPs are allowed to manage traffic, but the regulator requires them to be transparent about such network management so that their customers can make informed decisions about the services they subscribe to. In Singapore for instance, the regulator allows such network management, but ISPs must be transparent about those practices and offer choices to consumers. ISPs in Singapore offering fixed line Internet broadband services are also required to meet minimum quality of service requirements put in place by the regulator, to ensure that consumers can enjoy a reasonable quality of access to the Internet.

Public consultations on net neutrality have been conducted around the world, including in France, Singapore, the United Kingdom and the United States. These policy discussions have been most intense in Canada[40] and the United States. Both these governments are examining whether ISPs can reasonably discriminate against certain traffic, particularly where such discrimination degrades the quality of service of traffic flows in comparison with other traffic flows favoured by the ISP.

Requirements that service providers disclose their traffic management practices aim at providing greater transparency for end-users. The debate over what (if any) additional regulation to introduce in this area is highly contentious. Some observers view it as a referendum on the open nature of the Internet itself.

Box 7.10 Content regulation

As broadband expands, regulators need to consider regulatory measures pertinent to any content delivery platform. Given the superior functionalities of broadband, the need for regulation may be even more pressing. Concerns related to content include:

- Having an appropriate framework to effectively guard against intellectual property infringements
- Setting content regulation guidelines to protect consumers, especially minors, and
- Setting up appropriate regulatory mechanisms to ensure that national security is not compromised.

38 CISCO's Visual Networking Index (June 2009) forecasts at page 2, "Mobile data traffic will grow at a CAGR of 131% between 2008 and 2013, reaching over 2 exabytes per month by 2013…Almost 64% of the world's mobile data traffic will be video by 2013. Mobile video will grow at a CAGR of 150% between 2008 and 2013."

39 "The sum of all forms of video (TV, video on demand, Internet, and P2P) will account for over 91% of global consumer traffic by 2013. Internet video alone will account for over 60% of all consumer Internet traffic in 2013." See CISCO's Visual Networking Index, supra note 38 at page 2.

40 CRTC, Telecom Regulatory Policy CRTC 2009-657, Review of the Internet traffic management practices of Internet service providers, File number: 8646-C12-200815400, available at www.crtc.gc.ca/eng/archive/2009/2009-657.htm.

7.7.8 IMPACT ON INVESTMENT

In most countries, property rights imply a significant measure of exclusive control over use of an asset. This is often constrained by the government's right to encroach upon property rights for reasons of public welfare, which can include the development of national infrastructure such as roads. Nevertheless, a key economic rationale for property rights is the ability to develop and exploit the asset – a primary motive for investment. A key question regulators need to consider, therefore, is how to balance actions that attract investment, against rules that promote openness.

Investors and telecommunication providers often seek to persuade regulators not to impose infrastructure access obligations or the right for their customers to have access to the services of rivals. The arguments are particularly familiar in the mobile sector, which may be characterized by "walled gardens" — a term that refers to exclusive, closed networks whose operators allow no services or applications to be delivered other than their own. These closed networks might also limit which handsets can be used and apply traffic prioritization.

The challenge facing regulators is to weigh these arguments in the absence of clear information — sometimes due to the sheer newness of problems. In countries where regulators' resources are severely constrained, the lack of information might also be compounded by the inability to make effective analyses. Nevertheless, regulators must try to assess the various arguments and make decisions that will form the basis of investment over many years.

7.7.9 OPEN PROCESSES, STANDARDIZATION AND INTELLECTUAL PROPERTY

Networks and services are not the only subjects of debate over openness. Some industry processes have a major impact on the shape of markets as they develop. For example, the development of standards determines the technologies that may be used, the radio spectrum that will be required, and services that can be provided.

These technical standards may have so much importance in setting market conditions over long periods that they have a quasi-regulatory nature. Standards development, therefore, is a matter of public interest. It is important for regulators to understand these processes. They must recognize when standard-setting is sufficiently inclusive and transparent to avoid the risk of subversion by narrow interest groups, and when it is open enough to encourage innovation.

Box 7.11 What can be shared?

Defined broadly, sharing infrastructure, to increase efficiency and cut costs, can mean:

- Sharing of support infrastructure (e.g. ducts, poles, towers) and network elements among multiple service providers
- Sharing of access to facilities through the promotion of collocation and connection services (including international gateways and fibre backbone networks) that would be uneconomic to duplicate
- End users' sharing of equipment (handsets and computer terminals) at home or at telecentres, for example
- Increased sharing of radio spectrum resources through adoption of more efficient technologies and greater regulatory flexibility
- Service providers' "sharing" of customer revenues through international roaming agreements, and
- Sharing of previously separate networks through convergence, including the growing transmission of video content through IPTV and mobile TV.

Many standardization bodies are relatively open. But that is not always enough, since individual companies may still control assets that are essential to the development of a standard. An appropriate balance must be found between:

- The incentives to invest in new technologies and exploit them under legal monopoly rights conferred under patent legislation, and
- The need to ensure that industry development is not held hostage to such rights, for example through "patent ambush" whereby a standard is threatened by a patent holder.

Various standard-setting organizations seek to resolve these issues by focusing on "essential patents." These are patents that would be infringed by the implementation of a particular standard or specification. The standards bodies require members to disclose such essential patents and license them on fair, reasonable and non-discriminatory terms, on a reciprocal basis with other members. Despite this, the complexity of new technologies means that thousands of disclosures of essential patents might be made (together with royalty claims), putting at risk the rapid and efficient development of standards.[41]

Competition laws in several countries bolster the voluntary arrangements of standard-setting organizations. For example, regulators responsible for competition may require patent holders to honour their commitments to license essential patents.[42] However, many countries have not developed clear legal positions on such matters, and regulators face the challenge of broadening their vision of the dimension played by intellectual property rights and standards-setting processes.

7.8. INFRASTRUCTURE SHARING AND OPEN ACCESS

The booming volume of digital bits generated by the move to convergence and packet-switching has produced a need for increased network capacity. The single biggest reason to adopt sharing of infrastructure is to lower the cost of deploying broadband networks to achieve widespread and affordable access (see also Chapter 6).

Developing countries can harness the technological, market and regulatory developments that have fostered access to mobile services to promote access not only to voice, but also to broadband services for populations that today have few or no such services. For developed countries, infrastructure sharing promises to play an important role in the move to FTTx (fibre to the home/office, etc.), as well as reducing the environmental impact of network deployment.

Various studies have found that 65-80% of the cost of rolling out fibre networks consists of network-related construction.[43] So any policy that can reduce those construction costs would provide an important impetus to the expansion of fibre networks.[44] Deploying mobile base stations or fibre

41 For a discussion of this problem in the development of mobile WiMax, see Tobias Kaufmann, "Intellectual Property in Broadband Mobile Telecommunications: Predictions on 4G WiMAX". Available at www.frlicense.com/IntellectualPropertyinBroadbandMT.pdf.

42 See FTC "Challenges Patent Holder's Refusal to Meet Commitment to License Patents Covering 'Ethernet' Standard Used in Virtually All Personal Computers in US". Available at www.ftc.gov/opa/2008/01/ethernet.shtm.

43 See http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/nga/expl_note_nga.pdf. The UK's Ofcom has estimated that deploying passive infrastructure could represent 50-70 per cent of the costs of deploying next generation access infrastructure (see: www.ofcom.org.uk/consult/condocs/newbuild/statement/new_build_statement.pdf).

44 "Public Rights of Way for Fibre Deployment to the Home," April 2008, OECD, Committee for Information, Computer and Communications Policy

backbone networks to reach rural areas may be uneconomical if each company builds its own infrastructure. Likewise, laying fibre to every home, building or street cabinet may be unattainable if operators act alone. Companies can, however, share some infrastructure but, at the same time, compete in providing services.

In particular, it is critical for developing countries to create national fibre backbones to provide backhaul services, especially where satellite connections are expensive and microwave technology lacks the required capacity for broadband services and applications. Developing countries can leverage the decline in the price of optical fibre technology and adopt open access policies to meet this goal.

Developing countries also need to adopt measures to lower the cost of access to international Internet connectivity – for example, by promoting competitive and non-discriminatory access to international submarine cable and satellite networks.

Sharing does not mean abandoning market liberalization or universal access goals. On the contrary, further market liberalization is required, for example in international gateway markets, and to allow a new range of market players to meet the pent-up demand for broadband services.

Universal access practices can also be refined and improved. All sharing – and infrastructure sharing in particular – is an integral part of a competitive regulatory framework. Infrastructure-sharing regulations, whether mandatory or optional, are usually included in a country's interconnection framework, although they are occasionally contained in operators' licensing agreements.

7.8.1 ACCESS TO PUBLIC AND PRIVATE PROPERTY

Given the high cost of construction, access to publicly owned property can greatly reduce the cost of network deployment. This is particularly true for rights of way to such roads or power lines, for instance, duct systems, and dark or lit fibre-optic cables.[45] Much depends on the facilitating legislation. In Canada, service providers may set up construction sites along any highway or other public place for the purpose of constructing, maintaining or operating transmission lines.[46] German service providers may use public roads and waterways to deploy telecommunication lines without charge.[47] In the United States, the National Telecommunications and Information Administration facilitates service providers' access to a wide range of public properties.

A major impediment to accessing public resources appears to be lack of coordination across government bodies, along with regulatory barriers to approval. Regulators can take the lead in this regard. For instance, the Lebanese Telecommunications Regulatory Authority (TRA) published in 2009 a study identifying legal barriers preventing use of public properties, including rights of way. It proposed a decree to remove such barriers, establish application and approval procedures, and set out pricing principles for implementation by government bodies. The TRA sees this decree as a cornerstone of its broadband policy.[48] Such studies and legislative initiatives can lead to significant improvement in the use of public assets to support broadband deployment.

45 The UK Broadband Stakeholders Group found that the cost of national FTTH deployment would be 20% (GBP 5 billion) less if investors had access to alternative infrastructure. See Broadband Stakeholders Group, supra note 4.

46 Section 43, Canada's Telecommunications Act 1993.

47 See ITU "Trends in Telecommunication Reform 2009: Hands-on or Hands-off? Stimulating Growth Through Effective ICT Regulation", available at www.itu.int/trends09.

48 See the TRA study at www.tra.gov.lb/Use-of-Public-Properties.

Network investment can be advanced by greater exploitation of existing institutional and community assets, particularly those that could both serve as demand drivers as well as locations for resale, such as schools, libraries, hospitals, community centres and other public facilities. Even without major legal or financial powers, regulators can act as facilitators of such initiatives, coordinating the process of identifying the facilities and introducing relevant parties to each other.

Many of the assets required for network installation are not owned by public bodies, however. In the developing world, the lack of clear property rights often presents problems, particularly in the absence of land registers. Regulators can nevertheless facilitate negotiations with those who lay claim to the land. Laws enacted in 2009 in the Bahamas and Solomon Islands are examples of innovative approaches for securing access to private and customary land for telecommunication purposes.[49]

7.8.2 SHARING PASSIVE TELECOMMUNICATION INFRASTRUCTURE

The benefits of infrastructure sharing have been discussed extensively in recent years.[50] Due to the cost of installing towers, there is increasing focus on access to ducts that are privately owned by service providers. This includes interest in requiring operators to publish a "reference duct offer," such as has been introduced in Portugal.[51] Such a requirement also is being considered in the United Kingdom, which in 2009 carried out a major study of the country's duct system,[52] and in Lebanon, where the ducts are still in the public domain.

France's regulator, ARCEP, reached the conclusion in 2008 that the provision of access to ducts was a "relevant market" for the purpose of analysing market definition and power. ARCEP has determined that France Telecom has significant market power in that relevant market and has applied access obligations as a reasonable and proportionate remedy.[53]

Some countries' regulators and municipalities require coordinated planning for construction to avoid repeated digging, disruption and duplicated costs for operators. Some have considered ambitious mandatory planning requirements involving industry committees established by the regulator.[54] Such plans face operators' concerns about the managerial nature of such regulation, as well as the effect upon competitive strategies, such as the drag on operators' incentives to be the first to install infrastructure in an area.

Australia's access regime steers between these pressures: operators that are planning to install infrastructure may notify other operators to commence negotiations among those that are interested in participating in infrastructure sharing.[55] In some countries, the operators themselves

49 Bahamas Communications Act 2009, at www.pucbahamas.gov.bs, and Solomon Islands Telecommunications Act 2009.

50 See ITU "Trends in Telecommunication Reform 2008: Six Degrees of Sharing". Available at: www.itu.int/ITU-D/treg/publications/trends08.html

51 Portugal's Ministry of Public Works, Transport and Communications, Decree-Law No. 68/2005, and the Conduit Access Offer of incumbent PT Comunicações, available at www.anacom.pt.

52 Analysys Mason, "Telecoms infrastructure access – sample survey of duct access", a report for Ofcom (March 2009)

53 Décision no. 2008-0835, of 24 July 2008. Available at www.arcep.fr.

54 For example Saudi Arabia's Communications and Information Technology Commission: "Rights-of-Way Guidelines (ROW Guidelines), Co-location for Outside Plant (OSP) Guidelines (Co-location Guidelines)". Available at www.citc.gov.sa/citcportal/PublicConsultationsDetails/tabid/120/cmspid/%7B0238DEAF-738E-410D-97C5-096CF96CBE3D%7D/Default.aspx.

55 Australian Competition & Consumer Commission, "A Code of Access to Telecommunications Transmission Towers, Sites of Towers and Underground Facilities" (October 1999). Available at www.accc.gov.au.

have taken the initiative to coordinate planning, such as through the United Kingdom's Mobile Operators Association.[56]

In the active network infrastructure and wholesale services layers, meanwhile, regulators have adopted a variety of remedies, on the basis of significant market power, for dealing with cost barriers to new entry, including mandating non-discriminatory provision of leased lines and various forms of local loop unbundling (see Box 7.12). These are having varying degrees of success and, while they may increase the level of competition, they do not guarantee investment in new, high-speed network infrastructure. Regulators have to weigh the anticipated benefits of reducing new market entrants' costs against the incentives for investing in the infrastructure in the first place.

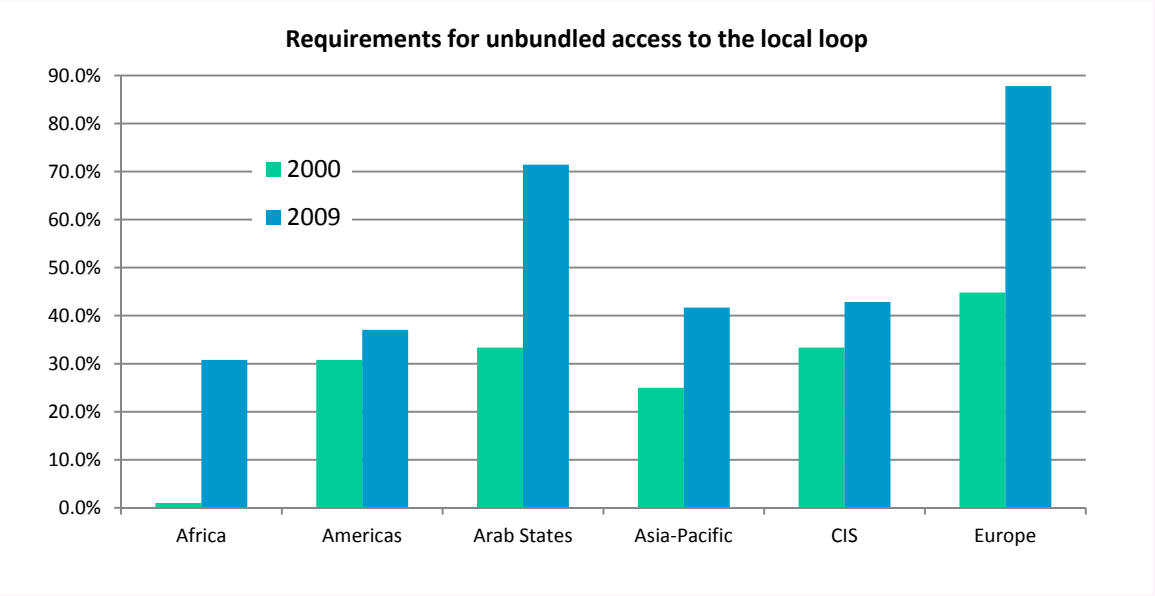
Box 7.12 Stimulating broadband growth through unbundling

One way of tackling cost barriers to new entrants into broadband markets is to introduce various forms of local loop unbundling. This permits multiple operators to use the "local loop" connection from an exchange to a customer's premises (the local loop is typically owned by an incumbent operator).

Between 2000 and 2009, the number of countries requiring unbundled access in all regions increased significantly, with Europe leading the way with close to 90% of countries, and the Arab States with over 70% of countries. In sub-Saharan Africa, some 30% of countries made unbundling mandatory (see figure below).

The provision of wholesale local loop products, including local loop unbundling, will meet with greater success in promoting the deployment of broadband access networks where certain regulatory and commercial conditions are in place. These success factors include:

- The existence of an extensive and well-developed incumbent network;
- Clear and complete regulations that spell out all unbundling requirements to ensure that strong operators do not impede access to their exchanges, and
- Conditions that encourage continuing investment by both incumbents and new operators in new infrastructure deployments. Regulators may decide to end wholesale local loop requirements once new operators achieve an appropriate level of commercial scale. Regulators can then place more emphasis on frameworks that encourage network deployment.



Source: ITU World Telecommunication/ICT Regulatory Database

56 See www.mobilemastinfo.com/index.html.

7.8.3 COMMON APPROACHES DEPEND ON POLITICAL WILL

Whether for mobile, fibre-optic or international gateway facilities, several key sharing practices are becoming common. These include providing collocation space and connection services, and sharing information (for example, publicizing the location of mobile sites that can be shared). Other common approaches include site sharing, the provision of power and air conditioning, access to collocation space for maintenance, and providing connections at guaranteed levels of quality of service. These provisions can be included in reference interconnection offers.

Infrastructure sharing also involves common principles, such as:

- Neutrality
- Transparency
- Non-discrimination
- Fair pricing
- Provisioning on a first-come, first-served basis
- Timely response to requests for sharing
- Fair competition
- Access to essential facilities, and
- Speedy dispute resolution.

All of these are well-tested principles and practices. There is an enormous body of experience and practice on which all countries, including developing ones, can build and develop their regulatory frameworks. Due to increased transparency among regulators, many of these practices and principles are freely described on websites, and other regulators can use them to create their own frameworks.

One of the keys to promoting infrastructure sharing and its benefits, however, is a clear policy decision to promote greater competition and to foster widespread network deployment through the adoption of infrastructure sharing and open access. Once the political will for such measures is articulated, regulators can then move to establish clear regulatory frameworks for implementation.

7.9 UNIVERSAL ACCESS TO BROADBAND

Some commentators have taken the position that the concept of a universal service obligation for electronic communications (including broadband) has become outdated with the evolution of the market, and should be replaced by policies to promote social and geographic cohesion in markets that differ in countries worldwide. Others, however, consider that the goal of universal service has an important role to play in stimulating the expansion of broadband.

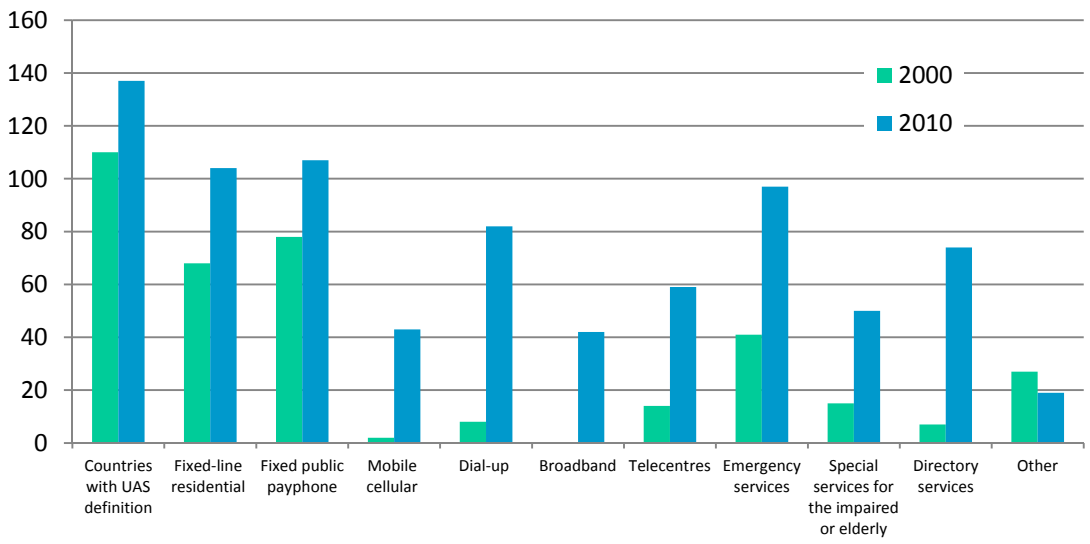
It is commonly accepted that the liberalization of telecommunication markets and the introduction of convergence-friendly policies can increase efficiency, boost service penetration, lower prices, and improve the choice and quality of services.[57] But even in open, competitive environments, ensuring universal access and/or universal service is a challenge, especially in an ever-changing market environment.

57 ITU "Trends in Universal Access and Service Policies: Changing Policies to Accommodate Competition and Convergence", at: www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR09/doc/USPolicy_ITUEC.pdf

In order to keep pace with technological developments and provide equal opportunities to all citizens, many regulators have begun re-examining traditional universal service obligations. Only a decade ago, the Internet was beyond the scope of most regulators, but today it is often considered as a utility and an essential tool for social and economic welfare. Out of 132 countries worldwide having established a definition of universal access and/or universal service, more than two-thirds had included Internet access in that definition by 2009 (See Figure 7.4).

In addition, by 2009 at least 30 countries had explicitly mandated access to broadband, including Brazil, China, Ghana, Kazakhstan, Malaysia, Morocco, Nigeria, Peru, Spain, Sri Lanka Switzerland, and Uganda, and their number is constantly growing.[58] Some countries have gone even further. For example, Finland was the first nation to declare broadband Internet access a legal right in 2009, entitling every person to a 1 Mbit/s Internet connection by mid-2010.[59]

Figure 7.4 Universal access/service definitions, 2000-2009



Source: ITU World Telecommunication/ICT Regulatory Database

Several mechanisms have been used to promote universal connectivity. In the 1990s and the early 2000s, the common practice was to impose universal service obligations on incumbent operators or certain market players, which were designated as "universal service providers." Funding might then be provided to finance these universal service obligations. More recently, many regulators are changing their approach to focus more on providing concrete regulatory incentives to market players to provide universal service, such as tax reductions and waivers or discounts on spectrum fees.

A range of financing mechanisms has also been put in place, ranging from Universal Service Funds (USF) to innovative public-private partnerships, and business-NGO partnerships. In many cases, the creation of a USF has been seen as one of the key requirements to achieve universal access and/or service. Consequently, the number of USFs has more than doubled over the last decade.

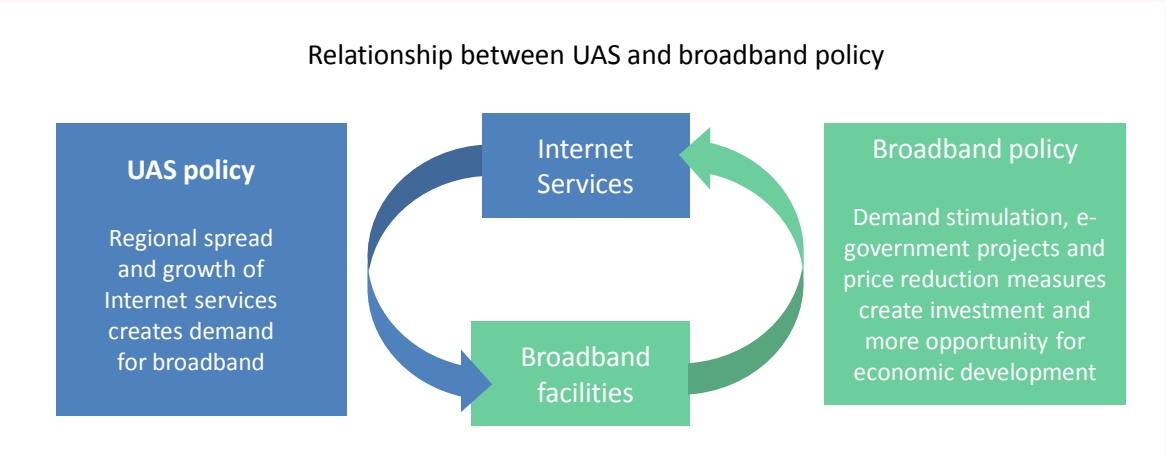
58 ITU World Telecommunication Regulatory database on the ITU ICT Eye, see: www.itu.int/icteye

59 See press release of 16 October 2009 from the Finnish Ministry of Transport and Communications, at www.lvm.fi/web/en/pressreleases/view/920100

But the strategy of solely relying on USFs to promote universal access is increasingly being questioned. Policy-makers are realizing that a series of elements must be taken into account when considering universality issues.[60] On the other hand, partnerships between incumbents, local service providers, municipalities and local public institutions such as schools and libraries, have provided rich evidence of their potential to bridge both the external and the internal digital divides.[61]

Box 7.13 Relationship between broadband policy and universal access/service policy

Universal access and service (UAS) policies and broadband policies influence each other. UAS policies promote the regional spread of Internet services and stimulate demand, which in turn can increase the demand for broadband. At the same time, broadband policies use a range of regulatory and fiscal options to reduce costs and facilitate broadband network investment, which in turn facilitate better access at lower prices.



Source ITU-infoDev ICT Regulation Toolkit: UAS Module

7.10 RESPONDING TO THE BROADBAND CHALLENGE

As policy and regulatory frameworks are gradually being redesigned, a clear message is being disseminated: the role of broadband is a critical catalyst to the process of economic growth, within and beyond the ICT sector, as well as a crucial tool for social development. Broadband Internet access (whether through fixed lines or wireless) is becoming increasingly relevant to the demands of subscribers in developed and developing countries alike.

One thing appears certain: broadband has started to irreversibly transform modern societies and the ICT sector is tending toward a more open, competitive, and transparent model, in which governments, operators, development agencies, educational institutions, civil society groups, and end users all have equally important stakes.

But regulators clearly face numerous challenges in the broadband context. In particular, they face a perceived lack of local demand and available revenue streams for broadband in many countries. This could delay the commercial deployment of broadband access networks — especially rural areas — at

60 ITU "Trends in Universal Access and Service Policies: Changing Policies to Accommodate Competition and Convergence", at: www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR09/doc/USPolicy_ITUEC.pdf

61 See the ITU GSR09 Background paper "Universal Access to Broadband: the Experience of the Dominican Republic" at: www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR09/doc/GSR09_Backgound-paper_UAS-broadband-DR-web.pdf

least by large-scale network operators. Furthermore, continued low penetration rates of Internet-enabled devices in many developing countries could negate any potential positive impacts that may arise from broadband network deployment.

A cost-benefit analysis should be performed before implementing any ex-ante regulatory measure, in order to avoid negative and irreversible effects on the dynamics of broadband markets. Some of the options open to regulators[62] are as follows:

- Seek to maximize investment flows by liberalizing markets and permitting foreign ownership. This includes allowing broadband providers to offer a full range of services and applications, such as the "multiple play" of voice, Internet access and video/multimedia programming.
- Build an adaptive regulatory framework by adopting a technology neutral approach, and an administratively simplified and flexible licensing regime providing for easy market entry of new players, such as through general authorizations and multiservice/unified licences.
- Create a regulatory framework that encourages a full range of potential broadband providers. Moving beyond large-scale national network operators, regulators can empower, for example, universities and government offices, local communities and smaller entrepreneurs to deploy broadband access networks. This may include tailoring regulatory frameworks to each group of potential broadband providers:
  - A regulatory framework tailored to small broadband providers will enable and encourage local community providers to harness the potential of broadband technologies and enable greater broadband access in rural areas;
  - Competitive large-scale operators can be encouraged to extend their networks to rural areas through infrastructure-sharing arrangements that guarantee open access to all competitive operators;
  - Competitive large-scale operators can be given incentives to deploy networks in return for appropriate rewards;
  - Regulators could seek to encourage the deployment of broadband access networks by providing direct, targeted subsidies from universal access funds or indirect financial benefits (such as tax exemptions) to a full range of broadband providers.
- Shift regulatory attention from retail to wholesale markets; i.e. by ensuring that alternative operators have access to dominant players' infrastructure (through passive sharing such as duct sharing, local loop and sub-loop unbundling, bitstream access, network and facility sharing, etc.) to offer competitive converged services, therefore avoiding unnecessary duplication of infrastructure and reducing costs.
- Create an asymmetric regulatory regime to prevent the dominant operator from constraining the development of competition in the broadband access market.
- Work with other government agencies or ministries to develop initiatives stimulating demand for services and applications within the framework of broader strategic goals, such as connecting public institutions (especially public administrations, schools, libraries and hospitals), businesses and residential users with broadband, promoting economic development, digital inclusion, social cohesion and equality of opportunity.
- Encourage the deployment of wireless broadband access networks by freeing up the requisite spectrum, while taking account of the range of demand. This strategy can be augmented by a technology-neutral approach to spectrum assignments.

62 See "GSR Best Practice Guidelines" 2003-2009, on various regulatory topics, available at: www.itu.int/ITU-D/treg/bestpractices.html

- Encourage the build-out of fibre backbone networks to boost the capability of both wire-line and wireless broadband technologies. These steps include forging synergies with transport and energy infrastructure projects and providing incentives for 2G mobile operators to replace their microwave links with fibre networks. It also means making it possible for all owners of such communication resources to lease unused capacity to others for commercial deployment.
- Link broadband access development strategies to efforts to help people have access to personal computers or other devices. Build government-sponsored Internet kiosks and access terminals, especially in areas where broadband networks are to be deployed.

As regulators consider and implement new strategies, they will have to remain flexible and committed to making course corrections as they go. As always, rules that apply in one scenario may be inappropriate in others. In addition, some policy approaches will need to be tried in multiple permutations before they can become effective. Regulators will have to continue painstakingly analysing and evaluating potential approaches and incentives to promote greater broadband access.

As the impact of regulation endures for many years after regulations are issued, and even after they are repealed, regulators face great responsibility to ensure that they maintain minds as open as the Internet itself.

8 BROADBAND FOR THE FUTURE

When the telephone was invented in the 1870s, having just one of these devices was obviously useless: there needed to be at least one other person able to answer a call at the end of a line in order to exploit the potential of the technology – which expanded exponentially as more and more subscribers joined networks, revolutionizing communications.

The same could be said today about broadband access to the Internet. While broadband already delivers many important services to an increasing number of individuals, institutions and businesses (as indicated in this report), its full potential is gained when the "tipping point" is reached and a high enough proportion of a population (as well as industrial and administrative processes) is connected. This allows many existing functions to migrate to the much more efficient broadband platform, while also offering a wide range of valuable – and sometimes literally vital – new services to be delivered.

The ICT industry and telecommunications providers play an essential role in the success of broadband deployment. Most of the investment for broadband is likely to come from the private sector, not only for infrastructure, but also for contents and innovative services that will benefit society. Therefore, policy makers need to engage with industry and investors to guarantee that their political vision can be achieved.

The challenge that remains to be answered is how to extend broadband to areas and communities that are not commercially profitable – and so help achieve the level of coverage that allows a whole nation to make a "broadband leap forward". Ways in which governments, regulators and industry can reach this goal have been outlined in this report. The savings, and the profits, that can be made are large indeed, if a coordinated trans-sectoral approach is taken to the deployment of networks. In the end, it is a "win-win" situation for all when broadband reaches the last mile, and the last community or business.

The benefits of broadband are of great significance, not only for all sectors of an economy, but also in support of culture and democracy worldwide. Communities and individuals can exchange experience and ideas, and each can express their particular and precious views of the world. And of course, broadband is a crucial tool in achieving the Millennium Development Goals.

Meanwhile, it is clear that more research is required on sustainable business models for infrastructure and services, especially in relation to developing countries. The Broadband Commission's online repository of case studies, recommendations and research materials (which can be visited at www.broadbandcommission.org/sharehouse) will continue to be an interactive resource that is aimed at becoming the focus of such research for the future of **broadband – a platform for progress**.

www.broadbandcommission.org