International Telecommunication Union

GSR 2005
DISCUSSION PAPER

ROLE OF REGULATORS IN PROMOTING BROADBAND

Comments are welcome and should be sent by 5 December 2005 to GSR05@itu.int

ITU International Telecommunication Union

GLOBAL SYMPOSIUM FOR REGULATORS

MEDINA CONFERENCE CENTRE
YASMINE HAMMAMET, TUNISIA

14-15 NOVEMBER 2005

Work-in-progress, for discussion purposes

The Role of Regulators in Promoting Broadband in Developing Countries

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GSR Discussion Paper*

The Role of Regulators in Promoting Broadband in Developing Countries

1 Introduction

A promising new landscape of broadband opportunities is emerging as waves of innovation reshape the information and communication technology (ICT) sector. These innovations are occurring across all levels of the industry from technological developments and business models to regulatory and policy frameworks, creating broadband opportunities for end users, large-scale network operators[1], small entrepreneurs, local communities and government alike. These new broadband opportunities require a new vision by potential broadband providers, and a new paradigm by policy makers and regulators. Broadband is completely transforming the ICT sector. Put simply, broadband cannot be treated as business as usual.

Network operators that fail to join the broadband world risk being left behind. The reality is, however, that deployment of broadband access technologies in developing countries is often constrained by a lack of supporting telecommunications infrastructure, especially backbone networks, and concerns over the potential for revenue generation by traditional large-scale network operators. Such large-scale commercial operators are often discouraged from commercially providing broadband access in marginal areas[2], given the costs of deploying broadband networks and the view that associated retail charges in many areas of developing countries may be too high relative to disposable incomes to result in large-scale take-up. At the same time, other potential broadband providers are kept out of the market by regulatory frameworks designed for another era.

A new pro-broadband regulatory paradigm will seek to harness the power of all potential broadband providers, tailoring the regulatory framework as needed. This pro-broadband regulatory paradigm expands on the existing regulatory practices developed following the revolutionary entry of Internet into the life of millions of citizens. Broadband technologies allow the Internet discussion to be taken to a higher level, as it provides for speed in access to the information and extended mobility. Regulators will seek to spur competition at all levels of the broadband value chain, from the link and transport infrastructure layers, to the content required to fuel demand, to the computers needed to access broadband services and applications. This will require regulators to take a comprehensive and coordinated approach, as identified by the world community of regulators participating in the 2004 ITU Global Symposium for Regulators (See box below).

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Box 1: GSR 2004 Best Practice Guidelines for the Promotion of Low Cost Broadband and Internet Connectivity

We, the regulators participating in the 2004 Global Symposium for Regulators, have identified and proposed best practice guidelines to achieve low cost broadband and Internet connectivity. Our goal is the creation of national regulatory frameworks that are flexible and enable competition between various service providers using multiple transport and technology options. We believe the best practices outlined below will help bring social and economic benefits to the world's citizens.

An enabling regulatory regime that encourages broadband deployment and Internet connectivity

1) We encourage political support at the highest government levels with such support expressed in national or regional policy goals. These include an effective regulator separated from the operator and insulated from political interference, a transparent regulatory process, and adoption and enforcement of clear rules.

2) We believe that competition in as many areas of the value chain as possible provides the strongest basis for ensuring maximum innovation in products and prices and for driving efficiency.

3) We encourage regulators to set policies to stimulate competition among various technologies and industry segments that will lead to the development and deployment of broadband capacity. This includes addressing barriers or bottlenecks that may exist with regard to access to essential facilities on a non-discriminatory basis.

4) We believe that the primary objective of regulation should be to secure fair and reasonable access for competitive broadband services, including Internet connectivity.

5) We encourage the maintenance of transparent, non-discriminatory market policies in order to attract investment.

6) We encourage regulators to adopt policies that are technology neutral and do not favor one technology over another.

7) We encourage regulators to take into consideration the convergence of platforms and services and that they regularly reassess regulatory regimes to ensure consistency and to eliminate unfair market advantages or unnecessary regulatory burdens.

8) We encourage regulators to allocate adequate spectrum to facilitate the use of modern, cost effective broadband radiocommunications technologies. We further encourage innovative approaches to managing the spectrum resource such as the ability to share spectrum or allocating on a license-exempt non-interference basis.

9) We urge regulators to conduct periodic public consultations with stakeholders to inform the regulatory decision-making process.

10) We recommend that regulators carefully consider how to minimize licensing hurdles.

11) We encourage the development of a regulatory framework that permits ISPs and broadband providers to set up their own last mile.

12) We encourage regulators to provide a clear regulatory strategy for the private sector in order to reduce uncertainty and risk, and remove any disincentives to investment.

Innovative Regulatory Policies Must Be Developed To Promote Universal Access

1) We recommend that the promotion of access to low cost broadband interconnectivity should be integrated from "grass-roots" efforts to identify local needs all the way through the "tree-tops" of international law. Governments, business and non-governmental organizations should be involved.

2) We recommend that regulators adopt regulatory frameworks that support applications such as e-education and e-government.

3) We encourage each country to adopt policies to increase access to the Internet and broadband services based on their own market structure and that such policies reflect diversity in culture, language and social interests.

4) We encourage regulators to work with stakeholders to expand coverage and use of broadband through multi-stakeholder partnerships. In addition, complementary government initiatives that promote financially sustainable programs may also be appropriate, especially in filling in the market gap that may exist in some countries.

5) We encourage regulators to adopt regulatory regimes that facilitate the use of all transport mechanisms, whether wireline, power line, cable, wireless, including wi-fi, or satellite.

6) We encourage regulators to explore programs that encourage public access to broadband and Internet services to schools, libraries and other community centers.

7) We encourage regulators to implement harmonized spectrum allocations consistent with the outcome of ITU Radiocommunication Conference process and each country's national interest. Participation in this well-established framework will facilitate low-cost deployment of equipment internationally and promote low-cost broadband and Internet connectivity through economies of scale and competition among broadband vendors and service providers.

Broadband is an Enabler

1) Regulation should be directed at improving the long term interests of citizens. Broadband can contribute to this by improving and enabling education, information, and increased efficiency. It can reduce costs, overcome distance, open up markets, enhance understanding and create employment.

2) We encourage regulators to educate and inform consumers about the services that are available to them and how to utilize them so that the entire population benefits.

3) We urge regulators to work with other government entities, industry, consumer groups, and other stakeholders to ensure consumers have access to the information they need about broadband and Internet services.

Such a regulatory paradigm will require regulators to at the same time do more and to do less than 'regulation as usual.' Regulators will do more in making potential broadband providers such as local communities and non-governmental organizations aware of the technologies and broadband provision opportunities they could seize. Regulators will also do more in coordinating with other organs of government and public institutions such as universities to drive demand for health, education and government services using broadband technologies and applications. Regulators will do less in maintaining outdated regulatory frameworks that restrict market participation

A successful comprehensive policy framework in a developing country with major challenges in rural connectivity is likely to be structured not only to foster long-term appeal to large scale operators, but to encourage public institutions and smaller players looking to deploy broadband to suit their own operational or commercial objectives. As was highlighted in the GSR Discussion Paper on Broadband Provisioning, many broadband technologies can be deployed incrementally. They are not limited to huge, nation-wide deployment plans. Enabled by the ability to deploy broadband on an incremental basis, local community aid and development projects find that providing broadband is an integral part of their work. Likewise, small and micro-entrepreneurs can launch new businesses based on broadband access. The key, therefore, is for regulators to determine which obstacles to their progress may be minimized. Such obstacles may include prohibitive pricing for interconnection with incumbent operators, high access costs to existing untapped infrastructure/resources from parallel utility sectors (i.e., energy/transport), and extensive and onerous licensing processes. Once community providers are able to establish the presence of demand, competitive large scale operators are more likely to see the benefits of market entry, and

may be further incentivized with proper rewards schemes (i.e., targeted subsidies from universal service funds or tax exemptions).

It is also important to highlight the importance of programs and content that may serve as initial drivers of broadband take-up in areas where it has been absent. Government in developing countries is often the largest user of information and communication technology. Government can also launch top-down initiatives (i.e., e-government) that will spur the initial interest of the citizenry in getting connected. And this interest will be fueled by the ability to minimize bureaucratic procedures and paperwork and save travel costs while developing the institutional capacity to interface with the citizenry en masse. Most importantly, e-government as a driver of broadband take-up is feasible only if it is sanctioned by a citizenry with its own capacity to demand and use the public information and transactions offered. Once demand is proven, commercial broadband providers will respond with entertainment content designed and priced for developing country users. In short, promoting broadband access and its associated full range of services in urban and rural areas of developing countries requires a new vision characterized by reduced regulatory burdens and conditions conducive to innovation, collaboration and creative incentives.

1.1 A look back

Ten years ago, the predominant model for the provision of telecommunications involved a state-owned incumbent operator deploying a fixed line public switched telecommunication network (PSTN). Over the same period of time, this model has given way to alternative competitive networks such as cable television, fibre optic, satellite, second generation (2G) mobile cellular, and more recently 3G and broadband wireless – all enabled by new technologies. Most telecommunication networks have been provided on a nation-wide, or at least regional basis[3]. Today, most large-scale networks are in private hands, meaning they must be profitable to operate. Even the majority of PSTNs today have been at least partially privatized.[4] The business model adopted by large-scale network operators requires significant infrastructure investment and high subscriber revenues to remain financially viable. Most national regulatory frameworks were designed for such large-scale network operators and service providers.

What has this first wave of sector reforms achieved? Telephone access has quadrupled since 1990, from 10 per cent to 40 per cent of the world population. By the end of 2004, there were an estimated 1.19 billion fixed telephone lines in operation around the world and 1.8 billion mobile subscribers. The rise in mobile subscribers is phenomenal. More than 50 per cent of mobile subscribers today are in developing countries[5]. Still, many of these users are located in urban areas. The challenge for regulators today is to build on this mobile growth to provide an enabling environment that will bring both voice and broadband Internet services to rural areas.

The stage is now set for such a rural renaissance as an entirely new player has appeared on the scene, the community broadband provider, largely enabled by low-cost broadband wireless technologies. Local community initiatives are providing broadband services to users in remote areas currently not served by large-scale networks. These small-scale broadband providers range from public institutions such as libraries, educational institutions, health facilities and local governments, to non-governmental organizations and small and micro-entrepreneurs that can be profitable with margins of only a few dollars a day. Whether private or public, all community broadband providers are concerned by costs. The lower the costs of providing broadband services and applications, the greater the opportunity for community initiatives to succeed in bringing ICTs to rural users. Keeping regulatory costs down will give these local initiatives a better chance of success.

1.2 A look ahead

A new regulatory framework, tailored to the unique circumstances of local community initiatives, is needed to help small-scale broadband providers foster growth in rural areas. This paper explores options for such a new regulatory framework. At the same time, evolution of the regulatory framework designed for large-scale network operators is also taking place. This evolution seeks to provide greater incentives to large-scale network operators to deploy broadband access networks in rural areas. This paper takes a hard-nosed look at the commercial realities of large-scale operators. Commercial operators are profit driven and cannot be expected to provide services that do not yield profits. The success of any regulatory framework targeted to large-scale operators depends on operator profitability and enforcement of regulatory requirements by regulators. Where regulators are unable to require large-scale operators to build broadband networks in rural areas, either due to inability to offer financial incentives or to enforce build-out requirements, regulators could focus efforts on developing new pools of broadband users in rural areas. Enabling small-scale or public service broadband providers to create new pools of broadband users in rural areas is likely to give large-scale operators the incentive to extend their networks out to these new commercially viable areas, offering Internet backhaul and interconnection with urban markets.

The paper begins by identifying the importance of broadband and the potential positive impacts that access to broadband technologies can provide, before discussing the key issues associated with such deployment in developing countries. The paper then highlights the role of competition in accelerating the deployment of supporting networks and reaches a number of conclusions with respect to the appropriate regulatory framework to create an environment conducive for the deployment of broadband enabled networks. The paper concludes by identifying a number of other potential policy measures that regulators can undertake to support the deployment and take-up of broadband access technologies

2 The role and importance of broadband in developing countries

The deployment and take-up of broadband access technologies offers a number of positive impacts for developing countries. These include:

- **Eroding information differentials** resulting from geographical constraints that prevent marginal communities from participating in regional, national or international processes.

These processes may be social (e.g. education and health), political (e.g. involvement in and input to decision-making and consultation) or economic (e.g. access to financial information and advice and markets (both buyers and sellers). Broadband technologies, therefore, can facilitate the integration of marginal communities into wider processes beyond the geographical limitations of their specific areas;

- **Access to regional, national and international resources** through broadband access technologies can substantially improve the living standards of marginal communities.

For example, improving accessibility to e-health systems that allow remote diagnoses and treatment via two-way rich voice and video are particularly useful in marginal areas where access to medical equipment and expertise would otherwise be limited. Similarly, broadband access technologies can be used to provide remote education and training services (for example, the African Virtual University[6] and at a more advanced level, Universitas 21[7]). The provision of such access can have a significant positive impact on living standards.;

- Furthermore, broadband access technologies can enhance the sustainability of marginal communities by **supporting the transfer of knowledge and expertise to marginal communities**.

For example, rural doctors can receive regular training via e-health systems ensuring that they can also remain on-location (rather than leaving an area for training) whilst learning the latest techniques and securing greater understanding of key medical issues. Similarly, broadband access technologies can be used to enable the transfer of agriculture knowledge to improve productivity and to limit desiccation of the environment through unsustainable farming techniques;

- Improved information flows, as a result of broadband access technologies, **increase the range of options available to marginal communities**.

For example, farmers need not be limited to the single buyer who is physically on-site but can use broadband access technologies to fully access geographically remote markets, including auctions. This benefit is particularly pronounced for perishable agricultural products where the physical transfer of produce limits the number of potential buyers to those in a particular location at a particular point. The use of on-line markets, however, allows producers to establish contacts with a far wider range of potential buyers across larger geographies and, therefore, to maximize potential incomes;

- Broadband access technologies will have **positive impact on the productivity of businesses** in developing countries.

Access to greater information sources, e-mail and other supported services, e.g. VoIP, allow businesses to improve their revenue-generating potential and to reduce their costs of conducting business. In India, for example, widespread broadband deployment is also expected to increase labour productivity by 11 per cent and lead to direct employment of 1.8 million and total employment of 62 million by 2020[8]; and

- The deployment of broadband access technologies may **support the growth of regional and national IT industries**.

This growth can impact positively on GDP growth. For instance, in Korea, IT, significantly underpinned by broadband deployment, accounted for approximately 50 per cent of GDP growth rate in 2002[9]. The Confederation of Indian Industry National Broadband Economy Committee estimates that broadband will contribute US$90bn to the Indian economy between 2010 and 2020[10].

Specific examples of how the deployment and take-up of broadband access technologies in marginal communities and developing countries include:

Box 2: The impact of broadband access: Examples in developing countries

In the Reserva Ecologica do Xixuanú of **Brazilian Amazon**, a telemedicine project has been launched where medical information from local communities are transmitted through satellite to the United States for remote diagnosis.

Rural villages in **Bhutan** that were previously not connected by traditional telephone service are now provided with inexpensive basic voice telephone access using wireless broadband technologies.

In **China**, students in rural villages are able to participate in distance-learning courses set up by major universities in Beijing using VSAT satellite broadband access.

In a small remote town located in the mountainous region of north-eastern **Ecuador**, Wi-Fi technology has enabled the local mayor to access online government databases. In addition, broadband access is used to promote ecotourism in the area and to help local SMEs become more competitive.

In **Laos**, Wireless LAN networks have been rolled out to villages, allowing people to make local and international (using VoIP) voice calls, and hence, significantly improving their connectivity. Other activities made possible by the network include accounting, letter writing and e-mails, as well as supporting local business activities.

In **South Africa**, institutions are connected to international institutions using broadband technologies, to advance co-operation in various R&D areas.

In **Uganda**, rural schools are able to gain access to educational tools via broadband access.

Recognizing the benefits of broadband for the agricultural sector, the government in **India** has just announced that it would set up a network of computer kiosks across 25,000 villages to help farmers sell their produce to the highest-paying customers. The national rollout is due to be completed in 2007.

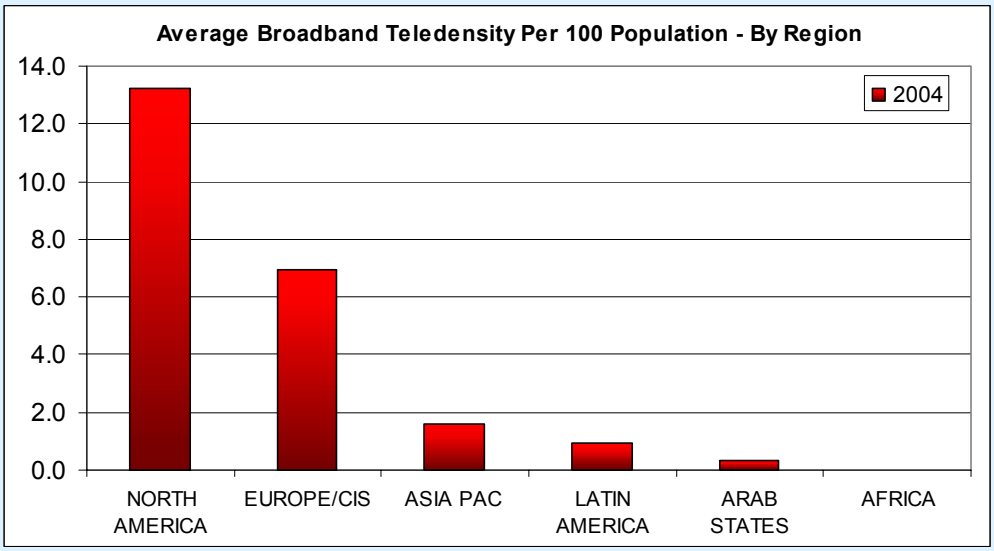
There is no doubt that broadband access technologies can provide substantial benefits to end-users in developing countries and marginal communities if the services subsequently provided over the networks are sufficiently targeted to offer end-users real benefits. Apart from regulations that aim to create a competitive broadband market providing universal and equitable broadband access, governments and regulators are also focusing on developing policy measures that include local communities into the design and implementation of broadband initiatives.

3 Current state of broadband deployment

As seen in the GSR Discussion Paper on Broadband Provisioning, up until 2004, the deployment and subsequent take-up of broadband access technologies remained largely concentrated in the developed world. While many developing countries still have not yet begun commercial deployment of DSL solutions, 2004 witnessed the beginning of broadband growth in developing countries, with some twenty-five per cent of broadband subscribers now located in non-OECD countries.

The graph below details the number of broadband subscribers per 100 population by region. Although it is evident that the total numbers of broadband-connected citizens in Africa, the CIS, the Arab States and Latin America currently comes to less than 1 for every hundred persons, it is important to bear in mind that this does not translate to a lack of growth, or to a lack of technological options for developing viable deployments. In fact, the pace of broadband deployments from year to year has been highest in developing countries over the last two years. (See Figure 1, GSR Discussion Paper on Broadband Provisioning.) This is in part because growth reflects drastic changes from a starting point of zero connectivity, but also because various entities are finding it in their interest to champion broadband.

Figure 1: Broadband penetration by region (year-end 2004)



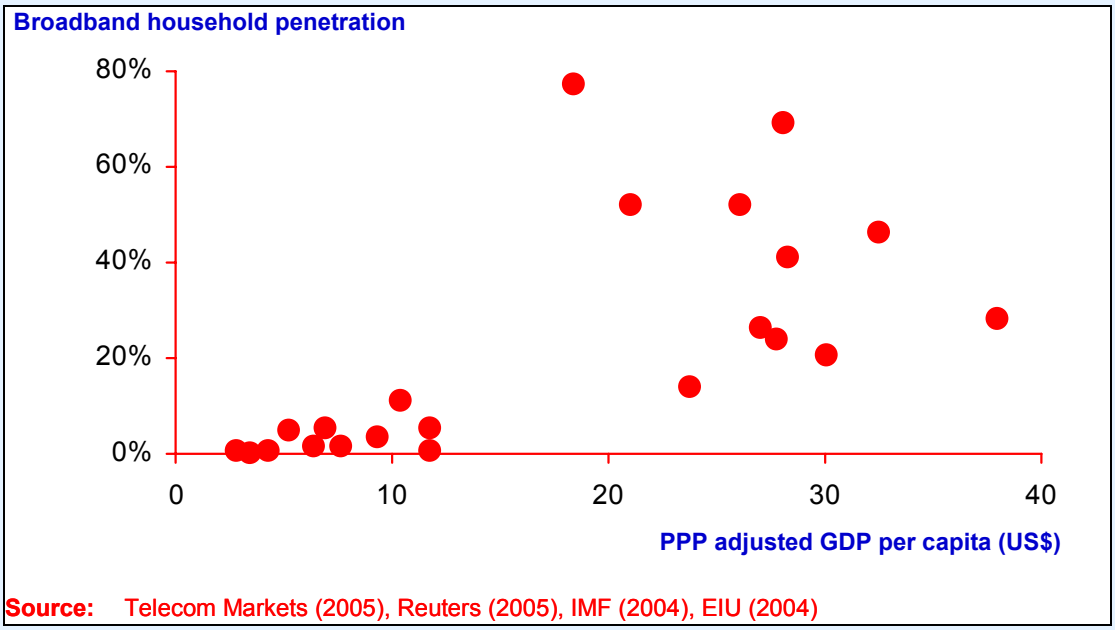
Source: ITU World Telecommunications Indicator Database

Certainly in terms of absolute broadband subscribers, there is a marked variance between the more developed countries in North America and Western Europe and the other regions, including Asia-Pacific. In North America there are more than 10 broadband subscribers per 100 inhabitants – and throughout Europe (including Western, Central and Eastern), there are nearly 7 subscribers per 100 inhabitants, whereas it is estimated that across Africa there is a take-up of less than 0.01 per 100 population. Other regions also record relatively low levels of take-up (e.g. the Arab States with 0.4 broadband subscribers per 100 population and South America with a ratio of 0.9).

Although the Asia-Pacific region has the largest number of broadband subscribers, its relative take-up is just 1.6 per 100 population. This ratio, however, is distorted by the inclusion of China and India as the Asia-Pacific region contains some of the most successful countries in terms of the take-up of broadband access technologies, for example, China, Hong Kong, China, Japan, Singapore and South Korea.

The finding that the take-up of broadband access technologies appears to be significantly higher in developed countries is further demonstrated when the take-up of broadband is compared against purchasing power parity (PPP) adjusted GDP per capita.

Figure 2: Comparison of broadband penetration and GDP for selected countries (year-end 2004)



While broadband growth is now beginning in developing countries, there remains a large disparity between urban take-up (especially in the primary urban centres) and non-urban areas. In Pakistan, for example, it is believed that the 40,000 broadband subscribers (as of June 2004) were all in Karachi, Lahore and Islamabad. Outside these three major urban areas, broadband networks are virtually non-existent.

Telecommunications networks are increasingly accepted as important as other forms of infrastructure (e.g. transportation and power) in supporting and promoting economic as well as political development. Regulators are thus seeking to address such geographical variations in the take-up of broadband services in their countries range of digital opportunities. Fortunately, there is evidence in the relevant literature to suggest a significant relationship between the deployment of preliminary communication infrastructure, and associated improvements in standards of living, health, education and overall sustainability.

Some developing countries are already demonstrating strong performance with respect to encouraging broadband take-up. Chile, for example, has a reported household penetration rate of greater than 10% driven by a set of policies and approaches detailed below.

Box 3: Promoting broadband in developing countries: Chile

Broadband development has benefited from a competitive telecommunications sector and early privatisation of the incumbent operator. Economic and regulatory policies that foster competition have also contributed.

In addition, the government has actively pursued initiatives to promote broadband deployment and take-up, often in co-operation with the private sector.

The "Digital Agenda" was launched in February 2004 and sets out a plan of action for a national ICT strategy to be completed in 2010. The programme is funded by both public and private funds. Some of the initiatives in the programme include:

Concrete goals in six areas, namely Internet access, education and training, e-government, business digital development, ICT industry development, and legal and regulatory readiness;

Ensuring public access, including connecting more than 8,000 state schools to some form of ICT, providing Internet access to 368 public libraries and launching over 1,300 Internet centres;

Review and amendment of the legal and regulatory framework to facilitate ICT development;

Launch of "National Digital Literacy Programme" which benefits poor communities and rural areas through the opening of school computer laboratories to facilitate public access to the Internet; and

Award of licences for provision of WLL service provision throughout the country.

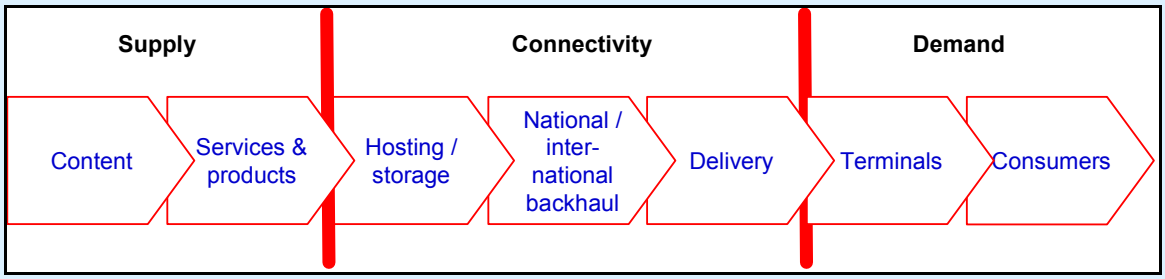
The key issue remains distilling and learning from the lessons of such apparent success stories and successfully implementing appropriate frameworks in other markets.

4 Key issues in promoting broadband in developing countries

Given the stated potential economic and social benefits of broadband access technologies, the need to develop solutions to counter the relatively low levels of broadband take-up in many developing countries is clear.

From a cost-benefit corporate perspective, the fundamental problem is that there are holistic constraints to broadband take-up in developing countries across all the value chain components from the supply of content, services and products through to connectivity and finally, demand. Limited consumer demand, however, is likely related to lack of awareness of the potentials of broadband. Once deployed, it is quite fair that the demand (in terms of content and volume) of consumers in the developing world will not be so different from their counterparts in the developed world. The main difference will lie more simply in the rates they are able to pay, and the portion of their disposable income they are willing to allocate to content.

Figure 3: Simplified broadband value chain



In terms of **supply**, key constraints to deployment of broadband services and products in developing countries are:

- Insufficient compelling content, especially in local languages and with specific reference to local circumstances;
- Lack of understanding on the benefits of broadband;
- Little incentive for fixed line incumbents to offer broadband access technologies and risk cannibalizing PSTN and ISDN revenue streams, especially in the absence of market competition;
- Competing demands for investment funds, for example in developing countries operators perceive that they could generate a better return and payback with deployment of second generation mobile networks than with fixed or 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 a full range of potential broadband providers from large-scale network operators, to universities and other national public institutions to local community initiatives.

In terms of **connectivity**, key constraints to take-up are:

- There is a lack of hosting/storage facilities within many developing countries requiring much content to be stored overseas with resulting strain on international connectivity;
- Often limited international connectivity impacts on the data rates available, the quality of the service and the cost of international bandwidth;
- Lack of backbone connectivity in many areas, with the incumbent often retaining control over many backbone networks where they do exist and, therefore, able to control the costs and quality of offered leased lines to competitors; and
- Concern over the commercial viability of deploying broadband delivery networks by large-scale network operators, especially in non-urban areas where the costs of service provision may be substantially in excess of the point at which it is affordable.

In terms of **demand**, key constraints in developing countries are:

- Lack of consumer demand (resulting from limited consumer purchasing power) and awareness (although linked to the offered pricing points and the above point) and/or lack of coordination by key stakeholders, such as end-users, universities, public institutions and local community initiatives, that could drive demand for broadband;

- Excessive pricing of broadband products and services, especially when compared to average incomes, which necessitates alternative cost modeling and targeting techniques;
- Greater priority on mobile voice communications than data services; and
- Limited availability of affordable end-user terminals. Deploying broadband access networks only makes sense if potential users have the ability to utilize the services and products.

Many of these points are not unique to developing countries but they are accentuated when compared to developed countries, in particular the ability of consumers to afford the services and products at an appropriate pricing point that accurately reflects the underlying costs of service provision. Similarly, the relatively low PC penetration rate (an issue of affordability but also electricity provision since it is difficult to use a personal computer where there is no electricity to power it) significantly reduces the demand for broadband access. The forces of innovation and the intensely competitive environment in developed countries, however, are pushing manufacturers and engineers to develop very low-cost, simple, converged devices expressly tailored for applications and content in developing country contexts. To a large extent, this could even be said to reflect the development of a niche market of low priced, functional products, as service providers consider their interest in catering to potential untapped markets.

The relevance of specific factors varies significantly between developing countries and between geographies within developing countries. However, given the relevance of such supply, connectivity and demand factors in constraining the take-up of broadband in many areas of developing countries, regulators have an important role in seeking to minimize the impact of these factors or developing appropriate solutions.

5 Regulators' role in promoting broadband

Unlike developed countries where the relatively high levels of teledensity allows for a greater focus on the promotion of service based competition, the primary role of most regulators in developing countries is to create a framework that creates and maintains an environment conducive for network investment.

In order to confidently commit to network investment, however, especially in potentially more expensive broadband access technologies and in developing countries where risks are often higher, operators seek a regulatory approach that is consistent and will not experience significant variations from stated positions. Therefore, any regulatory framework (and this covers both the legal framework as well the precedent to which the legal intent is enforced) that creates uncertainty and/or the risk of financial loss will deter market entry and subsequent network investment.

Regulatory agencies that fail to provide this consistency risk deterring investment and, therefore, constraining the development of their telecommunications networks, including the development and deployment of broadband.

Within this context, there are several steps/mechanisms that a regulator can undertake to promote the deployment and take-up of broadband. These are detailed in the following sections.

5.1 New entry and the role of market liberalisation

Market liberalisation remains the most effective mechanism to encourage greater investment in telecommunications networks. Experience shows that market liberalisation through the licensing or authorization of new operators will yield greater benefits than incentive- or obligation-driven approaches targeted at only a monopoly or duopoly. The absence of liberalisation removes a significant incentive for an incumbent to invest in networks, services and QoS and historical

precedent demonstrates that network investment is significantly enhanced after the introduction of market competition - both by new entrants and the incumbent (for example, inter alia, Brazil, Hungary and India).

It is clear, however, that after market liberalisation in many developing countries, the incumbent continues to invest significantly more in network deployment than new entrants, especially in marginal areas. As such, the incumbent can often be the most important (and often the largest) source of funds for telecommunications investment in the longer term.

Given this, a number of commentators have argued that excessive market competition may reduce the incentive for incumbents to continue large-scale investment. This may be particularly the case where tariff re-balancing has not been fully undertaken and new entry results in very rapid margin erosion in the more lucrative long distance and international markets while the incumbent continues to provide these services. Such a situation can result in a very rapid deterioration in the financial performance of the incumbent and, therefore, its capability/willingness to undertake investment, unless the incumbent introduces new services and seeks new lines of business.

It is necessary, therefore, that the regulatory framework does not impact adversely on network investment and the diversity of new lines of potential business.

Due to the costs of network deployment, especially of broadband access technologies, there have been some suggestions that network duplication, and hence duplicated investments, could be avoided by the creation of a "super" network operator. While this idea often has immediate appeal for developing countries, due to concerns about the availability of investment funds, implementation raises significant competitive concerns. In particular, incumbent operators tend to advance this argument on a regular basis. This 'super' operator would be responsible for the build-out of a comprehensive network to which other service providers would be able to secure access, i.e. a transition to service based rather than infrastructure or network-based competition. Incumbents often raise such arguments in an attempt to limit competition, however. This allows incumbents to retain complete control over infrastructure and, therefore, to a greater or less extent, control the development of competition. In both developing and developed countries, incumbents have proven remarkably effective at controlling access to their infrastructure even when the regulator is relatively strong. It is unlikely, therefore, that a 'super' network scheme would be effective in the absence of a very strong regulator that can ensure that service providers have access to the network.

An alternative is perhaps for governments to fund such networks directly and to oversee access to them by both incumbent and new service providers. Such an approach has been used successfully in Singapore where the government funded the roll out of a broadband backbone network in 1997 called SINGAPORE ONE, to which the incumbent and new operators, including the cable TV operator, have access. Furthermore, the potential threat that new entrants may secure access to end-users through deployment of networks encourages network build-out. Of course, not all governments have the resources to build such broadband backbone networks.

A more practical alternative, therefore, may be offered by infrastructure sharing. For example, allowing mobile operators to roam onto each other's second generation (2G) and 3G networks in rural areas would save significant network costs while enabling greater network coverage. In fact competitors have even started sharing the bulk of their Radio Access Network in non-rural areas as in the example of Telstra's and Hutchison's shared 3G network in Australia. Similarly, France has allowed infrastructure sharing among 2G operators to reach un-served rural areas known as "zones blanches". Such roaming and infrastructure sharing arrangements could also apply to new broadband wireless networks.

Fibre backbone networks are often lacking in developing countries, making broadband deployment more challenging. Fibre backbones can boost the capacity of DSL networks, and extending fibre backbone networks closer to rural areas can facilitate internet backhaul for wireless broadband technologies. Again, rather than resorting to a "super" fibre backbone operator, regulators can promote synergies between different kinds of energy and transport infrastructure projects, such as electricity, highways, railways and pipelines, to deploy fibre as part of their projects, and then encourage open access to such fibre communication resources. Since many infrastructure projects are already deploying fibre as they build energy and transport networks, regulators can launch a high-profile information campaign to create awareness of such fibre resources among key stakeholders driving broadband demand. Regulators could also provide incentives, such as tax breaks, for second-generation mobile operators to build their own backbones using (currently dark) fibre instead of the more commonly used microwave links. The regulatory framework can then make it possible for all owners of such communications resources to lease unused capacity to others for commercial deployment.

In conclusion, therefore, regulators have generally opted to promote the deployment of broadband access technologies through market liberalisation (and a supporting regulatory framework) rather than rely on the good will of incumbents, even if incumbents set ambitious targets. Concerns over the impact of competition on network investment can be mitigated through a series of traditional regulatory tools, such as including investment commitments on large-scale operators through the licensing framework, as well as more innovative measures, such as building synergies between non-traditional telecommunication players to promote investment in fibre networks or providing tax incentives to telecom operators to upgrade their transmission links to fibre.

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 rollout and coverage obligations on large-scale operators, it has achieved greater success in encouraging broadband infrastructure deployment by allowing wireless broadband providers to enter small local service areas. Ireland's practice of licensing small local service areas--defined as a 15-kilometre radius around a base station—has led to a significant rise of new broadband subscribers in non-urban areas.[11]

Encouraging competitive market entry is part of a larger package to promote broadband deployment by a full range of potential broadband providers. Additional elements of this larger package are explored below.

Box 4

A new regulatory framework, tailored to the unique circumstances of local community initiatives, can encourage small-scale broadband providers to provide broadband access in rural areas;

An incentive based regulatory framework, for example, using targeted grants or tax exemptions, can be used to encourage both large and small-scale network operators to deploy broadband networks in rural areas;

Where financially viable, broadband deployment requirements can be made part of the licensing commitments of new market entrants;

The promotion of sufficient supporting network infrastructure to enable the provision of broadband services, e.g. backbone connectivity; and

The development of government driven initiatives that provide an important source of demand for the network facilities and services.

These issues are detailed in the following sections.

5.2 The role of foreign ownership of operators

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 licensees - this is particularly the case in developing countries where capital availability may be limited. Foreign ownership brings the possibility of incremental capital funds as well as managerial expertise and international best practice.

Increasingly, governments and regulators seek to attract foreign ownership, rather than restrict it on the premises of national security, cultural protection and domestic economic development, although these often remain concerns for policy makers.

There are persuasive reasons to facilitate and support foreign ownership of new entrants in many circumstances, even allowing full foreign ownership of new entrants. These reasons include that:

- There is an international trend to ease foreign-ownership restrictions, partially encouraged by World Trade Organization ("WTO") agreements, but also driven by increasing recognition of the substantial benefits that foreign ownership provide;
- It is possible to address investment requirements through licence commitments; ensuring that these are not so high as to lead to excess capacity; and
- Foreign investors are more likely to view the risk associated with an investment as related to the extent to which it can retain managerial and operational control. Greater financial ownership is likely to be associated with greater managerial control and hence, ability to determine the business behavior of the company.

In addition, there are an increasing number of successful examples of foreign ownership of new entrants resulting in substantially improved telecommunications infrastructure. Foreign ownership will not per se result in greater broadband access network deployment, although foreign ownership may support such deployment through access to greater funds, managerial experience and potentially lower unit costs.

Besides allowing foreign ownership, governments can also tap into the global capital markets and international lending agencies for funds to improve and upgrade their telecommunication networks. This is now less difficult than before because it has been proven that telecommunications infrastructure, when properly deployed and managed, is across the board a commercially viable business.

5.3 Providing a simple and consistent licensing or authorization framework

The deployment of broadband can be expedited through relaxing the licensing conditions for large-scale broadband access providers and by ensuring a consistent framework that is clearly targeted towards a set of defined policy objectives. In addition, regulators are increasingly using general authorizations in lieu of onerous licensing frameworks to ease market entry.[12] Where licenses are used, it is important that:

- An efficient administrative process that is transparent and consistently applied, together with minimal administrative requirements helps attract investment and ensures that potential investment is not delayed;
- Any terms and conditions included in licenses are not financially punitive and allow operators to achieve sufficient financial return over the life-cycle of their investments, this can also be linked to the incentivisation approach detailed in the following section;
- Licence fees charged are commensurate with the required activities of the licensee, i.e., if the licensee is expected to deploy substantial broadband access network infrastructure licensee fees can be reduced to reflect this high level of investment. Increasingly policy

makers and regulators are moving away from the view that telecommunications operators, especially more profitable wireless operators, are to be treated as "cash-cows" and a source of funds for other activities;

- Regulators establish and enforce appropriate monitoring mechanisms that ensure licensees do meet their commitments where specific conditions are included in license agreements;
- It is recognized that re-negotiating licence commitments increases the risk associated with network investment that is required to promote broadband access deployment and take-up.

While licences or general authorizations are usually required for large-scale broadband infrastructure operators, increasingly regulators are lightening such requirements for operators and service providers in small, non-urban areas. Facilitating broadband market entry in small, non-urban areas allows broadband providers to test the business case for broadband provision on a small scale. Some small-scale broadband providers 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). Where broadband access will be used exclusively for public services, such as in health facilities or libraries, 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, and that licensing obligations that may apply to large-scale operators, such as roll-out and coverage obligations, or contributions to universal access funds, be minimized or eliminated in a regulatory framework targeted to community broadband providers.

There is also a case for allowing broadband services to be resold without any licensing requirements in rural areas. For example, broadband subscribers in a rural area could be allowed to use their broadband connection as a public kiosk and resell the service to occasional users who would otherwise not be able to afford it at all. In this way additional economic activities would be generated besides increasing broadband access.

It is important to note that reducing or eliminating licensing requirements is not synonymous with not regulating service providers. In some countries, for example, telecommunication licensing is not widely used as a regulatory instrument. Instead, regulatory rules for market players are enacted through the regulations, codes, decisions or orders made by the regulator. 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 and the fight against spam. Again, they could be treated like ISPs, who often come under general business regulation that applies to all commercial entities — or at least a certain group or "class" of companies.

Many of these issues increasingly represent best practice for regulators with respect to all products or services. However, given concerns over the commercial viability of broadband access technologies in developing countries and consequent risks with deployment, it is especially important that the regulator is consistent and minimizes the extent of regulatory burden on such operators.

5.4 Using licensing frameworks to encourage broadband access network deployment

Regulators could use the licensing framework to incentivise network deployment by large-scale operators, especially in early stages of market liberalisation, particularly with respect to the deployment of broadband access technologies13.

The intent of this approach should be to encourage operators to deploy networks that may otherwise not be considered commercially viable or may create less value than other options. It is particularly relevant to highlight the importance of looking at the appeal of such investments in the long-term,

as opposed to in the short-term perspective. Such networks may include build-out to more marginal geographies or broadband access networks that would otherwise be considered cost prohibitive (especially in the absence of large-scale commercial demand). The incentives could either be rewards for meeting licence commitments or, where they can be enforced, financial penalties for failing to meet agreed commitments.

Such licensing incentives could take several forms including:

- Extension of licence periods;
- Access to other operators' infrastructure;
- Provision of other more lucrative licences;
- 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 a licence commitment.

For example, rural areas could be packaged with lucrative locations for licence tender by potential operators14. In addition, multiple services may be bundled under one licence or authorization. Brazil, in 2005, for example, announced that it would issue licenses to enable operators to offer the triple play of voice, Internet and broadcast.

Such an incentive framework has been used to encourage network deployment in a number of countries (e.g. Hungary (possible extension of licence period) and in Brazil (possible provision of new licences for more lucrative business activities).

Box 5: Incentivising network deployment: The Hungarian approach

In February 1994, Hungary was divided into 54 franchise areas for local telecommunications access.

The incumbent and new entrants were invited to submit bids for each franchise area to act as the monopoly local access service provider potentially until January 2002.

The licence conditions required each operator to achieve annual growth in local access lines of 15.5% per annum and fulfill 90% of customer demand for new local access lines within 6 months by January 1997.

In 1993, teledensity was 14.5 main telephone lines per 100 inhabitants. This had increased to 26.0 per 100 inhabitants by year-end 1996 and 36.1 by year-end 2002 (over the period teledensity peaked at 38.0 at year-end 2000).

Post 2002, all service providers with significant market power were mandated to provide local loop unbundling to other service providers, including new entrants (including a special RIO for the local loop).

Box 6: Incentivising network deployment: The Brazil licensing model

Following the process of deregulation of the telecommunications sector from 1997, operators that reached their universal service obligations were allowed to acquire additional licences, including mobile and long distance services.

In early 2004, the telecoms regulator, Anatel, certified Brasil Telecom as having met its universal service targets, thereby allowing the operator to roll out mobile and long-distance services in addition to the local-line service that it was already offering in the country's southeast.

Brazil's other two major landline operators, Tele Norte Leste and Spain's Telefonica Internacional, had already met their targets and were offering wireless phone and long-distance services in other regions, prior to 2004.

As mentioned above, the converse of the above incentives is the threat of licence revocation if licence commitments are not met. There is, however, a natural tendency on the part of regulators not to revoke licences especially if the operator under review has achieved a sufficient number of subscribers and withdrawal of the licence would cause disruption to these subscribers.

Besides providing tax incentives for the operator such as tax "holidays" or tax concessions for equipment, reducing the burden of tax and duties for users can also encourage wider adoption and usage. A recent study commissioned by the GSM Association indicated that in many developing countries up to 20% of the total cost of owning and using mobile telephony goes to taxes and duties. If these are reduced or abolished more people would be able to afford the service.

To date, the above incentive mechanisms have been generally applied only to PSTN local access, but there is no reason why they are not also applicable to encouraging deployment of broadband access networks. For example, new entrants or even existing operators could be offered appropriate incentives to deploy all types of broadband access technologies, especially in non-urban areas. Given the relative success of such incentives for PSTN deployment, it is believed that such incentive frameworks could impact positively on broadband deployment, especially if they are available to all industry players.

Exclusivity periods as an incentive mechanism pose the danger of "crowding out" potentially more efficient new entrants and new investment sources. Generally, market liberalisation, as long as the licensing framework is appropriate, will yield greater benefits than the tandem exclusivity-obligations approach adopted in a number of markets (both developing and developed).

5.5 The role of technology neutrality

In principle, broadband regulation should be technologically neutral and the licensing or authorization regime should reflect this position. Increasingly, licensing/authorization frameworks focus on encouraging the provision of and investment in broadband access networks, rather than defining the specific method of delivery. This is particularly relevant when licensing radio spectrum for the provision of broadband wireless services, but it is also potentially applicable in terms of fixed line deployment (for example, allowing such licensees the flexibility to use copper, fibre or satellite (if the spectrum is available).

Technology and service-neutral licenses and authorizations also enable broadband providers the flexibility to offer a full range of services (including the triple play of voice, Internet and broadcast) in rural areas, 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 have allowed operators to provide both fixed and mobile services under the same license, leading to increased competition and subscribers as well as lower prices for consumers. Hong Kong, China is issuing unified licenses for broadband wireless access

providers designed to adapt to technological developments. Today, it allows broadband wireless access providers to offer fixed services; as BWA technology develops, the same license will authorize providers to offer mobile broadband wireless services.

It is recognized, however, that total technology neutrality in licensing frameworks may be quite difficult to achieve (for example, some technologies and services are specific to and standardized for certain radio frequencies), but regulators are increasingly providing licensees with the maximum flexibility possible when selecting which technologies they wish to adopt in the provision of broadband access services, within existing standards and international frameworks. Such flexibility may encourage broadband access deployment in marginal areas and developing countries by allowing licensees the ability to select the delivery technology that minimizes costs and accelerates financial return and customize the components of the technological infrastructure that will drive their service offerings to their specific organizational and technical needs. This may allow them to leverage whatever existing economies of scale they have been able to achieve in other, possibly adjacent, markets.

For example, such flexibility has been exhibited by India's unified access service licensing framework that effectively provides operators with the choice of either GSM or CDMA selection within their allocated spectrum blocks.

Box 7: Technology neutral licensing regime: India's unified access service (UASL) licensing framework

In 2004, The Indian regulator, TRAI, established a unified access service licensing regime in response to an increasing overlap between GSM full mobility and CDMA limited mobility operators.

The unified access service licensing framework covers all basic and cellular licences for now. In the next phase, the government plans to implement a fully unified licensing regime covering all telecommunication services.

The financial burden in terms of licence fees and registration charge is lessened for operators wishing to provide multiple services. This represents a significant lowering of entry barriers for new and small players, and may also translate into more affordable prices for end-users.[15].

Box 8: Technology neutral licensing regime: Proposed unified licensing framework in Nigeria

In February 2005, the Nigerian Communications Commission proposed a review of the telecommunications regulatory framework to establish a unified licensing regime.

Under the new regime, new and existing fixed wireless and mobile licensees will be allowed to provide both services, subject to geographical/regional limitations stated in their licences.

With the removal of the fixed-mobile differentiation, licensees will be free to offer voice, data or multimedia services as they deem fit once spectrum is allocated[16].

In contrast, the definition of a specific required technology within a defined spectrum block or for the provision of a defined service, although used in some countries as an industry development tool, may not result in the most efficient allocation of spectrum or the most rapid deployment of that service. For example, if the required technology is not the most appropriate (either in terms of cost or supported functionality) then take-up is likely to be constrained and spectrum usage limited.

This position does not, however, undermine the role of standards, especially international radio frequency allocations and technical standards, since such standards do provide a number of

advantages. In particular, they allow for economies of scale (both in terms of network and end-user equipment), large-scale vendor commitment and more consistent development road maps, inter-operability, reduced consumer switching costs and international roaming capabilities. They also provide collectively agreed upon best practices that can drive more efficient usage of spectrum and energy/power, two particularly important elements in resource-scarce areas. These advantages have accelerated deployment of telecommunications services above and beyond what could have been expected if technologies had remained fragmented.

Nevertheless, an acceptance of standards does not necessarily mean that regulators should specify which standards should be used with respect to any specific spectrum allocation or defined service. Nor does it necessarily mean that regulators should limit potential operator technology selection 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 access infrastructure.

There is, of course, the risk that licensees may choose to deploy non-standard, unique and proprietary technologies, but given the substantial benefits of internationally recognized and adopted technologies, this is considered a relatively low risk possibility.

5.6 The role of wireless technologies in providing local broadband access

Clearly the scope for deploying fixed-line broadband local access technologies (whether cable or xDSL) into non-urban or financially marginal areas is limited due to the costs incurred in laying lines. Consequently, there has been significant interest in the use of wireless technologies to provide broadband access.

The fundamental advantage of wireless technologies compared to wireline alternatives is the avoidance of the investments required to deploy a comprehensive fixed local loop. But due to radio planning requirements, different wireless technologies incur very different capital expenditures and, therefore, exhibit different relative levels of attractiveness as a broadband access technology.

There are in effect a number of generic categories of wireless technology available for deployment that support broadband access:

- Mobile telephony standards and developments, including EDGE, WCDMA (HSDPA/HSUPA), UMTS-TDD and CDMA 1x;
- 802 standards and developments, especially .11 (WiFi), .16 (WiMAX), .15 and .20 (Mobile-Fi); and
- Other standards, generally proprietary although often based on the above standards.

The relative advantages of these different technologies are summarized in the following table:

Figure 4: Relative functionalities/capabilities of alternative wireless broadband access technologies

Technology	Used frequencies	Supported data rates	Cell radius	Notes
EDGE	850 / 900 / 1800 / 1900 MHz	Up to 384 kbps	1 km	Deployed globally; extensive availability of terminals
WCDMA	1900 / 2100 MHz	Up to 2 Mbps	0.4-2 km	Large-scale deployment; widely-supported by vendors
HSDPA	1900 / 2100 MHz	Up to 14 Mbps	2 km	Enhancement to WCDMA; limited deployment in Japan
1xRTT	450 / 850 / 950 / 1800 / 1900 / 2500 MHz	Up to 144 kbps	Up to app. 50 km	Widely used as fixed wireless solution
1xEV-DO	2.3 GHz	Up to 2.4 Mbps	Up to 15 km	Deployment mostly concentrated in North Asia; widely supported by vendors
UMTS-TDD	1.9 / 2 / 3.4-3.5 GHz	Up to 7 Mbps	29 km	Deployed in a few countries, e.g. New Zealand, Australia, Portugal, etc.
WiFi	2.4 GHz	Up to 11 Mbps	100 m	Widely deployed globally; backed by major vendors with range of terminals available
WiMAX	3.5 GHz	Up to 75 Mbps	Up to 50 km with line of sight	Believed to be optimal solution for fixed wireless access and for pushing broadband into rural areas

Source: Selected vendor white papers.

Although Wi-Fi technologies often utilize unlicensed spectrum frequencies, which relieve potential operators of upfront investments in terms of licence fees and, therefore, has scope to improve the financial business case of broadband access provision, they have largely been used for wireless local area networks (WLANs), the use for which they were engineered. There have, however, been several cases where WiFi technology has also been used to provide Wireless Metropolitan Area Networks, and this is explored more fully in the GSR Discussion Paper on Broadband Provisioning. Such longer-range uses require outdoor routers and some form of Internet backhaul, either through cabling or the use of VSATs. From a global perspective, it is interesting to note that by region – including Africa, Asia Pacific, the Americas and Europe/CIS – on average about 67% of countries across these regions are allowing WiFi to remain unlicensed.

WiMAX is increasing being cited not only as a wireless backhaul technology (especially to connect Wi-Fi hotspots) but also as a mechanism for providing broadband connectivity directly to end-user terminals. If WiMAX fulfils its stated potential then the implications for developing countries will be substantial, and this could be the technology that makes an immediate and ready impact. This will be true especially if it can be overlaid on existing mobile network infrastructure (e.g. masts and sites). It is expected that vendors will commercially ship WiMAX equipment in the first half of 2006 and that this could change existing pricing models. Anticipating that WiMAX could become the key driver of broadband deployment, many regulators are already reviewing spectrum plans and

allocations in order to make provision for new fixed and mobile wireless access services including WiMAX, e.g. Hong Kong, China, Mauritius and Singapore.

To date, the primary broadband capable wireless technologies deployed and taken-up are in fact the standard dominant mobile technologies comprised of EDGE, WCDMA and CDMA 1x.

GSM and CDMA mobile technologies have, in many developing countries, become the primary form of telecommunications infrastructure and access to telecommunications services. The extent of geographic coverage of these technologies combined with the relative ease of taking mobile services has accelerated their take-up. As such, any discussion over network deployment, including the deployment of broadband access networks, should include a consideration of the role of mobile technologies.

There has been increasing deployment of high-speed mobile data networks in developing countries, primarily CDMA 1x - but also EDGE and in the longer term, WCDMA. Many limited mobility solutions deployed across Asia and Africa, for example, use CDMA 1x in the 450 and 800MHz frequency bands (e.g. Ethiopia, Indonesia, Nigeria, Sri Lanka and Uganda). In Nigeria, for example, private telecommunications operators have focused largely on fixed wireless for rapidly rolling out infrastructure, capturing 25% of the fixed line market in the process.

CDMA 1x, EDGE and potentially WCDMA all have the functionality to potentially act as broadband access networks. A number of CDMA 1x operators in developing countries now provide broadband functionality through, for example, the use of data cards (e.g. Reliance in India). Similarly, an Asian EDGE operator has privately suggested that its traffic performance indicates that some cybercafés in rural areas are using EDGE handsets as modems to provide internet connectivity.

Box 9: Providing broadband data connectivity using 1x: Reliance in India

Reliance launched its 1xRTT network in February 2003 as a limited mobility proposition although Reliance's licence was subsequently converted to full mobility under India's unified licensing framework.

As at 1Q05, Reliance had more than 9million subscribers.

There are plans to upgrade the network to one that is 1xEV-DO-enabled.

The operator provides a range of data services across the 1xRTT network to mobile handsets. For example, news video clips, e-commerce, mobile banking, cricket information and receiving of examination results.

The operator also provides data services to corporate customers (especially SMEs) including enterprise related services and data-cards to provide broadband access to PCs and laptops.

However, both 1xRTT and EDGE have limited functionalities when compared to alternative wireless broadband access technologies (e.g. in terms of supported data rates). Furthermore, the development paths for 1xRTT and EDGE (1xEV-DO and WCDMA respectively) may be difficult to justify in developing countries given expected revenue performance. For example, recent modeling exercises undertaken by the authors to determine the viability of large-scale WCDMA deployment in selected North African and Southeast Asian countries suggest that such deployment may make sense only in the main urban centres.

That said WCDMA and 1xEV-DO unit costs are declining rapidly. It has even been suggested that with the deployment of HSDPA, the functionality of WCDMA may be so enhanced as to become an appropriate substitute for fixed-line broadband access (e.g. xDSL or cable) and alternative fixed wireless broadband access technologies (e.g. WiMAX). However the costs of these networks are likely to remain relatively high in the foreseeable future and are therefore unlikely to achieve substantial geographic deployment outside designated core urban areas.

What is apparent, however, is that in the absence of fixed-line infrastructure ,and given the technical constraints (i.e., latency issues, etc.) of satellite broadband access provision (which is expected to remain limited to providing broadband access to targeted company and public organization locations), wireless technologies will remain key in providing broadband to the mass-market in non-urban and even urban areas of developing countries. Regulators that are keen to promote the deployment of broadband networks, therefore, will have to position wireless access as central to any strategy – even if this revolves around promoting the use of higher-speed mobile networks and encouraging their use for internet access. More specific technologies, e.g. UMTS-TDD and in the longer term WiMAX, are available for use if the appropriate spectrum frequencies are made available.

Consequently, regulators could seek to provide appropriate frequencies to licensees, allocating spectrum on a technology neutral basis; they may seek to provide incentives, as detailed above, to increase network investment.

5.7 Role of alternative technologies in providing local broadband access

Alternative broadband access technologies include cable, satellite and potentially power-line communications. These technologies have attracted significant attention, however, while cable delivery has demonstrated its role as a broadband access technology, take-up of satellite broadband access remains limited. It is nevertheless considered to be a viable option for developing countries. Power-line communications is often discussed though the extent of its validity in developing countries where powerline infrastructure may be limited has yet to be proven.

In more developed countries, a primary driver of broadband take-up is competition between PSTN and cable operators (e.g. Hong Kong, South Korea, United Kingdom and the United States). In many of these countries, for example, it was the initial move by cable operators that prompted incumbent PSTN operators to respond with xDSL. Furthermore, in the absence of large-scale local loop unbundling access, the only large-scale competitive threat to PSTN operators still comes from owners of alternative access infrastructure, of which cable operators tend to have the most extensive alternative networks.

Cable infrastructures are more limited in developing countries although they have been deployed in a number of upper middle-income economies (e.g. Hungary), some lower middle-income countries (e.g. Thailand) and even in some low-income economies (e.g. India). In these markets, however, the geography of cable remains limited to urban areas and even within these urban areas, are typically limited to the more prosperous areas. Fundamentally, cable remains more focused on wealthier urban environments. It is also a relatively expensive technology to deploy given the infrastructure requirements and options for reducing incurred costs (e.g. by not digging cable but using poles) further raise associated risks such as theft, etc. In some countries, there are also constraints resulting from the quality of the cable network and its ability to support broadband services. However, where there is existing cable infrastructure a number of operators are offering cable modem services, such as in the case of Thailand.

Reflecting its lower cost structure, satellite broadband delivery has attracted attention although take-up of such platforms remains limited to date, especially compared to other access technologies (DSL and cable) and has been marked by the failures of the Low Earth Orbit (LEO) platforms, e.g. Iridium. This is not to say, however, that such services are not widely offered (including in developed countries, for example, Canada, Ireland, the United Kingdom and United States) especially as many satellite operators (e.g. Eutelsat, Hughes Network Systems and Shin Satellite) have been aggressively promoting satellite broadband solutions.

There are a range of satellite broadband deployments in developing countries (including Chile, Ethiopia, Guatemala, Peru and Thailand), a number of which are highlighted below.

Box 10: Examples of satellite broadband service provision (developing and developed countries)

Algeria: provision of satellite broadband to enterprises and public organisations in rural areas.

Ethiopia: Schoolnet is a UNDP funded programme to provide satellite broadband to 400 schools.

Ireland: Smart Telecom has a contract with Eutelsat to provide satellite broadband access to 530 schools.

Thailand: Commercial deployment of satellite broadband services and delivery to schools.

Uganda: Trial provision of satellite broadband services to number of rural schools.

The primary advantage of satellite service provision is that it avoids the requirement for supporting backbone infrastructure compared to other technologies, both wireline and wireless. Furthermore, the VSAT required to access the satellite broadband service can be powered by batteries or solar-power, thereby removing the requirement for connection to the power-grid. This allows rapid provision of broadband access to all areas of a country (assuming that the satellite footprint is sufficient and that there is sufficient transponder capacity).

The key constraints in the use of satellite platforms, however, remain the issues over capacity (especially as new satellites are relatively expensive) and potential cost (although small VSAT/dishes have declined in cost substantially in recent years, transponder leasing costs can be relatively expensive).

Similarly, although power-line communications that support the delivery of telecommunications services over electrical infrastructure (with only minor modifications) (including broadband) has received much recent attention, it remains for the most part in trials phases. The use of existing electrical power infrastructure reduces the requirement to incur substantial telecoms network investment and consequently has attracted substantial attention as a mechanism for providing an alternative fixed local loop with broadband capabilities.

Powerline is dependent on existing electrical infrastructure that in many areas of developing countries is characterized by a marked absence. As such, powerline communications may be no more appropriate than other forms of fixed-line telecommunications infrastructure..

5.8 Other options for securing access to the local loop: wholesale provision

The deployment of broadband access services has to a certain extent been encouraged in more developed countries through various forms of local loop wholesale products, including full local loop unbundling and line resale. These products allow new entrants to access end-users without incurring the investments necessary to build local loop infrastructure.

There are various forms of local loop wholesale available. The key options are detailed below.

Box 11: Local loop wholesale options

There are three main types of local loop unbundling:

Local loop unbundling allows access seekers to have management control over the copper pairs connecting a subscriber to the incumbent's main distribution frame (MDF). The access seeker can provide both voice and data services on the incumbent's network.

Shared access refers to the arrangement where competitive service providers have access to either voice or data transmission over the incumbent's network. The access seeker leases part of the copper pair spectrum while the incumbent maintains control of the copper pair.

Bit stream (or wholesale) access involves the incumbent installing high-speed access links to its customers and opening these links to competitors. In this case, the access seeker has no management control over the physical line and is not allowed to add any equipment to the network.

The success of providing wholesale local loop products has varied between countries but in Hong Kong, China, the United States and Germany, unbundled local loops (or network elements in the United States) now account for a significant proportion of direct exchange lines. The establishment of LLU access prices, and other local loop wholesale services, at appropriate levels (i.e. levels that permit operators acquiring unbundled local loops an appropriate margin) has encouraged alternative operators to provide broadband services to end-users using unbundled local loops and this has played a role in creating demand for broadband access.

Provision of local loop wholesale services in developing countries, however, is fundamentally different from the provision of such services in more developed countries.

In developed countries, the local loop had often been substantially constructed prior to market liberalisation by an operator that had a significant period of time as a monopolist to recover the costs incurred. As such, there was no need to encourage further network deployments to improve teledensity but there was a requirement to encourage service competition by allowing new entrants access to end-users (especially as the need to encourage competition is often constrained by the incumbent's position in the local loop).

Therefore, when determining the pricing of wholesale products to the local loop in developed countries it is considered appropriate to use methods that incorporate incremental costs, i.e. the incumbent operator should only be able to recover those costs that it incurs in the provision of the wholesale product. The adoption of this pricing methodology has increased the viability of market entry by reducing costs involved in accessing the local loop and thereby encouraging the development of more competitive markets.

The situation in developing countries is fundamentally different for the following reasons:

First, many developing markets are being liberalised in order to achieve higher levels of network investment, i.e. the relative date of liberalisation is earlier than in many developed countries in terms of the state of development of their telecommunications industry. As demonstrated above, if managed correctly within an appropriate policy framework, liberalisation can result in substantial improvements to teledensity and this is the primary intent of the liberalisation process (especially improvements in network deployment to more marginal areas). Service based competition (as facilitated through the provision of wholesale local loop products) is, therefore, less relevant at this development stage.

Many incumbent operators may not have had sufficient time to recover the costs of local loop network deployment. As such the use of incremental pricing methodologies may not be appropriate and fully allocated costs approaches may have greater justification and validity. However, the use of such pricing approaches will result in higher wholesale prices (and may include the inefficiencies

and historic network structures of the incumbent) and consequently will reduce the relevance of local loop wholesale access to alternative operators.

There may be concerns over institutional capabilities and resources in many developing countries and their ability to implement a requirement for incumbents to provide local loop wholesale services. Even in developed countries, a number of countries have struggled to establish a local loop wholesale framework that encourages the development of market competition. Many incumbents have successfully impeded such processes through technical limitations (e.g. lack of space in exchanges to permit co-location), slow processes (e.g. limitations on visiting access by other operators to local exchanges) or by agreeing wholesale prices that do not allow other operators to construct a viable business case.

Therefore, few regulatory authorities in developing countries have opted to build their broadband access strategy solely on the provision of wholesale local loop products by incumbent operators. Those that have opted to implement local loop unbundling recognize that its success rests on the ability to enforce the associated requirements.

Although the provision of wholesale local loop products remains very limited in developing countries, a few developing markets are planning to or are implementing mandated local loop requirements.

Box 12: Acquiring access to the local loop: Local loop unbundling in Poland

In February 2005, the Polish Office of Telecommunications and Post Regulation issued a directive requiring the incumbent telecoms operator, Telekomunikacja Polska (TP), to provide other operators with access to its local loop. The move is part of a plan to further liberalize the telecoms market in Poland.

In the first phase of local loop unbundling, TP will provide both full (voice and data) and shared (data) access to competing operators. There are plans to extend the local loop unbundling offer to include bitstream access.

The regulator is still reviewing the cost model submitted by TP. However, it is understood that LLU tariffs will be defined by benchmarking them against other European providers operating in competitive markets.[17]

Likewise, in September 2005 the members of the West African Telecommunication Regulators Assembly (WATRA) agreed to a set of regulatory guidelines to govern regulation in West Africa that includes support for bit stream access.18

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:

- Where the incumbent operator has an extensive and well-developed network;
- The existence of clear and complete regulations that spell out all unbundling requirements to ensure that strong operators do not impede access to their exchanges; and
- The encouragement of continuing investments from both incumbents and new operators in new infrastructure rollouts

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.

5.9 Removing other network bottlenecks, e.g. backbone and international connectivity

There is scope for multiple network bottlenecks in the provision of broadband services, both by incumbents and new entry operators. In particular, bottlenecks can occur both in terms of the presence of actual infrastructure (i.e. a lack of required infrastructure) and/or ownership of the required infrastructure (i.e. all the required infrastructure owned by a single operator – typically the incumbent).

For example, in some markets, incumbents have used their ownership of backbone infrastructure to impose constraints on the ability of new entrants to compete by:

- Imposing excessive access/leasing costs (in some markets, for example, incumbents levy higher leasing charges on competing telecommunications operators than their corporate customers;
- Limiting the amount of bandwidth and the QoS supported; and
- Imposing restrictions on points of interconnection, for example, with respect to access to international switches or technical restrictions.

In a number of markets, control of backbone and international connectivity (whether by incumbents or other monopoly operators) has been used to manipulate and constrain the development of competition. This could lead to artificial shortages of bandwidth and inflated prices, thereby hampering the provision of robust global telecommunications services. Due to such concerns, the regulator in Singapore, for example, has moved towards opening up access to submarine cable landing stations in order to enhance competition in the provision of telecommunications services.

There are two main options available to regulators to remove the adverse consequences of such ownership of backbone infrastructure:

- Impose a tighter regulatory framework on those owners of bottleneck infrastructure to ensure that other operators, especially those providing broadband access services to end-users, can access such infrastructure at an appropriate pricing point; and/or
- Encourage existing licensees or new licensees to deploy alternative infrastructure.

Regulatory intervention to determine the terms and conditions associated with access to an operator's existing infrastructure is often required where the costs and timelines associated with duplicating such infrastructure would be so excessive as to not be commercially viable. It may also be necessary where the ability of new licensees to deploy local access infrastructure (and hence improve teledensity) is constrained by investments in backbone and international networks.

For example, with regard to access to international networks, it may not be expected that a new entrant be able to deploy such networks due to the high costs and advanced technical skills involved. Some countries, however, have permitted new entrants to install VSATs with international access, or are allowing local broadband providers to connect directly with the international backbone, rather than terminating traffic through an incumbent's international gateway. In many developing countries, however, even where international traffic has been opened to competition, the incumbent owns control of access to international network infrastructure and is able to use this control to impose excessive prices on other operators and, thereby, impede their market competitiveness. Thus, regulators are increasingly stepping in to ensure that new entrants gain fair and competitive access to existing backbone infrastructure. This is important to the commercial viability of market entry whether a new entrant relies on interconnection, leased circuits or is required to dig its own networks for trunk carriage of traffic. In addition, regulators are finding that the reliance on international connectivity can be reduced through the development of Internet Exchange Points and local caching, which the government can actively encourage or establish.[19]

Box 13: Removing network bottlenecks: Introducing competition to IPLC in India

The Indian telecommunications regulator, TRAI, is planning to introduce more competition into International Private Leased Circuits (IPLC), which are currently "bottleneck" facilities with implications for international telecom services like International long distance (ILD), internet and broadband.

There is a significant lack of competition in the IPLC market at present, forcing smaller operators out of the market for several services relying on such capacity. The reasons for lack of competition include:

- There are a limited number of landing stations in India, which are owned and controlled by a small number of operators;
- The IPLC providers, who are also Internet Service Providers (ISP), are able to charge other ISPs prices that are significantly above costs, thereby forcing out competition in the ISP space;
- IPLC providers also charge substantial prices to non-facility based ILD operators, with whom they also compete in the ILD space.

In response to this, TRAI has undertaken/is planning the following initiatives:

- TRAI has recently fixed the ceiling tariff for various capacities based on the cost of the incumbent operator. The differentiation in the pricing of IPLC based on usage by ILD operators and ISPs have also been removed.
- TRAI is reviewing the need to permit resale of IPLC to other operators, which was previously disallowed on the grounds that this would delay the setting up of sufficient ILD infrastructure in the country.
- TRAI recognises the need to facilitate the access to cable landing stations by new service providers as well as by the new international cable carriers.
- TRAI is also planning to facilitate mutual sharing of landing station infrastructure as well as international cable capacities amongst the carriers.[20]

It is also necessary to encourage the construction of supporting backbone networks, especially if the intent is to deploy infrastructure into rural areas. However, such requirements are more likely to be effective if they are not so prohibitive as to deter market entry. With respect to encouraging licensees to deploy alternative infrastructure and, furthermore, to deploy infrastructure into areas previously not accessed by telecommunications networks, there are a number of options/approaches for the regulator to consider:

- Facilitating existing operators of telecommunications infrastructure used for alternative activities, e.g. railway signaling or pipeline monitoring, to make excess capacity potentially available in their systems to licensed telecommunications operators (i.e. to become licensed telecommunications operators);
- Ensuring and facilitating access to government land, including railways, electrical grids and road networks (including tunnels). For example, by streamlining and standardising the application process, as well as ensuring just and reasonable fee structures;
- Ensuring that telecommunications networks are incorporated into new infrastructure developments, for example, by providing broadband ducts into new roads or by incorporating cables on to new electrical grids (for example, Chile's ICT project side-stepped difficulties of geographical isolation and infrastructure shortage in rural areas by taking advantage of infrastructure that provide electricity to rural communities); and
- Creating/joining a broadband alliance to pool financial and other resources and to enhance negotiation power with network vendors (for example, the Wireless Broadband Alliance which joins operators in the United States, United Kingdom and the Asia-Pacific region, provides the benefit of scale in areas such as testing of products and services, influencing

development and adoption of technology standards, international roaming agreements amongst member-operators, etc.).

Experience from a number of more developed markets, e.g. Australia and the United Kingdom, shows that backbone networks can be more quickly established by leveraging existing infrastructure. For example, cables can be strung across electrical pylons that can also act as the location of radio antennas for wireless technologies. Other alternative infrastructures include main roads, gas and oil pipelines, and water channels (especially maintained canals).

Box 14: Removing network bottlenecks: Using the Indian rail network for backbone connectivity

Railtel Corporation of India was set up in 2000 to exploit communication assets lying idle commercially along India's rail network. Since then, the company has laid 25,000 km of fibre optic cables along the rail network.

Railtel provides leased lines to telecoms service providers, along with other infrastructure like tower space and co-location services. In addition, it is also an Internet service provider, operating a network of Internet kiosks set up at railway stations.

The company has plans to open an additional 300 cybercafes at railway stations, providing services such as VoIP and video conferencing for local people with otherwise no access to computer equipment and broadband access. Owing to India's extensive railway network, broadband access can be rapidly extended into many marginal areas.[21]

Box 15: Removing network bottlenecks: Using gas pipelines for backbone connectivity in India

Gailtel, the telecoms services arm of the largest gas transmission company in India, operates as an integrated telecom infrastructure provider. The company started leasing bandwidth to telecoms operators like Bharti and Tata in mid-2001. It also operates as an Internet service provider serving corporate and residential customers.

The company has laid an optic fibre co-axial (OFC) network along about 8,000km of natural gas and LPG pipelines, and has plans to extend the network to 18,000km around the country. The network currently serves 73 cities across 8 states.

Due to infrastructural cost-savings derived from overlaying the OFC network on existing pipelines, Gailtel is able to offer broadband services to its customers at substantially lower costs compared to its competitors.[22]

Box 16: Examples of using water ducts for laying of fibre optic cables

Egypt: Egypt is reportedly evaluating the options of providing broadband access by laying fibre optic cables along water conduits.

Japan: Japan is planning to complete 100,000km of fibre optic cables in sewers by 2010.

Sweden: Fibre optic broadband access is provided by running 4,000km of cable along water, sewer and electricity ducts throughout Stockholm. The fibre network provides both "last-mile" and backbone connectivity.

USA: In New York, ducts of an inactive water system originally built for fire fighting is being used for laying of fire optic cables for broadband access. In Atlanta, tests have been conducted on the use of the sewer system as a fibre conduit.

The key issue for discussion remains, however, on circumstances and situations where such supporting infrastructure does not exist. A great deal of basic support infrastructure (e.g. electrical

grids, railways and pipelines) may be lacking in some areas of developing countries that are often separated from urban areas by large distances or rugged terrain. In such circumstances, the regulatory framework can facilitate the use of wireless technologies where traffic is not expected to be substantial – via satellite trunking. This can be achieved through the expeditious allocation of unused spectrum with low spectrum utilisation and/or licence fees. Developing countries may also explore the pooling of resources to collectively launch satellites that can provide broader regional service, or to back a commercial satellite operator. Shin Satellite of Thailand, for example, has just launched its Ipstar satellite, which has a wide footprint across Asia-Pacific. Although it is a commercial operator, its satellite has extended broadband access to rural areas of Thailand, Laos, Cambodia and Myanmar.

5.10 Funding network deployment

The need to deploy infrastructure into more marginal geographies is based on the recognition that without such access, the digital divide both between developing and developed countries as well as between urban and rural areas in developing countries would likely to be maintained and exacerbated over time. Given the benefits of broadband deployment, including cheap voice communication, regulators are playing a critical role in seeking to reduce this divide through the promotion of broadband access deployment.

Box 17: GSR 2003 Universal Access Best Practice Guidelines

We, the regulators participating in the 2003 Global Symposium for Regulators, have identified and propose the following best practice guidelines to achieving universal access to information and communication technology (ICT) services.

A An enabling regulatory environment: the role of governments and regulators

The success of any universal access/service policy is dependent upon political support at the highest level that recognizes the role of ICTs as a tool for development.

1) It is essential that Regulators exist or be established where they do not yet exist, and that their key role in implementing universal access policies and promoting competition be recognized and reinforced.
2) A series of policy and regulatory reform measures can be taken to achieve universal access to ICTs. These include:
   a) Formulating a national policy that identifies appropriate and realistic universal access/service objectives that take into account the differences between universal access—public access to ICTs—and universal service—household or private access to ICTs.
   b) Including all citizens, regardless of gender, ethnicity, socio-economic level or geographic location, in national universal access/service objectives.
   c) Reviewing universal access/service policies, regulations and practices periodically to adapt to the evolving nature of ICT services and the needs of end users.
   d) Conducting periodic public consultations to the extent possible with stakeholders to identify their needs and modify accordingly universal access policies, regulation and practices.
   e) Designing universal access policies, regulations and practices in order to create incentives for the private sector to extend universal access to communications services.
   f) Establishing a fair and transparent telecommunication regulatory framework that promotes universal access to ICTs.
   g) Adopting technologically neutral licensing practices enabling service providers to use the most cost-effective technology to provide services for end users.
   h) Adopting a framework of interconnection rates linked to costs.
   i) Reducing regulatory burdens to lower the costs of providing services to end users.

   .

j) Developing an effective regulatory body responsible for implementing policies directed towards assuring the best quality reliable services at the most affordable prices that meet the needs of consumers—existing and future.

k) Promoting competition in the provision of a full range of ICT services to increase access, affordability, availability and use of ICTs.

3) Countries can use regulatory reform as the first step in achieving universal access, recognizing that further steps may be necessary to achieve ubiquitous access to ICTs, e.g., in rural areas or to users with special needs.

4) Appropriate licensing schemes for rural service providers could be granted to meet the needs of un-served and under-served areas.

B Access to information and communication infrastructures

1) The lessons learned from the initial experiences developing countries have achieved with mobile cellular services can be applied to a broader range of ICT services to foster universal access. These lessons include providing services in a competitive framework, using new technologies that offer both innovative services and affordable pricing options (e.g., pay as you go options such as pre paid cards) to a wide range of end users.

2) Other measures to promote affordable ICT equipment could include national manufacturing of ICT equipment, reduced customs tariffs and duties, and end-user loans to foster affordability of ICT equipment.

3) A full range of public access options can be developed, including the creation of public telecentres.

4) Local input (including the content useful for local populations) into projects increases their long-term financial sustainability.

5) Educating local people on the benefits of ICTs and their use increases their long-term financial sustainability

C Guidelines in regard to finance and management of universal access policy

1) Universal service funds can be viewed as an option that complements regulatory reform and developed as a mechanism within a broader market-oriented approach to achieving universal access.

2) Universal service funds can be financed by a broad range of market players, managed by neutral bodies such as regulators, and be used to kick-start public access projects that meet the needs of the local community.

3) Governments may consider a full range of other financing mechanisms, including tax incentives for ICT providers and end users.

4) Competitive minimum subsidy auctions could be used, as an option, to reduce the amount of financing necessary for public access projects financed by a universal service fund.

5) Public access projects can be designed to achieve long-term financial self-sustainability, especially where consideration is given to innovative low-cost technologies

The first step regulators are taking is to develop a regulatory regime conducive to investment and supportive of commercially viable broadband access network deployment. In other words, they are specifically addressing the market access gap in broadband provision. The need to first address the market access gap in promoting ICT development was explored fully in the 2003 edition of the ITU Trends in Telecommunication Reform (Trends). Just as regulators in their attempt to achieve universal access to basic telecommunications first moved to close the "market access" gap in the telecom sector, regulators can also seek to face these challenges by removing regulatory burdens and encouraging market responses to broadband deployment. This includes facilitating market entry of small players, such as small enterprises and micro-entrepreneurs, as well as encouraging the full range of public service players, including NGOs, libraries and local governments, to drive broadband demand. In addition, regulators can encourage large-scale operators to deploy broadband networks in areas viewed as non-commercially viable in return for access to potentially more value creating business activities or other incentives.

It may also be necessary for regulators to establish mechanisms to fund network deployment especially if there is evidence that even an incentive framework and/or the use of alternative lower cost technologies (e.g. wireless) is unlikely to result in the extension of a broadband access network to certain areas. This may be suitable in the event that there is a market failure that is unlikely to be

resolved in the short to medium term except through some form of government intervention. As explored more fully in the 2003 edition of Trends, these measures can be maximized — as can governments' ability to afford them — by limiting such measures to addressing the true access gap. Thus, only once governments have moved to eliminate the market efficiency gap, through sector reforms, are they considering the use of targeted and limited "smart" subsidies to spur the deployment of broadband access networks to areas and populations that would otherwise not be reached.

There are various true access gap measures available to regulators, including:

- The licensing of special rural operators whose remit is to deploy broadband access networks in defined geographies (concession areas) with the support of universal access funds or other direct grants. Licensees would be selected on the basis of the minimal required subsidy to achieve specified targets. By licensing such rural operators within specific defined areas, regulators can "leapfrog" the traditional diffusion of new technologies from urban to rural geographies;
- Providing funding for local community initiatives to provide broadband access. While many universal access funding programmes have taken a top-down approach by which fund administrators (often regulators) identify the communities for which targeted subsidies will be made available, a bottom-up approach could also be used. Provided the development of an awareness raising campaign, this could allow communities themselves to apply for funds to deploy broadband access networks. This would help to ensure local community involvement in and demand for broadband access.
- Direct and indirect financial support in return for the deployment of broadband access networks. Governments could provide tax exemptions to operators that rollout telecommunications infrastructure in rural areas. Where this is still commercially unviable, full funding and partial funding may be considered. Alternatively, the government may provide preferential loans to operators with the specific purpose of funding the accelerated deployment of broadband access networks.
- Requiring operators (either the incumbent, a specific operator or all operators) to deploy broadband access networks, to be funded in whole or part by payments made by all operators (either as a flat-rate or as a percentage of qualifying revenues) or by general government revenues. The operator(s) responsible for the provision of universal broadband access would receive financial incentives or payment for each new broadband access line installed but could also be given the freedom to determine in which specific locations it would deploy such infrastructure. Before allocating financial incentives or payments, governments often prefer to calculate the net benefit of operators providing broadband access networks and compensate operators only where the costs of providing broadband access exceed the benefits of doing so.

Any such involvement in financially supporting the deployment of broadband access networks has a number of potential difficulties including ensuring that the allocated funds are used for the expressed purpose of deployment infrastructure in marginal areas. This requires the regulator to have the institutional capability to manage and oversee the allocation process and to provide maximum transparency.

There are examples of such regulatory frameworks, including Korea (Rep.) and a number of South American countries.

Box 18: Encouraging broadband access network deployment: Korea (Rep.)

The **Korea** Information Infrastructure (KII) Project was established in early 1995 as an avenue to promote nationwide broadband usage.

The ultimate aim of the project was to provide broadband networks to 13.5 million subscribers with the average transmission rate of 20Mbps by 2005.

To achieve its objective, the government supplied public funding to facilities providers for partially easing the burden of investment in access networks, with greater funding reserved for remote areas. In addition, some enterprises were offered tax exemption on deployment of broadband infrastructure.

The government provided loans at preferential rates worth US$77million to facilities service providers in 1999 and committed an additional US$77million in 2000 for the purpose of deploying infrastructure in less densely populated areas. Subsequently, public funding was extended to include infrastructure build-out in rural areas, with additional investments amounting to approximately US$900million.[23]

Box 19: Encouraging broadband access network deployment: Use of universal access funds

In 1995, the **Chilean** government established a Universal Access Fund to provide public telephone systems to isolated rural areas, through a competitive "bidding for subsidies" programme. The fund managed to secure approximately US$160m in investments, of which about 85% came from private companies. With support from the fund, public telephones were provided to about 6,000 rural localities, reaching 2.2m inhabitants within 7 years. Reliance on market forces and minimal regulation, amongst others, has been credited for the success of the scheme.

In **Peru**, universal access funds for the Fondo de Inversión en Telecommunicaciones (FITEL) are collected through a one percent tax on the gross revenues of all public telecommunications companies. The funds are then allocated through public competitive bidding to operators deploying infrastructure in locations of priority social interest.

Deployment of broadband access networks by large scale network operators, even wireless based, may only be commercially viable in many areas of developing countries (and even a number of areas in developed countries) if an incentive framework is incorporated into the licensing approach, coupled with government funding and initiatives that generate customer demand. Targeting such large-scale operators for broadband deployment, consequently, may require the use of regulatory incentives or funding, either directly or indirectly, to support and promote broadband access network deployment. Another approach is to encourage small-scale players to serve local communities by removing regulatory burdens that often apply to large-scale operators, and allowing small players to test the business case for broadband access and build demand. The key issue is deciding which approach has the best fit with the underlying regulatory and institutional capabilities, and which approach minimizes the extent of government involvement while maximizing the commitments of private investors.

5.11 Enforcing competition

To ensure a reasonable level of competition in an emerging broadband market, a regulatory framework that prevents anti-competitive behavior by operators (especially dominant operators, i.e. those operators that are capable of acting independently of competitors, buyers and sellers) is a pre-requisite. Such regulation should not be onerous and excessively restrict the business conduct of dominant operators but should be designed rather to prohibit conduct which has the potential of preventing or constraining the development of market competition.

Examples of potential business conduct by dominant operators that should be prohibited include:

- Predatory pricing (i.e. providing services at less than cost);
- Mandatory product bundling (i.e. 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 (i.e. applying different prices and terms and conditions according to end-user); and
- Cross-subsidisation (i.e. using profits generated in a market in which an operator is dominant to subsidize its operations in a market in which the operator is not dominant).

In addition, associated obligations typically applied to dominant operators include:

- Requirements to provide interconnection to competing operators on appropriate terms and conditions; and
- Obligations to ensure that tariff structures comply with regulatory requirements including price controls as appropriate.

All of these issues are relevant to the broadband access market. A dominant operator, i.e. the incumbent, could distort the development of broadband access market competition by undertaking the above business conduct in order to impede the business of new entrants, e.g. by undertaking predation or cross-subsidisation in order to force smaller broadband access providers from the market.

In addition, reflecting the regulation of other telecommunications products and given the dominant position of the incumbent in the provision of broadband access networks, as well as other required network components, the broadband access market could be subject to *ex-ante* rather than *ex-post* regulation. *Ex-post* tends to be applicable when there is sufficient evidence that competitive market forces will function properly and that no operator has an apparent dominant market position. Given the structure of telecommunications markets, including broadband access networks, there is no reason to suggest that such circumstances exist.

Even within an asymmetric regulatory framework, however, it remains important to avoid excessive regulatory burdens. Regulations can be carefully tailored and minimized to address key concerns, including the prevention of anti-competitive business conduct, compliance by operators with their licence commitments and the protection of end-users. This may include relaxing price regulation practices, for example, by replacing regulation of all tariffs levied by a dominant operator by a general price cap regime, with the goal of ending price regulation when the market is genuinely competitive. Even with such goals, however, new services may hasten the end of price regulation. While some regulators may prefer to give dominant operators pricing flexibility only once tariff rebalancing has been undertaken, the rise of new services, such as VoIP, whose prices are not regulated, may force dominant operators to lower their prices to retain market share.

Finally, section 5.7 of this paper has already detailed the role of competition between cable and telecommunications companies in driving competition in the broadband access market and hence, take-up. Therefore, cross-ownership of telecommunications and cable network companies can serve as an impediment to broadband development. This is because such an integrated provider is unlikely to deploy both DSL and cable modem networks as the two businesses would cannibalize on each other. As a result, only one of the two technologies would be deployed, leading to high retail prices.

Box 20: Enforcing competition in the telecoms and cable markets: Limiting cross-ownership in the EU

In 1999, the EU issued a directive requiring the separation of telecommunications and cable TV operations into distinct legal entities.

It is believed that cross-ownership of telecommunications and cable operations prevent cable companies from providing low-price voice telephony services in competition to those offered over telecoms networks. In addition, there is little incentive for telecoms operators to upgrade their existing telephony networks to full-scale broadband capability via xDSL.

Hence, under the new directive, dominant public telecoms network operators are required to run their cable operations as separate legal entities. It is thought that this would prevent emergence of new anti-competitive gatekeeper positions or bottlenecks and would encourage competition and innovation in both the telecoms and cable markets.

This is an issue for developing countries as well and could be incorporated into regulatory frameworks.

5.12 End-user terminals / equipment

Promoting broadband access requires more than access to broadband networks. People in developing countries also require access to personal computers or other end-user terminals. Are there low cost devices that can enable users in developing countries to receive broadband enabled services, products and content? What role can regulators play in improving PC and low cost devices penetration in the developing world? Without a solution to the problem of low PC penetration rates, the provision of broadband access networks will have little impact.

It is important that any policy to encourage the deployment of broadband access networks also considers appropriate policies that encourage the promulgation of end-user terminals, especially PCs, in order to achieve the full potential of broadband access networks.

There is of course a significant constraint to encouraging the take-up of PCs in terms of the incurred entry costs. One option relevant for most developing countries is the development of single access points where users can access PCs at a single location whether it is a cyber-café (often the primary mode of accessing the internet in many developing countries) or a community centre (including schools and public offices). For example, in Sud Mennucci, a town in southern Brazil, plans are underway to set up Internet centres to reach out to low-income rural communities.

Box 21: Extending broadband access to rural communities: Installing Internet centres in Southern Brazil

Sud Mennucci is a town with 7,500 inhabitants, located 700km southeast of Sao Paulo.

There is a plan to install two Internet access centres with 10 computers by end of 2005, to provide Internet access to low income inhabitants.

Three solutions have been proposed to realize this plan:

Have the federal government donate the computers for the centre;

Incorporate the plan into the state government's Acessa Sao Paulo programme, which aims to provide free Internet access to dozens of municipalities in Sao Paulo state, or

Engage private companies to set up the centre and provide training in the use of technology.[24]

There are, however, many alternative options for encouraging PC take-up, some of which are detailed below:

Box 22: Encouraging PC penetration: Selected examples

In **India**, the government has launched an "Indian PC Programme", which aims to improve PC penetration from the current 14 per 1,000 to 65 per 1,000 by 2008. Some of the initiatives include: launching Rs 9,999 (US$230) "no compromise" PCs, subsidized by software vendors and chipmakers; encouraging all incumbent operators to move towards a subscription model for broadband and PC as a package; setting up loan schemes, employee provident funds and other saving funds to encourage PC adoption amongst government employees; and amending the Income Tax Act to include deduction of home PC purchase price.

In **India**, cybercafe kiosks have been set up along railway tracks around the country to provide computer access to rural villages. As a result, rural communities now have access to e-Government, tele-education and telemedicine services.

In **Mexico**, under the e-Mexico project, community plazas equipped with public Internet kiosks were set up in 3,200 municipalities around the country. Each community plaza has an average of 10 computers and has Internet access via satellite technologies.

In **Sri Lanka**, in co-operation with the World Bank, the Sri Lankan government is planning to set up telecentres in rural areas around the country to improve community access to ICTs. The target groups for these include farmers, students, SMEs and other marginalized groups.

In **Thailand**, a "Computer ICT Programme" was launched in 2003 to provide low-cost computers. In addition, there is plan to establish a nationwide network of 751 tele-centres located at various post offices throughout the country.

In **Tunisia**, the World Bank is working with the Tunisian government to subsidize 6,000 Publinets and 10,000 PCs under the "PC Familial" programme. There is also an investment plan to increase the number of PCs in schools.

In **Uganda**, Uconnect, an NGO based in Uganda, imports used computers from Europe and the United States, revamps them and supplies them to schools and organizations. About 100 mostly rural-based schools have benefited from this project.

5.13 Increasing the awareness of broadband

This paper has thus far focused on the role of regulators in stimulating the supply side of the broadband access market, i.e. encouraging network build-out. There are, however, significant opportunities for regulators to promote usage of broadband through the expansion and improvement

of applications and services available to end-users, especially in terms of relevance, as well as improving end-user and other agency awareness.

Given scarce capital resources in many developing countries, there is a requirement by regulators (and appropriate ministries) to demonstrate the relevance and necessity of promoting the deployment of broadband access networks, especially if funding is required in some form. This requires a clear demonstration of the benefits of broadband access and the preparation of a holistic ICT strategy of which broadband access is but one component.

In particular, a number of countries have used e-government projects to initiate and support information and communication technology (ICT) and, specifically, broadband development. Such projects have a number of objectives including:

- To enhance the efficiency of government through more rapid and structured information and workflows, i.e. manual transactions to online transactions (e.g. more simplified procurement processes);
- To improve government linkages with the population (i.e. to allow more ready access to government services , officials, and information);
- To expand the reach, awareness and understanding of broadband access (especially important as governments are often one of the largest employers in many developing countries); and
- To provide a framework to attract local and foreign investments.

For example, the ITU is working on a Global E-Government Project to enhance government services through the use of secure and trusted Internet infrastructures and applications in selected developing countries[25].

The Vietnamese government, in co-operation with the World Bank, is currently working on implementing an e-government plan, which aims to promote and sustain extensive take-up of broadband.

Box 23: Increasing awareness of broadband: E-government project in Vietnam

The Ministry of Posts and Telematics (MPT) in Vietnam has recently drafted a National ICT Master Plan for 2006-2010 and an E-Government Master Plan to 2010. These initiatives will be implemented in co-operation with the World Bank.

The ICT Master Plan aims to achieve:

a wide diffusion of ICT through Vietnam's economy and society, such that ICT accounts for a higher percentage of GDP;

establishment of a nationwide information and communications network;

a comprehensive ICT skills development;

As part of the process to improve e-readiness in Vietnam, the ICT project will address the following issues:

- strengthen technical and managerial capacity of the MPT in implementing the ICT initiatives;
- facilitate increased access to telecommunications in the context of a gradual move towards a more competitive market environment and private sector participation;
- promote greater awareness of ICT and e-applications in the business community, with the view to encourage businesses to adopt e-commerce;
- support enhanced government online presence and content at the national and municipal level, through interactive and dynamic portals;
- roll out e-government services to businesses in areas such as e-procurement and business/land registration; and
- support extensive training and awareness-raising efforts to encourage diffusion of ICT in the private sector.

Within such projects, the provision of broadband access networks is just one component of a broader strategy to improve Vietnam's ICT positioning and, hence, provide substantive positive impacts across the economy.

Within the country, telecommunications regulators are in a good position to initiate greater collaboration and co-operation with other government agencies to promote broadband take-up. Apart from e-government projects, which allow other government agencies to be directly involved in the promotion and usage of broadband, inter-government-agency working groups could be established to facilitate the development of broadband infrastructure, particularly in commercially less viable areas where resources can be shared. For instance, the Singapore ONE initiative, which was officially launched in 1997, was designed to be a collaborative effort between government and industry to implement a nationwide broadband network. It was jointly supported and driven by a number of government agencies, including the telecommunications regulator, the Economic Development Board, Media Development Authority and a government research agency.

Regulators and government agencies could take the lead by actually building a broadband backbone network. The success of the Singapore ONE initiative was largely driven by its building and operating of a core Asynchronous Transfer Mode (ATM) backbone network, which enabled broadband access to be provided extensively to public libraries, schools and training centres across the island. This served to raise awareness of broadband and drove broadband take-up across various communities.

Importantly, however, in order to really act as advocates for broadband access, regulators must be able to clearly demonstrate its credible advantages. Indeed the regulator can even take the lead in coordinating the needs of the various government ministries and departments. This is the case in Singapore, where the IDA coordinates all ICT procurement for the government. This paper has

already provided a number of such advantages including the ability to support specific applications (e.g. educational or health). As a further example, the Turkish Ministry of Health is partnering with ITU to develop e-healthcare systems. Specific initiatives include providing healthcare providers and professionals, and citizens with access to health-related information via broadband access, and development of Primary Healthcare Information Systems and Electronic Health Records.

Similarly, the deployment of broadband access networks in Chile was supported by defined positive impacts on the educational system, especially in more marginal areas.

Box 24: Involving local communities: The Rural-Enlaces project in Chile

The Rural-Enlaces is part of an ICT policy to improve education in 3,600 rural schools around Chile, with an estimated reach of 130,000 students.

The project involves the provision of learning aids, such as computers, as well as telecommunication access, including broadband.

The proponents of Rural-Enlaces are convinced that technology should be seen as a means to support existing pedagogical approaches to rural education, rather than as a cultural invasion of the dominant group. Hence, the project aims to involve various segments of the local communities in the implementation process.

For instance, the project is positioned as an opportunity for professional development for local teachers. Apart from benefiting from technological knowledge transfer, teachers are also directly involved in the selection of educational software and nature of content information. In addition, they are consulted on the design of learning practices that are most appropriate and relevant to everyday reality.

Parents are also involved in helping out with various aspects of project implementation at the local schools.

The relevance and potential impact of broadband access networks can also be increased by providing content that is relevant to local communities, particularly in local languages. Morocco, for example, is in the early stages of developing Arabic content for both mobile and Internet services. In Laos, one of the least developed countries in the world, a Lao-language version of Linux-based graphical desktop and Lao-language office tools have been developed and provided to villages as part of a plan to promote wireless LAN.

Fundamentally, in order to be able to increase awareness of broadband access networks and to successfully advocate positioning broadband access at the forefront of a country's telecommunication strategy, regulators need to be able articulate the potential benefits, both direct and indirect within a cost-justified framework. Furthermore, the rationale for broadband is likely to be stronger when contained within a broader and holistic ICT strategy (including policies to improve the rate of PC penetration). This is the challenge for regulators, especially when there are so many other demands on a country's telecommunications infrastructure and on a country's scarce resources.

5.14 Other regulatory concerns

This paper has thus far focused on the promotion of broadband access as an information delivery platform. As broadband take-up and usage widens, regulation of broadband services and applications will become an increasing concern for regulators.

In view of the potential and growing demand for IP telephony, regulators in several countries have begun developing a regulatory framework to address associated issues with the service. These key concerns are examined in greater details in the GSR discussion paper on VoIP:

- Numbering
- Emergency services

- consumer-protection
- Quality of service

In addition to the above, regulators will also need to consider regulatory measures pertinent to any content delivery platform as broadband deployment takes off. Given the superior functionalities of broadband access, some of these concerns are arguably more pressing for regulating broadband than other telecommunications services. These include:

- Having an appropriate framework that can be used effectively against intellectual property infringement;
- Setting in place content regulation guidelines to protect consumers, especially minors; and
- Setting up appropriate and suitably non-invasive regulatory mechanisms over the broadband Internet to ensure that national security is not compromised.

6 Conclusions

Although basic PSTN teledensity is extremely low in many countries at the moment, the rapid development of technologies, especially wireless technologies, provides opportunities for these countries to plan beyond increasing basic teledensity and into broadband.

This should be viewed in the context of the following:

- First, broadband is rapidly taking off across the developed world and is beginning to be deployed in developing countries. Still, deployment in developing countries needs to grow in terms of real numbers and distribution throughout all regions of the world, and between urban and rural areas. In the absence of greater broadband deployment, developing countries will be left behind;
- Second, broadband access networks are able to support applications, services and products which can have substantial positive impacts, including cheap voice communication, and health and educational related services;
- Third, new wireless technologies are rapidly changing the underlying costs of the provision of broadband access and if these technologies meet all their expectations (in terms of unit costs and functionality), then the impact could be substantial; and
- Fourth, deployment of broadband access networks allows developing countries to effectively "leapfrog" the development road map, i.e. not to have to deploy circuit-switched PSTN local loops but to advance straight to IP based local loops with all the consequent advantages.

There are clearly a large number of challenges to be faced. In particular and amongst others, this paper recognizes that the current perceived lack of local demand and available revenue streams could prevent the commercial deployment of broadband access networks in many areas of developing countries, especially non-urban areas, at least by large-scale network operators. Furthermore, continued low PC penetration rates in many developing countries could effectively negate any potential positive impacts that may arise from broadband network deployment.

In response to these challenges, this paper has reached the following conclusions/recommendations:

- Regulators could seek to maximize investment flows into their industries by liberalizing markets and permitting foreign ownership. This includes allowing broadband providers to offer a full range of services and applications, such as the triple play of voice, internet access and broadcasting;

- Regulators can encourage the deployment of wireless broadband access networks by freeing up the requisite spectrum and linked to this recommendation, could adopt a technology neutral approach;
- Regulators can create a regulatory framework that encourages a full range of potential broadband providers, from large-scale national network operators, to universities and government offices to local community initiatives, 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 incentivised to deploy non-commercially viable networks in return for appropriate rewards;
  - Regulators could seek to encourage the deployment of broadband access networks by providing direct (e.g. targeted smart subsidies from universal access fund contributions/grants) or indirect (e.g. tax exemptions) financial support to the full range of broadband providers;
- An asymmetric regulatory regime could be defined, implemented and enforced to prevent the dominant (often the incumbent) operator from constraining the development of competition in the broadband access market;
- Regulators could work with other government agencies or ministries to develop initiatives such as e-government programmes (provided that this is supported by appropriate levels of institutional capacity to support large-scale automated transactions) that generate demand for broadband services;
- Regulators can take a number of steps to encourage the build-out of fibre backbone networks to boost the capability of both wireline 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 and then make it possible for all owners of such communications resources to lease unused capacity to others for commercial deployment;
- Any broadband access development strategy could be linked to efforts to support and promote PC take-up, including government-sponsored PC kiosks and other access terminals, especially in areas where broadband networks are to be deployed.

Promoting broadband access in developing countries, both in urban and non-urban areas, requires a new vision of reduced regulatory burdens, innovative incentives, and coordinated efforts by all links in the broadband value chain. It requires concerted political will to achieve, treating ICT and broadband as a tool for development, and an end to a 'business as usual' approach. Commercial deployment opportunities can be unleashed where unnecessary regulatory burdens are removed so that all potential providers can freely offer broadband access and a full range of broadband-enabled services. Many small players stand ready to respond if their market entry is authorized. For other potential small players, an awareness raising campaign related to broadband technologies and facilitated market entry, may be all that it takes. Public service institutions like libraries, universities and government offices can be tapped to drive demand for broadband access in rural areas. Some larger commercial players will be spurred to action when they see new local markets driving

demand. Commercial players can then continue to drive demand with entertainment content to complement public service content. Other large commercial players may require incentives and targeted government support in order to extend broadband network to rural areas. Moreover, untapped communications resources such as fibre in electrical grids and railways can be made available to boost broadband capacity and support the ease and viability of deployment. There are many challenges in the road ahead. Strategic and creative thinking to overcome these challenges through concerted efforts on all fronts promise to enable developing countries to join the broadband world.

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[1] Large-scale operators include main national operators, new entrants and mobile operators.

[2] Marginal areas include remote, rural and under served areas.

[3] While some private companies have also deployed private networks, these remain largely in urban areas.

[4] By year-end 2004, some 112 countries had at least partially privatized their State-owned incumbent operator. *Source:* ITU World Telecommunication Regulatory Database.

[5] ITU World Telecommunication Indicators Database.

[6] The African Virtual University was established in 1996 as part of a World Bank project. It was founded as a technology-based distance education network to bridge the digital divide in Africa. www.avu.org

[7] Universitas 21 is an international network of leading research-intensive universities, with the objective of facilitating collaboration and co-operation between member countries, as well as to create entrepreneurial opportunities for them. Established in 1997, it now has 17 member universities in 9 countries. www.universitas21.com

[8] TRAI, 2004, Recommendations on Internet and Broadband. www.trai.gov.in/Recommendations%20on%20Internet%20and%20Broadband%202004-04-29%20FINAL.pdf

[9] Yun *et al.*, 2002, The Growth of Broadband Internet Connections in South Korea: contributing factors. http://www.ciaonet.org/wps/yuk01/

[10] TRAI, 2004, Recommendations on Internet and Broadband. www.trai.gov.in/Recommendations%20on%20Internet%20and%20Broadband%202004-04-29%20FINAL.pdf

[11] Contribution of Ireland to GSR Consultation to identify best practice guidelines for spectrum management to promote broadband access (http://www.itu.int/ITU-D/treg/Events/Seminars/2005/GSR05/consultation.html).

[12] The trend away from onerous licensing practices toward more flexible market-entry authorization approaches, including technology and service-neutral licensing and authorizations, was explored fully in the 2004/05 edition of Trends in Telecommunication Reform: Licensing in an Era of Convergence (http://www.itu.int/publications/).

[13] See ITU Trends in Telecommunication Reform 2004: Licensing in an era of convergence.

[14] For a detailed discussion on this issue, See ITU Trends in Telecommunication Reform 2003: promoting universal access to ICTs.

[15] See ITU Trends 2004, Chapter 5. TRAI press release August 2004. www.trai.gov.in/Newpressrelease.pdf

[16] The Nigerian Communications Commission, 2005. www.ncc.gov.ng/Headlines/REPORT%20ON%20POST%20EXCLUSIVITY.doc

[17] See http://europa.eu.int/information_society/topics/telecoms/implementation/annual_report/7report/slides281101.

[18] The full set of regulatory guidelines agreed by WATRA are available at http://www.itu.int/ITU-D/treg/Events/Seminars/ITU-EC-Project/Ghana/modules/Guidelines-e.pdf

[19] 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 http://www.itu.int/ITU-D/treg/

[20] TRAI, 2004, Fixation of Ceiling Tariff for International Leased Line Circuit (Half Circuit). http://www.trai.gov.in/consultation%20paper-30th%20april%202004.pdf

[21] http://www.railtelindia.com/

[22] http://www.convergenceplus.com/apr03%20expert%20view%2002.html

[23] Ministry of Information and Communication, Korea. http://www.mic.go.kr

[24] LatinCom, 2005.

[25] For more information on this project see: http://web.itu.int/ITU-D/e-strategy/projects/E-Government/Executive-summary11.pdf

Printed in Switzerland
Geneva, 2005