OECD Digital Economy Papers No. 141

Global Opportunities for Internet Access Developments

OECD

https://dx.doi.org/10.1787/230536236463

OECD

Unclassified **COM/DSTI/DCD(2007)3/FINAL**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development **04-Feb-2008**

English - Or. English

DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY
DEVELOPMENT CO-OPERATION DIRECTORATE

COM/DSTI/DCD(2007)3/FINAL
Unclassified

GLOBAL OPPORTUNITIES FOR INTERNET ACCESS DEVELOPMENTS

English - Or. English

JT03239667

FOREWORD

In May 2007 this report was presented to the Working Party on Communication Infrastructures and Services (CISP) and to the Development Assistance Committee (DAC) in October 2007. It was recommended to be made public by the Committee for Information, Computer and Communications Policy (ICCP) in October 2007.

The report was prepared by Dr Sam Paltridge of the OECD's Directorate for Science, Technology and Industry as part of the policy coherence for development program. It is published on the responsibility of the Secretary General of the OECD.

TABLE OF CONTENTS

SUMMARY AND RECOMMENDATIONS

The Internet, in little more than a decade following its commercialisation, has been remarkably **successful in developing greater opportunities for communication access for the first billion users.** The challenge for all stakeholders is to expand the economic and social opportunities, made possible by the Internet, for the next several billion users. This report seeks to address the question of where these users will come from and to examine the large shifts in communications policy which are enabling this to be a practical possibility. It also considers how different Government policies affect the Internet accessibility. The question of whether these policies – in OECD or developing countries - are conducive for development and poverty reduction is discussed as part of the OECD's program on policy coherence for development.[1]

All indications are that the majority of the next several billion users, mainly from developing countries, will connect to the Internet principally via wireless networks. In some developing countries the number of wireless subscribers already outnumbers those for fixed networks by more than 20 to one. The characteristics of these "new" Internet users will be vastly different from the first billion users. The majority of users now joining wireless networks, for example, have incomes of less than USD 2 per day.

Liberalisation has played a key part in the expansion of fixed and wireless access networks, which in turn make possible access to the Internet, and in making these services increasingly affordable and applicable to people with very low incomes. The report notes the increasing innovation occurring in a number of developing countries with competitive markets. It also highlights the employment, micro-entrepreneurial and social development opportunities which have emerged as access levels have risen among low income users. More than 70 countries still have monopolies over international gateway services. Such monopolies raise the prices for accessing international capacity, far beyond costs, and reduce the affordability of Internet access to business and end users.

The report considers the international debate which has taken place, in international fora such as at the World Summit on the Information Society and the Internet Governance Forum. The report concludes, consistent with previous OECD work, that the current model for Internet traffic exchange has been highly successful and that regulatory reform over the past decade has been positive in developing communication access.[2] At the same time, tremendous opportunities exist for reducing costs and increasing competitiveness through the development of local infrastructure and human capital. In April 2007, 92 countries did not have an Internet Exchange Point (IXP) and continuing efforts are needed on capacity building in respect to inter-networking skills which are needed to run IXPs.[3]

The report raises issues of an economic nature which may surround security as the next several billion Internet users join the network. It highlights the challenges surrounding security for low income users and the impact that this may have on the rest of the Internet. It also notes the innovative approaches being taken to address these issues.

The report suggests that the characteristics of access in developed and developing countries are likely to exhibit significant differences, in the short to medium term, in areas such as fixed and wireless, narrowband and broadband. The largest differences in the commercial arrangements for interconnection

will not be North-South, but between countries with different models for traffic termination on domestic access networks.[4] As convergence toward the use of the Internet Protocol continues, more and more traffic will be exchanged, using the Internet's commercial model, across a variety of broadband platforms. When coupled with the commercial arrangements, which have typified these networks in the past, significant differences could emerge internationally.

This paper concludes with a number of policy recommendations applicable to the development of communication markets and the goal of extending the benefits of Internet access to the next several billion users.

- The next several billion Internet users represent a commercial opportunity rather than a burden and this should be reflected in policy approaches.

- There is now a large body of experience to draw on in reforming communication markets and orienting them towards growth. These include the introduction of competition, separating the function of policy making from operational responsibilities and the creation of an independent regulator with the power to enforce appropriate regulatory safeguards.

- Liberalisation of communication markets focuses competitive forces on the expansion of access and affordability for the poor as well as promoting innovation applicable to local circumstances as highlighted by the recent experience of some Asian and African developing countries. Improved access and lower communication costs generate general economic and social benefits. Historically, in markets typified by monopolies and little momentum for access growth, the cost of reaching and maintaining service to low income users was not sustainable.

- Opening communication markets enables private sector investment to respond to demand and scarce government resources to be used elsewhere for development in areas of high priority (*e.g.* health, education). The development of a competitive and commercial market stimulates the build out of infrastructure which can then enable targeted intervention by government to achieve public policy goals (*e.g.* for provision of access in those underserved areas of their countries at a reasonable cost such as a village access point).

- Higher prices for communication services generally exist where one or more players can exercise monopoly power in the use of existing infrastructure (*e.g.* an undersea cable or international gateway) or prevent the development of more cost efficient infrastructure (*e.g.* IXPs). Governments should aim not only to ensure competitive markets for users in their own countries but for the delivery of international services from their country and to their country through lower termination rates.

- The barriers to establishing IXPs in countries where they do not yet exist are largely non-financial. There is a lack of appreciation among all stakeholders of mutual benefits which they can enable. An efficiently managed IXP can rapidly generate savings that pay for its establishment and maintenance as well as improve Internet performance in the country concerned. It is estimated that expenditure of less than USD 40 000 in total would fund the establishment of an IXP in each of those 92 countries where they do not exist (i.e. a total of under USD 4 million). Such expenditure for example in the form of development co-operation, however, would only make sense if the conditions are in place to enable the IXP to operate efficiently and become industry driven.

- It is necessary for Governments in OECD and developing countries to consider closely the overall coherence of their policies in order to support development. The benefits of liberalisation

– supported by relevant capacity building - extend well beyond the communication sector to economic and social use of networks and services.

- Policy or regulatory approaches that place burdens on the communication not related to sector specific goals, which are additional to those applied to the rest of the economy or society (*e.g.* taxes, tariffs), or do not encourage competition to flourish, act as a barrier to overall economic and social development.

- The globally interrelated nature of the Internet means that the policies and practices adopted in any country have the ability to affect the security and stability of network use in another. In this context the development of a culture of security which benefits all users around the world, and the expenditure necessary to sustain that environment, will be particularly challenging for the next several billion Internet users. All stakeholders should support capacity building, developmental and cross-border co-operation to build a global culture of security.

INTRODUCTION: GLOBAL OPPORTUNITIES FOR INTERNET ACCESS DEVELOPMENT

The Internet, in little more than a decade following its commercialisation, has been remarkably successful in developing greater opportunities for communication access. Somewhere in the vicinity of one billion users have access to the Internet. They benefit from a wealth of opportunities the network-of-networks creates for economic and social development. Notwithstanding this success, more than 80% of the world's population do not have access to the Internet or the opportunities it brings.

The challenge for all stakeholders is to expand economic and social opportunities for the next several billion Internet users. This report seeks to address the question of where these users will come from and to examine the large shifts in communications policy which are enabling this to be a practical possibility. In terms of platforms, all indications are that the majority of the next several billion users will connect to the Internet via wireless networks. In some developing countries the number of wireless subscribers already outnumbers those for fixed networks by more than 20 to one.

The characteristics of the "new" Internet users will be vastly different from the first billion users. The majority of users now joining wireless networks, for example, have incomes of less than USD 2 per day. To the extent that individual handheld devices are the primary means for future growth in Internet access and use, by low income users, then wireless developments will certainly be at the forefront. There will, of course, be a vital ongoing role for fixed networks in both the provision of backbone carriage and access. Moreover, not all access will be individual with many new users taking advantage of community tele-centres or Internet kiosks. Both fixed and wireless networks will provide connectivity to these centres.

The trends in ICT development to meet these goals are promising. The price of bandwidth, which reflects costs in competitive markets, continues to fall as does the cost of ICTs in relation to functions such as storage and processing.[5] Basic mobile handsets capable of telephony are now wholesaled at less than USD 30 with USD 20 terminals likely to be in play by 2008. The price of handsets capable of accessing the Internet has fallen below USD 50. The minimum cost of ownership of a mobile phone in some developing countries can be less than USD 2 per month. In India, unlimited wireless Internet access is available for less than USD 6 per month.[6]

Liberalisation of telecommunication markets is generating unprecedented growth in access in developing countries. This growth is predominantly in wireless access but also, where market efficiencies are being given a chance, through developments to fixed networks including improving broadband capabilities. It is possible to point to an increasing number of success stories related to market reform. This paper looks at Bangladesh, India, Pakistan and Sri Lanka in South Asia and Ghana, Kenya, Nigeria and Uganda in Africa. All these countries are achieving expansion of access to basic telecommunication services at very high growth rates. This is a fundamental pre-requisite for their development of Internet access.

What all these countries have realised is that they can harness competitive forces to build out core networks to serve the commercial market which is, in itself, much larger than it had historically been perceived. The existence of these "commercial networks" in turn enables targeted policies (*e.g.* a village telephone, Internet kiosk or tele-centre) to be economically feasible when these are not supplied by the

market. In many cases, however, experience is beginning to show they can be supplied by the market. In Ghana there are reports that once popular tele-centres, opened only several years ago, are closing as the coverage and penetration of mobile wireless networks expands.[7] Recognition for a greater role for the market over turns a century of "development mythology" which held the only way to develop universal service was via communication monopolies.

Extending Internet access to the next several billion users will have profound consequences for their economic and social development. It is also affecting the strategies of access, equipment and content providers as low income users become part of communication markets from which they were previously excluded. Access providers are racing to roll out services, often in areas where there was little or no coverage and little incentive to previously provide service. Equipment manufacturers recognise the next several billion Internet users as a tremendous opportunity and are developing technologies to meet the requirements of new markets (*e.g.* affordable, robust). Content providers are tailoring services to be increasingly accessible to wireless users and addressing the constraints and opportunities created in the mobile environment.

The primary focus of this report are the changes being made in communications policy around the world and the opportunities this creates for the next several billion Internet users. This includes the benefits an enabling environment can bring in terms of social and economic development. For this to occur, however, broader support of policy coherence for development is required including areas such the inter-networking skills and taxation. Inter-networking skills are necessary to take advantage of the opportunities the Internet brings for providers. More broadly improving access to education is required in respect to the skills needed by users to take advantage of opportunities the Internet creates in areas such as employment, health and security. Governments should also assess whether the taxes they apply to communications, in areas such as mobile handsets or taxes which are specific to the telecommunications industry, act to disproportionately raise costs for low income users.[8] Reductions or elimination of taxes, specific to telecommunications, may be revenue neutral or have a positive impact on revenue when counterbalanced by greater tax income from higher usage, corporate tax and economic growth, particularly in countries where access is still low. These subjects, however, frequently go far beyond the mandates of communication policy makers.

What is at issue, in this paper, are those areas that fall squarely in the domain of communications policy makers, such as the importance of market reforms through liberalisation. Here the paper briefly recalls the still relatively recent shift from supply-led to demand-driven development. It recounts the debilitating impact of the supply-led environment for developing countries which had most to gain from the introduction of market reforms. This is exemplified by success stories from South Asia and Africa where typically less than 1% of the population had a telephone during the monopoly era. The paper also notes the paradigm shift which enables policy makers to think of communications as a driver for economic and social growth instead of growth in access being an outcome of such developments.

The results of the communications policy paradigm shift have been dramatic. It has allowed developing countries to begin to share in the ICT revolution and the benefits it potentially brings in a meaningful way for growth in their economies. It has also opened the market for private capital to be invested in the expansion of access. This has meant that no longer are goals for communications policy potentially in competition with other public policy goals in terms of scarce funding. Moreover access to communication helps empower people in developing countries to a far greater extent than relative to people in OECD countries. For people battling to sustain themselves, on meagre incomes, communications access can provide economic opportunities and social security in ways that may be difficult to fully appreciate in the developed world.

New research is beginning to emerge on how users on incomes of less than USD 2 per day utilise communication access. Users in developing countries, in particular, will allocate much higher relative proportions of their incomes to purchasing communication services than consumers in the developed world.[9] They do so because they see tangible benefits to themselves and their families. Research in the field increasingly indicates that communications can empower creativity and confidence in ways that would have been hard to imagine in the recent past. This ranges from micro-entrepreneurial activity in regions where there may be few other opportunities through to the direct employment created in a growing communications sector. But what is also clear is that in a competitive environment firms will find ways to provide services to low income users that would have not been developed in OECD markets. Innovation can thrive in developing countries if they have competitive markets and begin to make Internet access a more compelling proposition for those on low incomes.

The benefits of opening markets to competition, for low income consumers and the economy as a whole, far outweigh any supposed impediments or objections that may be forwarded by incumbent operators. Take the growing financial flows which result from migration or offshore workers, by way of example. Financial remittances from offshore workers and migrants are far higher than official development assistance or foreign direct investment. Communications access providers in competitive markets are developing tools to be part of this process and to provide services for those previously un-served (the so called 'unbanked'). One communications industry association believes providing tools for international remittances could double the number of recipients to 1.5 billion people while helping to quadruple the size of the international remittances market to more than USD 1 trillion per annum by 2012.[10] The greater the communication access people with low incomes have the more they will benefit from new processes such as these which provide tangible changes in their lives.

A further innovation, increasingly typical in the most competitive African mobile markets but still largely absent in OECD countries is "borderless roaming" for wireless users. Beginning in late 2006, the African mobile provider Celtel began allowing its customers in Kenya, Tanzania, and Uganda to cross the national borders of these countries, without additional roaming charges and without having to pay to receive incoming calls.[11] In June 2007, Celtel expanded this offer to a further three countries in which it operates: Republic of Congo, Gabon, and the Democratic Republic of Congo. Pre-paid and post-paid customers in all six countries can make calls at the same tariff whether they are in their home country or one of the other five countries. Prepaid users can also purchase air-time when roaming in other countries and the service initiates automatically when a user crosses a border without the need to register. Rival networks in some of these countries, such as MTN and Uganda Telecom, subsequently launched services which enabled their customers to make calls and send SMS at domestic rates, receive calls and SMS for free, as well as use a range of value added services, when roaming in some countries in their region.[12]

The impacts of liberalisation in terms of the demographics and structure of communication markets have been rapid and global in nature. Consider, for example, that the largest owners of undersea cable capacity are Indian owned firms. In 2007 Indian companies, depending on the measure used own nearly half of the world's undersea cable capacity. From 2000 to 2005, the centre of ownership in this industry shifted from North America and Europe to Asia. In terms of subscribers firms from the United States were historically the largest in terms of total numbers. Yet, although there has been industry consolidation in that market over recent years, only three feature in the world's 20 largest firms when ranked by proportionate subscribers for fixed, mobile and Internet (Verizon 8th, AT&T 9th and SprintNextel 17th).[13] It is not that the United States market has not been growing strongly - it has! Rather there has been a tremendous growth in access and Internet infrastructure around the world including in previously under developed markets.

As the Internet originated in the United States the first connections were to that country. Following commercialisation of the Internet, operators around the world began to build out local and regional

infrastructure to exchange traffic. These operators became known as Internet Service providers (ISPs). Each year since that time the Internet can be said to have become less "United States centric". The larger players put into place their own end-to-end facilities to carry traffic around the world or put in place commercial arrangements to accomplish that task. Smaller ISPs purchased or leased capacity to local or major international Internet Exchange Points (IXPs), where they could peer or buy global transit. Moreover the most popular content and service providers began to exchange traffic directly with the world's larger ISPs. Google, for example, exchanges traffic directly with more than 30 networks.[14] In contrast to the early days of the commercial Internet, content is also distributed and stored around the world. Akamai, a company which stores content globally on behalf of their clients, says 10% to 20% of the world's Internet traffic is delivered from their platform (20 000 servers across 71 countries).[15] In 2007, one study by computer scientists suggested that 80% of the world's networks could communicate with each other without their traffic traversing the networks of the largest players.[16] The key to taking advantage of the new environment, for all players, and the diversity of routes this enabled was liberalisation of telecommunication markets.

Notwithstanding the growing success of open markets more than 70 countries still have monopolies over the provision of international gateway services. Such monopolies raise the prices for accessing international capacity far beyond costs and increase prices beyond the affordability of Internet access to business and end users.[17] A further group of countries have liberalised their markets but face delays in the time it takes to roll out competitive facilities. Inherited monopolies or monopoly power are still firmly a barrier to bringing down the costs of Internet access for much of the world. Opening markets is the variable which can be most readily changed by communications policy makers but there are others. Encouraging the creation of local IXPs, that are open to all communications providers, would further enhance competitive opportunities and improve Internet services. In April 2007 some 92 countries did not have an IXP.[18]

In terms of creating an enabling environment there needs to be a greater focus on evidence based policy making. Fora such as the Internet Governance Forum have an important role to play in that respect. All stakeholders need to do a better job in explaining the factors which have contributed to the successful growth of communication access and identify the barriers. In the years leading up to the World Summit on Information Society (WSIS), in the debate over international interconnectivity, critics of the system of Internet traffic exchange tended to look backward toward the model which had provided the framework for circuit switched networks in the monopoly era. This led to a misreading of where the real barriers to development are in getting the next several billion users on the Internet.

The "Tunis Agenda for the Information Society", contained positive recommendations to promote an enabling environment for innovation, competition and investment.[19] There was not, however, universal agreement on issues surrounding international interconnectivity The claimed deficiencies in policies pursued by OECD countries are that by allowing a commercial market to develop for the exchange of Internet traffic, in contrast to the traditional settlements system for circuit switched traffic, developing countries have been disadvantaged. Based on this, it is argued, the direction of the market is working against the development of access.

In this context it is important to draw attention to the flaws in the traditional system and build a better understanding of the opportunities of the new environment, in terms of increasing access for the next several billion Internet users from developing countries. This report takes note of previous work on Internet traffic exchange and summarises, in a forward looking way, issues arising from convergence, security and different termination models for wireless networks as well as the benefits from liberalisation of communication markets.

Claims of negative impact on developing countries, in respect to the commercial model used for the exchange of Internet traffic, are not reflected in the actual market developments. The Internet's commercial approach has been remarkably successful in connecting more than 24 000 networks supporting millions of customer networks and the first billion Internet users. This does not mean there are not deficiencies in international connectivity. Connectivity costs are still high in many developing countries due to gaps in key facilities necessary to connect national networks to international networks in some regions (*e.g*. East Coast of Africa) or regulatory frameworks which do not encourage market growth to support the development of this infrastructure.

The necessary framework conditions for growth include liberalisation of markets, the separation of operational and policy responsibilities and the creation of an independent regulatory authority. The Internet creates some specific considerations, such as the need to establish IXPs, but the key is policy approaches which enable the opening of the market to investment and innovation which show the greatest benefits for developing communication access.

Governments need to consider carefully the overall policy coherence for development. For developing countries the benefit of liberalisation extends beyond the growing size of the market. It also supports the broader economic and social development goals from employment creation through to improving education and health. For countries yet to reform telecommunication markets, in areas such as liberalising international gateways, fundamental barriers will remain. A policy coherent approach also needs to consider other sectors that may affect the development of access, such as policies which place high tariffs on ICT equipment or tax services over and above those applicable to the rest of the economy. Strategies can also involve international Multi-Stakeholder-Partnerships and Networks that bring together the relevant stakeholders, provide them with platforms to share knowledge, discuss policies and build implementation oriented partnerships.

The report highlights a specific concern, in relation to policy coherence, which can be said to exist in the majority of OECD countries. The prices for telephony and text messages, originating from an Internet connection and terminating on a wireless network, can sometimes be twice as high in many OECD countries as in some developing countries. The differences occur due to the different rates set by various wireless operators in OECD countries for traffic termination. High termination rates are reflected in higher prices for users in the developed or developing country where the call is initiated. In general, higher or lower rates reflect different termination models and the level of competition or regulatory intervention in that market segment. To the extent that large differences in prices are not cost oriented they could be viewed as a barrier to trade between some OECD countries and some developing countries. They are also counter to international World Trade Organisation (WTO) principles that support cost-oriented rates for interconnection to public telecommunication networks.

The importance of liberalisation

The development of communication access has undergone tremendous change over recent years. At the same time, a great deal of analysis has focused on technological developments which have accompanied these changes. This is understandable in that such developments, in the areas of wireless or fibre optics, have dramatically increased capabilities and lowered costs. The role liberalisation has played in opening markets to these developments, however, has only recently been widely accepted. Consider, for example, that the drive toward introducing fibre optics was created by competition in the long distance telephony market. The rapid development of wireless service, including innovations such as prepaid cards, was squarely driven by competition in mobile communications. The commercial Internet itself is highly unlikely to have emerged in a monopoly environment, let alone have been the source of dynamic innovation that has come to characterise it.

Underlying all the changes in technology was a fundamental shift in the communication policy paradigm whose implications for social and economic development are now only beginning to be appreciated. The realisation that competition could be applied as a tool for the development of communications markets is a relatively recent one. Yet, understanding this is critical to answering the question of how the next one, and then two, billion users will benefit from access to the Internet. Each Internet connection needs fixed or wireless network access facilities to support it.

Paradigm shift: from supply-led to demand-driven development

Jipp's Law (1963-1983)

In 1963 an article appeared in the International Telecommunication Union's journal entitled "Wealth of nations and telephone density".[20] It compared, for the first time, the ratio of tele-density to per capita income levels. The article demonstrated as might be expected that wealthy countries had higher tele-densities than poorer countries. The comparison later became known, as the "Jipp Curve" after its author.. Professor Jipp's purpose was not, however, to simply correlate wealth with telephone density. The goal was to create a tool that could be used to help establish criteria for investment in telecommunication networks. In his words:

> "In all cases where the point representing the telephone density of a country is below the curve, a rapid expansion of telecommunications is to be expected and *vice versa*. Furthermore, an examination of the curve will lead to useful conclusions as to whether the development of a network is in harmony with the other requirements of a country related to its wealth."[21]

In an environment characterised by monopolies, in which decisions were supply-led rather than demand-driven, this tool was used to assess how many telecommunication lines would be added in any given period. If a country was on or close to the trend line network planners held that the correct settings were in place for telecommunications relative to the overall state of economic development.[22] On the other hand, conventional wisdom supposed that a position significantly above or below the line, indicated over investment or under investment. This became known as "Jipp's Law".[23]

At the time the "Jipp's Law" was created, and for two decades following, most telecommunication operators, outside Canada and the United States, were State owned.[24] These operators were frequently part of a government department responsible for post and telecommunications. Decisions on the level of investment funds available were often taken outside the Ministry responsible for communications. Network expansion had to compete for scarce resources against government priorities in other areas. Greater investment in telecommunication development potentially meant lower expenditure in areas such as health or education. More to the point, many policy makers were not convinced that the benefits of expanding communication access outweighed the opportunity cost in other areas of public expenditure. If efficient levels of telecommunication provision ought to track economic development, as was widely accepted, investment should be proportionate to growth in the economy. The key question was how much could be "under invested" without disrupting economic growth.[25] A widely held view was that telecommunication services were a luxury which could be afforded once other more pressing needs were satisfied.[26]

The problem in securing capital for expansion was generally not because the telecommunications sector, as a whole, was unprofitable. Aided by their monopolies even poorly run operators, for the most part, generated a surplus. However, these funds were frequently directed toward other areas of government activity or to subsidise postal services.[27] Given limited access to capital and scepticism over the value of investing in communications ahead of more general economic growth, operators understandably tended to invest in those market segments which produced the highest returns and had the lowest costs. For the most part this meant providing service to urban areas. This also had the seeming advantage of generating very

high returns and valuable foreign hard currency exchange, from the international settlement system, for a minimal investment cost.

By 1983 questions were beginning to be raised about some parts of the dominant model for telecommunication development at both the OECD and the International Telecommunication Union (ITU). In a joint project, co-ordinated by both organisations, a series of studies were undertaken which focused on the economic impacts of developing telecommunication in rural and remote areas including in developing countries.[28] In a preface to the report, Richard Butler, the then Secretary General of the ITU, noted that the prevailing paradigm had led to significant under investment and that if present trends were to continue "…much of the world's rural population will still be waiting for a telephone 100 years from now".[29]

From Maitland to ICCP (1984-1993)

The ITU-OECD project set out to demonstrate that investment in telecommunications generated significant economic and social returns and contributed to growth in GDP. The report also argued that the greatest benefits would accrue in the countries and regions with the lowest incomes.[30] This was an important first step in changing the perceptions of policy makers and many of the insights from this work remain relevant. The report did not, however, discuss or recommend the types of reform which might assist achieving an expansion of service other than advocating higher investment levels and the use of new technologies. This task fell, in the following year, to the ITU's Independent Commission for World Wide Telecommunications Development, better known as the "Maitland Commission".

The Maitland Commission, in a landmark way, documented the first efforts to reform telecommunication markets with a goal of economic and social development. An example of such a reform was to note the increasing number of countries separating the entity responsible for the delivery of telecommunication services from being part of a government department and the postal service.

While acknowledging the, then emerging, idea that the market could play a role the "Maitland Report" did not go as far as recommending the introduction of competition. The report noted the seeming dichotomy between any notion that the market could play a role and the priorities of policy makers in developing countries:

> "In the industrialised world some may argue that, since telecommunications systems should begin to earn money as soon as they are installed, the expansion of telecommunications worldwide can best be effected through the operation of the market. Leaders of many developing countries, preoccupied with problems of hunger, poverty, disease and ignorance, aggravated all too often by natural disasters such as drought and flood, may believe that investment in sectors other than telecommunications is more urgent."[31]

The work of the Maitland Commission was in many respects ground breaking and contained some recommendations now held to be conventional wisdom. It challenged policy makers to have an "open mind" to new ideas which could foster telecommunication development. On the other hand, perhaps as a pragmatic concession to the times, the report largely took a supply-led approach to reform. Questions of development were still posed as ones for allocative decision making particularly for developing countries:

> "For their part, developing countries may wish to set themselves specific targets, taking account of their own specific circumstances. They may wish to allocate a percentage of the gross domestic product to investment in telecommunications over a defined period; or to specify targets for increasing the density of telephones per head of their population in stages."[32]

The approach by the Maitland Report is readily understandable. At that time, competition in the provision of telecommunication services was a relative novelty. Countries such as Japan, the United Kingdom and the United States had only recently taken the first steps or were about to liberalise their markets. Prior to the 1980s competition had not played a role in developing markets since the very early days of service provision. Indeed, it would be another decade before OECD member countries, as a whole, acknowledged the role competition could play in development.

This was not because the model had worked in a particularly effective way. Until relatively late in the twentieth century most OECD countries did not have high levels of telephone penetration. In 1971 more than half the then OECD countries had less than 20 telephones per 100 inhabitants.[33] The main exceptions, in terms of having significantly higher penetration rates, were Canada and the United States in North America and Sweden and Switzerland in Europe.[34] Even in these countries there were growing levels of dissatisfaction ranging from what equipment could be connected to the network to the availability and prices paid for products such as leased lines.

The growing recognition of the importance of communication services in OECD countries accentuated the need for reform. Accordingly, policy makers in several OECD countries began to introduce the types of changes that would begin to boost penetration rates and, in some countries, increase State sponsored investment to support a growth in access. This led to the reforms that would eventually find their way into the Maitland Report as recommendations.

In the developing world, as is clear from the Maitland Report, some policy makers still felt they could still replicate the then dominant "supply-led model". Critics of liberalisation held it would open markets to "cream skimming" and that new entrants would only provide service in the most profitable market segments. In turn, it was argued, the monopolist's ability to subsidize unprofitable service would be jeopardised with negative consequences to universal service policies. The reality, as opposed to the mythology, was vastly different.

While OECD countries had the relative luxury of using their wealth to drive investment, and penetration growth paced at "Jipp's Law", this was a debilitating course for developing countries. It led to a perpetual cycle of under investment and inefficient allocation decisions that meant many countries were unable to break out of levels of tele-density below 1% of their population. It also made realising the goals inherent in the mythology (*e.g.* extending universal service through means such as a village telephone) prohibitively expensive. This compounded the natural inclination of monopolies in these countries to ration supply and seek to "skim the cream" for themselves. As a result there was a high reliance on providing access, and highly profitable international services, to small percentage of urban elites but few incentives to expand service to rural areas or even to those users who could afford service (long waiting lists were common at the time even in many OECD countries). There were little or no incentives to extend service to those people with very low incomes.

The benefits of infrastructure competition (1994 to 2003)

In 1994 the OECD's Committee for Information, Computer and Communications Policy (ICCP) issued a statement on the benefits of infrastructure competition in the provision of telecommunication services.[35] This included an acknowledgement that developing countries could also benefit from competition in the provision of facilities for underserved regions. The ICCP's statement noted the positive role competition could play in enhancing universal service, meeting unmet demand and attracting investment. Soon thereafter, ICCP reaffirmed these conclusions for mobile communications and stated wireless services could enable policy makers to reshape their vision of universal service.[36] This included extending service to areas not covered by fixed networks. From that point, until the present, more than three billion fixed and mobile subscribers have been added to global networks.[37]

The main change between the publication of the Maitland Report and the "ICCP Statement" was the recognition that liberalisation was an essential step towards development. The growing evidence that competition could be applied to expand and enhance service was undoubtedly a fundamental factor. In addition, econometric work undertaken for the ICCP demonstrated that investment in telecommunication networks could be considered as an independent variable in terms of stimulating economic growth.[38] In a study of 21 OECD countries, a causal relationship was found between investment in telecommunications infrastructure and higher aggregate output.

To their credit a number of pioneering developing countries, during the 1990s, also began to realise that the historical model for telecommunication development was deeply flawed. They concluded that it would not develop their markets fast enough to capture the economic and social benefits they could see emerging in liberal markets in the OECD. They also realised that they were not in a position to overcome the limitations of monopolies, as had occurred in some parts of the wealthier developed world using government funding. New strategies emerged which went far beyond the reforms recommended in the Maitland Report (*e.g.* independent regulator, liberalisation and privatisation).

By the turn of the century the success of the developing country pioneers (*e.g.* Sri Lanka) in reforming their telecommunication markets was clearly evident. In the new millennium the demand-driven model is becoming increasingly universal with results which would have undoubtedly astounded many policy makers in the recent past. It was now clear, for example, that competition could be harnessed to increase tele-density at rates that are unprecedented in developing countries. Moreover a commercial approach, in a competitive market, entails providers reaching out to users with low incomes and extending access to under-served regions.

This does not necessarily mean that governments do not have a role to play in some circumstances. It does mean, however, that when governments do intervene, the cost of actually providing a service such as a village phone or Internet access point, is now realistic. Service can today be built out from core commercial networks (*e.g.* backbones or nearby network access points) in a way which was uneconomic in the past. It also means that the market can be used to determine those instances where intervention is genuinely required. Experience is increasingly showing that the market can in fact reach out to those people who may have been considered a "burden" using the supply-led model for service development. In addition new services, such as Internet access, are increasingly part of the overall offering.

In 2003, at an ITU event for communication regulators, Muna Nijem, the Chairman of the Board and CEO of the Telecommunications Regulatory Commission of Jordan, succinctly summarised the shift which had taken place:

> "No longer do we live in the world whose portrait was sketched by the Maitland Commission … Many countries are beginning to move beyond the conundrum of how to provide access to basic services within reach of each village. Clearly, many of us are now considering how to provide an array of network services, from voice to broadband Internet access, not only to each household, but ultimately to each individual. …More importantly I see a fundamental change in the way we view universal access. Call it a paradigm shift, if you will. No longer do we define universal access as an obligation to force on operators, more or less against their will. Rather, we increasingly recognize universal service as an opportunity. It is an opportunity not only for the people to be served by new technologies and services, but for the operators themselves. Recent experience with the rapid growth of pre-paid mobile services provides a tantalizing hint of the true market potential of the millions of currently under-served consumers."[39]

In the following sections, this report briefly explores the transformation in growth rates for communication access being experienced by four countries in South Asia (Bangladesh, Sri Lanka, India,

Pakistan) and four countries in Africa (Ghana, Kenya, Nigeria, Uganda). All these countries have introduced competition in the provision of telecommunication services and have relatively low levels of GDP per capita. They are all experiencing remarkable rates of growth in telecommunication access that are impacting on their overall social and economic development. It is from that basis that a strategy for expanding the benefits of the Internet to the next several billion users begins to come into focus. To exemplify this process a modified "Jipp Curve" can be used to demonstrate recent performance of these countries getting ahead of the curve.

Liberalisation and access growth in South Asia

Sri Lanka was one of the first countries outside the OECD area to introduce infrastructure competition. The first mobile wireless licence was issued in 1989 and by 1995 there were four operators competing in the market.[40] In 1996 the Sri Lankan Government introduced direct competition to the incumbent network operator by granting two fixed-access licences and created the Telecommunications Regulatory Commission of Sri Lanka. The two new entrants in this market segment used fixed wireless platforms. In January 2007, Sri Lanka awarded a fifth mobile wireless licence.

In 1994 the Government of India announced the National Telecommunications Policy which set a number of objectives including opening the sector to private investment and competition.[41] In 1995 the first fixed and wireless licences began to be awarded via auctions. The first private sector mobile services also began in 1995 with virtually all in operation by 1997. In 1997 the Telecommunications Regulatory Authority of India (TRAI) was established. New entrants into the fixed market commenced services in 1999. In 2003 TRAI issued unified licences, allowing operators, originally entering the market under fixed or wireless licences, to enter each other's markets with their technology of choice.

The first limited competition in Bangladesh emerged in 1997 when two of the then three licensed mobile wireless operators commenced service. At that stage, however, the new mobile operators were not permitted to own their own long distance or international infrastructure.[42] The incumbent was the government-run Bangladesh Telegraph and Telephone Board (BTTB) which acted as both the fixed line operator and regulator. One of the new entrants, in 1997, was Grameen Telephone which later became renowned for pioneering a micro-credit scheme to extend service in rural regions of the country. In 1998 a new National Telecommunications Policy set out a goal of promoting competition and improving services. In 2002 the Bangladesh Telecommunications Regulatory Commission (BRTC) was established as a result of the Bangladesh Telecommunication Act, 2001. By 2004 there were four mobile wireless providers. In 2005 this increased to five when BTTB launched its state owned mobile operator.[43] A sixth operator, Abu Dhabi-based Warid Telecom, entered the market in 2007.

The Pakistan Telecom (Re-organisation) Act became law in 1996 and created an independent regulator in - the Pakistan Telecommunication Authority (PTA). In 2003 the Government of Pakistan released a new policy framework for the communications sector.[44] Among the objectives were to open the local fixed access and long distance markets to competition. This change allowed new entrants to offer fixed wireless service with technologies such as CDMA.[45] In the mobile sector service was first introduced via a duopoly in 1994. By 2005 there were five mobile operators in the Pakistan market.

The impact of changes in these four South Asian countries, in terms of growth in tele-density, can be viewed in **Figure 1**. Tele-density is here defined as the number of mobile subscriptions plus fixed line subscriptions per 100 inhabitants. In 1990 none of the four countries had one telephone per 100 inhabitants. By 1996 when the first reforms began to be introduced none of the four countries had yet reached two telephones per 100 inhabitants. From that time onwards, depending on when liberalisation was introduced, the benefits of competition began to accrue. As might be expected, given the earlier introduction of competition, Sri Lanka quickly developed higher growth rates than its South Asian

counterparts. Yet as liberalisation has increased the growth rates for access in the other South Asian countries have also increased rapidly. Indeed, by the beginning of 2007 Pakistan was approaching the same level of tele-density as Sri Lanka.

The Indian and Bangladeshi markets were also growing apace following the introduction of reforms in those countries. In all countries it is necessary to remember that following liberalisation it may take several years for a new operator to roll out their network or for interconnection arrangements conducive to growth to be arranged. In India, for example, mobile network coverage was only 20% of the population by 2004 and this was expected to increase to 75% by the end of 2006.[46] The high proportion of India's population living in rural areas has been a factor. It takes a longer time to roll out coverage, measured in terms of population coverage, in countries with higher proportions of total inhabitants living in rural areas than those that are highly urbanised.

Liberalisation and access growth in Africa

In 1996 Ghana created a regulator (the National Communications Authority or NCA), began the privatization of its incumbent fixed line operator (Ghana Telecom) and opened its market by selling a license for a second national fixed network operator (Westel).[47] In the previous year a second mobile operator commenced service and in the following year a third mobile operator. In 2006 InternetGhana announced it was building a WiMax network and service is now available in a growing number of cities.[48] In addition, Westel has been granted the license by the NCA to provide mobile service in addition to its fixed line products.

In 1997 Uganda introduced competition under the Ugandan Communications Act.[49] Towards the close of that year MTN was awarded a full service licence for fixed and wireless service to compete against UTL (the incumbent fixed network operator) and Celtel (the incumbent wireless operator).[50] The period under which these licenses were held to be exclusive ended in 2005. In 2006 Warid Telecom was granted a full services and infrastructure licence to operate fixed and mobile serices in Uganda. In 2007 Uganda licenced a fifth mobile provider (Saudi Arabian owned HiTS Telecom).[51]

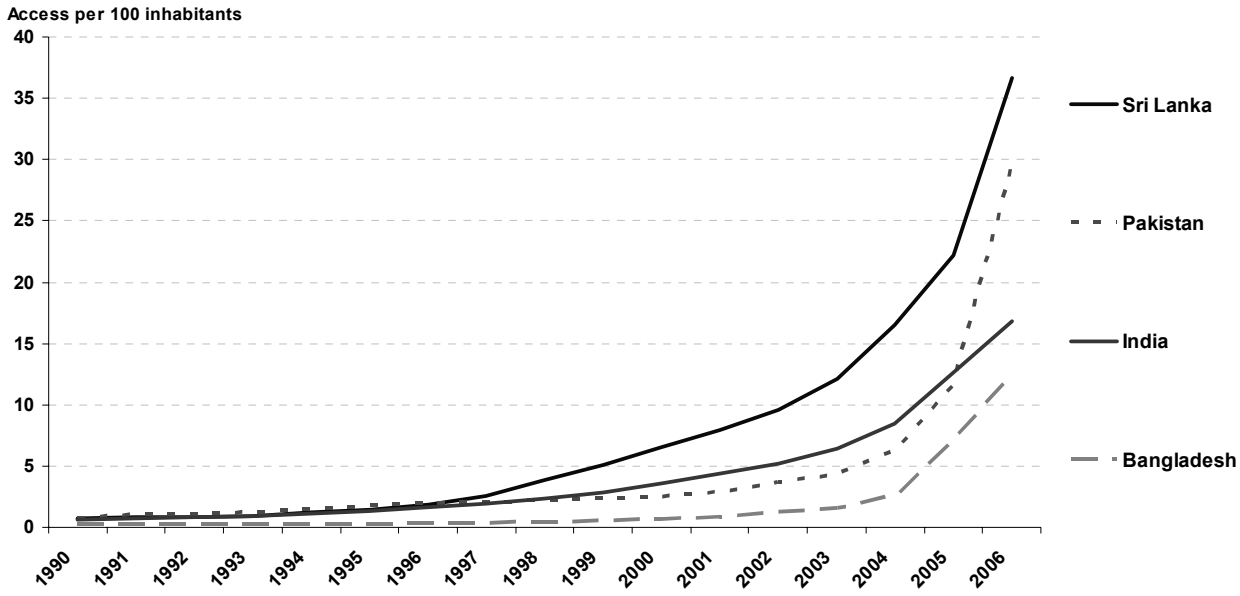
In 1998 the Kenyan Communications Act split the former Kenyan Posts and telecommunications Corporation into three entities: the Postal Corporation of Kenya, Telkom Kenya, and the regulator (the Communications Commission of Kenya or CCK).[52] In 2007 the Kenyan cellular mobile market was served by Safaricom - a joint venture between Telkom Kenya and Vodafone and Celtel, a subsidiary of MTC, a Kuwaiti-based operator.[53] A third mobile operator, Econet Wireless, based in Johannesburg, has been licensed. CCK has also offered a second unified fixed and mobile network licence but had not been able to agree terms with prospective new entrants by early 2007.[54]

In 2000 Nigeria released a new communications policy which was to form the blueprint for subsequent liberalisation. In 2001 the country licensed four digital mobile operators, fixed wireless operators, a second national fixed line operator and two long distance operators. At the same time a new license was issued to the incumbent fixed line operator Nitel. In 2003 a new telecommunications law specified the powers and independence of the regulator (the Nigerian Communications Commission or NCC). By June 2006 there were 10 entities licensed to provide mobile communications service if operators licensees to operate both fixed and mobile services are included.[55] Some 27 operators were licensed to provide fixed services.

The impact of changes in these four African countries, in terms of growth in tele-density, can be viewed in **Figure 2**. Growth has been most spectacular in Ghana and Nigeria most likely due to their licensing of a greater number of operators than in Kenya and Uganda. Notwithstanding this growth in all countries has been rapid and should increase as the impact of newly licensed operators comes into play. In

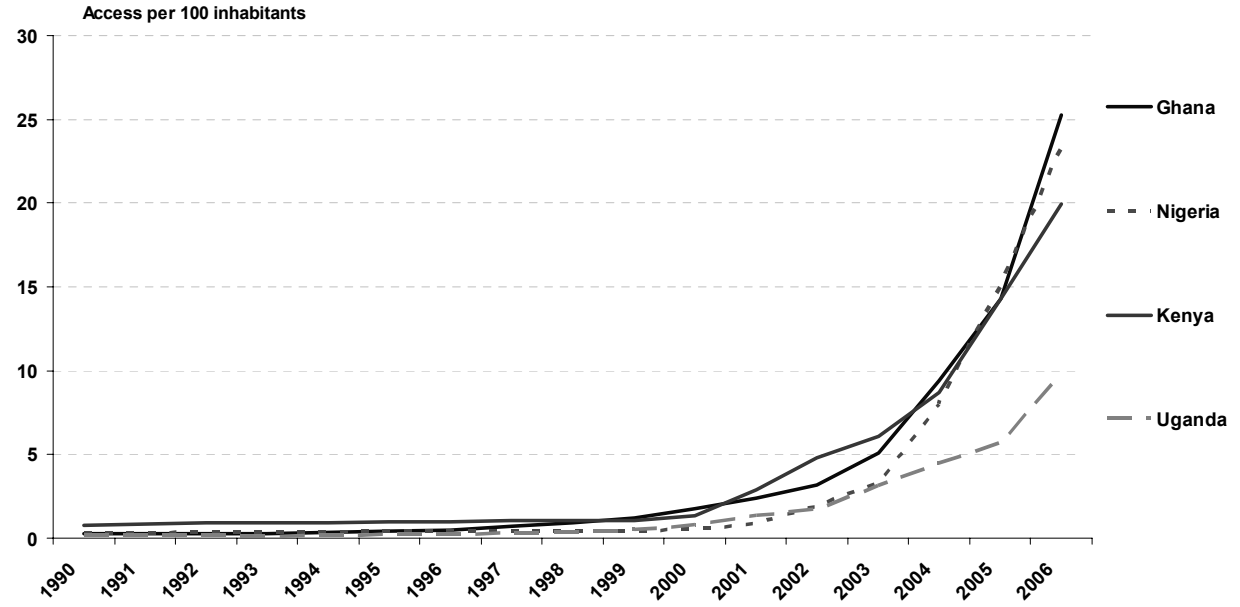
Ghana and Nigeria, for example, more mobile subscribers are added each month than for the entire pre-reform period.

Figure 1. Selected South Asian countries tele-density (fixed and mobile), 1990-2006.



Source : OECD with data from ITU, National Regulatory Organisations

Figure 2. Selected African countries tele-density (fixed and mobile), 1990-2006.



Source : OECD with data from ITU, National Regulatory Organisations

Getting ahead of the curve

An important conclusion policy makers can draw from the past decade of growth in telecommunications access is that performance is increasingly less dependent on wealth. A number of observers have noted the relationship between wealth and income has become weaker over time.[56] Some attribute this to the increasing complexity in measuring wealth or to the falling cost of equipment and faster pace of wireless network rollout. A more persuasive explanation is simply that competitive markets are better able to satisfy unmet demand at affordable prices.

A major drawback of the "Jipp Law" approach was that it held that the expansion of access should occur in lockstep with economic growth and was a natural outcome of the accrual of wealth. In a supply-led environment this became a self-fulfilling prophecy as planners invested to stay close to the curve. The result was an environment which discouraged policy makers from believing higher growth rates were either possible or desirable. At the heart of this approach were false assumptions about demand for access even in the face of long waiting lists for telephone service, in both the developed and developing world. In addition monopolies tended to prefer to ration service and charge high prices absent of regulation which provided other incentives (*e.g.* rate of return regulation in Canada and the United States in the monopoly era).

Figure 3 and **Figure 4** display a "Jipp Curve" for all economies with GDP per capita below USD 2 000 between the years 2000 and 2006. This is the period in which liberalisation has had the greatest impact on the growth of access. In South Asia, Sri Lanka and Pakistan have had the largest gains consistent with early liberalisation. India and Bangladesh look set to be on a path to quickly mirror this growth. In Africa all four countries have significantly exceeded average growth rates for their peers.

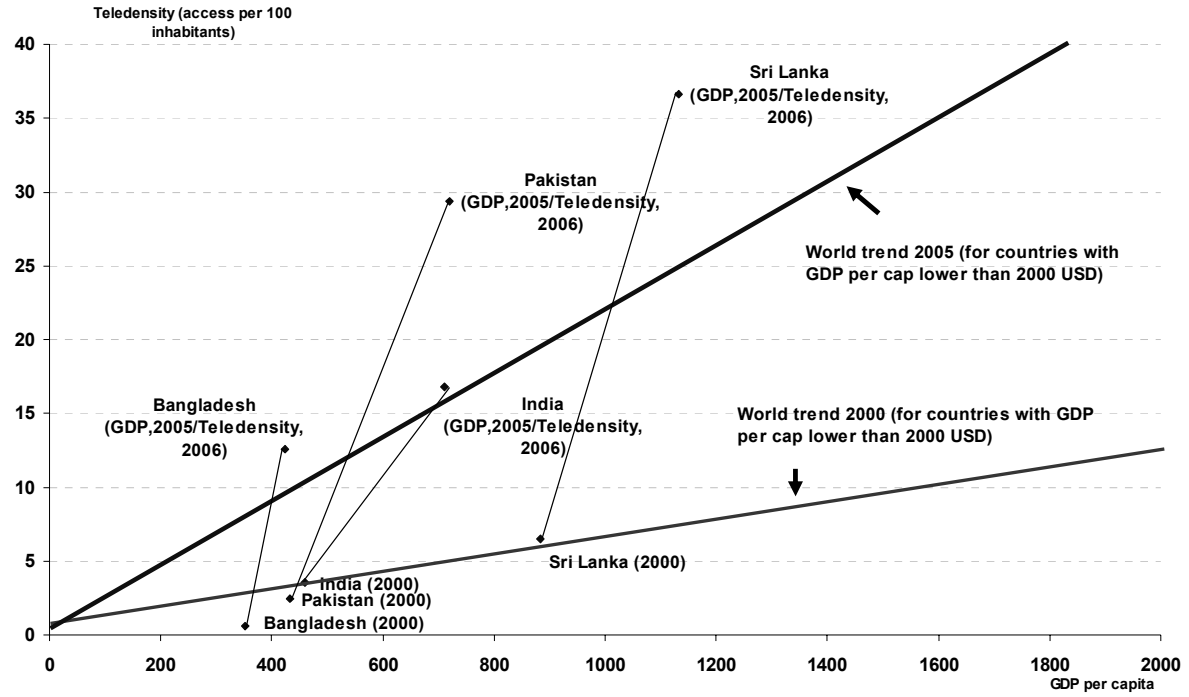
All eight countries, in Figures 3 and 4, have experienced economic growth, as measured by GDP per capita, as communications access has expanded. Economists have long posed the question of a causal relationship between the two. Have wealthy economies enjoyed better communications performance because they were rich or were they able to develop their economies at a faster rate because they benefited from superior communication networks and services? In the era when "Jipp's Law" influenced investment decisions, however, it is not clear that such a question made sense. In that environment investment was undertaken to keep pace with economic growth. By way of contrast in the new environment it is clear that communications development can run far ahead of general economic development.

In a study of the economic impact of mobile communications in developing countries sponsored by Vodafone, Waverman *et al* found the average CAGR was 64% between 1996 and 2002 while GDP per capita increased by 2% each year over the same time period (*i.e.* average compounded growth of 19%).[57] This work suggests it makes more sense now to look for a causal relationship with communications driving economic growth than at any time in the past.[58]

There are tremendous challenges in modelling causal relationships including deficiencies in the available data and taking into account other factors affecting the economy. In their modelling of the economic impact of mobile communications Professor Waverman and his colleagues used two different approaches. The results of their Production Function Model suggested that a doubling of mobile penetration, from its then average level of 8% would lead to a 10% increase in output. They also applied an Endogenous Growth Approach which attempts to take into account other factors which cause countries to differ in their long-term growth rates. The range of factors included mobile penetration through to primary school completion rates. From their Endogenous Growth model they concluded:

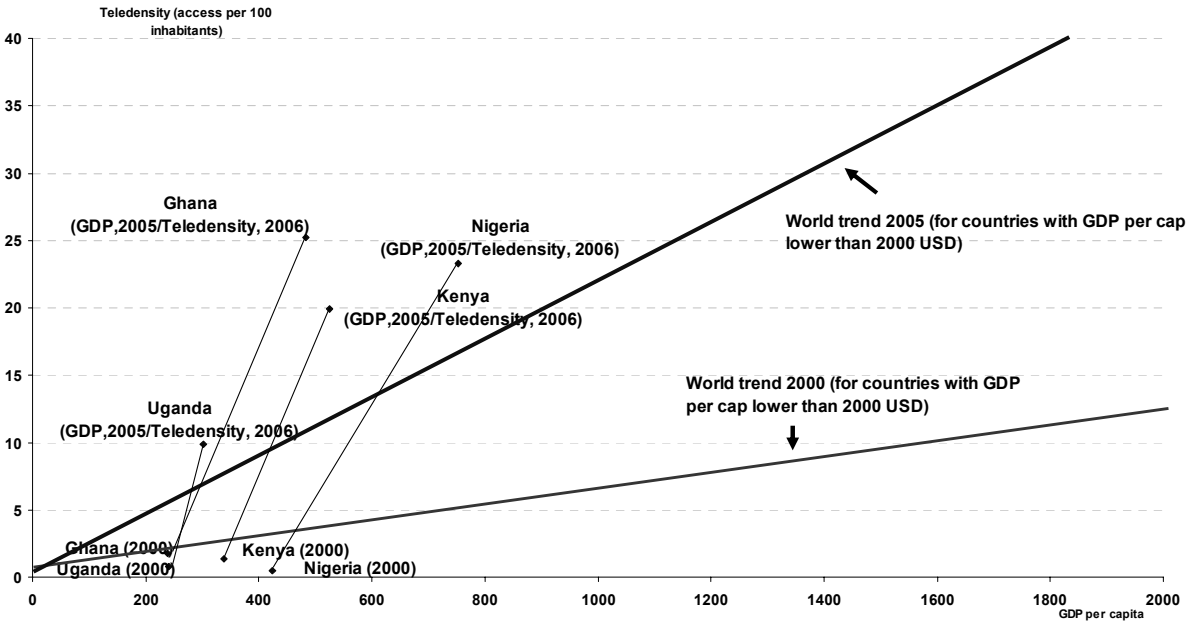
- A 10% difference in mobile penetration levels over the entire sample period implies a 0.6% difference in growth rates between otherwise identical developing nations.
- The impact of mobile communications on economic growth is twice as large in developing countries as in developed ones.

Figure 3. Selected South Asian countries "Jipp Curve", 2000-2006



Source : OECD with data from ITU, World Bank, National Regulatory Organisations

Figure 4. Selected African countries "Jipp Curve", 2000-2006



Source : OECD with data from ITU, World Bank, National Regulatory Organisations

Providing Internet-based opportunities to low income mass markets

Some two-thirds or more of world's population subsist on incomes of less the USD 2 per day. One of the best known advocates of treating the poor in developing countries as a mass market, is Professor C.K. Prahalad from the University of Michigan's Ross School of Business.[59] In his words:

> "…if we stop thinking of the poor as a burden and start recognizing them as value conscious consumers, a whole new world of opportunity will open up".[60]

Prahalad's main message is that providing affordable goods and services to the poor can be a profitable exercise. Professor Prahalad argues this approach to poverty relief can be more successful and sustainable than aid flows or action by Governments and NGOs.[61] The approach could be termed pricing that is "income-appropriate for mass markets" (IAMM).

Aneel Karani, also of the University of Michigan's Ross School of Business, is a leading critic of the IAMM approach. Karani says the size of the market for low income users is overstated by Prahalad, that a successful strategy would treat the poor as producers, rather than consumers, and that governments do have a role to play.[62] Karnani argues that only by treating the poor as producers will their incomes be raised to levels which alleviate poverty. He further stipulates governments have a role in the creation of private enterprises in labour intensive sectors of the economy through appropriate policies (*e.g.* de-regulation, creation or reform of capital markets) and in facilitating the availability of sound infrastructure (*e.g.* transportation) as well as in safeguarding non-economic freedoms.

As in all academic debates positions tend to be elucidated over time, common ground identified and other contributions made in support. In response to his critics, Prahalad increasingly cites the expansion of communication access as in successful example of the competitive marketing services making them increasingly affordable to the poor.[63] At the same time, his detractors seem to generally avoid discussion of developments in the communications sector as a potential area of critical review. Critics of micro-finance, of which there are many in the development community, also tend not to review how it has affected the positive development of communication markets when discussing what they see as the shortcomings of the IAMM approach.[64] This is unfortunate as there are positive elements in current market developments for the poor as consumers, employees and producers in the communications sector, as well as the creation of a higher level of successful entrepreneurial activity. There is also a growing body of independent research based on the "IAMM approach", in the communications sector, which bear this out.

Two organisations, who have recently undertaken research on communication markets and low income consumers, are the Washington based World Resources Institute (WRI) and the Sri Lankan-based communications research centre LirneAsia.[65] The WRI report, released in early 2007, sets out to describe and quantify the four billion low-income consumers which constitute the IAMM. They conclude that "…empirical measures of their aggregate purchasing power and behaviour as consumers suggest significant opportunities for market-based approaches to better meet their needs, increase their productivity and incomes, and empower their entry into the formal economy."[66] Chapter Three of the WRI report deals specifically with ICTs and low income users.

In February 2007, LirneAsia reported the results of their study of telephone users with incomes of less than USD 2 per day across five countries – India, Pakistan, Sri Lanka, Philippines and Thailand.[67] The objective of the study was to better understand telecommunication use among people with very limited incomes. The findings present the most comprehensive picture yet of how people on low incomes use communications services and their motivations for doing so. Together with a growing body of other research, these reports begin to build a greater understanding of the benefits of greater access for the users

with low incomes. This includes a greater understanding of the key policy challenges and solutions for extending the benefits of greater access, including to the Internet, for the next several billion users.

Creating opportunities for the poor as producers and employees

The development of telecommunication markets in low income regions and communities has brought forth a growing array of employment and micro-entrepreneurial opportunities. In Nigeria, the NCC says 10 000 people are directly employed by mobile operators.[68] They estimate, however, that a further one million employment opportunities have been created by the introduction of competitive wireless services. These opportunities range from hawkers who recharge mobile cards through to resellers who have become known as the "umbrella people". In Nigeria the entry costs for setting up a small business reselling mobile services are low -- a table, an umbrella for shade and a street corner.[69] One counter trend, however, is that mobile companies in some markets are selling credits for service in lower units of denomination. In countries where this is occurring it can potentially limit the market for resale.[70] Notwithstanding this development there are a growing number of countries that have created micro-entrepreneurial opportunities by opening their markets.

The reported direct and indirect employment increase in Pakistan, following the opening of the communications market, has been similarly impressive with some 80 000 jobs created directly and 500 000 jobs created indirectly.[71] In India, one study found 3.6 million jobs were connected to the mobile services industry made up of 171 000 direct employees and 912 000 in support services.[72] The total figure included an estimate of 720 000 jobs created through indirect expenditure and 1.8 million generated across the rest of the economy as a result of mobile services expenditure.

In Kenya, reselling telephone service has provided opportunities for the disabled. Micro-entrepreneurs have modified wheel chairs, using them as platforms for payphones, from which they provide a nomadic telephone service at fixed network rates. A two minute video clip on "YouTube", showing an example of this Kenyan development, has attracted attention among the development community including the World Bank.[73] Improved communications also offers opportunities for higher paid jobs. Thomas Friedman, the columnist for *The New York Times*, has highlighted the case of KenCall.[74] The company is located in an abandoned avocado processing plant, and it is the largest of Kenya's growing number of call centres with annual revenues of USD 3.5 million after three years of operation. KenCall's 300 employees can earn in a month the average yearly income of half Kenya's population (USD 350). The employees also get health care and free transportation.

Perhaps the best known story of communication access expansion through the empowerment of the low income users, in underserved rural areas, comes from Bangladesh. In 1997 the Grameen Bank began to provide small loans, in the amount of USD 133 each, for women to become a village phone operator (VPO) as part of the Grameen Phone network. By August 2005 there were some 165 000 VPOs with 50% of villages covered.[75] Numerous studies of the Grameen scheme report that it has provided business opportunities for women and elevated their status in village life as well as providing a profitable telephone service in regions where none previously existed.

In Uganda, MTN has partnered with the Grameen Foundation and local micro finance institutions to introduce a similar scheme to the one in Bangladesh.[76] Some 2000 local entrepreneurs have been given USD 230, a car battery or solar panel, a mobile phone and a fixed line dedicated SIM card. The agents pre-purchase airtime and sell it to other village residents. As in Bangladesh, the local entrepreneurs in Uganda are mostly women.[77] Significantly as their service has prospered some village operators have introduced a payphone service which frees up their own time from continuously staffing the service.

In South Africa, on a larger scale, the mobile operator Vodacom sells resale franchises for USD 3 950.[78] The price includes the provision of a modified shipping container (which acts as a shop) and five lines for customers to make calls at rates which are about one third of standard cell phone prices. Some of the independent shop owners also provide fax and data services. Vodacom says a typical store may serve 100 hours per month per line generating USD 3350 of revenue of which the local entrepreneur retains USD 1 190. In 2003 the programme was reported to be profitable with some 1800 entrepreneurs operating more than 4 400 phone shops.

In the Philippines, Smart Communications, a leading mobile operator has pioneered the transferral of pre-paid airtime between users via short message service (SMS). As well as enabling payment for small transactions, thereby providing a payment service for people without bank accounts, the service enables resellers to transfer airtime to their customers with a 15% commission. Smart's reseller network provides micro-entrepreneurial opportunism for 800 000 resellers.[79] Rival mobile operator Globe Telecom has a 700 000 strong reseller network where agents can earn commission on services such as sending and receiving payments using mobile phones.[80]

Innovation, creativity, and investment in developing country markets

One of the most interesting developments in the shift to demand-driven development in markets typified by consumers with very low incomes has been in the rise of innovative business models catering to local requirements. The experience of the South African owned MTN, while operating in Uganda, provides a good example. By MTN's own account, when it entered the Ugandan market, it dropped the developed country model which it felt had an elitist image and was characterised by inappropriate pricing structures.[81] This included not differentiating between fixed and mobile pricing, not differentiating between pre-paid and post-paid pricing and allowing small top-up denominations for pre-paid service.

Perhaps the most remarkable development in African communication markets has been "borderless roaming". First pioneered by Celtel a growing number of wireless providers (*e.g.* MTN, Uganda Telecom) now offer their customers the ability to roam internationally in their region without additional charges. In other words users can make or receive calls for the same prices when visiting other countries as when they are in their home countries. This innovation can be contrasted to OECD countries where such options, for the most part, do not exist even when the same provider operates in neighbouring countries.

In competitive markets, serving low income users, operators are increasingly conscious of the minimum cost of ownership (MCO).[82] The MCO for a pre-paid card user is the minimum cost of 'top-up' divided by the period in which this can be exercised. For example, if a card can be purchased for USD 5 and the credit has a duration of three months, the MCO is USD 1.67 per month. Mobile operators in competitive markets have learned to respond to user demands with new services, and add value to the MCO. For example users in the lowest income groups in many countries find ways to minimise costs like 'beeping' other users, such as an employer, to call them back With this in mind, Kenya's Safaricom introduced a service called 'Flashback 130' ("Please call me back, thank you") for its customers.[83] In Ghana, Onetouch enables pre-paid users to send a "call me back message" even when they have no credit existing on their service.

New entrants in markets typified by low incomes have also become very adept at introducing innovative services which provide solutions for their customers. In the Philippines, Smart Communications was the first mobile operator in the world to introduce international cash remittances by text or SMS service.[84] By way of background, Filipinos working offshore remitted some USD 8 billion in 2004 and by some estimates 44% of households have a family member abroad. Some 98% of the Filipino population is covered by mobile networks and more than 20 million inhabitants have mobile phones. The service, called "Smart Padala", enables users to remit cash to electronic wallets on the mobile phones of beneficiaries.

The beneficiaries can then decide whether to use the funds for electronic payments or withdraw cash from participating cash points or merchants (*e.g.* ranging from ATMs through to McDonald's Restaurants and 7-Eleven Stores). Not only is the service more secure than traditional remittance systems it is significantly less expensive. Whereas a USD 5 charge might apply to a traditional remittance on a USD 100 transfer, the cost of a Padala can be as low as 1%. Offshore workers can also pay bills directly in the Philippines using the system.

Economies typified by low incomes have also provided fertile grounds for new mobile providers. By way of example, leading operators headquartered in Africa with continental and international operations include:

- The South African based MTN, which has operations in Afghanistan, Benin, Cameroon, Congo Brazzaville, Côte d'Ivoire, Cyprus, Ghana, Guinea, Guinea Bissau, Liberia, Nigeria, Rwanda, South Africa, Sudan, Swaziland, Syria, Uganda, Yemen and Zambia.[85] In 2006 MTN's subscribers were up 73% to 40 million with revenues of USD 7.1 billion. The Group employed 8 360 employees as at December 2005.

- Egypt based Orascom Telecom operates GSM networks in Algeria, Pakistan, Egypt, Tunisia, Iraq, Bangladesh, and Zimbabwe.[86] Orascom Telecom had over 50 million subscribers as at December 2006. Orascom Telecom owns 19.3% of Hutchison Telecommunications International Limited, a leading telecommunication services provider operating in eight countries (*e.g*. India, Indonesia and Vietnam).[87] In 2005 the Group had revenues of more than USD 3.2 billion. In the third quarter of 2006 the Group had quarterly capital expenditures of over USD 1.3 billion and had 15000 employees.

- The Econet Wireless Group is a diversified global telecommunications group operating in mobile cellular telephony, fixed lined networks, satellite services and Internet operations.[88] The Group is registered in Botswana and has operations in Botswana, Lesotho, Nigeria and Zimbabwe. The group is newly licensed to provide service in Kenya and New Zealand. The privately owned group has interests in mobile companies with more than 5 million subscribers and more than 1 400 employees

- In April 2007, Telkom South Africa acquired a 75% share of Multi-links Telecommunications Limited for USD 280 million.[89] Multi-links is a Nigerian Private Telecommunications Operator with a Unified Access License providing fixed, mobile, data, long distance and international telecommunications services throughout Nigeria. Telkom has also invested in Africa Online, the largest Pan-African ISP in sub-Saharan Africa, which offers a wide range of services in Cote d'Ivoire, Ghana, Kenya, Namibia, Swaziland, Tanzania, Uganda and Zimbabwe. In a number of these countries this includes broadband Internet access delivered over various wireless technologies. Telkom's mobile subsidiary Vodacom, jointly owned with Vodafone, has operations in South Africa, Tanzania, Congo and Lesotho. In 2006 Telkom had revenues of over USD 3.4 billion.

Markets in Africa, when open to foreign investment, have also been increasingly attracting investment from outside the OECD area. The World Bank has highlighted the increasing amount of South-South investment and more recent indications are that this is increasing.[90] In Africa, for example, Tata owned VNSL, a leading Indian and international communications carrier, is active. The company successfully led the winning bid for South Africa's second national telecommunications license in 2005 and planned to invest USD 230 million between then and 2008.[91] In Uganda, the Saudi Arabian owned HiTS Telecom plans to invest USD 343 million after being awarded a mobile license in March 2007.[92] Elsewhere, in Africa, HiTs plans to set up eight operators by 2009 and another two in 2010, offering a range of mobile and fixed-line voice, 3G, WiMax, data, and international gateway services with an investment value of USD 1 billion [93].Abu Dhabi based Warid Telecom plans to invest a further USD 200 million to establish their operations in Uganda.[94]

Perhaps the largest foreign investor in Africa, from outside the OECD area, is the Kuwaiti based MTC. In 2005 MTC acquired Celtel for USD 3.36 billion. Towards the close of 2006 Celtel operated in 14 countries serving more than 15 million customers. The countries in which Celtel offers telecommunications services are: Burkina Faso, Chad, Democratic Republic of the Congo, Republic of the Congo, Gabon, Kenya, Madagascar, Malawi, Niger, Nigeria, Sierra Leone, Tanzania, Uganda and Zambia.[95]

To put into perspective what opening a market can achieve over time, the regulator estimates that USD 8.1 billion was invested in Nigeria between December 1999 and June 2006.[96] In Pakistan the telecommunications sector attracted USD 9 billion foreign investment between 2004 and 2007 and authorities expect to get another USD 4 billion in the next three to four years.[97]

An important point underlying all this investment is that the growing Pan-African and South Asian integration provides an incentive for greater regional and pan-continental connectivity. In previous times independent monopolies had few incentives to establish direct communications with neighbours when both parties were seeking to extract monopoly rents. They preferred to send traffic to lower cost exchange points even if they were in Europe or North America. If the restrictions on the provision of international gateways services are lifted, pan-African companies will develop far better local and regional connectivity. The major obstacles currently standing in their way, are regulatory restrictions on the provision and operation of international facilities.

Economic and social opportunities for the low income users as consumers

From the foregoing it is increasingly clear that firms and micro-entrepreneurs can both benefit in developing country markets. At the same time access to communications is a powerful enabling tool. Communication access providers in markets typified by low income users increasingly understand this dynamic. In March 2007, S.D. Saxena, Director of Finance at India's BSNL stated:

> "People are also talking about digital divide. In India, the situation is reverse – poor people are using the state of art technology: 7-8 percent of BSNL's customers are businesspersons, 8-10 percent are among the youth, but 75 percent are using the phone for survival in a competitive environment. If you give technology to people, they themselves find out how to use it effectively."[98]

The LirneAsia research is perhaps the most comprehensive available today to understand the use of telephone services by users with incomes of less than USD 2 per day across five countries – India, Pakistan, Sri Lanka, Philippines and Thailand.[99] Some of the key results were that almost everyone in competitive markets can afford to use a phone but not yet to necessarily own one. While affordability is

still a barrier to many people the addressable market is very large. LirneAsia projects 140 million people, with incomes of less than USD 2 per day in the five countries studied, will purchase a phone before the end of 2008. Currently, they have determined, around 60% of people with low incomes, in all five countries, could get to a phone in less than five minutes but, as might be expected, differences were greater in rural areas.

The LirneAsia research also indicates the key social and economic benefits the poor see in owning a phone. First is that phone owners can see benefits in the efficiency of their daily activities (**Figure 5**). Second is that they perceive economic benefit in their ability to earn or save (**Figure 6**). That being said the main perceived benefit is a greater sense of security and ability to act in an emergency (**Figure 7**). In terms of economic benefits, access to phones are valued most highly by Indians and Filipinos. This includes the ability to avoid large transaction costs such as substitution of communication for travel. In India this is particularly the case for the agriculture and services sectors. Overall, access to phones are perceived as slightly higher value propositions in the Philippines and Thailand than India, Pakistan and Sri Lanka. A question worth asking is the degree to which this reflects the externalities of higher telephone penetration rates in Thailand and the Philippines compared to Pakistan, Sri Lanka and India.

There is a growing body of other research on the benefits of improved communications access for low income users. Access provides opportunities for economic advancement and social development, as for example in the following cases:

- Micro-entrepreneurs in Rwanda have used mobile phones to start and run small businesses ranging from bakeries to hair dressing.[100]
- Banking services are provided over mobile phones to people who previously had no bank accounts in countries such as South Africa.[101] This enables the secure transfer and storage of funds in environments where migrant workers sometimes have to pay bribes to pass through checkpoints.[102]
- In the Philippines mobile providers are connecting schools in remote locations with connections to the Internet combined with local Wi-Fi access.[103]
- In Kenya, the United States Centers for Disease Control and Kenya's Ministry of Health are using PDAs and cellphones to improve Kenya's capacity to detect, prevent and control disease.[104] This includes monitoring diseases in slum communities.
- In India the n-logue program provides a range of information via Internet kiosks to small villages including agriculture information for farmers (*e.g.* weather, advice on seeds, fertilisers and so forth) and telemedicine (*e.g.* eye care consultations via Internet video).[105]

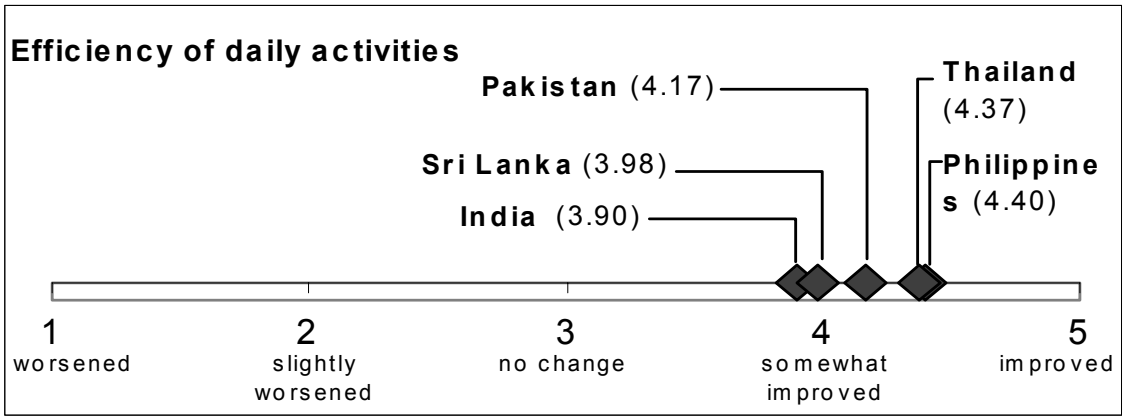
From the foregoing it is clear that users with low incomes can benefit from greater access to communication services and, therefore, have an incentive to join networks that serve their needs in affordable and useful ways. The question that is increasingly raised in international fora, such as the Internet Governance Forum, is the extent to which the Internet will play a major role for the poor in their economic and social development. Sometimes this is phrased in the form of the question: "How can the next several billion users benefit from the Internet?" Before turning to this question it is worth reporting one additional finding from the LirneAsia study. When the question was posed, to people in low income groups, as to whether they knew about the Internet, a significant proportion had no knowledge (**Figure 8**). More than two-thirds of those questioned in India and roughly a third in Pakistan, Thailand and Sri Lanka fall into that category. The Philippines was the major exception with just 14% having no knowledge of the Internet. At the same time a high proportion of these people expressed the desire to own a phone.

In the conclusion to their study of the size of the communications market in developing countries, the WRI pose the question:

> "Will phones become the Internet platform for [low income] households and rural communities? Several factors suggest they will, including the business strategies adopted by some major mobile phone manufacturers and information technology companies."[106]

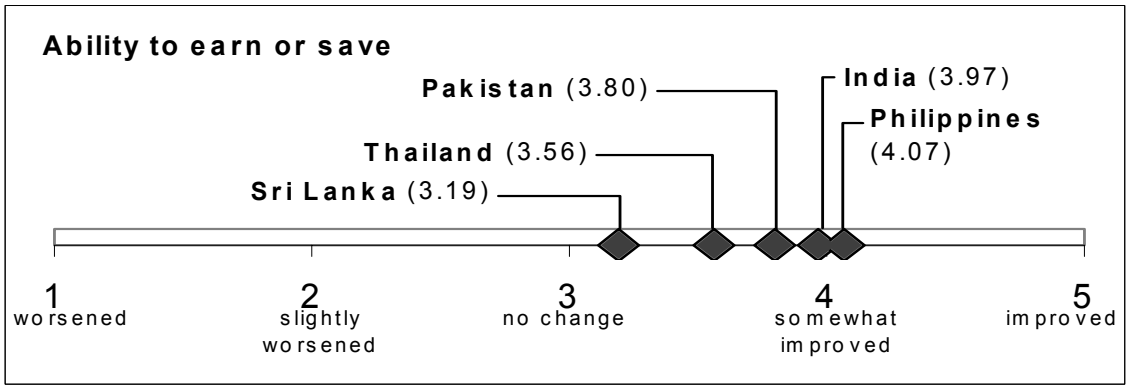
To the manufacturers and IT companies can be added be added service providers which, in competitive markets, will seek to offer relevant and affordable propositions to their customers. The strategies which emerge may be different to those in developed countries and experience to date would suggest it would be surprising for them to be the same. That being said developing countries can harness the same competitive forces, evident in developed countries, which are bringing forth a convergence of fixed and wireless services including those based on the Internet Protocol. Indeed, many are already doing so for the development of Internet access in their countries.

Figure 5: Use of Telephone: Efficiency of daily activities



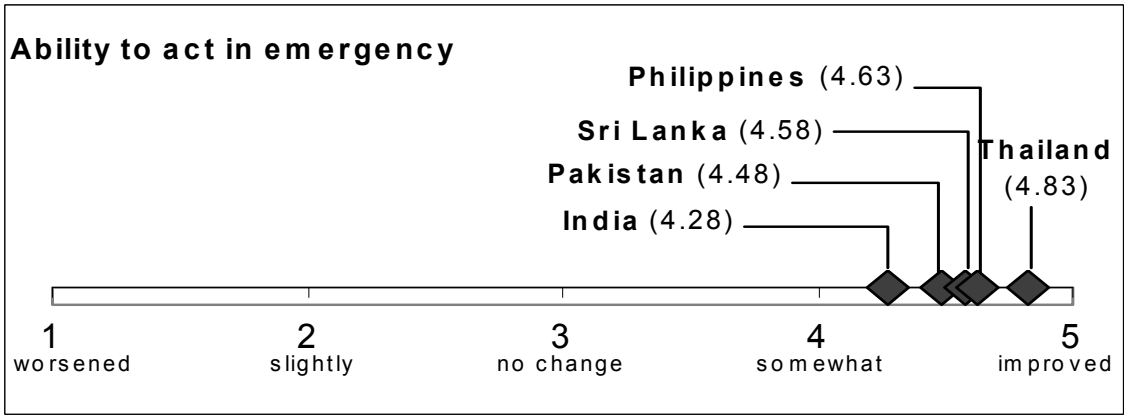
Source: Harsha de Silva, LirneAsia.

Figure 6. Use of Telephone: Ability to earn or save



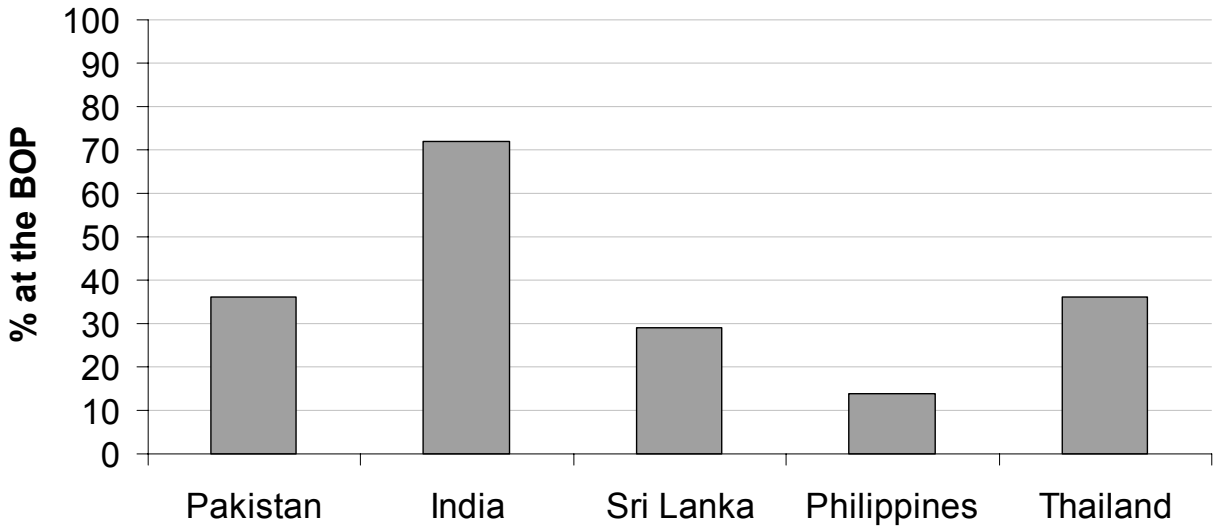
Source: Harsha de Silva, LirneAsia.

Figure 7: Use of Telephone: Ability to Act in an emergency



Source: Harsha de Silva, LirneAsia.

Figure 8: People who had not heard of the Internet in the LirneAsia Survey



Source: Ayesha Zainudeen, LirneAsia.

Growth in access and convergence toward the Internet

In 2006 the founder of Grameen Bank, Professor Muhammad Yunus was awarded the Nobel Peace prize for his pioneering of micro-finance for development in some of the world's poorest communities. Early, in 2003, Professor Yunus, referring to improving opportunities for women in poor rural regions, had stated:

> "The quickest way to get out of poverty right now is to have one mobile telephone, and you will see how quickly she is changing her life. Come back in two years and you will not recognise what she was before."[107]

In February 2007, Professor Yunus said he now aims to train young rural women to be Internet service providers operating from cyber-kiosks.[108] In the same month GrameenPhone announced it had signed a deal with Ericsson to build and integrate a complete IP mobile backbone network across Bangladesh.[109] Ericsson said this marked Grameenphone's first step towards an all-IP network. In the first stage of this development, during 2006, Grameenphone set up 500 village Internet access points, which the company calls community information centres.[110] The centres have a computer and other IT equipment (*e.g.* printer, scanner, webcam). Internet connectivity is currently provided via GrameenPhone's mobile phone network at a speed of 128 kbps.

Internet access over wireless devices is already pervasive in some OECD countries. In Japan, for example, the number of users accessing the Internet from wireless devices (*e.g.* cellular phones, Personal Digital Assistants) now exceeds the number of individuals using computers for this purpose.[111] In Korea, just under 90% of people between the ages of 12 and 19 access the Internet using a wireless device - the highest for any age group.[112] There are now suggestions in some countries that the use of computers is declining among young people due to greater use of mobile phones for Internet access.[113]

It is true, of course, that devices such as computers or mobile phones usually have different capabilities and that some content and services, created with fixed access users in mind, are often not

readily accessible by cellular phone users. In addition, the pricing of data services over cellular networks has historically been much higher than fixed networks making comparisons between the two reliant on qualifications. On the other hand, competition is driving innovation in pricing and service access in this respect. Inexpensive Internet access and multimedia services, via wireless in Japan and Korea, are taken for granted. Content is also increasingly being tailored for mobile users by service suppliers that are beyond the 'walled gardens' which have, in the past, typified mobile Internet access.[114]

In some countries the walled gardens approach is starting to break down. In the United Kingdom, "Hutchison 3" regards itself as a mobile media company offering a convergence of communications, entertainment and information services. Hutchison's 3G service enables users to have unlimited access to the Internet for a flat rate price for its own content, the content of other service providers and a user's own content.[115] Users of this service can access the World Wide Web (*e.g.* BBC, Amazon) as well as services tailored to their device (*e.g.* Yahoo, Ebay, Microsoft Messenger).[116] In addition the mobile phone becomes a networking device enabling users to access the content on their own computer (via Orb) or their television service (via a Slingbox). The service also provides users with Skype enabling them to make unlimited telephone calls to other Skype users.

Internet access via cellular phones is also developing apace outside the OECD area. In the Philippines, access to Internet services such as e-mail, news and information, via GPRS, is available for USD 0.21 per 30 minutes.[117] For 3G users in the Philippines high speed Internet access, live television and so forth is available for USD 0.31 per 30 minutes.[118] In Nigeria one of the country's largest CDMA 3G Mobile networks offers Internet access priced on a per minute basis (USD 0.06 per minute during peak time and USD 0.04 per minute during off-peak).[119] This service costs a USD 7.80 one-off activation fee payment.

While metered prices for Internet access via 3G networks in developing countries tend to be relatively high for low income users they do allow the purchase of small quantities of time from resellers. Moreover competition can be expected to reduce prices over time. In India, for example, BSNL launched unlimited Internet access using their CDMA 2000 1X network (at speeds up to 144 kbps) with a fixed monthly charge of USD 5.85.[120] The company had earlier trialled the offer in rural areas of India.[121] Shared use and resale of such an offer makes an already inexpensive option even more affordable.

The use of fixed wireless options is also increasing in developing countries and can be particularly useful in areas not covered by fixed networks or cellular networks.[122] To date, prices for pre-WiMax and WiMax systems, for individual use, tend to be relatively expensive. In the context of linking communities for shared use or offering the opportunities for resale such pricing can, however, be affordable. In Namibia, MWEB offers a WiMax access service for USD 70 per month.[123] Internet Ghana offers a similar service called Skyburst for USD 81 per month.[124] Fixed wireless networks are also being rolled out in India. BSNL, for example is planning to add 1 000 WiMax towers by the middle of 2008 which would cover as many as 20 000 to 30 000 villages.[125]

Further research and development in respect to fixed wireless for rural areas as well as an increasingly competitive market for equipment manufacturers can also be expected to drive capabilities. Intel, for example, is collaborating with Universities in Calfornia and Russia to develop a low-cost antenna that can transmit and receive Wi-Fi signals over distances as far as 100 kilometres.[126] Researchers are also turning their attention to how to scale wireless networks to cope with a large increase in devices connected to the Internet. At Stanford University this includes researching ways to give wireless devices the flexibility to find and access unused spectrum when they need it.[127]

Prior to direct wireless or fixed access being available in rural areas, entrepreneurs in developing countries have sometimes introduced interim solutions. Just as the "pony express" once provided a bridge

between geographically separate telegraph lines, suitably equipped buses now carry cached e-mail and web-content for villages without direct access. One such initiative, United Villages, say their technology brings Internet access to about 110 000 people living in rural areas of India, Cambodia, Rwanda, Costa Rica and Paraguay.[128] Under this programme computer kiosks are set up in each village for users to compose e-mails, conduct web searches, read the news, access voicemail, buy products from online stores, send SMS and so forth even if they do not have a mobile phone. Wi-Fi equipped buses visit the villages up to six times a day, automatically collecting requests from the computers and physically transporting the data to the nearest direct Internet connection. Users pay for the service through prepaid cards, which they can buy from the kiosk in their village providing a self employment opportunity for the vendor.[129]

Wireless operators and Internet Service Providers (ISPs) in developing countries are also marketing less expensive devices. The GSM Association (GSMA) has a goal of making terminals increasingly affordable to users in developing countries.[130] In 2005 they announced a price point of under USD 30 had been reached at the wholesale level.[131] This is part of the GSMA's Emerging Market Handset Program for handsets priced below USD 30 to USD 40.[132] Furthermore the GSMA's "3G For All" programme aims to bring 3G multimedia services and mobile Internet access to a mass-market user base around the world through more affordable handsets.[133] The GSMA also points to the role refurbished handsets can play in developing countries by way of providing affordable options.[134] In 2006 they estimated 1 in 10 phones purchased, in that year, was a 'used phone'.

Code division multiple access (CDMA) handsets with Internet capabilities are also increasingly affordable.[135] The CDMA Development Group (CDG) reports that CDMA2000 1X handsets are available in many markets for less than USD 50. In India they note prices differ by as little as USD 4 for second generation handsets. The CDMA Development Group further reports that Korean manufacturers are aiming at producing USD 30 handsets in 2007 and USD 20 handsets by 2008. A CDMA2000 1X can deliver Internet data at 153 kbps at peak performance or between 60 to 100 kbps in commercial service. Higher performance is being introduced, in a growing number of markets, with the next generations of CDMA technology.[136]

The wireless industry is also expanding into portable devices with larger screens, keyboards and so forth. In Ghana and Kenya operators have launched services with OGO devices.[137] The aim is to repeat the success enjoyed by BlackBerry and Smartphone, with inexpensive terminals and services aimed at young adults and those with lower incomes. The offering in Ghana includes the following services: MSN Instant Messaging, e-mail, contact book, calendar, web browser, GSM voice, and SMS.[138] Such services, using OGO handsets, are already available in Germany, Switzerland, Turkey and the United States. The Turkish operator Telsim, for example, offers 'free terminals' with a 12 month contract and unlimited data plans for around USD 15 per month.[139] In Uruguay, Ancel's prepaid users purchase OGO terminals for USD 70 and pay around USD 7 per month for unlimited data access.

The growing availability of wireless Internet access may be the reason that local surveys are beginning to find higher levels of Internet use than expected. In late 2006, a survey commissioned by CCK, found 2.9 million Internet users or roughly 9.3% of the total population in Kenya.[140] This was almost double the previous best available estimate of the level of Internet use. Between 2002 and 2006, the ITU reports that the number of economies with broadband mobile services grew from 2 to 79.[141]

In community settings, educational institutions and Internet cafes larger and more affordable devices will also be increasingly available. Perhaps the best known initiative is the so called USD 100 laptop launched by faculty members at the MIT Media Lab.[142] Based on this initiative the One Laptop per Child (OLPC) is a non-profit association dedicated to research to find a technology that could make such devices increasingly affordable in educational settings. The private sector is also increasingly involved in such areas. In March 2007, Intel Corporation launched a PC platform that has been developed exclusively to

meet the needs of rural villages and communities in India.[143] Intel aims for its "Jaagruti" programme to support the spread of rural Internet "kiosks" with community computers. The new platform is designed to deal with weather conditions (*e.g.* heat, dust, humidity) and unreliable power sources which can compromise typical computers used in such environments. For its part, Microsoft has announced it will sell software for USD 3 in an effort to bring the benefits of ICTs to the next several billion users.[144]

Expanding access and affordability are critical components in taking advantage of the convergence between various platforms and the Internet. When users are empowered by complementary skills (*e.g.* education), to take advantage of opportunities the Internet creates, this can be a powerful force for economic and social development. Information, when it is applicable to user's needs and tailored to be accessible over the platforms they use, is fundamental to this process. From the two, relevance is likely to be the larger, though far from insurmountable, challenge. Major content and service providers are increasingly devoting greater resources to tailoring their products to the dimensions of handheld devices. New information management tools such as browsers specifically designed for handheld devices, with graphical instead of text interfaces, GPS Widgets linked to local information and voice commands are all increasingly available.[145] As these technologies develop, they enable opportunities for local developers to create relevant content and services that can be more accessible to users with lower literacy rates.

The **.mobi** domain encourages content and service providers to develop to content formatted for handheld devices.[146] An example of a site, providing local information in India, is **eindia.mobi**. The company responsible for the **.mobi** domain has made a tool available at http://ready.mobi which enables users to enter an address, such as www.oecd.org, and see how the website would be treated by a hand held device. This includes whether the content will be displayed, the time to download the content via Wi-Fi, 3G and GPRS as well as an estimated cost per page for users in Australia, Latin America, China, Europe and the United States. While it is not necessary to use **.mobi** to format a website for a handheld device, the tool nicely illustrates the expense incurred to mobile users downloading web pages not formatted with hand held devices in mind. This is something that providers targeting the poor with information on health, education and so forth will need to bear in mind.

The services some users access are among the most popular on the Internet. Subscribers to Onetouch's OGO service in Ghana, for example, can download e-mail from Gmail and Hotmail or access news sites such as the BBC and CNN.[147] If, however, the tools are made available along with the skills to take advantage of them, local content and services will be developed including those which produce revenue opportunities. In Kenya, young computer programmers have produced African themed adventure video games.[148] The games can be purchased and downloaded online. In Ghana software engineers have developed code as part of the Semapedia project which aims to connect real objects with online data at Wikipedia.[149] In Accra prominent landmarks have Semapedia tags which allow mobile users to call up related Wikipedia content.[150] This creates a market opportunity whereby tourists can call up information over their mobile phones.

Content must also be relevant to the poor as users. Research from the first decade of Internet use in developing countries demonstrates that access is not sufficient if the information is not applicable or useful. In Uganda, research published in 2003, showed rural Internet Kiosks were under-utilised by farmers as the relevant pricing information from local markets was not available and that other potentially relevant content was not available in local languages.[151] More recently efforts have endeavoured to integrate ICT more broadly. The creation of commodity exchanges in developing countries which use ICTs to improve the availability of relevant local market information and connect buyers and sellers and reduce transaction costs are a leading example.[152]

In some areas, such as education and health, governments have a clear requirement to provide locally relevant content. That being said the Internet also provides micro-revenue opportunities for content

creation. Cyber cafe owners in developing countries, for example, are beginning to compliment their access income with advertising revenues. [153] The barriers to participate in Google "adsense and adwords" programs, Microsoft "adCenter" or Yahoo! "Search Marketing Products", for example, are very low on the part of advertisers and content producers. Nor should popular services, among the poor, be discounted in their ability to develop access and create sustainable markets which complement the delivery of essential services in areas such as agriculture, health and education. In India, "Bollywood" is already developing films for mobile devices and this is expected to enhance the overall profitability of the wireless market.[154] In Nigeria a flourishing market for film making has emerged with the advent of inexpensive digital cameras and computer editing.[155] By some measures the country is now said to have the third largest film industry in the world after the United States and India. "Nollywood", is reported to be producing 2000 films annually with a typical cost per film of USD 10 000 to USD 40 000 and a seven day production cycle. The films are sold on disc for a few dollars or rented for a few pennies with the target market being the consumers with low incomes.

Economics of security for a global Internet

One aspect of the Internet, as an interdependent network-of-networks, is that the economic costs of any action, which potentially impact on other networks and users, may not be taken into consideration by various actors in their own decision making. Expenditure on security is generally seen as a cost. Network owners and users are primarily motivated by the need to protect their own economic and social interests and, to the extent they internalise costs, the overall health of the Internet.

When operators and users do not internalise costs they are potentially passed to other networks and users. For example, if a user's computer becomes compromised by a "botnet" that Internet connection may then be used to launch attacks on other users. The owner of the infected host may be little impacted and may be unaware of any such infection. Indeed, it can be in the "bot herder's" interest to minimise the likelihood of detection and impact on the host's own computer and connection. The challenges in this respect are being considered in the OECD's work on the economics of malware and need not be repeated here. Notwithstanding this, all stakeholders need to consider the impact the economics of malware could have as the next several billion users join the Internet.

In Europe there is some evidence that in regions with lower incomes there is less use of security measures such as anti-virus software. In comparison to developing countries these areas are, of course, relatively wealthy. For low income users communications access can form a significant part of their total household income. They need to be convinced that this expenditure is in their interest before they will join a network and, once they have done so, actively employ strategies to minimise their costs. This is economically rational behaviour on their part. Like their counterparts in developed countries, low income users in developing countries may not consider the economic impact on other users if they bear the cost of security but do not see direct benefits to themselves.

The purveyors of malware tend to "follow the money" in terms of the primary targets of their activities. Denial of service attacks, for example, are more likely to targeted against those with a greater propensity to pay or be politically motivated. To be sure, users in developing countries can be impacted negatively by non-discriminatory attacks such as spam and viruses and their resources (*e.g.* bandwidth) can be abused by such attacks. They may, therefore, see social and economic benefits in taking preventative measures. That being said, it is necessary to recognise that, their propensity to pay for security will be far less than their counterparts in the developed world.

In India the average revenue per Internet subscriber, including dial-up and broadband is around USD 60 per annum. An "always-on" DSL connection at between 256 kbps to 2 Mbps can be had for a similar price in India.[156] By way of contrast a similar connection in an OECD country can cost in the order

of USD 360 per annum. To protect their connection to the Internet with a basic product, from a leading security vendor in an OECD country, it can cost a user in the order of USD 80 per annum. Accordingly, in the OECD area, this represents an additional 22% cost to users whereas in India it would represent a potential additional 133% cost to users. For users in developing countries, with metered Internet access service (e.g. with low bit caps), regular updates may also impose an additional cost.

This raises a challenging issue in terms of expanding the benefits of the Internet to the next several billion Internet users. Will solutions emerge from the market in an area where expenditure may be regarded by users as a cost rather than, as is the case for access, an opportunity for their own economic and social well being? Certainly there are some 'freeware' firewall and anti-virus products available that afford basic protection. Freeware may not, however, be available in local languages or have the technical support which accompanies purchased products. On the other hand the development of technology for low income users throws up opportunities for innovation. The One Laptop per Child initiative is working to incorporate security measures into the design of the inexpensive laptops that are aimed at preventing theft or resale as well as protection against malware.[157] Some experts suggest that security innovations developed in such a challenging environment may find their way back to the computing environments in OECD countries.[158] An example highlighted is that the developer of the OLPC is trading compatibility with legacy applications in favour of stronger security.

Global connectivity

The market for international connectivity has been radically transformed over the past decade. Liberalisation of markets, and the competition it has introduced, combined with falling technology costs have largely discounted international costs as a major determinant in the pricing of end user services in developed countries. Local Internet traffic exchange, via IXPs, and greater local content creation and hosting have further contributed to this process. The cost of international capacity, however, still represents a significant obstacle to more affordable Internet access in some developing countries.

The greatest barrier to ISPs securing less expensive international capacity is either monopoly control over international gateways or inherited monopoly power derived from the time it takes alternative facilities to be rolled out. At the beginning of 2007 there were more than 70 countries with a monopoly supplier of international gateway services.[159] Even where markets have been liberalised or partially liberalised incumbents can still generally exercise considerable market power in respect to the prices they chanre for leased lines to access international gateways. In general each of these incumbents will seek to extract monopoly rents from the provision of these services and this is reflected in the prices for Internet access paid by end users.

Monopolies act as a deterrent to growth and therefore limit the attractiveness of developing facilities to serve developing country markets. In the South Asian countries considered in this report, as liberalisation increased, the total number of fixed and mobile access subscribers grew from 15 million in 1995 to 172 million in 2005. Over the same period Africa's fixed and mobile access subscribers grew from 13 million to 161 million. Both figures will dramatically increase in the near future. The increase in market size in turn attracts new investment.

The increasing size of markets has altered the economic attractiveness of rolling out new facilities such as undersea cables. Take the SAT-3 cable connecting Portugal and Spain to South Africa.[160] At the time of its inauguration there were around 21 million fixed and mobile subscribers in the African countries with direct landing points. By the end of 2005 this had grown to 72 million. The cable, of course, serves many more users including some landlocked African countries and supports many purposes (*e.g.* ISPs, broadcasters, private networks, mobile providers, PSTN operators and so forth).[161] In addition, the cable

provides connectivity for the rest of the world when it carries traffic to and from African countries. In that sense anyone communicating over SAT-3 can be said to be a user.

Some estimates put the total cost of building and running SAT-3 at USD 100 million per annum with a break-even point after about five years of operation.[162] Following this period, without upgrades, the annual cost for administration and maintenance has been put at USD 30 million. Even if such figures were to significantly under estimate the cost of providing international connectivity via SAT-3 the unit cost rapidly decreases as the directly served market expands from relatively few users to a market serving more than 100 million users.

The growing size of the African market is attracting a considerable number of proposed undersea cables. The Nigerian operator Globalcom, for example, is proposing to build a cable between Nigeria and the United Kingdom to provide competition over that part of the route with SAT-3 at a cost of USD 170 million.[163] On the East Coast of Africa there are currently at least four proposed undersea cables at various stages of development or under consideration.[164] These include the EASSy project, the Kenyan Government's TEAMS, Flag Telecom's proposed cable and Sithe's proposed SEACOM cable.

The main impediment to any of these systems is the reluctance of some incumbent operators to give up international gateway monopolies. All the proposed African East Coast cables have the potential to dramatically lower the cost of Internet access, in a region which currently has no direct under-sea cable connectivity, if competition is allowed to take root. By licensing all mobile operators to provide international services African countries would considerably increase the number of facilities based providers that operate across borders. As many of the operators are African, Middle Eastern or Indian owned, the potential to fill East and West Coast African undersea cables would grow as these companies developed their own pan-African connectivity. This could include cable connections across land borders. Allowing ISPs to enter this market would further enhance competition and allow them to access the least expensive capacity linking their networks to global transit hubs (*i.e.* major IXPs where global transit is bought and sold just like any other commodity at increasingly inexpensive prices).

Operators in neighbouring landlocked countries can also benefit from liberalisation. One of the barriers for landlocked countries has been the high prices they must pay to access undersea cables landing in neighbouring countries with monopolies. This problem is particularly acute in Africa. In such circumstances the only alternative may be satellite circuits which may also be expensive and have high latency rates. India's experience shows that developing undersea cables and opening this market to neighbouring countries can benefit both economies. In late 2006, for example, Nepal Telecom announced it could achieve a 77% saving on the cost of international bandwidth by routing traffic via Indian fibre optic cables rather than over satellites.[165] BSNL agreed to provide international connectivity at a monthly price of USD 1 700 per Mbps compared to the best rate available for using satellites of USD 7 400 per month.

India and the global undersea cable market

In South Asia, liberalisation has not only dramatically changed the market for undersea cables in that region but also around the world. Indian owned companies, entering global communication markets, are now the largest undersea cable operators in the world. In part this reflects Asian companies purchasing the assets of firms in OECD countries which invested ahead of demand during the "Internet bubble". These assets were purchased at very inexpensive rates compared to the original investments. Following Asia Global Crossing's bankruptcy, for example, China Netcom purchased the company and its assets for USD 120 million in 2003.[166] This proved a shrewd investment in that China Netcom subsequently sold the company for USD 403 million to a group of private equity investors in 2006.[167] However, it is Indian companies which have been most active in expanding their ownership and operation of undersea cables.

Following the bursting of the Internet bubble, Indian companies purchased cables originally valued at over USD 4.5 billion for less than USD 600 million (Table 1). By acquiring companies, such as Teleglobe, they also took over Indefeasible Rights of Use (IRUs) on many other cables around the world which are operated by Consortiums. IRUs provide their owners with the right to use a certain amount of capacity on an undersea cable system or to lease that capacity to their customers. Indian companies have also participated as consortium members (*e.g.* Sat-3/WASC/SAFE, the Sea-Me-We series) and are investors in other private cables in South Asia. From publicly available data it is not possible to provide a precise total for the amount of bandwidth owned and operated by Indian companies. Taking directly owned and operated capacity (*i.e.* excluding IRUs), Indian companies manage just under a quarter of all the world's major undersea cables as measured by route kilometres. Measured in terms of capacity Indian firms directly own and operate 44% of all capacity and 70% of upgradeable capacity for the undersea cables shown in Table 1.

The changes in the undersea cable market reflect a shift in communication access demographics as more and more users join networks in previously under developed Asian markets. More broadly, however, it can be seen as reflecting globalisation. The undersea cables owned by Indian companies provide the conduits for the export of services which are driving economic growth in that region. Asian companies have responded to this demand and the centre of the world's undersea cable ownership has shifted from the North American and European region to India, China, Hong Kong (China) and Singapore.

To further enhance competition in April 200, the Telecommunications Regulatory Authority (TRAI), directed India's former incumbents to open international landing stations to rival networks.[168] Prior to TRAI's action, Videsh Sanchar Nigam Ltd (VSNL) and Bharti Airtel were the only licensed international gateway operators in the country. The changes mean that cable companies such as Reliance, the largest single owner of cable capacity in the world, can now access their own facilities directly and other ISPs can directly access foreign owned capacity.

Recognising the growing demand for capacity in the Asia-Pacific region and around the world, a growing number of operators have announced a number of new cables planned for the near future which should further enhance the competitive availability of connectivity. Some examples include:

- Reliance (FLAG Telecom), plans to invest USD 1.5 billion in laying 50 000 additional kilometres of undersea cable linking 60 countries which they say will provide service to countries in which five billion people reside.[169] On completion, FLAG Global Network would span over 115 000 kilometres by December 2009 taking the total optic fibre assets of Reliance to over 230 000 kilometres by that date.
- Verizon and five Asian partners (China Telecom, China Netcom, China Unicom, Korea Telecom and Chunghwa Telecom) are building a USD 500 million undersea cable linking the United States and China, expected to be in service in 2008.[170] The cable will have about 60 times the capacity of existing lines between China and the United States - 1.28 TBps. Branch cables will also land in Chinese Taipei and Korea.
- Vietnam's EVN Telecom is teaming with VSNL International and investing US 200 million in an undersea cable network, which will link major telecom hubs in Asia.[171] The cable's initial capacity will be 320 Gbps (Gigabyte per second), and can be upgraded to 5.6 TBps. The cable will travel 6 800km, connecting Singapore, Viet Nam, the Philippines, Hong Kong (China), Chinese Taipei, China, Japan and Guam. The new network will also connect Asian servers to the United States via existing cables from Japan and to Europe via cables landing in Singapore.
- Pipe Networks announced in December 2006 that it had signed a MoU with VSNL International, to lay the cable between Sydney and Guam to provide competition from Australia on the United States route currently dominated by the Telecom New Zealand majority-owned Southern Cross cable.[172] Meanwhile, Telstra has announced it plans a 1.28 TBps cable between Australia and

Hawaii where it will interconnect with other cables providing direct access to mainland United States in which Telstra already owns capacity.[173] Telstra's cable is due to be in service by mid 2008.

Table 1: Major Undersea Global Cables in Service, 2006

Cable Name/Region	RFS Date	Route Km	Original Capacity (Gbps)	Upgradable to Capacity Est. (Gbps)	Owners	Original Investment (USD, M)	Change in Ownership
Trans-Atlantic							
Columbus-2	1994	12188	2	2	Consortium	345	
CANTAT-3	1994	7500	5	5	Teleglobe (VSNL)	385	VSNL purchased the whole of Teleglobe for USD 239 million in 2006.
TAT-12/TAT-13	1995	12533	30	30	Consortium	760	
Atlantic Crossing-1 (AC-10)	1998	14000	140	140	Global Crossing (ST)	875	In 2002 Singapore Technologies Telemedia purchased the Nasdaq listed Global Crossing.
Columbus-3	1999	10000	20	40	Consortium	273	
Yellow (Level 3)/ Atlantic Crossing-2 (AC-2)	2000	8960	320	1280	Level 3, Global Crossing (ST)	700	See above
Hibernia Atlantic	2001	11700	220	1920	Columbia Ventures	680	Cable purchased from 360Networks for USD 13.6 million
Flag Atlantic (FA-1)	2001	12800	530	2400	Flag Telecom (Reliance)	750	Reliance purchased Flag for USD 211 million in 2004
TAT-14	2001	15000	640	640	Consortium	1400	
VSNL transatlantic (Tyco)	2001	12500	480	2560	VSNL	900	VSNL purchased Tyco for USD 130 million in 2004
Apollo	2003	13000	320	3200	Cable and Wireless	950	
Total Trans-Atlantic		130181	2707	12217		8018	
Direct Indian Ownership/Management of Trans-Atlantic Cables		32800	1015	4965			
%		25	37	41			
Trans-Pacific							
TPC-5	1995	22560	20	20	Consortium	1240	
Pacific Crossing- (PC-1)	1999	13076	180	640	Pacific Crossing Ltd.	1350	A former Global Crossing Subsidiary now privately owned by a diverse group of investors.
China-US Cable Network	2000	30800	80	80	Consortium	1400	
Southern Cross	2000	32000	240	1200	Telecom NZ (50%), Singtel (40%) and Verizon (10%).	1500	Singtel purchase of Optus, Verizon acquisition of MCI
Japan-US Cable Network	2001	21000	400	640	Consortium	1150	
VSNL Transpacific (Tyco)	2002	24100	640	7680	VSNL	900	See above
Total Trans-Pacific		143536	1560	10260		7540	
Direct Indian Ownership/Management of Trans-Pacific Cables		24100	640	7680			

Cable Name/Region	RFS Date	Route Km	Original Capacity (Gbps)	Upgradable to Capacity Est. (Gbps)	Owners	Original Investment (USD, M)	Change in Ownership
%		17	41	75			
South Asia							
Sea-Me-We-2	1994	18000	1	1	Consortium	780	
Flag (Fibre Optic Link Around the Globe)	1997	27763	10	20	Flag Telecom (Reliance)	1600	See above
Sea-Me-We-3	1999	39000	58	80	Consortium	13000	
2i ISCN	2002	3200	160	8400	Bharti Group, Singtel	259	New investment
Sat-3/WASC/SAFE	2002	27850	30	120	Consortium	581	
Tata Indiocom Chennai-Singapore (TICSCS)	2004	3100	320	3175	Tata (VSNL)	96	New Investment
Sea-Me-We-4	2006	20000	160	1280	Consortium	500	
Falcon	2006	10300	90	2560	Flag Telecom (Reliance)	270	See above
Total South Asia		149213	829	15636		17086	
Direct Indian Ownership/Management of South Asian Cables		44363	580	14155			
%		30	70	91			
Total of Above Regions		422930	5096	38113		32644	
Direct Indian Ownership/Management of Above		101263	2235	26800			
%		24	44	70			

Note: Shaded companies indicate Indian ownership and management.

*Source***:** OECD, based primarily on Michael Ruddy of Terabit Consulting and cable company websites.

Policy coherence for a globally accessible Internet

The 2002 OECD Ministerial mandate calls upon the Organisation to "enhance understanding of the development dimensions of Member country policies and their impacts on developing countries. Analysis should consider trade-offs and potential synergies across such areas as trade, investment, agriculture, health, education, the environment and development co-operation, to encourage greater policy coherence in support of internationally agreed development goals." [174] The concept of policy coherence for development covers the following main areas: *a)* internal coherence within development co-operation policies; *b)* intra-country, meaning interaction between aid and non-aid policies; *c)* inter-donor coherence and *d)* donor-recipient coherence.

Promoting whole-of-government coherence to achieve members' development co-operation objectives is an important priority for the OECD. Greater attention to policy coherence for development, on the part of developed countries, seeks to avoid negative spillovers from policies introduced by OECD countries that could adversely affect the development prospects of poor countries. More positively, attention to policy coherence seeks to exploit the potential for beneficial synergies in the way OECD policy objectives are pursued.

In terms of policy coherence there is a perception that the policies pursued by developed countries, in respect to the exchange of traffic over the Internet, are impacting negatively on the development of communications access in developing countries. Yoshio Utsumi, the former Secretary-General of the International Telecommunication Union (ITU), for example, argued in 2000:

> "At the moment, developing countries wishing to connect to the global internet backbone must pay for the full costs of the international leased line to the country providing the hub. More than 90% of international IP connectivity passes through North America. Once a leased line is established, traffic passes in both directions, benefiting the customers in the hub country as well as the developing country, though the costs are primarily borne by the latter. These higher costs are passed on to customers [in developing countries]. On the internet, the net cash flow is from the developing South to the developed North." [175]

At the 2005 World Summit on the Information Society (WSIS), this was reflected in the Tunis Agenda for the Information Society which concluded:

> "We acknowledge that there are concerns, particularly amongst developing countries, that the charges for international Internet connectivity should be better balanced to enhance access."[176]

The Tunis Agenda also called for the creation of an Internet Governance Forum (IGF) to advise all stakeholders in proposing ways and means to accelerate the availability and affordability of the Internet in the developing world. As a result, at the inaugural IGF in Athens (30 October - 2 November), "Access" was one of four key themes selected for the program with the cost of international Internet connectivity the leading issue.[177] The issues will continue to be discussed at successive IGFs and be the subject of an ITU meeting in the first quarter of 2009. [178]

To assess whether reforms to global communication markets are having negative or positive impact on the development of access for the next several billion Internet users it is necessary to examine the evolution of the market for Internet traffic exchange. Along the way there is a need to critically assess the assumptions upon which the concerns expressed during WSIS are premised. Is it correct, for example, to say that on the Internet the net cash flow is from the developing South to the developed North? In addition,

what is implied by the negotiated text, in the Tunis Agenda, which states "…the charges for international Internet connectivity should be better balanced ...."? It is worth asking whether the alternative wording of "have a lower cost" rather than "be better balanced" would lead to a better choice of policy settings, to enhance growth in access.

The most important factor in achieving greater affordability is to reduce the cost of communications interconnectivity and access through the use of competition. Commercial negotiations best serve this purpose as they encourage each player to seek the most economical option for their needs. Striving for "balance", through an internationally mandated system would not increase affordability. Rather it would provide incentives for operators to inflate purported costs instead of seeking low cost solutions. In Kenya, for example, Kencall says it costs close to USD 17 000 per month to place 25 agents online in a call centre.[179] The company says elsewhere in countries against which they compete the cost is USD 600 to USD 900 a month. The best way to achieve a reduction in such prices is not through a return to a regulated international settlements system, which produced high costs and low rates of development, but through an open and competitive market. It should be borne in mind that the pricing structures Kencall and others face are the inheritance of a "balanced" regulated international settlements system designed to benefit operators rather than users.

From regulated settlements to a commercial Internet

To understand the debate which took place during the WSIS it is necessary to recall the international settlements system which applied for public switched telecommunication networks. This system can then be contrasted to the commercial model which has emerged with the Internet in liberalised markets together with an assessment of whether concerns about policy coherence are justified.

Historically, circuit switched telecommunication networks exchanged traffic internationally in two principle ways.

- For traffic, such as telephone calls, an accounting rate specified the price at which a provider in one country would terminate the traffic with an operator in another country. If more traffic originated in Country A destined for Country B, than was the case for the reverse direction, a settlement ensued whereby the operator in Country A paid a financial amount to the operator in Country B to compensate them for their presumed net costs.

- Large users could also lease a private circuit between two international points *(e.g.* to connect operations in one country to those in another country). The price to the user was the sum of two, so called, "half circuit prices" set by the operator at each end of the circuit.

Both these mechanisms relied on there being a monopoly at one or both ends and international infrastructure was provisioned based on these financial arrangements. The system can be said to have had a "balance" for monopoly operators but, importantly, the same cannot be said for users or in terms of promoting development. The prices for international telephone calls, for example, were typically very high while the growth in access in developing countries was very slow. The primary reason for high prices and absence of growth were the monopolies upon which the system rested. In the absence of competition, operators set high accounting rates and high half circuit prices. These costs were then passed to existing or potential customers discouraging use, the expansion of service and impeding overall economic and social development.

Those wishing to impose greater "balance" on the exchange of Internet traffic often use this wording as a euphemism for imposing a regulated settlement system, akin to the one which historically existed for

circuit switched networks. There are many reasons why this is inappropriate. Perhaps the leading reason is that in a liberalised environment all players are free to build, buy, lease or otherwise put together facilities on an end-to-end basis. There is no longer a hypothetical mid-point for half circuit pricing and any operator can provide end-to-end services. Unlike the regulated settlements system this provides each actor with an incentive to find the most economical solution for their network and, in a competitive market, these benefits are passed to customers in the form of lower prices. It is worth noting that the increase in "borderless roaming" for cellular wireless users in African countries is the result of providers operating seamlessly across different countries.

Some critics of the current arrangements for the international exchange of Internet traffic say that while it may lower costs the historical system provided funding, including hard currency, for the expansion of access. Several points need to be made in this respect. First, the intent of the regulated system was to compensate operators for their presumed costs and there was no obligation to expand access. Second, while the regulated system did as a rule result in a net flow of cash between operators in developed and developing countries the prevailing paradigm was such that little development of access ensued as a result. As far back as the "Maitland Report" it was recognised that income from international traffic was frequently redirected to other areas with a higher government priority (*e.g.* health, education) even though expanding access could have helped in meeting government objectives in these areas.[180]

The third point which can be made is that it is not at all clear that the net cash flow on the Internet is from the "developing South to the developed North". The United States is the only country for which data are available on international settlements with the rest of the world. The most recent data available show an increase in out-payments to many developing countries.[181] The main factor here is the higher volume of calls terminating in newly expanded networks in developing countries. A fourth, and perhaps related point, is that by opening markets a huge increase in capital, to develop access, has been attracted in a growing number of developing countries. In the past there was no guarantee that investment would produce a return for the operators of networks if revenue was redirected to other government priorities.

When and why did the issue emerge?

The issue of international Internet connectivity costs arose, with the emergence of the commercial Internet in the mid-1990s, in the transition from monopolies (and limited availability of infrastructure based on monopoly frameworks) to competitive markets. As the Internet originated in the United States the first international connections were to that country. Over time the Internet has been increasingly localised, in the rest of the world, as infrastructure for domestic traffic exchange was put in place and local sources of content creation and storage were developed.

In the OECD's experience players adapted to the transition to open markets and commercial solutions were adopted (*e.g.* Internet exchange points or IXPs, end-to-end infrastructure). Allowing full infrastructure and services competition was a fundamental step in meeting concerns. As a result the international backbone market between OECD countries became highly competitive and prices rapidly fell. For countries outside the OECD area, the subject became a development issue, albeit some incumbent operators, and their State owners, look to a replacement for settlement revenue –- hence the ongoing discussions in international fora.

Peering, transit and IXPs

The Internet, as is often stated, is a network-of-networks. Networks which have independent routing policies are called Autonomous Systems. In 2007 there are more than 24 000 Autonomous Systems providing connectivity for themselves, thousands of private networks and hundreds of millions of customers. In a liberalised environment each autonomous system makes a decision on which other

networks with which they will directly exchange traffic. While many Autonomous Systems are not ISPs, in the traditional sense of that term, it is generally easier to conceptualise negotiations over transit and peering occurring between ISPs.

In some cases the exchange of traffic between ISPs will take place under an arrangement known as "Peering". Peering occurs when two ISPs agree to exchange traffic because it is mutually beneficial to both parties. Neither party pays the other for delivering traffic to their own customers or users. If, however, one network receives payment from the other to carry the traffic to third party networks, or to the rest of the Internet, the arrangement is termed "Transit".

Peering generally takes place when two similarly sized networks exchange traffic directly and therefore avoid payment to an upstream operator (*i.e.* a transit provider). While any two networks are free to establish bilateral exchange points, peering and transit mostly occurs at Internet Exchange Points (IXPs). If networks cannot agree to terms for peering it is likely that one party believes the relationship is not equally beneficial. That being said configuring networks for peering involves a degree of inter-networking skills and the presence of an effective IXP.[182] This enables ISPs to build trust in their mutual exchange of traffic. In countries where these attributes are in short supply or non-existent the only option may be to purchase transit.

For ISPs in any country the establishment of an IXP is a fundamental element of an efficient inter-networking market. Following the commercialisation of the Internet IXPs were quickly established in OECD countries and a growing number of developing countries. There are still, however, many developing countries which do not have IXPs. As a result ISPs in these countries either exchange traffic via expensive international links or pay high prices for domestic transit through what is generally a monopoly provider. These costs could be substantially reduced through the establishment of an IXP and other benefits such as improved inter-networking can result (Box 1).

There may be several reasons IXPs have not been established in some 92 countries by April 2007. There could, for example, be a monopoly service provider. IXPs only exist where there are multiple providers needing to exchange domestic traffic. In these cases liberalisation is required before the establishment of an IXP. Alternatively the lack of an IXP may indicate that a single player, with monopoly power over certain infrastructures or rights of way, exists in the market concerned. If low levels of competition exist ISPs may have little choice but to exchange domestic traffic via the dominant player rather than directly between themselves. The absence of an IXP may also indicate there is a lack of trust between ISPs or an understanding of the potential economic benefits necessary to establish such a facility.

The financial cost of establishing an IXP should not be a barrier for several reasons. First, unlike many infrastructures, IXPs can be established for a relatively modest cost (*e.g.* USD 20 000 to USD 40 000) depending on the country concerned. Second, a well functioning IXP will easily return greater benefits in financial savings than the initial cost of establishment (*e.g.* reducing the cost of international capacity for traffic which can now be exchanged locally). The main cost elements in the establishment phase might be one or two Ethernet switches (USD 3 000 to USD 9 000 depending on size) and the initial cost of training local ISP staff. From this point on the facility should save more money than it costs to maintain or it will have failed to meet its objective.

It is sobering to calculate that the total cost of establishing an IXP in every country where they do not yet exist would be less than USD 4 million in total (*e.g.* 92 x USD 40 000). Indeed it could be viewed as self defeating if a greater amount of expenditure was required. If an IXP is established at a higher up-front cost than USD 40 000, a facility will have been created which has correspondingly high maintenance costs. As the point of an IXP is to save money, building something which costs a greater amount than it saves defeats the purpose. An efficiently run IXP ensures all recurring costs are directly met by its participants

who are the prime beneficiaries of its existence. Sometimes these costs can be met in kind (*e.g.* donation of equipment or staff time) as the participants have an economic incentive to look for low cost solutions. The IXP itself should primarily be a place of operational exchange rather than having a financial existence in its own right. This ensures that ISPs have a lower potential barrier to trusting each other in meeting the joint and common costs involved in maintaining the facility. Frequently when IXPs do not get established it is because the potential participants do not trust each other with the shared costs.

One question worth asking is whether there is a role for financial aid, to establish IXPs in those countries where they do not exist, from appropriate agencies or donors, to initiate the development process. Certainly the financial assistance needed for start-up costs of an appropriately sized IXP is very modest compared with the potential long term economic benefits. In addition, as the majority of IXPs are non-profit facilities, financial aid can be said to be assisting the growth of the market and not distorting its natural development. Thirdly as the majority of the expenditure is on the initial training of staff, to establish and maintain the facility, it meets the objective many donors have for local capacity building.

Before aid is dispersed, however, there must be a good understanding of the potential benefits of an IXP among all stakeholders. Without this understanding regulatory or other actions in the marketplace may impede the development of any IXP. While aid can be a tool to initiate IXPs, the facilities themselves should be industry driven in terms of ongoing operation, management and financial support. Many of the best performing IXPs, in developed and developing countries, are run on a non-profit basis between actors co-operating at the facility itself but elsewhere competing in the marketplace. For the IXP to function efficiently trust between participants needs to be established. This includes developing the inter-networking skills to facilitate the operational exchange of traffic and to ensure confidence that this process is mutually beneficial.

The establishment of an IXP can have indirect or secondary benefits. In Nigeria, for example, the IXP negotiated lower rates for international connectivity for its members. In July 2007, the price for 1 Mbps of international capacity on the SAT3 cable was reduced from USD 6 300 to USD 2 800 per month for ISPs participating at NIXP.[183] Such a reduction could, of course, have been negotiated independently of the existence of the IXP. On the other hand it could be argued that the creation of the IXP created a catalytic effect. By having a group of ISPs, at the same location, NIXP could negotiate a better deal with the upstream provider and, at the same time, offer benefits over and above the economies gained by exchanging local traffic. NIXP estimates communication providers in Nigeria spend USD 100 million annually on international connectivity for data traffic. ISPs participating at the IXP have the opportunity to substantially reduce their international transit costs by exchanging traffic locally and indirectly through negotiating lower prices.

Box 1: Kenya's Internet Exchange Point (KIXP)

Kenya's IXP was established in 2000 with aim of reducing costs, improving performance, promoting local content and building technical capacity.[184] The initial experience in launching the IXP and overcoming regulatory barriers was documented at the time.[185] From that time on, the benefits of having an KIXP have grown.

From an initial membership of four ISPs, the not-for-profit IXP had grown to have 21 participants by early 2006.[186] One of the first issues addressed by local traffic exchange was improved inter-networking among Kenyan ISPs. Prior to the establishment of KIXP Internet traffic was exchanged via international satellite circuits with high latency. From the outset the latency of local traffic exchange was reduced from an average of 1 200 milliseconds to 100 milliseconds. Costs were also dramatically reduced. Instead of paying USD 3 335 for transit ISPs could exchange local traffic over USD 200 circuits. At the outset of KIXP about 30% of traffic was local. As traffic has grown so too have the savings of what would have otherwise been paid for international bandwidth. From February 2004 to February 2005 traffic exchange at KIXP grew by 77.8%. From February 2005 to February 2006 traffic exchange grew by 137.6%.

KIXP's membership has expanded beyond traditional ISPs to include cellular mobile operators, multi-media operators, education networks and government agencies. The Kenyan Revenue Authority is a peer at KIXP for customs clearance and in the first year of participation generated an increase in revenues. For the future KIXP is seeking to attract great numbers of content providers to connect to the IXP, seek better transit deals for its members at larger international exchange points (*e.g.* LINX in London) as well as facilitating greater regional traffic exchange.

Once IXPs are established, they facilitate more efficient local exchange of traffic providing a support for services that become part of everyday life. In Kenya, for example, services that communicate between the world wide web and SMS are very popular with users. Sasanet, a company providing web to SMS services is a member of KIXP.[187] The Kenya National Examinations Council through technology developed and supported by Sasanet released the 2006 KCSE results via SMS.[188] Candidates sent a text message with the word KCSE followed by their index number to receive their examination results direct to their mobile phones.

The evolving international market for interconnectivity

Three large trends are evident in the global market for interconnectivity in relation to the Internet in the short (five years) to medium term (ten years):

- The characteristics of access in developed and developing countries are likely to exhibit significant differences in the short to medium term in areas such as fixed and wireless, narrowband and broadband.

- The largest differences in the commercial arrangements for interconnection will not be North-South, however, but between countries with different models for traffic termination on domestic access networks.

- As convergence toward the use of the Internet Protocol continues, more and more traffic will be exchanged, using the Internet's commercial model, across a variety of broadband platforms. When coupled with the commercial arrangements which have typified these networks in the past significant differences could emerge internationally.

International access differences

In the developed world, mobile communications are already at near ubiquitous levels. Broadband access is also growing apace, somewhat countering the decreases in fixed line access, as wireless substitution takes place for fixed line telephony. Though there are challenges (*e.g.* rural or remote areas, skills, affordability) based on current trends, broadband access in the developed world will soon be near to ubiquitous. When users make telephone calls they will increasingly use the Internet Protocol even if this is not evident to the user.

In the developing world, growth of fixed line networks is static while the growth of wireless access is frenetic. Due to low penetration rates the priority for most developing countries will be to expand access opportunities and wireless is highly likely to continue to be the primary means to accomplish this goal. To be sure there are real opportunities for "leap-frogging" access opportunities through the provision of broadband enabled networks. For those users with the lowest incomes, however, it is likely that broadband access for communities rather than individuals will be the norm though individual access should not be discounted as the market goes to work.

What then is the most likely pattern of traffic exchange for telephony, for example, between users in the developed and developing world given current pricing structures, income levels and so forth? For users in developed countries broadband access to IP telephony will be the norm though in the short term this will be more a characteristic of fixed than wireless networks. In developing countries individual access will be overwhelmingly via wireless networks. It is also likely, in the short term, that there will continue to be significant differences between the cost of international calls depending on whether they originate from a fixed or a wireless network. The main reason for this is that users in both developed and developing countries generally choose the service with the domestic package that best suits their needs. They rarely choose their service based on the price of international calls, placing less competitive pressure on mobile providers in this market segment. The net result is that the greater weight of international Internet North-South telephony traffic is likely to originate from users of fixed broadband networks in developed countries and terminate on mobile phones in developing countries. This will continue to engender significant financial flows from operators in developed countries to those in developing countries.

North and South or Pacific Rim and RoW

While the debate over Internet connectivity was posed at WSIS as being an international one, the seamless end-to-end nature of connectivity in open markets, has rendered this conception as largely obsolete in terms of commercial exchange of traffic. The main factor shaping financial flows for international communications in the new environment is the cost to terminate traffic on domestic networks. Here the main difference is not the North–South divide but one which could be broadly categorised as differences between a group of countries surrounding the Pacific Rim and the Rest of World (RoW).

To be more precise two models form the basis for the termination of traffic on wireless networks. One is the calling party pays (CPP) model where the originator of the call pays the entire cost. The other system is the mobile party pays system (MPP) where both the calling and called parties bear part of the cost.[189] The majority of mobile users reside in countries with CPP. There has also been a significant shift in recent years toward CPP in countries that started mobile service with MPP (*e.g.* Brazil, India, Pakistan, Russia and Mexico) (**Table 2**). In large part this has been driven by the belief that CPP provides a model that encourages faster penetration growth among lower income groups. There are several arguments forwarded in this respect. One is the proposition that CPP provides a more attractive framework for pre-paid cards favoured by low income users. The second is that in terms of its pricing structure mobile service with CPP is more akin to fixed services which use CPP, and therefore viewed as substitutable for low income users.

Countries that operate MPP in 2007 largely surround the Pacific Rim. They include Canada, China, Hong Kong (China), Singapore and the United States.[190] Sri Lanka also has MPP though it has considered changing several times.[191] The Chinese Government is promoting a shift from MPP to CPP for the provision of service in that country.[192] By April 2007, China Mobile had begun to implement CPP for some of its subscribers.[193] Advocates for MPP rightly point to the greater transparency for users in terms of pricing. This has advantages in that it enables competition to be applied across the price for both making and receiving calls. The lower level of competition, in this segment of CPP markets, is reflected in far greater intervention by regulators to influence the price of termination on mobile networks. Proponents of an MPP pricing structure say it enables avoidance of what is a very contentious regulatory issue in CPP markets.

Proponents of MPP note that competitive markets have overcome some of the perceived disadvantages with making users pay for receiving the call. In the United States, for example, the very large amount of minutes included in many post-paid subscriptions means that there is little or no impact on calling patterns (*e.g.* users do not switch off a mobile phone to avoid being called and bearing part of the cost which was said to be an early characteristic of MPP markets). In CPP markets, of course, users receiving calls on mobile phones do not pay for incoming calls. Consequently there is no economic incentive in CPP markets for users to switch off their mobile phone. For a low income user, reliant on a mobile phone as a "lifeline" this can have significant advantages. The main need for developing countries is to ensure that there is sufficient competition to make service affordable to low income users.

The question for the future is how markets with MPP and CPP will be impacted by convergence. If for example, broadband users in developed countries make calls to mobile users in countries with CPP or MPP, using Internet telephony, how will this affect financial flows? It is here that large differences emerge in pricing due to CPP and MPP. The prices for using Skype-Out, an Internet telephony service which terminates calls in fixed or mobile networks can be illustrative. As Skype has little in the way of operating costs, compared to a facilities based provider, the price of calls is closely aligned to the cost of termination in each country. Accordingly, while just one of many services (Internet telephony and traditional) Skype's rates are a good indication of underlying termination rates around the world.

The average price, using Skype, to call a mobile user in countries with CPP is USD 0.24 per minute and for countries that do not differentiate fixed and mobile termination USD 0.39 per minute.[194] By way of contrast it costs just USD 0.02 per minute to call fixed or mobile users in Canada, China, Hong Kong (China), Singapore and the United States. To call Sri Lanka, for fixed or mobile users, costs USD 0.15 per minute.

It is not that countries with MPP have no mobile termination charges – they can and do.[195] They are, however, generally very low compared to countries with CPP. It is also the case that when operators in MPP or CPP countries set their own termination rates these can be different from domestic termination. In many developing countries, for example, wireless service could not have been made affordable to low income users if the same termination rates which apply for international traffic were in place for domestic traffic. The point is, however, that differences in the termination models between countries are likely to have large impacts on financial flows. The Office of the United States Trade Representative (USTR) has estimated that the additional cost to users in the United States, of Mexico's shift from MPP to CPP in November 2006, would be USD 400 million.[196] Mexico is just one of many countries to make this change in recent years. This raises the question of how such financial flows will be impacted, between countries with MPP and CPP, as greater convergence occurs between the Internet and wireless access networks.

If a Skype user in Europe calls a mobile user in Canada or China they will only pay USD 0.02 per minute (Table 2). A call in the reverse direction, from Canada or China to Europe, could cost ten times that amount. If a Skype user in the United States or Singapore calls a Mexican mobile they will pay USD 0.34

per minute.[197] A Mexican Skype user who calls a Singapore or United States based mobile user would pay just USD 0.02 per minute.[198] While these rates are for Skype-Out they closely reflect the underlying termination rates and, hence, are a likely indication of net financial flows from one operator to another particularly if large traffic imbalances result.

The case of Zimbabwe is illustrative of the effect large differences in pricing can have on traffic patterns.[199] Although it is a CPP market price controls and hyperinflation have combined to produce inexpensive international calls from mobile networks in Zimbabwe to foreign mobile networks. The price of an outgoing international call is around USD 0.03 while, depending on which CPP market is the destination, the termination rate may be USD 0.20 to USD 0.30 or more. As a result 90% of calls are reported by operators to be outgoing and they are losing money on each call to CPP markets. In response some operators have banned prepaid card users from making international calls.[200]

Not all countries with CPP have high termination rates for mobile services. Countries such as Malaysia, Korea, and Russia have some of the lowest termination rates to mobile phones. Kenya, Mexico, New Zealand, Honduras and Switzerland have some of the highest termination rates for the same service. The experience in Russia would suggest that transitioning from an MPP to a CPP market does not mean that prices rise to above average levels. There are also remarkable differences in the price to send text messages (*i.e.* SMS short message service) ranging from inexpensive countries such as China and Japan through to the highest rate in Mexico.

Termination rates for mobile telephony and text messages can affect foreign users to a greater extent than domestic users. In some countries there are differences between domestic and international termination, leading to lower and higher prices respectively at the retail level. In addition, domestic users will frequently elect service options which have inclusive or lower priced products (e.g. minutes or SMS) for communication with other users on the same mobile network. In some instances such offers also have inclusive or lower priced communication to users on other mobile networks. These options are the result of competition in the market place and prices which are transparent to consumers.

At the international level there is less competitive pressure to reduce the cost of termination rates on mobile networks, as operators may not have a direct relationship with the customer of a network in a foreign country. This effect is negated in MPP markets because the pricing is transparent to the domestic recipient of an international call. In CPP markets, however, the range of prices for Skype-Out in OECD countries, from USD 0.07 in Korea to USD 0.37 in Switzerland, suggest a wide array of underlying termination rates. It can also be noted that Uganda, Ghana, India and Pakistan have lower Skype-Out prices, to call mobiles in those countries, than all those OECD countries with CPP markets except Korea and Japan.

In terms of policy coherence, OECD governments need to ensure there is sufficient competition in respect to the termination rates for incoming international traffic. Absent of competition, to discipline these rates, governments put at risk the social and economic gains that would otherwise result from greater volumes of communication between developed and developing countries. In some OECD countries regulatory authorities have determined there is insufficient competition and acted to put down mobile termination rates. Notwithstanding these instances, termination rates on mobile networks are much lower in some developing countries than in some OECD countries. This could be viewed as a barrier to trade in communication services and, given the tremendous differences in prices across countries, does not meet the criteria of cost orientation at the high end of the scale.

Box 2: Calling Party Pays and Mobile Party Pays

For consumers of mobile communications services one of two pricing structures are typically used. One is Calling Party Pays (CPP) where the user initiating a telephone call pays the entire cost of the call. The second is Mobile Party Pays (MPP) which is sometimes also called Receiving Party Pays (RPP). In the case of MPP both the user initiating the call and the user receiving the call share the cost. Countries in which the MPP system is used include Canada, China, Hong Kong (China), Singapore, Sri Lanka and the United States. Elsewhere in the world the CPP system is predominant with MPP only being used when a user roams outside the territory covered by their network provider (*e.g.* if a Australian or French mobile user receives a call while roaming outside Australia or France they share the cost of that call with the initiator of the call). The recent development of "borderless roaming" in some African countries is the exception with CPP users still being able to receive calls for free.

Emerging commercial and service differences

The different termination models for MPP and CPP markets may throw up different services as the Internet and mobile markets converge. MPP and CPP markets are eminently capable of fostering innovation as evident by the many new services which have been launched by operators under both systems. In CPP markets Hutchison's 3G approach, for example, goes well beyond the so-called 'walled gardens' and other operators such as Verizon and Vodafone are making mainstream Internet services (*e.g.* YouTube, Myspace) available to their wireless users. Yet the question can be raised as to whether one system will encourage innovation more than another and what this may mean for different communities.

In the United States one new service at the interface between the Internet, fixed and mobile telephones is GrandCentral.[201] The service provides users with a single phone number that enables calls to reach them on any device they choose and enables control over how their incoming calls are handled. GrandCentral customers can manage which phones ring, which ring-back tones are played and which voicemail greetings are heard, all based on who is calling. Other features include listening to voicemail messages by phone, e-mail or online, and being able to switch calls between any of their phones and record calls. Mobile users can listen to voicemail messages as they occur if they do not wish to take the call and the service provides the first "spam filter" for telephony. The service works with any service or operator.

GrandCentral can offer this service for "free" in a MPP environment because it is users who pay for incoming calls. In a CPP environment GrandCentral would have to pay for the call forwarding and recover that cost from the user. In the case of the United States, competition has driven operators to offer ever larger "buckets" of minutes or unlimited airtime for flat rates, such that the MPP cost of incoming calls has become little considered by users. In a CPP environment, however, the termination fee which has largely gone unconsidered by users (as the cost is borne by others) would now become a direct cost to them using a service such as GrandCentral. Operators in CPP markets could introduce such services but this would entail a different approach to termination across different wireless networks.

A broader question, in the context of the subject of this paper, is how such innovation might benefit the poorest users in respect to their interface with the Internet. In the case of GrandCentral, the company participates in San Francisco's Project Homeless Connect program.[202] As part of this project GrandCentral has registered more than 1 500 homeless and needy citizens in the region providing them with a telephone number and voicemail even though they may not have a telephone service.[203] Such an approach can provide permanent communication option for the homeless as well as providing a conduit for the delivery of information on health, employment opportunities or e-government services.

A further difference which may emerge between CPP and MPP markets is greater service integration. Take RedPocket Mobile as an example.[204] The service is aimed at Asian Americans or those with people doing business in Asia. It enables users to call fixed or mobiles users in China, Hong Kong (China), Singapore or Canada for the same rate as calls within the United States. The rate is a standard USD 0.15

per minute to all countries (USD 0.14 per minute with greater volume) and a small fixed fee.[205] In European CPP markets some small business and consumer discount plans are available for "in-region" calling. Vodafone in the United Kingdom offers several plans with USD 0.24 per minute calls to other European countries but this is in addition to a minimum fixed monthly fee (USD 45) for a fixed volume of domestic calls.[206] For consumers discount plans with T-Mobile in the United Kingdom offer USD 0.39 per minute calls to the rest of Europe, in return for a small additional fixed fee (USD 5) or standard rates at USD 1.38 per minute.[207] The differences suggest termination models are more influential than geography in setting prices. That being said the differences in this case are the cost of termination. China's decision to introduce CPP may affect the service, but if termination rates do not rise unduly as was the case for Russia's transition, RedPocket Mobile users may be little affected.

MPP and CPP markets have both exhibited strengths and weaknesses relative to each other in the development of wireless markets. Both have shown capabilities for innovation and growth. A number of open questions for the future relate to how will both models will deal with convergence with the Internet. Will one model, for example, prove more adept at fostering innovation at the interface with the Internet? How will financial flows between countries be affected by the different termination models? Will one system lead to greater integration in service offerings between countries or networks with the same termination model irrespective of geography? Finally, if termination rates are about compensating networks for costs what explains the vast differences between charges and how will this impact on the competitiveness of countries with high termination rates?

A lack of data about the Internet

From the time of the establishment of the International Telecommunication Union, data have been available on international communication traffic. In 1885, for example, Italy sent 1.4 million international telegrams which was about double the number sent from that country in 1865.[208] In 1983, France had around a billion international minutes of outgoing telephone traffic and had this doubled to 2.3 billion minutes a decade later.[209] Data were also abundantly available on domestic traffic exchange.

While the Internet produces an abundance of data on the operation of each network, there is a distinct lack of data providing a holistic view. At the OECD-NSF Workshop on the "Future of the Internet" discussion ranged over the lack of data which would enable researchers to make improvements to the Internet's technical design, allow capital markets or other decision makers (*e.g.* aid agencies) to make informed choices on investment and fund allocation as well as providing information on the growth of such a key economic and social infrastructure around the world.[210] The availability of such data could also inform industry players in assessing future investment requirements, in terms of meeting traffic growth, in an environment where some are projecting a steep increase.[211]

Participants at the OECD-NSF Workshop recognised that R&D has a key role to play in this process and advocated that governments should play a supportive role in this respect. Discussion also ranged over how initiatives from the within the Internet community could provide a neutral measurement of traffic growth and improve the information available to all stakeholders while respecting commercial sensitivity of data specific to any individual firm. At the Working Party on Communications Infrastructure Services Policy in May 2007 a proposal was presented on good practices in Internet Exchange Point Documentation and Measurement prepared by Packet Clearing House (PCH).[212] The aim of this document was to provide a harmonised approach to the collection and reporting of a baseline set of data in a way that is useful to all stakeholders.

Efforts to extend the range of data available must rest on the current foundation of capabilities and collected data. The PCH report noted that many Autonomous Systems do collect some information on their own network and how it exchanges traffic with its immediate neighbours. It stated that some go further and

analyze their traffic exchange more generally, with the rest of the Internet. For the most part these data are regarded as proprietary and, therefore, not available to inform the many uses to which such information has been put in the past. Examples might include researchers developing technologies to support the carriage and exchange of traffic, capital markets or operators making decisions on demand for services and potential returns from investment in existing or new markets, aid or development agencies funding infrastructure in developing countries as well as the many uses such data could be put to in respect to informing policy making. This could range from an assessment of the affect of major outages and restoration, following natural disasters or malicious attacks, through to providing a more general picture of the size and growth of the Internet in any particular country following a change in regulation such as market liberalisation. For governments such data would also enable progress in the implementation of the Tunis Agenda which recommended the establishment of IXPs where they do not currently exist.

Specifically the PCH report proposed documentation and measurement in three primary areas:

- Collection and publication of traffic statistics: The amount of Internet capacity being created at each IXP, measured at five-minute intervals.

- Publication of membership contacts: The list of Internet Service Providers that are collaborating to create capacity at each IXP, including contact information.

- Maintenance of the IN-ADDR zones: The machine-readable information about the ISPs which allows diagnostic tools like Traceroute and Dig to accurately identify ISPs' networks.

The PCH report deemed it critical that the documented practices consist exclusively of techniques which are already in widespread use, and widely demonstrated to be easily implemented. The aim was to specify readily achievable goals, with an eye to universal or essentially-universal adoption. The PCH document harmonised a broad and widely divergent set of practices by boiling them down to a simple and uniform subset. The results are intended to be both human-readable and machine-readable, with a particular emphasis on making results accessible and intelligible despite any lack of a shared language between the researcher seeking data and the IXP operator publishing it.

CONCLUSION

The report focuses on the desirability of extending the economic and social benefits made possible by the Internet, to the next several billion users mainly in developing countries. The argument made is that this should be seen as an opportunity and not a burden. Liberalisation makes the access to communication services for the people in developing countries more affordable and consumers are willing to invest in it due to the tremendous positive impact on their daily lives. These users represent a commercial opportunity for businesses and a social and economic development opportunity for policymakers. The report highlights the employment, micro-entrepreneurial and social development opportunities which have emerged as access to communication services has risen among low income users.

The report reviews the evolution of policy making from a supply-led approach to demand-driven development. It recalls the era typified by monopolies in which many policy makers believed the development of communications should occur in lockstep with overall growth in the economy. Now the sector is recognised as one which can drive economic and social development. Moreover the success of the communications sector in developing countries is arguably attracting investment in other parts of these economies.

The necessary framework conditions for growth include liberalisation of markets, the separation of operational and policy responsibilities and the creation of an independent regulatory authority. The Internet creates some specific considerations, such as the need to establish IXPs, but the key is policy approaches which enable the opening of the market to investment and innovation which show the greatest benefits for developing communication access.

Governments need to consider carefully the overall policy coherence for development. For developing countries the benefit of liberalisation extends beyond the growing size of the market. It also supports the broader economic and social development goals from employment creation through to improving education and health. For countries yet to reform telecommunication markets, in areas such as liberalising international gateways, fundamental barriers will remain. A policy coherent approach also needs to consider other sectors that may affect the development of access, such as policies which place high tariffs on ICT equipment or tax services over and above those applicable to the rest of the economy.

OECD countries need to be conscious of their communication policies' potential impact on developing countries. The report has highlighted, for example, that it may cost twice as much to make a telephone call from the Internet to a mobile telephone in some developed countries than in developing countries. Such differences are in most cases due to different levels of competition in the prices charged for terminating calls. In wireless markets with MPP the transparency of pricing to users ensures greater competitive discipline is applied. In markets with CPP the cost of termination can range from less than USD 0.06 per minute to more than USD 0.30 per minute suggesting a lack of competitive pressure and cost orientation in countries with higher prices. As communication between the Internet and mobile devices grow the large differences in the cost of terminating traffic on wireless networks, particularly between countries with MPP and CPP, can be expected to affect the financial flows between countries. While seeking ways to increase competition should be the preferred option, applying regulatory safeguards may be necessary in market segments where there is insufficient competition.

OECD governments need to be diligent in ensuring that development co-operation helps to develop rather than distort market opportunities in developing countries. Recognition of profitable business opportunities for the private sector arising from the changing communications policy paradigm is fundamental. At the same time financial support from OECD countries for developing human capital, sharing experience in institutional capacity building or funding key not-for-profit infrastructures, such as IXPs, could be extremely beneficial.

The paper concludes that claims of negative impact on developing countries, in respect to the commercial model used for the exchange of Internet traffic, are not reflected in the actual market developments. The Internet's commercial approach has been remarkably successful in connecting more than 24 000 networks supporting millions of customer networks and the first billion Internet users. This does not mean there are not deficiencies in international connectivity. Connectivity costs are still high in many developing countries due to gaps in key facilities necessary to connect national networks to international networks in some regions (*e.g.* East Coast of Africa) or regulatory frameworks which do not encourage market growth to support the development of this infrastructure.

Notwithstanding the challenges ahead a large amount of private investment is pouring into African markets in recognition of the opportunities in the communication sector. The growing number of companies operating in multiple African markets, the increasing market size and liberalisation all contribute to the incentive to put into place greater regional connectivity. The striking example of "borderless roaming", an innovative approach adopted first in Africa, reflects a potential benefit of closer integration in the development of infrastructure, the exchange of traffic and innovative services.

In closing, the report highlights the need to continue to build a culture of security and to extend it to the next several billion users as they join the Internet. As an interdependent network of networks the security and stability of one part of the global Internet may affect all other parts. To the extent that service providers or consumers do not take into account costs borne by others, lack awareness of the need for a culture of security or cannot afford to meet the costs of online protection and best practice they can affect the overall health of the Internet and the experience of its users. These issues raise specific challenges for users on low incomes and a growing need for all stakeholder communities to address building a culture of security around Internet provision and use.

Table 2: Skype-Out Prices for calls or SMS to Fixed and Mobile Networks (April 2007)

Countries with Calling Party Pays (CPP)				Countries which changed from MPP to CPP				Countries with Mobile Party Pays (MPP)			
Destination	USD (excluding tax)			Destination	USD (excluding tax)			Destination	USD (excluding tax)		
	Fixed	Mobile	SMS		Fixed	Mobile	SMS		Fixed	Mobile	SMS
Malaysia	0.02	0.06	0.10	Russia	0.05	0.07	0.07	Canada	0.02	0.02	0.11
Korea	0.02	0.07	0.10	Costa Rica	0.06	0.08	0.10	China	0.02	0.02	0.06
Cyprus	0.06	0.07	0.10	Colombia	0.10	0.10	0.10	Hong Kong (China)	0.02	0.02	0.06
Uganda	0.15	0.15	0.10	Israel	0.02	0.14	0.10	Singapore	0.02	0.02	0.10
Japan	0.02	0.15	0.07	Pakistan	0.14	0.14	0.10	United States	0.02	0.02	0.11
Ghana	0.15	0.17	0.10	El Salvador	0.13	0.15	0.10	Sri Lanka	0.15	0.15	0.10
Ireland	0.02	0.20	0.11	Trinidad and Tobago	0.15	0.15	0.22				
Australia	0.02	0.20	0.09	Guatemala	0.15	0.15	0.10				
Finland	0.03	0.20	0.10	Bolivia	0.15	0.17	0.10				
France	0.02	0.20	0.13	India	0.15	0.17	0.08				
Norway	0.02	0.21	0.11	Argentina	0.03	0.17	0.22				
Turkey	0.14	0.21	0.13	Dominican Republic	0.09	0.17	0.22				
Slovak Republic	0.07	0.21	0.10	Antigua Barbuda	0.18	0.18	0.22				
Hungary	0.02	0.22	0.13	Dominica	0.18	0.18	0.22				
Belize	0.22	0.22	0.10	Czech Republic	0.02	0.19	0.11				
Botswana	0.15	0.22	0.10	Panama	0.11	0.19	0.10				
Greece	0.02	0.23	0.12	Grenada	0.20	0.20	0.22				
Luxembourg	0.02	0.24	0.10	Venezuela	0.05	0.20	0.10				
Denmark	0.02	0.25	0.05	Mongolia	0.21	0.21	0.10				
Germany	0.02	0.25	0.13	Chile	0.02	0.21	0.10				
Poland	0.02	0.25	0.11	Brazil	0.05	0.21	0.21				
United Kingdom	0.02	0.25	0.10	Jamaica	0.13	0.22	0.23				
Belgium	0.02	0.26	0.12	Cayman Islands	0.23	0.23	0.22				
Austria	0.02	0.27	0.15	St Kitts and Nevis	0.23	0.23	0.22				
Netherlands	0.02	0.27	0.13	Ecuador	0.18	0.24	0.10				
Spain	0.02	0.27	0.14	St Lucia	0.25	0.25	0.22				
Estonia	0.02	0.28	0.10	St Vincent Grenadines	0.25	0.25	0.22				
Portugal	0.02	0.29	0.13	Uruguay	0.13	0.26	0.10				
Iceland	0.03	0.29	0.10	Cambodia	0.29	0.26	0.10				
Sweden	0.02	0.29	0.10	Romania	0.12	0.29	0.13				
Italy	0.02	0.31	0.13	Peru	0.08	0.31	0.22				
New Zealand	0.02	0.31	0.10	Mexico	0.10	0.34	0.31				
Kenya	0.25	0.35	0.10	Honduras	0.36	0.39	0.10				
Switzerland	0.02	0.37	0.11								

1. National prices are used albeit rates to capital cities are sometimes less expensive. Rates are per minute except for SMS which is per message.
Source: OECD with Prices from Skype.

NOTES

[1] Coherence can be promoted at four levels *a)* internal coherence within development co-operation policies; *b)* intra-country coherence, meaning consistency between aid and non-aid policies; *c)* inter-donor coherence, meaning consistency of aid and non-aid policies across OECD countries and *d)* donor-partner coherence to achieve shared development objectives.

[2] The OECD has held a number of workshops considering Internet traffic exchange including in Dublin (1996), Osaka (1998), Venice (1999) and Berlin (2001). OECD reports on this subject include: "Internet Traffic Exchange: Market Developments and Measurement of Growth" (April 2006), "Internet traffic exchange and the development of end-to-end international telecommunication competition", (March 2002) and Internet Traffic Exchange: Developments and Policy (March 1998).

[3] IXPs are places where different Internet networks can physically interconnect to send and receive traffic between their networks.

[4] Different types of models include those used for meeting the cost of terminating calls (*i.e.* completing calls) on cellular mobile networks. These include, for example, payment by the calling party (*i.e*. Calling Party pays or CPP) or both the calling party and the receiving party (*i.e*. Mobile Party Pays -- MPP or Receiving Party Pays -- RPP).

[5] Robert D. Atkinson and Andrew S. McKay, "Digital Prosperity: Understanding the Economic Benefits of the Information Technology Revolution", ITIF, Washington, March 2007.

[6] http://www.bsnl.co.in/newsdetailed.php?news_id=368.

[7] Isabella Gyau Orhin, "Ghana: Small Scale Mobile Phone Business On the Verge of Collapse", 13 April 2007. http://allafrica.com/stories/200704160963.html

[8] Deloitte, "Global Mobile Tax Review 2006-2007" http://www.gsmworld.com/TAX/.

[9] This is sometimes cited with a critical overtone but it should also be noted that in liberalised markets competitive forces are hard at work to make services increasingly affordable to ever greater numbers of people. In the monopoly environment there was little incentive to supply low income groups in developing countries and little understanding that this could be a profitable activity.

[10] GSMA, "Global Money Transfer Pilot Uses Mobile To Benefit Migrant Workers And The Unbanked", 12 February 2007 http://www.gsmworld.com/news/press_2007/press07_14.shtml.

[11] "World's First Borderless Mobile Network Expands Into Central Africa", Allafrica, 6 June 2007, http://allafrica.com/stories/200706070001.html.

[12] "Uganda Telecom Goes Borderless", Issue Number 365, 2007 http://www.balancingact-africa.com/news/current1.html.

[13] Infocom, "Top-20 Telecom Groups - based on proportionate subscribers", 19 October 2006. http://www.infocom-de.com/pressarchives/press_191006.html.

[14] OECD, "Internet Traffic Exchange: Market Developments and Measurement", April 2006 http://www.oecd.org/dataoecd/25/54/36462170.pdf.

[15] http://www.akamai.com.

[16] Julie J. Rehmeyer, "Mapping a Medusa: The Internet spreads its tentacles", *Science News*, 23 June 2007. http://www.sciencenews.org/articles/20070623/fob2.asp.

[17] FT, South Africa: Interview with President Mbeki, *Financial Times*, Reprinted at All Africa, 12 April, 2007 http://allafrica.com/stories/200704120185.html?page=6.

[18] https://prefix.pch.net/applications/ixpdir/summary/ Accessed 25 April 2007.

[19] "Tunis Agenda for the Information Society", WSIS-05/TUNIS/DOC/6(Rev.1)-E, 18 November 2005. http://www.itu.int/wsis/docs2/tunis/off/6rev1.html

[20] Jipp, A., "Wealth of nations and telephone density", ITU Telecommunication Journal, July 1963, pp.199-201.

[21] Ibid.

[22] An interview with Robert Chapius, Electrical Engineer conducted by Frederik Nebeker, IEEE History Center, Rutgers University, New Brunswick. 24 August 1993. p21. see

http://www.ieee.org/portal/cms_docs_iportals/iportals/aboutus/history_center/oral_history/pdfs/Chapuis176.pdf

[23] Gwenaelle C. Jeunhomme, demonstrates how the "Jipp Law" was used in practice in "Measuring Telecommunication Infrastructure Needs and Demand", submitted to the Technology and Policy Program in partial fulfilment for the degree of Master of Science in Technology and Policy, MIT, 2000. http://itc.mit.edu/rpcp/Pubs/Theses/gwena.pdf.

[24] Co-operatively owned local telecommunication carriers also existed in countries such as Finland and the United States. Finland's long distance provider was, at the time, state owned. Private ownership and rate of return regulation provided a different set of incentives for operators. It meant surpluses could be retained by operators for re-investment and that cross subsidies were more effectively used in expanding service.

[25] William Pierce and Nicolas Jequier, "Telecommunications for Development", ITU/OECD, Paris. 1983 p 56.

[26] Ibid.

[27] ITU, "The Missing Link", The Independent Commission for Worldwide Telecommunications Development (The Maitland Report), 1984. http://www.itu.int/osg/spu/sfo/missinglink/index.html.

[28] William Pierce and Nicolas Jequier, Op.cit.

[29] Richard Butler, Preface in William Pierce and Nicolas Jequier, Op.cit.

[30] Refer to Chapter 3: William Pierce and Nicolas Jequier, Op.cit.

[31] ITU, "The Missing Link", Op.cit.

[32] Ibid.

[33] Lars Hendrik Roller and Leonard Waverman, Op.cit.

[34] In countries such as Canada and the United States factors such as private ownership, rate of return regulation and subsidies to underserved areas had undoubtedly played a role in increasing access. In

addition the better performing state-owned monopolies demonstrated much better performance levels were achievable.

35 OECD Statement on the Benefits of Telecommunication Infrastructure Competition, SG/NR(94)20, Paris 31 March 2004.

36 "OECD Reflections on the Benefits of Mobile Cellular Telecommunications Infrastructure Competition", Paris, 1996 http://www.oecd.org/dataoecd/11/44/2090995.pdf.

37 At the end of 1994 there were around 703 million fixed lines and 56 million mobile subscribers in the world. By 2007 the combined total was more than 3.7 billion.

38 Lars Hendrik Roller and Leonard Waverman, Telecommunications Infrastructure and Economic Development: A Simultaneous Approach, Social Science Research Centre, Berlin. 1996 p 16 http://skylla.wz-berlin.de/pdf/1996/iv96-16.pdf. Subsequently published in *The American Economic Review*, September 2001.

39 GSR 2003 Chairman, Muna Nijem, in her closing remarks to the 4th Annual Global Symposium for Regulators (GSR), hosted by the International Telecommunication Union, 8 to 9 December 2003.

40 Rohan Samarajiva, "Sri Lanka's telecom revolution", *OECD Observer*, February 2001 http://www.oecdobserver.org/news/fullstory.php/aid/487/Sri_Lanka%92s_telecom_revolution.html. A more detailed history can be found in Rohan Samarajiva and Anupama Dokeniya, with a new annex by Sabina Fernando, Shan Manikkalingam and Amal Sanderatne, "Regulation and Investment: Sri Lanka Case Study, including a Pilot Assessment of the Telecom Regulatory Environment," September 2004.

41 Mahesh Uppal, S.K.N. Nair and C.S. Rao, "India's Telecom Reform: A Chronological Account", NCAER, 2006. http://www.iipa.ernet.in/upload/PAPER%2015%20-%20TELECOM%20REFORM.pdf.

42 Jean Camp and Brian L. Anderson, "Telecommunications Re-Regulation in Bangladesh: A Broadband Future Through a Development Initiative?", ISOC, 2000 see: http://www.isoc.org/inet2000/cdproceedings/8c/8c_2.htm.

43 http://www.teletalk.com.bd/AboutTeletalk.html.

44 Ministry of Information Technology, "De-Regulation Policy for the Telecommunication Sector", July 2003. http://www.pta.gov.pk/media/telecom25092003.pdf.

45 PTA, "Industry Analysis Report 2004". http://www.pta.gov.pk/media/industryanalysisreport.pdf.

46 TRAI, "Consultation Paper on the growth of Telecom Services in Rural India", 27 October 2004. http://www.trai.gov.in/trai/upload/ConsultationPapers/17/27octconspap.pdf.

47 Haggerty, Luke, M. M. Shirley, and Scott Wallsten, "Telecommunication Reform in Ghana", November 2002 http://rru.worldbank.org/Documents/PapersLinks/2405.pdf.

48 http://www.skyburst.com.gh/coverage.htm.

49 Shirley, Mary M. and Tusubira, FF and Gebreab, Frew and Haggarty, Luke "Telecommunications reform in Uganda", World Bank Policy research Working Paper 2864, June 2002.

50 Econ One Research, Uganda Telecommunications: A Case Study of the Private Provision of Rural Infrastructure" 30 July 2002. See: http://www.itu.int/ITU-

D/treg/Events/Seminars/2005/Thailand/Reference%20Material/Reference%20Material%20-%20Uganda%20Experience.pdf.

[51] Uganda gets 4th mobile phone service provider, 14 March 2007 http://www.angolapress-angop.ao/noticia-e.asp?ID=516496.

[52] Sean Kane, "Telecom Reform and Poverty Alleviation in Kenya", http://link.mgmt.wits.ac.za/journal/j0301-kane-fin.pdf.

[53] Katie Nguyen, "Kenya's telecoms players faces crowded market – Celtel", 27 March 2007. http://africa.reuters.com/business/news/usnBAN723778.html.

[54] R. Jai Krishna, "Kenya eyes Indian cos for SNTO licenses", 26 March 2007 http://www.ciol.com/content/search/showarticle1.asp?artid=95758 Zachary Ochieng, "Kenya's Telecom Liberalization Suffers Setback", 26 March 2007.

[55] E.C.A. Ndukwe, Chief Executive/Vice Chairman Nigerian Communications Commission, "An Overview of the Nigerian Telecommunications Environment and successful Initiatives to Promote Communications Development", 10 October 2006 see: http://www.ncc.gov.ng/speeches_presentations/EVC's%20Presentation/EVC's%20CTO%20Presentation101006.pdf.

[56] Gwenaelle C Jeunhomme, "Measuring Telecommunication Infrastructure Needs and Demand", Op.cit. p48 http://itc.mit.edu/rpcp/Pubs/Theses/gwena.pdf.

[57] Leonard Waverman, Meloria Meschi and Melvyn Fuss in "Africa: The Impact of Mobile Phones", The Vodafone Policy Paper Series, Number 2, March 2005 p 16 see: http://www.vodafone.com/assets/files/en/AIMP_17032005.pdf

[58] In a study for the GSM Association McKinsey and Company attempt to assess the direct and indirect impacts of the spread of wireless communications. "Wireless Unbound: The Surprising Economic Value and Untapped Potential of the Mobile Phone", McKinsey and Company, December 2006. http://www.mckinsey.com/clientservice/telecommunications/WirelsUnbnd.pdf.

[59] Coimbatore Krishnarao Prahalad is the Paul and Ruth McCracken Distinguished University Professor of Corporate Strategy at the University of Michigan Ross School of Business.

[60] C.K. Prahalad cited in Harsha de Silva, "Teleuse on a Shoestring" 28 February 2007. http://www.lirneasia.net/wp-content/uploads/2007/03/1-hdes-shoestrings-sing-28feb07.pps.

[61] C.K. Prahalad, "The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits", Wharton School Publishing, Fourth Printing, November 2006.

[62] Karnani, Aneel G., "Fortune at the Bottom of the Pyramid: A Mirage", November 2006. Ross School of Business Paper No. 1035, Available at SSRN: http://ssrn.com/abstract=914518.

[63] C.K. Prahalad, "Pyramid Schemer", Interview with Bill Breen of Fast Company, March 2007. http://www.fastcompany.com/magazine/113/open_fast50-qa-prahalad.html.

[64] Mac Margolis, "Lining Up the Loan Angels: Critics put trendy poverty lenders to the test, and find they're neither a real business nor a real help.", *Newsweek International*, 9 April, 2007 accessed at: http://www.msnbc.msn.com/id/17886720/site/newsweek/. In contrast the *Economist* is positive on Microfinance: "Time to take the credit", 15 March 2007. http://www.economist.com/opinion/displaystory.cfm?story_id=8853734.

[65] By way of disclaimer the author is on the advisory board of LirneAsia.

[66] Allen L. Hammond, William J. Kramer, Robert S. Katz, Julia T. Tran, and Courtland Walker, "The Next 4 Billion: Market Size and Business Strategy at the Base of the Pyramid", WRI, 2007. The report can be found at: http://www.wri.org/business/pubs_description.cfm?pid=4142.

[67] LirneAsia, "Teleuse at the Bottom of the Pyramid", February 2007 http://www.lirneasia.net/projects/current-projects/bop-teleuse/.

[68] Chief Executive/Vice Chairman Nigerian Communications Commission, Op.cit. http://www.ncc.gov.ng/speeches_presentations/EVC's%20Presentation/EVC's%20CTO%20Presentation10 1006.pdf.

[69] Ibid.

[70] Isabella Gyau Orhin, Op.cit.

[71] Staff report, "$9 billion foreign investment in telecom sector: PM" 25 March, 2007:http://www.dailytimes.com.pk/default.asp?page=2007%5C03%5C25%5Cstory_25-3-2007_pg5_5.

[72] Ovum, "The Economic Benefits of Mobile Services in India", A study prepared for the GSM Association, 2005 http://www.gsmworld.com/esb/esb_documents/india_exec.pdf.

[73] The Private Sector Development Blog (PSD Blog) gathers together news, resources and ideas about the role of private enterprise in fighting poverty. The post on Kenya is at: http://psdblog.worldbank.org/psdblog/2006/09/really_mobile_p.html and the YouTube clip at: http://www.youtube.com/watch?v=wvvLdIz08Q4.

[74] Thomas Friedman, "Bandwidth pays off for Kenya", 6 April 2007: http://www.recordonline.com/apps/pbcs.dll/article?AID=/20070406/OPINION/704060304

[75] Malathy Knight-John, Ayesha Zainudeen and Abu Saeed Khan, "An Investigation of the Replicability of a Microfinance Approach to Extending Telecommunications Access to Marginal Customers", Version 3.1, LirneAsia, December 2005 see: http://www.lirneasia.net/wp-content/uploads/2006/02/KnightJohn%20Zainudeen%20Khan%202005%20Replicability%20GP%20micro finance.pdf

[76] William Kramer and John Paul, "Mobile-enabled transactions for the base of the economic pyramid: A brief review of 2006 'state-of-play", in "Economic empowerment through Mobile", Vodafone CR Series, 2006, p 12
see: http://www.vodafone.com/assets/files/en/VF_CR_Dialogue_3_Economic_Empowerment.pdf.

[77] Erik Van Veen, General Manager Marketing and Sales, MTN Uganda Case Study, "Wireless Telecommunications for Small Business Market in Uganda", Undated. http://www.ilo.org/dyn/empent/docs/F111PUB1453_01/PUB1453_01.pdf.

[78] Jennifer Reck and Brad Wood, "What Works: Vodacom's Community Service Phone Shops", World Resources Institute, August 2003: http://www.digitaldividend.org/pdf/vodacom.pdf.

[79] James Goodman and Vedat Walia, "A sense of balance: A socio-economic analysis of airtime transfer service in Egypt", in "Economic empowerment through Mobile", Vodafone CR Series, 2006, p 9:http://www.vodafone.com/assets/files/en/VF_CR_Dialogue_3_Economic_Empowerment.pdf.

[80] Ibid.

[81] Erik Van Veen, Op.cit.

[82] "Wireless Unbound: The Surprising Economic Value and Untapped Potential of the Mobile Phone", McKinsey and Company, Op.cit.

[83] Nyaki Adeya, "Wireless Technologies and Development in Africa", Paper and presentation to Wireless Communication and Development: A Global Perspective 7-8 October, 2005. The Ritz-Carlton, Marina del Rey, CA.see: http://arnic.info/workshop05/Adeya_WirelessDev_Sep05.pdf and http://arnic.info/workshop05/Adeya.ppt.

[84] Smart Communications, Smart Connect, *The Magazine for Living Wirelessly*, Issue 3, pp 15-17:http://www.smart.com.ph/smartcorporate/contents/Connect_No[1]._3.pdf.

[85] 1. Footnote by Turkey: The information in this document with reference to « Cyprus » relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the "Cyprus issue". 2. Footnote by all the European Union Member States of the OECD and the European Commission. The Republic of Cyprus is recognized by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

[86] http://www.otelecom.com/Investor_Relations/Contents/default.aspx?ID=437.

[87] http://www.otelecom.com/files/financial/1325899065_Investor%20Presentation%20-%20Feb-07.pdf.

[88] http://www.econetwireless.com/.

[89] http://www.telkom.co.za/minisites/ir/sens/sensarticle_199.html.

[90] "Information and Communications for Development 2006: Global Trends and Policies", World Bank, March 2006. www.worldbank.org/ic4d.

[91] "Tata to invest USD 230 million in South African telecoms", 24 November 2005. http://www.vsnlinternational.com/news/files/20051124-bto-southafrica.pdf.

[92] "Uganda gets 4th mobile phone service provider", Angola Press, 14 March 2007, http://www.angolapress-angop.ao/noticia-e.asp?ID=516496.

[93] Nicole Willing, "Saudis unveil $1 billion telecom plan for Africa", *Light Reading,* 19 June 2007. http://eetimes.eu/wireless/showArticle.jhtml?articleID=199905292&printable=true.

[94] Elias Biryabarema & Muhereza Kyamutetera, "Uganda: Competition Heats Up Telecom Sector", AllAfrica, 19 March 2007. http://allafrica.com/stories/200703191855.html

[95] http://www.mtctelecom.com/muse/obj/lang.default/portal.view/content/About%20us/Worldwide%20Presence

[96] E.C.A. Ndukwe, Op.cit.

[97] Staff report, "$9 billion foreign investment in telecom sector: PM" 25 March, 2007:http://www.dailytimes.com.pk/default.asp?page=2007%5C03%5C25%5Cstory_25-3-2007_pg5_5.

[98] S.D. Saxena, Director-Finance at BSNL, Remarks reported at The Convergence India Conference, Nikhil Pahwa, @ Convergence India: Users, Not Technology, Pushing For Convergence,

http://www.contentsutra.com/entry/419-convergence-india-users-not-technology-pushing-for-convergence/.

99 Harsha de Silva, Lorraine Carlos Salazar and Ayesha Zainudeen provide summaries of the results and methodology at 28 February 2007 at the Changi Village Hotel, Singapore. The presentations are available at: http://www.lirneasia.net/projects/current-projects/bop-teleuse/.

100 Jonathan Donner, "The use of mobile phones by micro-entrepreneurs in Kigali, Rwanda: Changes to social and business networks" Columbia University, Paper and presentation to Wireless Communication and Development: A Global Perspective 7-8 October, 2005. The Ritz-Carlton, Marina del Rey, CA. http://arnic.info/workshop05/Donner%20_MobileKigali_Sep05.pdf and http://arnic.info/workshop05/DonnerSlides.pdf

101 WRI, Op.cit, p 43.

102 Tatum Anderson, "Mobile phone lifeline for the world's poor", BBC, 19 February 2007:http://news.bbc.co.uk/2/hi/business/6339671.stm.

103 Smart Communications, Smart Connect, "Educate Anywhere", *The Magazine for Living Wirelessly*, Op.cit.

104 Anant Shah, "The Future is Now: Mobile Technology and Public Health", The Yale Journal of Public Health (Winter 2007). http://www.cdc.gov/about/news/2007/03/images/mobiletech.pdf.

105 http://www.n-logue.com/index.html and Ashok Jhunjhunwala, "Wireless Communications and Development: Rural India Focus", Wireless Communication and Development: A Global Perspective, October 2005. See http://arnic.info/workshop05.

106 WRI, Op.cit, p 50.

107 Cited in Malathy Knight-John, Op.cit.

108 Nava Thakuria, "Muhammad Yunus' next crusade", 28 February 2007. http://nationmultimedia.com/2007/02/17/opinion/opinion_30027104.php.

109 Ericsson, "Ericsson to provide Grameenphone with IP mobile backbone network solution" Press release, 12 February 2007: http://www.ericsson.com/ericsson/press/releases/20070212-1104039.shtml.

110 Eric Sylvers, "Cellphones, an aid tool", *International Herald Tribune*, 30 October 2006: http://www.iht.com/articles/2006/10/30/business/wireless31.php.

111 Ministry of Internal Affairs and Communications "Information and Communications in Japan 2006 – Feature Ubiquitous Economy Outline", July 2006
see: http://www.johotsusintokei.soumu.go.jp/whitepaper/eng/WP2006/press_information01.pdf.

112 http://isis.nic.or.kr.

113 Justin Norrie, "Mobile boom, computer doom", *The Age*, 14 April 2007. See: http://www.theage.com.au/news/mobiles--handhelds/mobile-boom-computer-doom/2007/04/13/1176575723410.html.

114 A 'walled garden', in this context, refers to whether users can access content and services from any source, such as the open Internet, or are limited to content and services provided by a mobile operator and its partners.

115 The prices are USD 10 or USD 20 per month, over and above the regular subscription, depending on the package chosen.

116 http://www.three.co.uk/xseries/what_is_x_series.omp.

117 http://www.smart.com.ph/Gold/Services/SmartMobileInternet.htm.

118 http://www.smart.com.ph/Gold/Services/3G.htm.

119 This service costs a USD 7.80 one-off activation fee payment. Frances Ovia, "Nigeria: Starcomms Introduces 'Pay As You Surf' Service", 21st March 2007: http://allafrica.com/stories/200703220609.html.

120 http://www.bsnl.co.in/newsdetailed.php?news_id=368

121 "BSNL launches Unlimited Internet on CDMA 2000 1X", 15 March 2007: http://sifybroadband.techwhack.com/658/bsnl-cdma-2000-1x/.

122 Professor Eric Brewer, "Technology Research and Developing Regions", 7 October 2005. http://arnic.info/workshop05/Brewer.ppt#1.

123 http://209.85.129.104/search?q=cache:7EaLSfakKN8J:www.economist.com.na/oldsite/08dec06/08-12-08.htm+mweb+wimax&hl=en&ct=clnk&cd=4.

124 http://www.skyburst.com.gh/payment%20method.htm.

125 "BSNL to spend Rs 2,000 crore on broadband infrastructure", 24 December 2006 see: http://sifybroadband.techwhack.com/586/broadband-infrastructure-bsnl/

126 Antone Gonsalves, "Intel Research Goes For Long Distance Wi-Fi", Information Week, 30 March 2007. http://www.informationweek.com/hardware/showArticle.jhtml?articleID=198701336&cid=RSSfeed_IWK_News

127 David Orenstein, "A broad-based team of Stanford researchers aims to overhaul the Internet" 14 March 2007: http://news-service.stanford.edu/news/2007/march14/clean-031407.html.

128 The United Villages website is at: http://www.unitedvillages.com/. See also Ashes Moses "Rolling hotspots take villages online", 3 April 2007: http://www.brisbanetimes.com.au/news/wireless--broadband/rolling-hotspots-take-villages-online/2007/04/03/1175366225249.html.

129 See United Villages brochure: http://www.unitedvillages.com/United_Villages_India_3-Fold_Brochure_English.pdf and Jason Margolis, "Wi-fi buses drive rural web use", 29 March 2007 http://news.bbc.co.uk/2/hi/technology/6506193.stm.

130 The *Groupe Speciale Mobile* (GSM) Association was formed in 1987. See: http://www.gsmworld.com/about/history.shtml.

131 GSM Association, "GSM Association Forges Sub-$30 Mobile Phone Segment For Developing Countries", Singapore, 27th September 2005, http://www.gsmworld.com/news/press_2005/press05_23.shtml.

132 http://www.gsmworld.com/emh/index.html.

133 http://www.gsmworld.com/3gforall/index.html.

134 http://www.gsmworld.com/using/health/mobile_lifecycles.shtml.

135 CDG, "CDMA2000 For Developing Markets", January 2007 http://www.cdg.org/resources/white_papers/files/CDMA2000_Developing_Markets_Jan07.pdf. The CDMA Development Group is a trade association formed to foster the worldwide development, implementation and use of CDMA2000 technologies.

136 CDMA2000 1xEV-DO Rel 0 can deliver peak performance of 2.4 Mbps (DL) or commercial performance of between 300 to 700 kbps. CDMA2000 1xEV-DO Rev A offers higher performances levels again. http://www.cdg.org/technology/3g/resource/CDMA2000%20Market%20Facts%204-4-07.pdf.

137 http://www.ogo.com/.

138 http://www.onetouch.com.gh/othome/default.aspx.

139 http://www.secinfo.com/d12TC3.u68n.d.htm.

140 James Ratemo and Elizabeth Mwai, "Kenya: State Ready to Open Up Rural Areas for ICT", 15 April 2007: http://allafrica.com/stories/200704160811.html.

141 "World Information Society 2007 Report: Beyond WSIS", ITU and UNCTAD, June 2007. p 52:http://www.itu.int/osg/spu/publications/worldinformationsociety/2007/WISR07_full-free.pdf.

142 http://laptop.media.mit.edu/.

143 Intel, "Intel Launches New Ruggedized PC Platform For India", 29 March 2006. http://www.intel.com/pressroom/archive/releases/20060329corp.htm.

144 BBC Online, "Microsoft aims to double PC base", 19 April 2007. http://news.bbc.co.uk/2/hi/technology/6571139.stm.

145 For example: http://zenzui.com/ and http://www.where.com/ and http://www.tellme.com/.

146 http://pc.mtld.mobi/.

147 "Onetouch Outdoors OGO", 12 March 2007. http://www.mobileafrica.net/n1935.htm.

148 "Kenya: Young Computer Expert Makes African Video Game", 17 April 2007 http://allafrica.com/stories/200704170907.html. The website is: http://www.gwimgrafxstudios.com/.

149 http://www.semapedia.org/.

150 Alice Lander, "The signs of Ghana's tech success", BBC, 21 March 2007 http://news.bbc.co.uk/2/hi/africa/6411961.stm.

151 Jennifer Bakyawa, "Duplicate and unavailable': How the internet bypasses Ugandan farmers", reporting on Research paper | Fertile Grounds: Opportunities For Greater Coherence In Agricultural Information Systems (International Institute for Communication and Development, December 2003):http://www.bizcommunity.com/Article/220/23/13756.html.

152 For example in India and Ethiopia. Refer: Ethan Zuckerman, "Ethan Zuckerman Blogs TED", 5 June 2007. http://allafrica.com/stories/printable/200707121125.html.

153 Carolyn O'Hara, "In Google We Trust", Foreign Policy, March - April 2007. See: http://www.foreignpolicy.com/story/cms.php?story_id=3387&fpsrc=ealert060301

154 "Bollywood Goes Mobile", 12 February 2007.
See: http://www.gsmworld.com/news/press_2007/press07_17.shtml

155 Ethan Zuckerman, "Ethan Zuckerman Blogs TED", 6 June 2007. http://allafrica.com/stories/printable/200707121141.html. See also: Jeevan Vasagar, "Welcome to Nollywood", 23 March 2006: http://film.guardian.co.uk/features/featurepages/0,,1737425,00.html.

156 For example BSNL prices are at: http://www.bsnl.co.in/newsdetailed.php?news_id=352.

157 Simson Garfinkel, "$100 laptop: How to beat the hackers: Countless threats to One Laptop Per Child", 20 April 2007 http://www.pcadvisor.co.uk/news/index.cfm?newsid=9078.

158 Ibid.

159 GSMA, "International Gateway Monopolies Stifle Growth & Damage Competitiveness", 1 February London: http://www.gsmworld.com/news/press_2007/press07_07.shtml.

160 http://www.safe-sat3.co.za/HomePage/SAT3_WASC_SAFE_Home.asp.

161 A further 25 landlocked African countries can potentially link into cable the system through terrestrial and satellite facilities.

162 Russell Southwood, "The Sat3 Fibre – a Monopoly That Stands in the Way of Cheaper International Bandwidth", 4 March 2005: http://www.mybroadband.co.za/nephp//?m=show&opt=printable&id=169.

163 GSMA, "International Gateway Monopolies Stifle Growth & Damage Competitiveness", Op.cit.

164 Russell Southwood, "East Africa: Outsider East Coast Fibre Project Comes in From the Cold - Seacom Goes Public", Balancing Act, 2 April 2007: http://allafrica.com/stories/200704020670.html.

165 Rupak Sharma, "Internet costs to go down by 65 pc", 7 December 2006. See: http://www.kantipuronline.com/kolnews.php?nid=93747

166 Singapore's ST Telemedia purchased Global Crossing itself.

167 Michael Ruddy of Terabit Consulting http://www.terabitconsulting.com/ provides a rich source of information on the under sea cable market in a series of presentations including: "An overview of the International Submarine Cable Markets", Executive Telecom Briefings, Boston University, 12 December 2006 and "Analysis of the Caribbean Submarine Cable Market" at the CANTO Annual Meeting, Punta Can ta Dominican Republic, June 2006.

168 *Business Standard*, "Trai for open access at cable landing stations" 14 April 2007, http://www.business-standard.com/common/storypage.php?autono=281141&leftnm=3&subLeft=0&chkFlg=.

169 Reliance Communications' FLAG Telecom Announces FLAG NGN FLAG Global network to cover 60 countries, 28 December 2006: http://www.flagtelecom.com/index.cfm?channel=4328&NewsID=27318.

170 Victoria Shannon, "Deal signed for U.S.-China cable", 18 December 2006 http://www.iht.com/articles/2006/12/18/business/cable.php.

171 "EVN to invest in $200m undersea fibre optic cable" VNS, 10 April 2007 http://vietnamnews.vnagency.com.vn/showarticle.php?num=02ECO100407.

172 Stuart Corner, "Pipe Networks very positive on Guam cable", 27 March 2007. http://www.itwire.com.au/content/view/10824/127/.

173 Stuart Corner, "Telstra to build Australia-Hawaii cable link", 28 March 2007. http://www.itwire.com.au/content/view/10877/127/.

174 The OECD Council at Ministerial level met on 15-16 May 2002. In response to this mandate, a horizontal OECD project on Policy Coherence for Development was established in the 2003-2004, 2005-2006 and 2007-2008 OECD Programme of Work and Budget. The Council follows progress under the project through periodic reports by the PCD Co-ordinator and the Deputy Secretary General responsible for project. The OECD Horizontal Project on Policy Coherence for Development explores ways to ensure that government policies are mutually supportive of the countries' development goals. The project includes a seminar series, thematic workshops, and a publication series. The horizontal project has helped to fund and deliver collaborative work across the OECD on a wide variety of topics. For more information see the Policy Coherence for Development webpage at www.oecd.org/development or at: https://www.oecd.org/department/0,2688,en_2649_18532957_1_1_1_1_1,00.html.

175 Yoshiro Utsumi, quoted from a presentation at an ECOSOC meeting of the United Nations in 2000 and cited in: European Commission, "Internet Network Issues", 30 October 2000 p 11http://ec.europa.eu/information_society/activities/internationalrel/docs/itu/internet_traffic.pdf The quote is frequently cited elsewhere such as in "Via Africa: Creating Local IXPs to Save Money and Bandwidth", Discussion Paper prepared for the 2004 Global Symposium for regulators, http://www.itu.int/ITU-D/treg/publications/AfricaIXPRep.pdf.

176 Tunis Agenda, 2005. Paragraph 50 : http://www.itu.int/wsis/docs2/tunis/off/6rev1.html.

177 http://www.intgovforum.org/.

178 The Government of Brazil will host the 2007 IGF meeting. It will take place in Rio de Janeiro on 12 - 15 November 2007. The Governments of India and Egypt offered to host the 2008 and 2009 IGF meetings respectively, while the Governments of Lithuania and Azerbaijan have indicated their willingness to host the 2010 meeting.

179 "Kenya: EASSy Winner of Fibre-Optic Cable Race", 10 April 2007. See: http://allafrica.com/stories/200704100360.html

180 Maitland Report, Op.cit, p 19.

181 Total net outpayments from the United States to the rest of the World increased 16.2% from USD 3.1 billion to USD 3.6 billion between 2003 and 2004. FCC, 2004: Section 43.61 International Traffic Data Report. Released 3 June 2006, by the International Bureau. http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-264294A1.pdf . Between 2004 and 2005, however, the United States carriers' total net settlement payments returned to the USD 3.1 billion level. Net outpayments to some developing countries continued to increase and decrease for others. http://fjallfoss.fcc.gov/edocs_public/attachmatch/DOC-272545A1.pdf.

182 OECD, "Internet Traffic Exchange: Market Developments and Measurement", April 2006: http://www.oecd.org/dataoecd/25/54/36462170.pdf.

183 Efem Nkanga, "Nigeria: Bandwidth for National Data Costs $100m", 11 July 2007http://allafrica.com/stories/200707110344.html

184 http://www.kixp.net/.

185 OECD, "Internet Traffic Exchange and the Development of End to End International telecommunication Competition", 13 March 2002: http://www.oecd.org/dataoecd/47/20/2074136.pdf.

186 Michuki Mwangi, "Kenyan Internet Exchange Point", Presentation to LINX 52, Goodenough College, 20-21 February 2006.

187 http://www.sasanet.co.ke/sasanetv5/.

188 http://www.sasanet.co.ke/sasanetv5/results.asp.

189 This system is sometimes also call receiver party pays (RPP).

190 The United States has some CPP but the market is predominantly MPP.

191 Rohan Samarajiva, "Preferred Option", 5 April 2007 see: http://www.lankabusinessonline.com/fullstory.php?newsID=266482801&no_view=1&SEARCH_TERM=24

192 "HK-listed China Unicom sees long-term benefits from 'call-party-pays' scheme", http://www.hemscott.com/news/latest-news/item.do?newsId=41233833719933.

193 AFX News Limited, "Hong Kong shares lower on Wall St retreat; China Mobile extends fall", 24 April 2007.

194 Excluding tax.

195 Sri Lanka's rate to terminate international traffic to a mobile or fixed user, for example, is much higher than the domestic rate.

196 USTR, "Results of the 2006 Section 1377 Review of Telecommunications Trade Agreements", 2006 http://www.ustr.gov/assets/Trade_Sectors/Telecom-E-commerce/Section_1377/asset_upload_file43_9276.pdf.

197 Mexico changed the pricing structure from MPP to CPP in late 2006. "Probable Increase in Charges for Calling Wireless Telephones in Mexico", FCC Advisory, 19 October 2006:http://www.fcc.gov/cgb/consumerfacts/Mexico_caller_pays.html.

198 The range of Skype's prices to terminate SMS also vary widely from USD 0.31 in Mexico to just USD 0.05 in Denmark or China.

199 Shame Makoshori, "Zimbabwe: Mboweni Says Mobile Operators Being Cheated", 20 April 2007: http://allafrica.com/stories/200704200625.html.

200 "Zimbabwe: Econet Bars Prepaid Customers From Making International Calls", *The Herald* (Harare), 11 April 2007: http://allafrica.com/stories/200704110255.html.

201 http://www.grandcentral.com/.

202 http://www.sfconnect.org/AboutUs/index.php/homeless_connect/phc_our_mission.html.

203 "GrandCentral Caps 2006 with PCH Event; More than 1,500 Homeless and Those-In-Need Citizens Benefit from Free Phone Numbers and Voicemail", 7 December 2006. See: http://www.grandcentral.com/home/pressdetails/11

204 http://www.redpocketmobile.com/.

205 A daily fee of USD 0.25 per day also applies on days when users use their phone.

206 For example Vodafone's plans for UK small businesses are at: http://online.vodafone.co.uk/dispatch/Portal/appmanager/vodafone/wrp?_nfpb=true&_pageLabel=template10&pageID=BPP_0032.

207 http://www.t-mobile.co.uk/personal/pages.do/our-services/costs-from-the-uk/international-option.

208 Tim Kelly, "International good practices in data collection and comparison" Presentation at a LirneAsia Workshop, Delhi 1-3 March 2006. See: http://www.lirneasia.net/wp-content/uploads/2006/03/tkelly_2mar06.pdf.

209 ITU, World telecommunication Development Report, 1994.

210 NSF/OECD Workshop "Social and Economic Factors Shaping the Future of the Internet", 31 January 2007:http://www.oecd.org/document/59/0,2340,en_2649_37441_37921851_1_1_1_37441,00.html.

211 Internet Innovation Alliance (IIA), "Leading Internet Alliance Says Web's Capacity is Nearing Its Limit", 18 April 2007.see: http://home.businesswire.com/portal/site/google/index.jsp?ndmViewId=news_view&newsId=20070418005312&newsLang=en.

212 Bill Woodcock, "Good practices in Internet Exchange Point documentation and measurement" DSTI/ICCP/CISP(2007)9 Secretariat Working document.