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DISCUSSION PAPER

NGN and Universal Access

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

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NEXT GENERATION NETWORKS AND UNIVERSAL ACCESS THE CHALLENGES AHEAD

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THE CHALLENGES AHEAD

This paper has been prepared ***Eric Lie****, Telecommunication Consultant (eric.lie@gmail.com), as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.*

1 Introduction

In 2003, signatories to the Plan of Action of the World Summit on the Information Society (WSIS) set themselves a number of Information Communication Technologies (ICT) access and connectivity targets.[1] Nine years away from the deadline of 2015, voice penetration rates have been given a boost by the doubling of mobile subscribers numbers over just the past few years. At the end of 2005, ITU indicators showed that global telephone penetration rates (fixed and mobile) were at 52 percent. While enjoying similar levels of growth, Internet usage currently extends only to around 16 percent of the world's population. If all the WSIS access and connectivity targets are to be met by 2015, countries, both developed and developing, will have to focus on reviewing and renewing their policies and regulations that support universal access[2].

A reconsideration of universal access in the present is timely also from another perspective. In recent years, a growing number of operators have embarked on a transition from traditional circuit switched networks to Next-Generation Networks (NGN). NGN offers end-users access through a variety of networks, and because they are based on IP technology, they rely on much cheaper bandwidth and make available a wide range of services more easily.

However, is a discussion on universal access and NGN premature? Admittedly, no major operator has yet completed its transition to an end-to-end NGN. Even for the most advanced, the replacement of existing circuit-switched networks with NGN is expected to be completed no earlier than 2010. While the transition from circuit-switched to NGN is not complete, ICT markets are already feeling the impact of this migration in terms of service offerings, traffic flow and revenue. This can be most clearly seen in the increasing amounts of voice traffic that are being routed through IP networks and its accompanying effect on prices. In turn, these changes have already begun to force a rethinking of ICT policy and regulation in many countries.

On the one hand, the deployment of NGN promises to benefit universal access efforts in the form of cheap voice services and affordable access technologies. On the other, it also brings along with it a number of significant challenges that include the erosion of the revenue base used to fund universal access programmes, and, more alarmingly, the possibility of an even widening digital divide stemming from an uneven distribution of NGN related benefits.

Section 2 of this chapter looks at some of the different NGN related technologies and the role they play in expanding ICT access. Section 3 takes a look at the role sector reform plays in expanding ICT access, especially in the areas of licensing, spectrum management, interconnection, VoIP regulation, quality of service and price regulation. Only in the event that universal access goals remain unmet after such sector reform measures are implemented should universal access funding be considered by regulators. Sections 4 to 6 look at some of the issues that are raised when universal access funding becomes necessary. These include:

- How should the scope of universal access be defined?
  - In an NGN environment where infrastructure is decoupled from services, what should universal access funding support?
  - Should broadband be included in a universal access definition?
- Where funding is required, how should funds used to support universal access be collected?
- How should funds for universal access be distributed?
  - How should needs be identified - top down or bottom up?
  - What role do not-for-profit organizations play?

- How should funding be distributed (e.g. micro-finance)?

2 Universal Access and NGN technology

Simply put, the transition to NGN involves the replacement of legacy PSTN equipment by packet-based technology in the core of the network. This allows for a more defined separation between the transport portion of the network and the services (e.g. voice, data and video) that run on top of that transport. (See Box 1.)

Box 1: What are Next Generation Networks?

A Next Generation Network is defined by the ITU as "a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility that will allow consistent and ubiquitous provision of services to users."

Source: ITU-T Recommendation Y.2001

The technological innovations associated with the transition to NGN have already started to transform the way universal access is being extended to rural and remote areas in both developed and developing countries. To a large extent, this transformation is fuelled by the introduction of new wireless technologies such a Wi-Fi and Broadband Wireless Access (BWA) that have dramatically reduced the price of infrastructure deployment. Affordability and availability have also been given a further boost by the introduction of new services and applications, such as VoIP, that have been designed to run over these networks.

2.1 Infrastructure

Despite the remarkable success of mobile technology in providing access to voice services, many internet services still depend on fixed line based networks for connections to end users. While this fact may have led to the mandatory use of fixed-line infrastructure as part of a universal access obligation or programme in a number of countries in the past, it is important to note that this situation is rapidly changing. Wireless technologies such as Wi-Fi and BWA in particular have been singled out for their ease of installation and their ability to provide affordable access in rural and remote areas. Coupled with backhaul delivered through very small aperture terminals (VSAT), even the most remote villages can be connected, albeit with limited and expensive bandwidth.

Advances in mobile technology, especially 3G and 3.5G technologies, have also made mobile networks a viable platform to deliver services beyond voice, especially where coverage has to be extended over a wide area. Advances in mobile technology that have added increasing amounts of capacity have further contributed to the narrowing of the gap between wireless and fixed line technologies.

2.1.1 Wi-FI

Wi-Fi (wireless fidelity) refers to wireless local area networks that use one of several standards in the same "family" of 802.11 standards. Due to its affordability, scalability and versatility, its popularity has spread to rural and urban areas in developed and developing countries alike.

Using mesh network architecture[3], Wi-Fi networks can be scaled to match coverage area and the terrain of the target population. Coupled with solar powered generators, such networks have proven to be sufficiently robust to withstand deployment in the most isolated areas of the world. (See Box 2)

Box 2: Mesh Networking in the Amazon basin

Yachana in the Amazonian region of Ecuador, is located 2.5 hours by motorized canoe from the nearest small city. There, the Foundation for Integrated Education and Development (Funedesin), a non-governmental organization (NGO) dedicated to community development, has deployed a wireless mesh network to connect a school to an ecotourism centre and a bioscience centre.

The different sites are between 1.5 km and 5 km apart and the Wi-Fi mesh is connected to the internet via a VSAT link. All power for the meshboxes and laptops is provided using solar panels. VoIP is used to provide voice services within the network and to link users to the PSTN through Skype.

Supported by the revenue it gains through 2,000 annual visits from ecological tourists, Funedesin is setting up a college nearby to train others in the art of mesh networking, with support from its equipment provider LocustWorld.

Source: Funedesin at http://www.funedesin.org

Used as a point-to-point link, Wi-Fi can also be used as backhaul with line-of-sight ranges that reach up to 20km. In rural areas, where the risk of interference is low, increased power could be used to boost the signal to extend the range. For example, an agricultural community in Chancay-Huaral in Peru uses a backbone of 12 Wi-Fi links, the longest of which stretches over 10km. This network covers the entire 220km^2 valley and connects 14 telecentres that serve the 6,000 farmers who initiated and partially funded the project. Installation costs for the towers and radio equipment was around US$1,500 per site.[4]

The increasing use of Wi-Fi networks to extend coverage in rural areas with minimal capital has also been emulated in urban environments, albeit on a larger scale. Citywide Wi-Fi networks, which are constructed and managed by governments alone or in partnership with private operators, have become increasingly popular over the past few years. Small countries such as Singapore as well as large cities, such as Sydney, Philadelphia and San Francisco, have started to deploy ubiquitous Wi-Fi coverage within their borders. The majority of these initiatives are public-private sector partnerships that are non-profit in nature. While such initiatives do not strictly fall under universal access programmes, they nevertheless demonstrate the ability of new wireless technologies to make high speed Internet access an affordable and available proposition to the inhabitants of large urban centres. (See Box 3)

Box 3: Surfing for free in Singapore

From the beginning of 2007, Singaporeans will enjoy free wireless connectivity at up to 512 kbps speeds almost everywhere for at least two years under the regulator's 'Wireless@SG' programme.

Run by three private local wireless operators, the programme intends to increase the number of public Wi-Fi 'hotspots' from 900 to about 5,000 effectively covering most of the small island state. This two-year free offering with unlimited usage is extended to all residents and visitors in Singapore, including tourists and business travellers. Users do not have to be existing subscribers of these operators to enjoy the free service. The commercial model of the programme will be reviewed after the two year period of free access.

The three operators are expected to invest around SGD 100 million (USD 65 million) to extend the network over the next two years. IDA, the Singapore regulator, is expected to defray around SGD 30 million (USD 19 million) of the cost.

Source: Infocomm Development Authority of Singapore (IDA) at http://www.ida.gov.sg

While Wi-Fi access equipment is affordable and readily available to end-users, the deployment, operation and maintenance of such large citywide networks require a significant capital expenditure. The United States city of Philadelphia, for example, estimates it will spend USD 10 million to build and maintain its network over the next several years while the city of San Francisco plans to spend USD 15 million over the next decade.[5] In total, network providers and local governments building their own networks are expected to spend USD 235 million to build and operate citywide networks in 2006 alone. By 2010, it is estimated that more than USD 3 billion will spent on these networks.[6] Many of these networks, however, have not yet been deployed and remain only in the planning phase. Such delays have led to a number of innovative "bottom-up" approaches aimed at achieving ubiquitous high-speed Internet access on a citywide basis. (see Box 4)

2.1.2 Power Line Communications (PLC)

Power Line Communications (PLC) or Broadband over Power Lines (BPL) is a term describing several different systems for using electrical power distribution wires for the simultaneous distribution of data. Plugging in a PLC modem into any power outlet in an equipped building will allow high-speed Internet access. While not a wireless technology, PLC offers a number of benefits relative to regular fixed line connections such as cable or DSL. In many countries, electrical infrastructure is usually more extensive than fixed line telecommunications infrastructure, making it suitable for expanding coverage. Moreover, PLC offers higher speeds over its networks than what is now commonly available through cable or DSL.

Box 4: Grassroots Wi-FI

Spanish start-up FON is giving away Wi-Fi routers loaded with software that allows broadband subscribers to share their Internet connections with Wi-Fi users throughout their communities. FON's package allows broadband subscribers to split their internet connection so that it offers a secure connection indoors and an open connection to people outside the home. Its self designed La Fonera router uses standard 802.11g technology and was designed for easy installation. Users simply plug the device into their existing broadband modem to convert it into a FON access point. Once users have registered, they become part of the FON community, which allows them free access to any FON hot spot in the world. Non-FON members can also access the network, but they must pay USD 1 or USD 2 for 24 hours of access. This small fee is how FON generates revenue.

Currently, about 112,000 La Fonera and FON-enabled routers have been registered with the company. To help spur adoption it's been offering the routers on its Web site for USD 5 apiece. It offers routers for free in cities such as San Francisco and in New York.

There are, however, certain issues that remain unresolved. Many Internet service providers consider the concept a violation of their customer contracts. Interference in densely populated areas also remains a big problem while the viability of the network is dependant on individuals that keep their routers turned on.

Source: CNET, Taking Wi-Fi power to the people, Oct 2006, at http://news.com.com/Taking+Wi-Fi+power+to+the+people+-+page+2/2100-7351_3-6130059-2.html

As a communications network, PLC is understandably more useful in countries with high electricity penetration rates. With rural and remote communities in many parts of the world still relying on independent generators to provide electricity, the use of PLC may be limited in the context of universal access. One possible alternative is to use PLC as backhaul for wireless communications. By hanging Wi-Fi access points, Broadband Wireless Access (BWA) points or mobile phone base stations on utility poles or towers, for example, end-users within a wider range could connect to PLC networks.

As a technology, however, PLC is still in an early stage of adoption with limited deployments on a significant scale. Trials are still ongoing in many developed countries with a focus on an eventual deployment first in urban areas. Nevertheless, there have been rare instances of PLC trial deployments in rural areas. In January 2006, in the rural locality of Band, Romania, a PLC trial was introduced by the Ministry of Communications and Information Technology. The network offers voice service and broadband Internet access for around USD 10 per month. The technology was introduced initially to 50 households. If successful, the project will be extended to other rural areas throughout Romania.[7]

2.1.3 Second and Third Generation cellular mobile systems

Second generation (2G) mobile technology is regarded as mature technology for the delivery of voice services. Unfortunately, however, data transfer speeds on 2G and 2.5G networks remain significantly slower than that available through fixed line networks. The high cost of greenfield installation also acts as a further deterrent to its adoption as a universal access solution for rural services beyond the urban fringe.

Nevertheless, in many parts of the world, mobile network coverage typically reaches areas far beyond that covered by fixed line infrastructure. As such, a large proportion of the population stands to benefit from an upgrading of the existing networks to provide faster data speeds. In some cases, an upgrade from 2G to 2.5G, Third Generation (3G), or 3.5G systems can be a cost effective way of extending high-speed Internet coverage as a main component of a mobile network's capital cost is the installation of towers and base stations. An upgrade from 2G to 2.5G, for example, typically involves changes in the hardware subsystems of certain base stations, a software upgrade and, in some cases, the addition of new base stations. Furthermore, the cost of adding new subscribers and capacity is distributed among all users on the network.

The introduction of 3G CDMA450 technology, in particular, has rekindled interest in the use of mobile technology to provide universal access. By transmitting at a lower frequency the technology allows for large cell sizes. In turn this allows reductions in installation costs as fewer base stations are required to cover the target area. As a 3G technology, it also supports the transmission of high-speed data with speeds reaching up to 2.4Mbps. A number of countries have already deployed CDMA450 as part of their universal access programmes.[8] (See Box 6 below)

2.1.4 Broadband Wireless Access (BWA)

Broadband wireless access is a technology aimed at providing high-speed wireless access over a wide area. It typically supports data rates faster than 1.5 Mbps at ranges that can go up to 30km. Currently, the most widely used technologies are Local Multipoint Distribution Service (LMDS) and Multichannel Multipoint Distribution Service (MMDS).[9] WiMAX technology, built on the IEEE 802.16 standard, is expected to be the eventual BWA platform of choice as deployments pick up speed over the next few years.[10]

In general, BWA systems show considerable promise in delivering cost effective voice and high-speed services to both urban and rural areas in developing countries. For example, Ghana and Pakistan plan ambitious rollouts of WiMAX networks that are expected to provide nationwide coverage progressively.[11] The growing availability of interoperable WiMAX equipment is expected to reduce the cost of BWA deployment in a similar way the Wi-Fi standard has resulted in large reductions in equipment prices. (see Box 5)

2.2 Applications and Services

The ability of NGN to deliver a suite of services and applications over a single network is expected to result in direct cost-savings to end-users. As importantly, it opens up the possibility of rural operators to tap into demand for services that go beyond just voice telephony, such as Internet Protocol Television (IPTV). The commercial sustainability of most universal access programmes depend on aggregating demand of the target population in order to meet the cost of network deployment and operation. As services can be provided over NGN for marginally incremental costs, the cost of NGN deployment and operation can be more easily offset by the larger demand each additional service generates. The marketing of service bundles facilitated by NGN, such as triple-play[12], would offer households in rural and remote markets both greater incentives to subscribe and better value for their money. Even in the absence of NGN, the cost of operation of many commercial and non-commercial telecentres is often offset by the provision of a wide range of commercial activities including Internet services, international calling, voice mailboxes as well as non-telecommunications services such as post office, photocopying, faxing, etc. In some cases telecentres already act as full business centers, adding to their profitability and social utility.

Box 5: BWA in Sierra Leone

In Sierra Leone, Omniglobe, a network solutions provider, and Limeline, a local operator, installed a satellite hub and pre-WiMAX BWA system with 6 wireless access points providing coverage to the population living within a radius of 5 to 10 km of the antenna. With each base station capable of supporting a maximum of 250 subscribers, the configuration supports up to 1,200 subscribers in the coverage area. The configuration is easily scalable with additional equipment easily added on.

The cost for equipment, installation and training for such a typical system supporting between 250 to 1,500 subscribers including satellite antenna, satellite terminal, wireless base stations and antennas lies between USD 18,000 and USD 40,000. (excluding the antenna structures, customs duties, shipping, taxes and travel for one engineer). The Consumer Premises Equipment (CPE) cost about USD 400 each. The overall capital cost for a 250 subscriber system is about USD 480 per subscriber.

Limeline's operating costs consist of: (i) bandwidth capacity purchased from Omniglobe with prices in the order of USD 2,000 to USD 4,000 per 2 Mbps downlink / 512 Kbps uplink speed capacity; (ii) remote technical support, (iii) salaries, employee benefits, administration and selling costs; (iv) licence and other fees; and (v) Ominglobe's share of monthly revenues.

Installation took only 8 to 10 weeks from the moment the contract was signed to when it was launched. Limeline charges USD 195 per month for its basic service offering 1Mbs download and 512kbps upload.

Source: Peter A. Stern, David N. Townsend and Robert Stephens, New Models for Universal Access to Telecommunications Services in Latin America, Regulatel and World Bank, Nov 2006; Omniglobe at http://www.omniglobe.net and Limeline at http://www.limeline.sl/

There is some evidence to support the idea that there exists a high demand for television content in developing markets. In developing countries, the penetration rate of television sets is often higher than fixed line penetration. For example, in India the number of cable TV subscriber lines far outnumbers that of fixed-line telephones. Globally, the overwhelming popularity of television ownership and cable TV subscribership indicates the ability of many rural populations to pay for services that they demand. As such, the bundling of ICT services with television programming may act as a stimulus to demand and as an attractive value proposition to populations in rural areas (see Box 6)

Box 6: Service Bundling in the Andes

In June 2006, Peruvian rural operator Valtron became the first commercial CDMA450 network operator in Latin America. Operating under the name, Televias de Huarochirí, Valtron will supply a comprehensive suite of 5 services that covers fixed, mobile, public telephone, Internet access and cable TV services to 127 low income towns in the Andean mountain province of Huarochirí.

Valtron was established with a grant awarded by the Fondo de Inversión en Telecomunicaciones (FITEL), the Peruvian regulator OSIPTEL's universal services fund. The 10-year project has a goal of reaching 38,000 direct subscribers and 59,000 indirect subscribers by the end of that period. Televias de Huarochirí's initial network will cover seven of its 32 districts and support 5,000 lines. Ultimately, Valtron's capacity will reach 400,000 lines and cover 32 districts.

Source: Fondo de Inversión en Telecomunicaciones (FITEL) at http://www.fitel.gob.pe/contenido.php?ID=48&tipo=H&pagina=contenidos/PPT/Valtron/Valtron.html.

With the deployment of NGN in rural areas, the provision of IPTV presents itself as a possible add-on service. IPTV refers to a system where a digital television service is delivered using IP over a network. IPTV uses standard networking protocols and is typically delivered over broadband Internet connections to households equiped with IPTV set-top boxes.[13]

The feasibility of deploying an IPTV service in a rural area is currently limited due to the bandwidth intensive nature of the service and the high cost and complexity of IPTV equipment. The scarcity of backhaul in a rural network is likely to act as a bottleneck to the delivery of IPTV services. The delivery of a standard definition television (SDTV) channel using MPEG2, which is a common standard for digital television, requires around 4 Mbps per channel. An IPTV service offering around 50 channels would require the network to support 200 Mbps in total, a requirement that would be easily met by an urban network but not by a rural or remote one, especially where VSAT backhaul is used. Similarly, last mile bandwidth requirements are also high with many existing IPTV implementations requiring at least 10Mbps in bandwidth to the home.

Currently, most IPTV solutions are relatively new. Equipment prices are high and devices supplied by different vendors are not yet interoperable. Eventually, advances in technology and improving economies of scale will allow IPTV to overcome most of these obstacles. However, it is unlikely that it would be suitable for deployment in rural and remote areas in the immediate future.

3 Sector Reform

The transition to NGN is a timely catalyst for regulators to review and rethink the mechanisms that they rely on to reach their universal access goals. Such a review should focus, first and foremost, on the sector reform process which allows market forces to play a greater role in achieving universal access.

While universal access funding programmes play a large role in bringing ICT services to the "socially excluded", they are no substitute for continuing sector reform. Liberalization and competition have brought far greater benefits over the past few years than decades of universal access efforts channeled through incumbents. As such, regulators and policy makers have to look at other areas of regulation that play a vital role in supporting the expansion of ICT access. The need to look at policy and regulation holistically is even more urgent today as the transition to NGN brings about profound changes in ICT markets. Such an approach should take into consideration the areas of spectrum management, licensing, interconnection, VoIP regulation, quality of service and price regulation which are discussed below.

3.1 Spectrum Management

3.1.1 Providing Licence-free Spectrum Use

The growing popularity of mobile services and the introduction of new wireless technologies has increased the demand for spectrum dramatically over the past few years. As a result, countries are looking at new ways to manage spectrum use more efficiently. As part of this effort, increasing amounts of spectrum are being allocated to license free use worldwide in order to exploit the potential of technologies such as Wi-Fi and WiMAX to propel the rapid expansion of affordable high-speed access in both rural and urban areas.

Not all countries have embraced the idea of allocating spectrum to licence free uses for a variety of reasons such as fear of revenue loss or potential congestion. These fears, however, do not appear significant when compared against the potential of these technologies to provide cheaper and more accessible broadband access. Potential revenue loss from forgoing licensing fees would be offset by substantial savings in terms of disbursements of subsidies for universal access. Alternatives such as the levying of a small fee attached to the cost of purchasing equipment that are used in unlicensed spectrum, such as Wi-Fi routers, could obviate the need for a licence to operate in a particular frequency band while still providing revenue to the government.

3.1.2 Issuing Rural Spectrum licences

As a general principle, regulations should reflect market differences in urban and rural areas. In rural areas, spectrum is available in more abundance than in urban areas. With spectrum congestion being less of a concern in rural areas, spectrum licences should be awarded more cheaply or even licence free in certain bands. This would substantially reduce the cost of wireless network deployment in rural areas.

In many countries, current spectrum management practices leave many rural providers with mediocre spectrum while frequencies that have far better propagation characteristics remain idle because they are allocated to urban centers that are located far away. Such situations clearly reflect the shortcomings of a uniform spectrum management approach and the need for spectrum managers to recognize rural - urban differences. In practice, pilot testing for such a spectrum management approach could take place initially in specially designated "white spaces" in rural areas. In some countries, these could be within frequencies currently allocated to television broadcasting but be completely outside any existing broadcast contour.[14]

3.2 Licensing

Burdensome licensing requirements like high licensing fees are significant barriers to investment, particularly for small operators and those intending to invest in rural areas where margins are smaller. A simplification of the licensing process and a reduction in licence fees for operators providing services in rural areas would alleviate some of the obstacles rural providers already face. In practice, regulators could designate specific areas where operators would face minimal regulation beyond obtaining authorization and ensuring against interference with other users.

Where licensing requirements have already been eased, regulators and policy makers can consider further licence related incentives to encourage market entry into rural and remote areas. Obligations to provide services in rural areas, for example, can be bundled with licences to provide services in more lucrative markets. For example, in Uganda, 154 underserved counties were packaged into three separate “Universal Access Regions” for licensing purposes. Each Universal Access Region bundled together a mix of counties with different levels of market potential.[15]

3.3 Interconnection

A number of experts have made strong arguments for having asymmetric interconnection charges for rural areas. With interconnection rates moving towards being cost based, higher termination rates for calls originating in urban areas and terminating on rural networks would be justified because it costs more to construct, operate and maintain networks in rural areas. Higher termination rates would then be accompanied by higher tariffs on such calls. The fact that income generated by rural operators tends to come mainly from termination rates levied on incoming calls increases the appeal of mandating asymmetric interconnection rates. Chile, for example, allows cost-related asymmetrical interconnection rates. In 2002, the largest Chilean rural operator derived 60 percent of its total revenues from its positive interconnect balance with urban operators, allowing it to recover costs and develop the significant business opportunity from incoming calls.
As a practical first step to implementing asymmetrical termination rates, regulators could use rate approximations pending further refinement as further studies are done.[16]

The increasing popularity of mobile services, however, has made it increasingly difficult to designate operators and end-users as being purely rural or urban. This complicates the levying of asymmetric interconnection charges. The transition to NGN, will further limit the benefits of adopting such an asymmetric system as interconnection for IP networks relies on peering and transit arrangements that remain largely unregulated. In an NGN environment, small rural ISPs are more likely to have to pay national ISPs transit charges to obtain connectivity to the internet as they are unlikely to have a large enough traffic volume and subscriber base to qualify for peering.[17]

3.4 VoIP

VoIP has become increasingly popular, particularly for long distance and international calling where calling prices on the PSTN are high. For a variety of reasons, a significant, although decreasing, number of countries have banned or restricted the use of VoIP for reasons that typically include the fact that it deprives incumbent operators of revenues that could otherwise support the expansion of universal access. In Panama, for example, a hefty 12% tax is levied on VoIP calls.

While this is true, lifting restrictions on the provision and use of VoIP, particularly for rural operations, would support universal access goals directly. Firstly, VoIP services provided through telecentres or internet cafes make long distance and international calls more affordable and secondly, its revenue supports the operation of high-speed access in these centres. One of the factors contributing to Peru’s “Cabinas Publicas”, which were discussed earlier, has been the fact that they are allowed to use VoIP.

While the application of technology neutrality may eventually entail the levying of universal fund contributions on VoIP operators, these contributions should not be set at punitive levels but at levels comparable to those paid by operators of other technologies.

3.5 Quality of Service

Regulations concerning quality of service may not recognize that it may not always be possible to guarantee the same quality of service in rural as in urban areas. Equipment may be subject to more wear and tear in rural and remote areas and technical assistance might not be easily available to repair faulty equipment as promptly as in urban areas. Furthermore, where VoIP services are provided in rural areas over wireless and satellite technologies, quality or service may be even more difficult to maintain given possible interruptions in terms of power supply and connectivity.

In this context, strict quality of service requirements may be an impediment to investment in rural networks. Operators may be daunted by high quality of service requirements or they may have to spend considerably more in order to meet quality of service requirements. Given the limitations rural operators face, regulators should look into whether more flexibility can be built into quality of service standards in rural areas.

3.6 Price Regulation

Irrespective of the transition to NGN, rate rebalancing should remain a priority for regulators in their efforts to achieve universal access goals. Allowing incumbents to continue cross-subsidies for rural services, precludes new entrants from entering those markets and in effect compels them to "cream skim" in urban areas. Mandating below cost prices in rural areas also effectively discourages new market entrants without sources of cross-subsidy from entering rural areas.

The lowering of international and domestic long distance prices through VoIP will inevitably increase the level of cross subsidies necessary to maintain below cost prices in rural areas. In turn, this will render the provision of such services more unattractive even to operators with sources of cross-subsidy. A policy of rate rebalancing should be pursued to make prices more reflective of costs, allowing higher prices to reflect higher costs of service to rural areas. This will make rural markets more attractive to operators. Many low-income users have demonstrated a willingness to pay for services they require. For example, although mobile services tend to be more expensive than fixed line services, the use of pay as you go charging (e.g. pre-paid) have proven to be very popular. If necessary, higher end-user costs in rural areas may also be mitigated by transparent subsidies that do not distort the market.

4 The Scope of Universal Access in an NGN Environment

In the vast majority of countries, however, there will inevitably be segments of the population that will be inadequately served by market forces, regardless of the sector reform efforts taken. In these situations, the government intervenes directly to promote universal access, usually in the form of funding or mandatory obligations.

While there is a common understanding of the objectives that underlie such universal access frameworks, there is no single definition of what commitments they include. Beyond the generic goals of promoting "availability, affordability and accessibility" to ICT services, universal access definitions vary from country to country in terms of the ICT services to which these goals should apply.

For example, in the European Union, member states are required to ensure that a set of basic telecommunication services would always be available at a determined quality and an affordable price. This set includes the following rights[18]:

- Connection to the public telephone network at a fixed location
- Access to publicly available telephone services
- Availability of a directory information service
- Availability of public pay telephones
- Facilities for disabled users and those with special social needs.

Connections to the public telephone network at a fixed location should be capable of supporting speech and data communications at rates sufficient for access to online services such as those provided via the public Internet. No minimum data rate is mandated in the directive in order to allow member states the flexibility to determine what technology choice suits the particular member state best.

In contrast, in India the obligation extends to the following services that its Universal Service Obligation Fund supports[19]:

- Installation, operation and maintenance of the Village Public Telephones in each revenue village in India[20]
- Provision of additional rural community phones after achieving the target of one Village Public Telephone in every revenue village
- Upgrades of Public Telephone to Public Tele Information Centers with data transmission facilities in villages with populations exceeding 2000
- Phased Installation of High Speed Public Telecom Information Centers in villages with populations exceeding 2000
- Provision of household telephones in rural and remote areas according to targets that may be determined by the Central Government

Differences in individual and shared access aside, the two examples above show that there is a clear recognition of the importance of catering to voice as well as data services. The inclusion of data services as part of universal access definitions itself is a relatively new trend in most countries, both developed and developing. In the EU, for example, access to narrowband services was only added to the definition of universal service in 2002.

With the transition to NGN technology, both voice and high-speed data services will be delivered using only one transmission platform. While this supports universal access efforts that focus on providing both voice and data services, the technical characteristics of NGN may require countries to rethink how universal access is defined.

4.1 Separating service and transport

NGN's architecture rests on the separation of the network into different layers. This allows for decoupling the network's transport and service layers. As such, whenever a provider wants to enable a new service, it can do so by introducing it directly at the service layer without considering the transport layer. As services are independent of transport, one provider can easily supply services while a different provider supplies the infrastructure. This is common, for example, in the case of VoIP where a service provider (e.g. Skype, Vonage, etc.) provides the voice service and a carrier (e.g. BT, SingTel, etc.) provides the infrastructure. Such a separation allows customers much greater choice in the selection of service providers.

This raises the issue as to whether universal access funding programmes should apply only to infrastructure access or whether they should apply also to access to services. The argument that the scope of universal access funding programmes should eventually only extend to access to infrastructure is conceptually sound. The installation and maintenance of physical infrastructure is the largest cost factor in providing service in rural and remote areas. Services can typically be provided on top of this at marginal cost. Furthermore, the provision of services itself is geographically agnostic. End-users in rural and remote areas will by and large pay the same amount for the same services as end-users in urban areas. In this way, rural populations will be able to enjoy the same benefits of competition and scale that urban populations already enjoy for services. For example, an end-user in a rural location pays the same rates for a VoIP service like Skype as an end-user in an urban area.

The question of whether access to infrastructure can be practically decoupled from access to services in a universal access programme, however, will depend on the extent the two have been decoupled in commercial markets and how available and affordable independently provided services are. Currently, operators of transport networks enjoy significant advantages. They tend to be the default providers of the services that flow through their networks, particularly in the case of voice. Added to that, they are also usually in the best position to offer service bundles of voice, data and video. Regulators will have to grapple first with the competition policy issues that arise from the present market realities as well as deal with concerns over network neutrality before a similar policy can be introduced for universal access. In its submission to the EU consultation on universal service, for example, Ofcom noted that while there could be a case for separating the two elements for purposes of universal service, more studies would have to be done on the availability and affordability of services when decoupled from access to infrastructure.[21]

4.2 Technology Neutrality

As early as a decade ago, the definition of universal access extended only to fixed line infrastructure in the absence of other practical alternatives. However, as highlighted in section 2 above, this no longer appears to be the case. Access to a full range of ICT services can be provided over a wide variety of means, both wireless and fixed. With NGN, the type of technology used for infrastructure no longer impacts the kind of services that are delivered through it. As a result the choice of technology used to deploy infrastructure ultimately depends on the particular circumstances and needs of the target population.

Faced with a wide range of infrastructure possibilities, regulators have to devise guidelines that promote the deployment of the best possible infrastructure solution for each particular universal access target area identified in a universal access plan.[22] Instead of mandating a single infrastructure technology, the setting of minimum performance criteria that support a given range of services would allow universal access providers to propose or select the most cost effective technology from all the options available. (See Box 7.)

With an ever-increasing range of interoperable telecommunications infrastructure options available to choose from, restricting support to just one option or a single category of options appears increasingly unwise. In commercial markets, competition between different infrastructure platforms that supply the same services has led to greater availability, affordability and accessibility for the consumer. The same improvements can be expected when similarly applied to universal access programmes.

Box 7: Access Technologies and Universal Access in Malaysia

Under the Universal Service Programme (USP) implemented by Malaysia's regulator the MCMC, universal service providers are selected via a tender process where interested parties submit bids based on specifications laid out by the regulator. A remarkable amount of flexibility is given to the bidder in terms of technology used. Tender specifications are usually generic, specifying mainly the number of lines required and the type (residential or payphones). Bidders are allowed to propose the technology to be used, a suitable timeframe for network deployment as well as the target sites within a given district.

In practice, solutions ranging from the provision of mobile satellite phones to the deployment of CDMA wireless local loop networks were employed in different locations throughout the country. This large flexibility given to industry has been seen as a key contributor to the rapid pace of implementation of the USP programme.

Source: Eric Lie, "Building Digital Bridges: The Case of Malaysia", ITU, Sep 2004 available at http://www.itu.int/osg/spu/ni/digitalbridges/docs/casestudies/malaysia-rv3.pdf

4.3 Data

The need for some form of access to the internet whether it is on an individual basis, like in the member states of the EU, or on a shared basis, like in India, has become an integral element of universal access programmes in most countries, both developing and developed. While the transmission speeds mandated by such programmes are mostly narrowband, the present transition to NGN raises questions regarding the adequacy of existing requirements.

4.3.1 Should broadband be part of Universal Access?

The question of whether access to broadband should be included in the scope of universal access obligations assumes greater importance as the transition to NGN continues apace. NGN services such as high-quality VoIP and streaming video can only be delivered through broadband networks.

Although broadband penetration rates have been rising on a global basis, the deployment of such networks has been uneven with broadband network expansion taking place primarily in urban areas. As a result, exclusion from the benefits of broadband based services has become a concern for many countries.

Such concerns have led a small number of developed countries to contemplate mandating broadband access for all individual households as part of a universal access obligation in order to avoid "social exclusion" on the part of those who do not have such access. (See box 8)

Box 8: Broadband Switzerland

In September 2006, the Swiss Federal Council adapted the content of its universal service order to mandate, among other things, the provision of broadband access to the entire population of Switzerland from 1 January 2008.

Under this order, the connections currently available as part of universal service were supplemented by new connections permitting internet access at a minimum transmission rate of 600kbps (down) and 100kbps (up). In order to minimize the cost of including broadband access for universal service, however, it is envisaged that in exceptional cases the future universal service provider could reduce the transmission rate.

An upper price limit of CHF 69 (USD 55) per month was set for this service which includes not only the broadband connection but also a voice channel, a telephone number and an entry in the public telephone directory. The upper price limit will be re-examined in 2010 in order to take account of developments in the broadband connection market.

A public call for tenders was launched in October 2006 for the award of a universal service licence which will enter into force on 1 January 2008. Reults of the tender will be available in June 2007.

Source: Federal office of Communications (OFCOM), Switzerland at http://www.bakom.ch/dokumentation/medieninformationen/00471/index.html?lang=en&msg-id=7308

While there are obvious benefits associated with the expansion of broadband access, is it nevertheless necessary to include broadband access as part of the universal access obligation now? A review of current trends indicates, however, that there does not seem to be a persuasive case for including broadband as a universal service at the present time.[23] While there is little doubt that there are potential benefits from expanding high-bandwidth broadband penetration, broadband is not yet so pervasive that those without broadband access can be considered to be “socially excluded”. This view is supported by limited broadband take up, the risk of stifling competitive entry into the broadband market and the views of some regulators on that question.[24]

Indeed a comparison between broadband penetration rates on a global basis would indicate that broadband access has not reached the level of ubiquity where those who do not have access could be considered as “socially excluded”. As of the end of 2005, only 3.3 inhabitants per 100 had access to broadband on a global basis. Even in leading broadband countries such as Korea (Rep.), broadband penetration rates have only just exceeded a quarter of the population. (See Figure 1.)

Figure 1: Broadband Market Data

Top 20 economies (ranked by total subscriber numbers) as at 31 December 2005

Total fixed broadband subscribers, penetration rate, broadband as a percentage of all internet subscribers and price per 100 kbit/s in USD.

Economy	Total fixed broadband Subscribers (000s)	Penetration (per 100 inhabitants)	As % of Internet subscribers	Price in USD per 100 kbit/s
1. United States	49'391.1	16.6	73.9	$0.49
2. China	37'504.0	2.9	51.2	$1.43
3. Japan	22'365.1	17.5	66.0	$0.07
4. Korea (Rep.)	12'190.7	25.2	100.0	$0.08
5. Germany	10'686.6	12.9	53.4	$0.51
6. United Kingdom	9'539.9	16.0	63.1	$0.63
7. France	9'465.6	15.6	75.3	$0.36
8. Italy	6'820.0	11.7	38.5	$0.30
9. Canada	6'706.7	20.8	90.1	$1.01
10. Spain	4'994.3	11.7	90.0	$4.84
11. Taiwan, China	4'602.2	20.1	61.2	$0.18
12. Netherlands	4'100.0	25.2	58.6	$0.14
13. Brazil	3'304.0	1.8	41.8	$1.08
14. Mexico	2'304.5	2.2	58.0	$6.25
15. Australia	2'102.9	10.4	35.2	$3.45
16. Belgium	1'974.8	19.1	90.3	$1.21
17. Sweden	1'838.0	20.3	55.8	$0.23
18. Switzerland	1'725.4	23.1	71.6	$1.58
19. Hong Kong, China	1'659.1	23.6	62.8	$0.83
20. Turkey	1'589.8	2.2	70.6	$10.52
WORLD	215'477.7	3.3	56.2	$72.20

Note: «Broadband» is ≧ 256 kbit/s in one or both directions

Source: ITU World Telecommunications Indicators Database

If it is not appropriate for broadband to be included in universal access obligations now, the question then arises as to when or if regulators should move away from just promoting broadband access towards making broadband access obligatory. In this respect, a set of guidelines based on the approaches taken in Australia, the United States could be followed when a regulator wants to consider whether broadband should be part of a universal service obligation. (See Box 9.):

Box 9: Rules for systematically considering whether broadband should be a USO

1. Consideration of whether broadband is an essential service of significant 'social importance'
2. Estimation of the degree of expected market penetration of broadband service
3. Assessment of the nature and extent to which broadband will not be made available by the market and why
4. Identification and specification of objectives and desired outcomes clearly and specifically
5. Assessment of the extent to which market demand and delivery can/will meet the specified objectives.
6. Consideration of the social and economic disadvantages incurred by those without access to broadband if there is no government intervention in this expected market situation.
7. Estimation of the costs of intervention to widen broadband deployment through the use of the USO mechanism
8. Estimation of the costs of intervention through the use of the USO mechanism compared against the use of other approaches to establish that the USO mechanism is superior.
9. Establishment that the benefits of intervention through the USO exceed the costs of doing so, taking into account the incidence of such benefits and costs (especially those on unsubsidised telecommunications/Internet/broadband Internet customers); and of effects on other communications and broader policy objectives. (Intervention should only occur where overall benefits persuasively outweigh overall costs and where a substantial increase in the level of USO expenditure would not result.)

Source: Xavier, Patrick, "What Rules for Universal Service in an NGN Environment", ITU, Apr 2006 available at www.itu.int/osg/spu/ngn/documents/Papers/Xavier-060323-Fin-v1.pdf

4.3.2 Backbone and Backhaul Infrastructure

While the problem of providing affordable last-mile access has been alleviated by cost-effective technologies such as Wi-Fi, the expansion of networks into rural and remote areas has been limited by the lack of affordable backhaul and backbone infrastructure. Isolated sites typically rely on expensive satellite backhaul through very small aperture terminals (VSAT) stations.

At present, most universal access programmes have focused more on increasing last-mile access and have not devoted sufficient resources or incentives to support the deployment of more backhaul and backbone infrastructure to support greater last-mile access. While this asymmetry allows for a faster expansion of voice and narrowband data services, the lack of backbone and backhaul infrastructure threatens to act as a severe bottleneck especially with the introduction of more bandwidth hungry applications that ride on NGN.

Aside from funding backbone and backhaul from universal access funds, there remains considerable scope for governments to encourage the deployment of such infrastructure. Governments can leverage on the nationwide reach of infrastructure providers such as railways, highway operators and utility companies by encouraging them to enter into the market for backbone and backhaul services on an open access basis. These companies usually enjoy nationwide customer penetration and extensive communication infrastructure. Electricity utilities, for example, have internal needs for data communications within their power networks. These companies often have extensive networks of fibre-optic cables within the power grid to enable communications between electrical sub-stations. Once fibre is installed in the power grid, the excess capacity can be used to accommodate other rural users in the service area. Most of the cost of laying the fibre can be justified through savings achieved from more efficient electricity distribution. As a result, the incremental cost of opening up the network for backbone or backhaul access is minimized. By leveraging the existing telecommunication infrastructure between their installations, power companies in countries such as Iceland and Japan have already entered the ISP market. In Iceland the Reykjavik Power Company has established a data transmission network over its power grid that connects its power transformer stations around the capital. Supplemented by fibre and fixed-wireless access, the company is able to offer broadband services to its customers.[25]

The power network, however, is not the only public infrastructure network to be leveraged on to expand access. In developing countries in particular, infrastructure networks such as railways and highways can be used as an alternative. India provides a good example of the use of its railway network to extend internet access to its rural areas. (See Box 10)

Box 10: India's Railway Backbone

In December 1988, the first fibre optic cable system was commissioned on Indian Railways over a distance of 60kms. Over the next few years, the network was slowly expanded. In September 2000, the RailTel Corporation of India Limited, a public sector company under the Ministry of Indian Railways, was formed to deploy fibre optic cables over the entire Indian Railways system to meet railway requirements as well as for the commercial sale of surplus capacity.

Railway communications typically require bandwidth to be available at each railway station for the operation of railway switches and junctions and for communications. As only 2 to 8 Mbps is required for this purpose out of the 155 Mbps the network supports, the remaining capacity can be used for other purposes such as backhaul services for rural and remote areas.

RailTel currently offers a number of services including the provision of leased lines and facilities such as tower space, as well as national long distance voice services. The company is also in the process of establishing broadband internet kiosks at railway stations while also deploying wireless broadband networks to provide broadband voice and data services to ISPs serving towns and cities astride its network of railways across India.

Source: RailTel Corporation of India at http://www.railtelindia.com/

4.3.3 Capacity Building and Content Support

Currently, most universal access programmes that focus on providing access to the internet in rural areas concentrate exclusively on the rollout of infrastructure. Community internet centers, however, have enjoyed at best mixed success in the countries where they have been deployed. Studies show that the most successful community internet centre programmes are those that are linked from their inception to a wide variety of capacity building and support programmes that are implemented with other government entities, local communities, businesses and NGOs.[26] The success of universal access programmes depends as much upon the availability and quality of the content and applications available as well as upon the level of training of its users, operators, service providers as upon the availability and affordability of infrastructure access. In Malaysia, for example, the regulator's Community Communications Development Programme (CCDP), which established semi-rural areas with broadband internet centers, was accompanied by a support programme aimed at encouraging capacity building and public outreach. Under the programme, centre operators are expected to act as promoters of broadband services, particularly by encouraging members of the community to establish a web presence on the Internet for purposes such as the marketing of local products and attractions (e.g. handicrafts and local tourist sites). Having been technically trained, operators are also expected to give users basic courses on subjects such as e-mail, web surfing and word processing.[27]

Equally important, suitable content and applications for the target populations should also be developed alongside infrastructure based programmes. These typically include eGovernment, telemedicine and teleeducation services. As a complement, universal access programmes should also support applications and content that highlight innovative uses of ICTs and multimedia applications, which can generate increased demand and economic benefits for local communities. Such services that can generate grassroots appeal could include, for example, local human interest content (news, entertainment, public affairs) transmitted via web based streaming audio or video; instructional and informational software applications for small businesses, farmers, families and other interest groups; and on-line forums to encourage the exchange of local or indigenous cultural heritage. Interactive multimedia services such as IPTV assume an even greater role in the dissemination of information and education in areas where illiteracy is prevalent. The Open Knowledge Network (OKN), run by the NGO One World, is one such example of an initiative aimed at supporting the creation and exchange of local content in developing countries through the use of ICT solutions. Using the OKN system, individuals in developing countries in Africa, Asia and Latin America are able to create digital content in their own language, which is then exchanged with others through networks of existing community access points.[28]

With the increased number of services and applications NGN networks are expected to support, such as IPTV, capacity building and content support programmes are expected to play an increasing role in making ICT access beneficial and meaningful to these populations.

4.4 Voice

4.4.1 Mobile Voice

NGN aside, it is useful to remember that in most parts of the developing world, the overwhelming success of mobile technology means that mobile services are the de facto option for universal access to voice services. Due to its availability, affordability and convenience, it has exceeded in less than a decade the impact fixed-line phones achieved in a century.

At the end of 2005, 33.5 percent of the world's population subscribed to mobile services.[29] Already, it is estimated that mobile coverage extends to 80 percent of the world's population.[30] This remaining unserved segment of the population is likely to be disadvantaged in terms of geographic isolation, with its associated high cost of providing backbone and local transmission facilities.

Universal access programmes that are concerned with voice services should bear in mind these market realities and avoid investing scarce resources on alternative network deployments where mobile services can or are expected to serve the market without subsidy.

4.4.2 VoIP

Whether a fixed line network or a mobile network is used, the transition to NGN is expected to be accompanied by the increasing use of VoIP for voice. In the context of universal access, the migration to VoIP raises a number of issues that revolve around its quality of service (QoS) and access to emergency services. Currently, VoIP calls differ in terms of quality and reliability from voice over the PSTN as the former is more susceptible to Internet related technical problems and, in the case of fixed line VoIP, reliant on electrical power supply for calls. VoIP services also do not normally include free calls to emergency numbers, the automatic rerouting of emergency calls to the nearest emergency call centers nor caller identification.

These VoIP shortcomings relative to voice over the PSTN have led regulators to introduce a variety of different measures regulating the provision of VoIP. For example, in Canada the Canadian Radio-Television and Telecommunications Commission (CRTC) mandated VoIP providers to offer emergency 911 services. In addition, they were obliged to notify customers about limitations to their services.

Mandating VoIP to have the same quality of service and emergency related features as voice over the PSTN, however, increases the cost of providing that service. Given that VoIP's affordability is its major appeal, light-handed regulatory measures may be more suitable to strike a balance between meeting consumer expectations and lowering costs. (See Box 11.)

Box 11: The VoIP Framework in Singapore

In June 2005, the Singapore regulator, IDA, introduced a regulatory framework that included minimal obligations to encourage provision and adoption of VoIP services. Two sets of numbering ranges were assigned to VoIP services for this purpose.

Under the framework, operators providing VoIP services using level '3' numbers, are not required to provide number portability, emergency service connection, directory enquiry and printed directory services, or conform to QoS levels set by IDA. Operators, however, are obliged to keep their subscribers informed of any service limitations, for example, as to whether their service allows access to emergency services and whether it meets the minimum QoS levels set by IDA for local fixed-line services.

Facilities-based operators may use level "6" numbers, the number range currently reserved for fixed-line PSTN voice services, for VoIP services if they can provide number portability; connection to emergency services; directory enquiry and printed directory services; and, ensure QoS levels that are currently required for local fixed-line services.

Source: Infocomm Development Authority of Singapore (IDA) available at
http://www.ida.gov.sg/News%20and%20Events/20050706170936.aspx?getPagetype=20

5 The Implications of NGN on Universal Access Funding

The funding base for universal access programmes has been under constant pressure over recent years due to a number of factors that have eroded traditional sources of revenue. Revenues from international and domestic long distance services, have been declining rapidly over the past few years as a result of a combination of factors, such as increased competition, the circumvention of the international accounting rate system and an increase in the use of VoIP. Added to this, mobile phone services have spread dramatically, allowing subscribers to avoid paying high domestic long distance charges. On a smaller scale, cable television systems and internet service providers have also started to offer VoIP services in many countries with rate plans that charge a flat rate for voice services or bundle free voice services with broadband access. The transition to NGN will inevitably lead to further falls in voice related revenues with analysts predicting an acceleration in the migration of voice traffic to VoIP and private corporate networks.

The problem of revenue erosion has been particularly acute for incumbent fixed line operators in developing countries where falling voice revenues, resulting largely from falls in international and long-distance revenues, have not been matched by a growth in internet usage through services such as broadband that have been giving fixed line operators in developed countries new revenue streams.

Fortunately, most developing countries that have implemented universal access programmes over the past few years have favored the creation of a central fund to support their universal access goals. Countries that have set up universal access funds have been more insulated from the effects of fixed-line revenue erosion, particularly if their funds rely on funding from general taxation revenues or from a wide and diverse operator base.

To cushion against the effect of unpredictable revenues resulting from a transition to NGNs, contributions to universal access funds should come from as broad an economic base as possible. Options for diversification include funding from general taxation revenues, specific taxes levied on end-users and from expanding the categories of operators that contribute to the fund. Revenues generated through the levying of spectrum and licensing fees as well as proceeds from the privatization of public owned operators can also form part of the funding base of a universal access fund.

5.1 General taxation revenue

In a general taxation system, the government allocates a certain percentage of the national budget to meet the cost of providing services. In many countries, this system is used to fund schemes to provide gas, electricity and water. While less prevalent, a number of countries also rely on general taxation revenue to fund their universal access programmes. Chile, for example, receives its universal access funding from the State Consolidated Revenue Fund. A universal access fund financed in part or in whole from general taxation revenue ensures a measure of security and consistency that permits long term planning for universal access programmes. It also guarantees that the burden of providing communication services is distributed evenly across all sectors of the economy that benefit from wider ICT access. Some operators have also argued that general taxation makes sense where governments have decided that ICT is key to general socio-economic development.

5.2 Tax on End-users

Another alternative that has been proposed is the charging of an explicit tax on telephone service subscribers. In this system the operator collects and submits proceeds from this tax to the universal access fund. Depending on the user base, a relatively small levy on each subscription could generate a large sum of money.[31]

Nevertheless, for such a system to remain equitable in an NGN environment, it must necessarily extend to all users of ICT services. Users of VoIP, which does not require a subscription to a telephone service, may evade such taxes if internet access is not treated similarly.

5.3 Tax on Operators

Currently, many universal access funds rely on financing derived from taxes imposed directly on operator revenues. In many cases, this tax only applies to large fixed-line and mobile operators. ISPs and smaller service-based operators relying on resale are largely exempt from such contributions because of their small revenues or as part of government policy to leave internet related services largely untaxed and unregulated to promote their expansion. For example, in Malaysia only licensees that generate revenues above MYR 2 million (USD 560,000) from designated services are subject to mandatory contributions to the universal access fund.

This, however, appears to be evolving. Following increasing usage of VoIP, some countries have extended taxes to include VoIP providers and ISPs in an effort to mitigate the effects of revenue erosion suffered by PSTN voice operators and ensure a more consistent treatment of all voice operators, VoIP and PSTN alike. (See Box 12.)

Box 12: FCC approves new Internet phone taxes

In June 2006, the FCC voted unanimously to require taxes on all voice over Internet Protocol services that connect to the public-switched phone network. The tax revenue will be used by the Universal Service Fund, which subsidizes phone service in rural and low-income areas. Wireless, wireline, payphone, and DSL providers already contribute to the fund.

The taxes approved by the FCC will apply to companies such as VoIP provider Vonage but not to peer-to-peer services, such as those offered by Skype, in which connections are made entirely over the Internet.

Source: Federal Communications Commission (FCC) available at
http://news.com.com/FCC+approves+new+Internet+phone+taxes/2100-7352_3-6086437.html

6 The Distribution of Universal Access Support and Funds

As discussed in the preceding sections, the transition to NGN has opened up new possibilities in the context of universal access. As a result, the distribution of universal access support should be reconsidered in order to maximize the potential offered by NGN in meeting universal access goals.

The general question of how universal access support should be distributed encompasses a number of more specific questions: Who should be supported? (e.g. end-users, small operators, the incumbent, NGOs, etc.), What form should the support take (e.g. subsidies, loans, venture capital, etc.) and How should universal access providers be selected? (e.g. incumbent, auction, tender, etc.). While no one answer will prove to be the most ideal, it is nevertheless good practice to consider all the available options. Ultimately, what may be the most effective option could be a diversified approach to the allocation of universal access support over a range of actors and activities.

6.1 A top down vs. a bottom up approach

Early phases of universal access programmes are often undertaken on a large scale with supply-driven objectives that are measured in terms of infrastructure deployment on a national level (e.g. one public phone per village). In the past, traditional top-down, supply-driven approaches were typically adopted for large scale universal access projects. In such a scenario, a single provider - usually the incumbent - is selected to provide a standard set of services, using a narrow set of technologies, over a wide geographical area. The benefit of such an approach lies in the economies of scale a single provider can harness to achieve savings in cost. Taking a standardized approach over a wide area allows equipment to be purchased in bulk and for costs to be spread over a wider subscription base.

The introduction of NGN related technologies, such as BWA and Wi-Fi, however, has challenged this premise. NGN has substantially reduced economies of scale in both the infrastructure segment (as a result of cost-effective new wireless technologies) as well as in the service segment (e.g. VoIP). This opens up the field to a wider range of small or local providers to expand universal access from a bottom-up, demand driven angle.

A number of recent studies show that projects which originate from the communities that will be benefiting from the services to be provided or from the entrepreneurs that will be taking risks rather than those designed by bureaucrats have shown more promise. For example, studies by the International Institute for Communications and Development (IICD), a Dutch NGO involved in Bolivia and Ecuador, indicate that it is possible to implement small-scale universal access projects in rural areas.[32] The studies show that there is demand from farmers, small businesses, education institutions and local government.

As a result, more regulators have established programmes that encourage smaller operators and venture oriented companies that are closer to the target communities to participate in universal access projects. Since 2004, for example, small operators in Peru could request for subsidies for their self-initiated projects.

In cases where large-scale projects must still be undertaken, top-down approaches can still be used. However, these should be combined with a bottom-up approach to identifying requirements such as proposals delivered by communities, towns and municipalities.

6.1.1 Competition for Universal Access Delivery

Where a top-down solution is used in universal access projects, competitive methods of selecting a universal access provider should be considered. In such a system, potential universal access providers would bid through an auction, tender or other competitive selection process to provide specific types of services at specified levels of quality, scalability, upgradability and price. The winner would be the operator that requires the least amount of subsidies or funding to meet those requirements. Requirements should be kept to the barest minimum to allow potential providers the flexibility to propose the most efficient solutions. (See Box 7 above).

Such an approach is advisable for a number of reasons: Firstly, with economies of scale more easily attainable, incumbents should no longer be viewed as being the most ideal provider of universal access. Secondly, technological innovation has led to a wide range of access and service options to choose from. Given their limited resources, regulators and policy makers may not possess the same level of information and familiarity concerning the viability of these options as commercial providers. Allowing providers to propose solutions that they feel are the most cost-effective may result in greater cost savings as a result.

To ensure that winning providers would have incentives to keep investing and remain responsive to changing technologies and market conditions, a new competitive selection process might be held every 5 to 10 years, with the original winner facing the potential of being replaced.

6.1.2 The Role of Not for Profit Private Initiatives

The increasing ease with which small-scale universal access projects can be launched has also catalyzed the entry of non-traditional actors onto the universal access scene. These entities engage in activities from funding support to infrastructure deployment and service provision. As a common denominator, however, they have tended to focus on small-scale projects that are initiated closely with local communities or enterprises.

For example, Red Cientifica Peruana (RCP) in Peru started life in 1993 as nonprofit company set up with one computer and three modems. To date, its co-operative, self-sustaining model has inspired the setting up of more than 30,000 "cabinas publicas" or booths with computers across Peru, accounting for the bulk of the country's Internet use.[33]

Beyond the deployment of infrastructure and services, a small but growing number of not-for-profit organizations have emerged to focus on supporting local small-scale projects in developing countries. For example, an innovative funding mechanism intended to fill the "financing gap" for entrepreneurs who are unable to find capital was established recently in South Africa. (See Box 13.)

Box 13: Funding Support through Enablis

Enablis Entrepreneurial Network's is a not for profit, membership based organisation that supports individuals who adopt ICT as a significant enabler for social and economical development in the developing world. It has the support of private sector companies and the Canadian Government's Fund for Africa.

At present, it offers its members access to a ZAR 50 million (USD 65 million) fund, which provides a 90% loan guarantee exclusively to Enablis members in South Africa. This fund allows entrepreneurs with approved viable and sustainable business plans to obtain risk funding under favourable terms. Loan amounts are available in the ZAR 100,000 to ZAR 2.5 million range.

The model Enablis uses relies on its closeness to the borrower to ensure loan repayment. Relationships with members are fostered by the capacity building services and coaching Enablis offers. In addition to supporting borrowers with networking mentoring and coaching support, Enablis also provides support through an e-advantage seminar programme and e-circle peer-to-peer support programme and an e-finance risk capital programme.

Source: Enablis at http://www.enablis.org

6.2 Types of Funding Support

Before the wave of liberalization swept global ICT markets, universal access funding support was typically directed towards compensating the incumbent for maintaining high cost networks through the payment of an "access deficit charge" or through one off grants that supported the large scale roll-out of infrastructure. The entry of competition and the introduction of cost-effective access technologies, however, have introduced a wider range of operators that could benefit from universal access funding support.

6.2.1 Micro financing

The introduction of micro credit in the ICT sector has been a relatively recent phenomenon although it has been used in other sectors, such as agriculture, with considerable success. Micro credit fills a funding gap that allows individuals and small enterprises to obtain financing which would otherwise be denied to them by the traditional banking system for want of adequate returns and for high transaction costs. A loan of a few thousand dollars would already allow the setting up of a small internet booth equipped with a computer and Wi-Fi access. Money pooled may even support the rollout of a small mesh network in a rural community on the urban fringe.

Restructuring of universal access funds where a portion can be used for micro-financing operations including loans, grants, equity participation in projects run by small local entrepreneurs, local authorities and not-for-profit organizations could trigger the beginning of a grassroots movement to expand ICT access. This was the logic behind the partnership forged between the ITU and Grameen under the "ICT Empowerment Network" initiative in December 2006.[34]

6.2.2 Targeted End User Programmes

In a number of developed countries, universal access funds have been used to assist end-users directly through programmes that specifically target certain groups such as low-income households, the elderly and the disabled. Programmes range from the provision of subsidies to the mandating of special tariffs for certain target groups. For example, the Low Income Program in the United States reduces the cost of initiating a new telephone service as well as reduces monthly charges for basic telephone service. This programme forms part of the country's Universal Service Fund's activities.[35]

The benefit of targeted subsidies rests on its transparency and on its ability to target specific "excluded" end-users with assistance. When applied in areas where a selection of access technologies and services is available, a suitably designed end-user programme would also allow such end-users to select the particular solutions that they require. For example, end-users benefiting from such a programme would have the choice of using their subsidies for a mobile phone or a fixed line phone, for voice or internet services.

It should be noted, however, that most end user subsidy programmes are implemented in areas where commercially provided services are already available and not in rural and remote areas which do not yet have ICT access. Nevertheless, there appears to be some merit in considering the introduction of an end-user subsidy programme even in unserved populations. Government assurances of the establishment of such programmes once services are introduced may increase the commercial viability of service provision in these areas provided an adequate mechanism is put in place to ensure that such assistance is used for ICT services and not for other purposes.

7 Conclusion

The transformation brought about to ICT markets as a result of the ongoing transition to NGN has led to a reconsideration of all areas of ICT policy and regulation. In the context of universal access, this paper has highlighted both the opportunities and the challenges this transition brings.

In deciding between the different options available for regulators and policy makers to take, it should be recalled that the transition to NGN is ongoing with markets still having to adjust to on going changes. With future developments being hard to predict, greater reliance in general should be placed on market forces in the provision of universal access. A systematic review of a country's universal access policies should first and foremost include a revision of its sector policies and regulations concerning licensing, spectrum management, interconnection, VoIP and price regulation with a view towards lowering barriers to market entry in rural and remote areas.

Intervention by regulators and policy makers in the form of universal access funding should only be attempted where there has been a clear failure of market forces in meeting universal access goals and when sufficient time for deliberation has passed. In such an event, a number of considerations are recommended. Given the changes the transition to NGN entails, the principle of technology neutrality should be adopted to ensure sufficient flexibility to employ the most effective and practical technology solutions that NGN allows. The separation of infrastructure from services which NGN heralds will also need to be considered when policy makers and regulators decide on what aspects of universal access they should fund. During that process, attention should also be paid to backbone and backhaul infrastructure deployment, capacity building and local content development.

In the distribution of universal access funds, policy makers and regulators should also take advantage of the reduction in economies of scale brought about by NGN related technologies in the provision of infrastructure and services. Innovative grassroots funding mechanisms such as micro-financing would allow a new set of actors such as small businesses, civil society and even individuals to play a larger role in bringing about universal access, thereby reducing the dependence on incumbent operators. In this respect, the transition to NGN can be regarded as a catalyst which allows the pursuit of universal access to become more of a universal endeavor.

[1] The following targets were set, to be achieved by 2015, with special attention to be paid to the needs of developing countries.

- to connect villages with ICTs and establish community access points;
- to connect universities, colleges, secondary schools and primary schools with ICTs;
- to connect scientific and research centres with ICTs;
- to connect public libraries, cultural centres, museums, post offices and archives with ICTs;
- to connect health centres and hospitals with ICTs;
- to connect all local and central government departments and establish websites and email addresses;
- to adapt all primary and secondary school curricula to meet the challenges of the Information Society, taking into account national circumstances;
- to ensure that all of the world's population have access to television and radio services;
- to encourage the development of content and to put in place technical conditions in order to facilitate the presence and use of all world languages on the Internet;
- to ensure that more than half the world's inhabitants have access to ICTs within their reach.

[2] A Definition of Universal Service

Universal Service policies generally focus on promoting or maintaining "universal" availability of connections by individual households to public network facilities and services at affordable prices.

Universal Access generally refers to a situation where every person has a reasonable means of access to a publicly available network facilities and services. Universal Access is typically provided through pay telephones, community telecentres, community Internet access terminals and similar means.

While Universal Service and Universal Access policies can be quite different, the concepts are closely related. In some cases, the two terms are used interchangeably. For simplicity, the term universal access in this paper will refer to both Universal Service and Universal Access.

[3] Mesh networks are networks formed out of a number of access points that can automatically form connections with other nodes within range, and reroute traffic if a node drops offline. This allows the network to be self-organizing, making it extremely robust. Mesh networks using Wi-Fi usually can be set up in a matter of days and at a cost significantly below that of a similar wireline network.

[4] See http://www.huaral.org/ for more information.

[5] For more information see, for example, http://www.wirelessphiladelphia.org/

[6] MuniWireless, "More Than $3 Billion Will Be Spent On Public Wi-Fi By U.S. Municipalities During Next Four Years" Oct 2006 at http://muniwireless.com/municipal/1431

[7] For more information, see http://www.jurnalul.ro/articol_45928/broad_band_internet_via_power_sockets_in_rural_romania.html

[8] See http://www.450world.org/ for further information.

[9] **LMDS** is a technology that uses microwave signals operating between the 26GHz and 29GHz bands. It is a point-to-multipoint service, allowing access by multiple parties. Links up to 8 km from the base station are possible, but distance is typically limited to around 2km due to weather and terrain. Download speeds vary according to the number of users served but can attain more than 500mbps. **MMDS** uses microwave frequencies between the 2 GHz to 3 GHz bands. It is a point-to-multipoint service and has a range of up to 25kms with line of sight. Typical download speeds offered go up to 3Mbps.

[10] WiMAX is a standards-based technology that will operate in the 3.5 GHz, 2.3/2.5 GHz, or 5 GHz bands, depending on local spectrum allocations. It uses interference mitigation technologies that make it suitable for use in unlicensed frequencies. Its typical transmission radius ranges from three to 10 kilometers and can be expected to deliver capacity of up to 40 Mbps per channel, for fixed and portable access applications.

[11] See http://voipforsmb.tmcnet.com/news/2006/05/23/110235.htm and http://www.ghana.com.gh/ncs.html respectively for more information.

[12] Triple Play refers to the commercial bundling of IPTV, VoIP and Internet access.

[13] For more information on IPTV technology see ITU's website on the technology at http://www.itu.int/ITU-T/IPTV/ and a presentation by Reza Tadayoni, CICT, Technical University of Denmark at http://www.itu.int/ITU-D/treg/Events/Seminars/2006/ceotraining/documents/3Dec_Session%20A_2_IPTV.pdf

[14] Entman, Robert, "Policy Issues for Telecommunications Reform Reports of the 2005 Aspen Institute Conferences on Telecommunications and Spectrum Policy", Feb 2006 available at www.aspeninstitute.org/atf/cf/%7BDEB6F227-659B-4EC8-8F84-8DF23CA704F5%7D/2005TelecomReportText.pdf

[15] For more information see "Licensing in the Era of Liberalization and Convergence: The Case Study of the Republic of Uganda, 2004", ITU available at http://www.itu.int/ITU-D/treg/Case_Studies/Index.html

[16] Andrew Dymond, Telecommunications Challenges in Developing Countries, Asymmetric Interconnection Charges for Rural Areas, World Bank Working Paper No. 27, 2004

[17] To some extent, the challenges facing small rural ISPs are similar to those faced by developing country ISPs such as limited market size and geographic isolation. Some of the solutions proposed to such as demand aggregation can be used effectively in both situations. Please see the 2007 ITU GSR Discussion Paper on International Interconnection, NGN and Development for more information.

[18] Directive 2002/22/EC of The European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive)

[19] See http://www.dot.gov.in/uso/usoindex.htm for more details.

[20] A revenue village is an administrative unit comprising of an agglomeration of habitations which has a definite boundary.

[21] Ofcom's response to the European Commission's "On the Review of the Scope of Universal Service in Accordance with Article 15 of Directive 2002/22/EC" 24 May 2005, COM (2005) 203, 24 May 2005

[22] A target area can be defined in a number of ways. This could include specific villages that do not have any telecommunications services to entire regions that have teledensities below the national average.

[23] See Xavier, Patrick, "What Rules for Universal Service in an NGN Environment", ITU, Apr 2006 available at www.itu.int/osg/spu/ngn/documents/Papers/Xavier-060323-Fin-v1.pdf

[24] For example, Ofcom undertook a preliminary review of the case for extending USOs to include broadband and concluded that: "…as yet, the efficiency case for a broadband USO is not compelling" due to the "…still limited take-up, the dangers of distorting the market (through non-technology neutral intervention at an early stage of market development), the lack of convincing efficiency or social policy arguments for universal broadband access and the number of existing private and public broadband initiatives" - Ofcom's response to the European Commission's "On the Review of the Scope of Universal Service in Accordance with Article 15 of Directive 2002/22/EC" 24 May 2005, COM (2005) 203, 24 May 2005.

[25] Srivastava, L. "Promoting Broadband - The Case of Iceland", Apr 2003, ITU available at http://www.itu.int/osg/spu/ni/promotebroadband/casestudies/iceland.pdf

[26] Peter A. Stern, David N. Townsend and Robert Stephens, New Models for Universal Access to Telecommunications Services in Latin America, Regulatel and World Bank, Nov 2006

[27] Eric Lie, "Building Digital Bridges: The Case of Malaysia", ITU, Sep 2004 available at http://www.itu.int/osg/spu/ni/digitalbridges/docs/casestudies/malaysia-rv3.pdf

[28] For more information, see http://www.openknowledge.net/

[29] ITU World Telecommunication Indicators Database

[30] ITU World Telecommunication Indicators Database

[31] Supra note 26

[32] Joitske Hulsebosch, Bénédicte Marcilly, Loeki Schaeffers, "Uniting Through Networks", Nov 2006 available at http://www.iicd.org/articles/uniting-through-networks

[33] See http://www.rcp.net.pe/ for more information.

[34] For more information, see http://www.itu.int/newsarchive/press_releases/2006/35.html

[35] See http://www.usac.org for more information.