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DISCUSSION PAPER

International Internet Interconnection

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

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INTERNATIONAL INTERNET INTERCONNECTION NEXT GENERATION NETWORKS AND DEVELOPMENT

PREPARED BY ERIC LIE
TELECOMMUNICATION CONSULTANT

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gsr07@itu.int

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

1 Introduction

The subject of international interconnection has been dominated for some time by issues related to the accounting rate system and the cost of international internet connectivity. While these issues have been with us for some period of time, a greater sense of urgency to resolve them has been brought about by the accelerating transition from PSTN to NGN networks. This transition is expected to lead to further declines in the amount of PSTN traffic that goes through the accounting rate system, lowering the already reduced amounts of foreign exchange developing countries receive through settlement payments. At the same time, this transition is also expected to place a greater burden on developing countries in the form of costs related to international internet connectivity. For a variety of reasons, developing countries have had to bear high costs for international connectivity to the internet. These costs are expected to increase as more traffic migrates to NGNs.

This paper discusses some of the current trends in international interconnection as well as the implications international interconnection practices have on telecommunications development. Section 2 describes the charging arrangements related to international PSTN connection and international IP connection. It also discusses some of the international traffic trends that have had an effect on these arrangements. Section 3 considers the impact of international interconnection practices on telecommunications development, focusing in particular on the effects of the declining accounting rate system and the high cost of international internet connectivity on developing countries. The chapter also makes some suggestions as to how some of these challenges can be addressed.

2 Trends in International Interconnection

2.1 International Interconnection on the Public Switched Telecommunications Network (PSTN)

2.1.1 *The Accounting Rate System* [1]

The accounting rate system is a series of arrangements between national operators in which they jointly provide international calls and divide the revenues from such calls between them. It was developed as a way to allocate revenue for international telephone services and to cover the costs of international transmission, the international gateway and call termination. The system provides a set of agreed prices or "accounting rates" for the interconnection of international calls. The originating carrier charges the customer making the call a retail rate, and is charged generally half the accounting rate by the terminating carrier for the termination of the international call. Under this system, there is a joint provision of service, each carrier providing service to an imaginary halfway point on the international circuit (half circuit). It should be noted, however that accounting rates do not necessarily reflect costs.

The accounting rate system is set out in the *International Telecommunication Regulations (ITRs)*, an international treaty administered by the International Telecommunication Union (ITU). The ITRs are complemented by "D-series" Recommendations, which are the work of Study Group 3 of the ITU Telecommunication Standardization Sector (ITU-T).[2]

The accounting rate system contains a number of different methodologies, but the most common system of remuneration has been the "accounting rate revenue division procedure". Under this system, a net settlement payment is made on the basis of excess traffic minutes, multiplied by half the accounting rate. This amount is usually paid in United States Dollars (USD) or Special Drawing Rights (SDR)[3]. If traffic flows along a route are balanced, the accounting rate system does not generate significant cash flows. However, for many less-developed countries, traffic on international routes is unbalanced as more calls are terminated in these countries than originate from them. As a result, the accounting rate system has produced considerable revenue inflows to many developing countries.

During the 1990s, net settlement payments grew extremely large as traffic flows become less balanced. During the period between 1993 and 1998, the ITU estimated that net flows of settlement payments from developed to developing countries amounted to some USD 40 billion. However, an increasing volume of traffic now passes outside the accounting rate system (e.g. via VoIP), or is routed in such a way as to exploit the least-cost route between two end-points, which is not necessarily the most direct one. Participants in ITU-T Study Group 3 have estimated that developing countries may now pay USD 3 billion to developed countries.

2.1.2 *Decline of the Accounting Rate System*

The accounting rate system has come under sustained pressure for more than a decade. The wave of telecommunications sector liberalization that started in the late 1990s led to the entry of new competitive carriers into both the international and domestic telecommunications market of many countries. The presence of these competitive carriers made it possible for carriers in other countries to deal with more than one correspondent in the delivery of international calls, opening the gates to different arrangements in search of lower prices. In some cases, foreign carriers entered into domestic markets to interconnect directly with local operators.

Arbitrage opportunities from the uneven pace of liberalization on a global basis allowed carriers to offer customers prices that were well below international accounting rates even for calls to countries without liberalized telecommunications markets.

At the same time, the system also came under increased regulatory pressure. In 1997, the United States Federal Communications Commission (FCC) acted to reduce accounting rates by prohibiting US-based carriers from paying rates above certain benchmark levels. (See Box 1)

Box 1: FCC intervention in international accounting rates

In 1997, the FCC established its benchmarks policy with the goal of reducing above-cost settlement rates paid by US carriers to foreign carriers for the termination of international traffic. The benchmarks policy requires US carriers to negotiate settlement rates at or below benchmark levels set by the Commission in its 1997 Benchmarks Order. The *Benchmarks Order* divided countries into four groups based upon economic development levels as determined by information from ITU and the World Bank.

Currently, more than 95 percent of U.S. outbound international minutes are reported by US carriers to be in compliance with the prescribed benchmark rates. The Commission's Benchmarks Policy has contributed to a decline in international settlement rates. FCC staff estimate US consumer savings of up to $38 billion due to the decline in settlement rates from 1997 through 2002.

Source: FCC at http://www.fcc.gov/ib/pd/pf/account.html

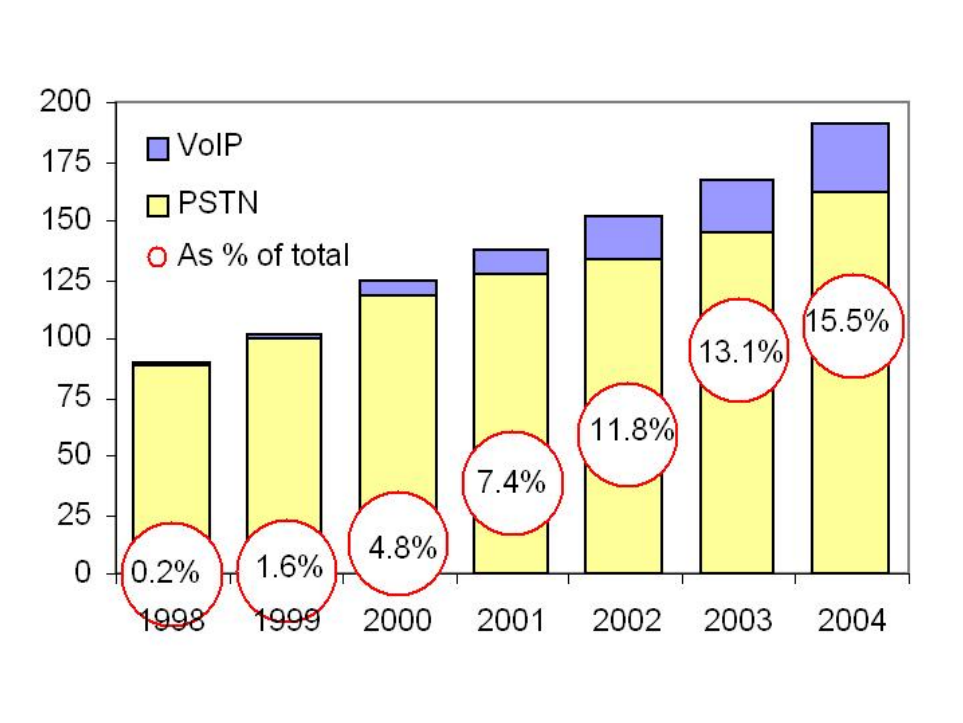
The increasing use of VoIP, which bypasses the international accounting rate system, has further undermined the system's relevance. While VoIP traffic still accounts for only a modest share of international voice traffic, that amount is expected to rise exponentially as more carriers transition to end-to-end NGN. (See Figure 1.)

The accounting rate system has now been largely replaced by directly negotiated rates to terminate traffic, in some cases with long-term contracts, in other cases on a short-term or spot basis. Electronic exchanges like Arbinet and VPF, have emerged that enable trading of international voice, data, and mobile capacity. In most cases the prices for terminating traffic around the world at such exchanges are significantly lower than even those prescribed by the FCC's benchmark rates.[4] Studies conducted by the ITU indicate that on a global basis

settlement rates have fallen consistently. Since 1998, the rate of reduction has accelerated to more than 20 per cent year on year. In SDR, average settlement rates were 1.06 in 1998, 0.258 in 2001, 0.229 in 2002, 0.195 in 2003, 0.125 in 2004, 0.088 in 2005 and 0.071 in 2006.[5] The accounting rate system still exists, but in a far more modest scale than a decade ago. The ITU estimates that only 20 percent of international traffic still uses the accounting rate system. This percentage is predominantly made up of traffic originating and terminating in developing countries. No developed countries exchange traffic with other developed countries using the accounting rate system.

The combined effect of all these trends has contributed to a general decline in the volume of international voice traffic over the PSTN, its retail price and consequently the revenue it generates for carriers. (See Figure 2.)

Figure 1: International Voice Traffic
in billions of minutes



Source: ITU World Telecommunication Indicators Database

Although this decline has been felt globally, its effects have been more pronounced in developing countries. Some of the effects that present themselves in the context of telecommunications development are discussed in Chapter 3.

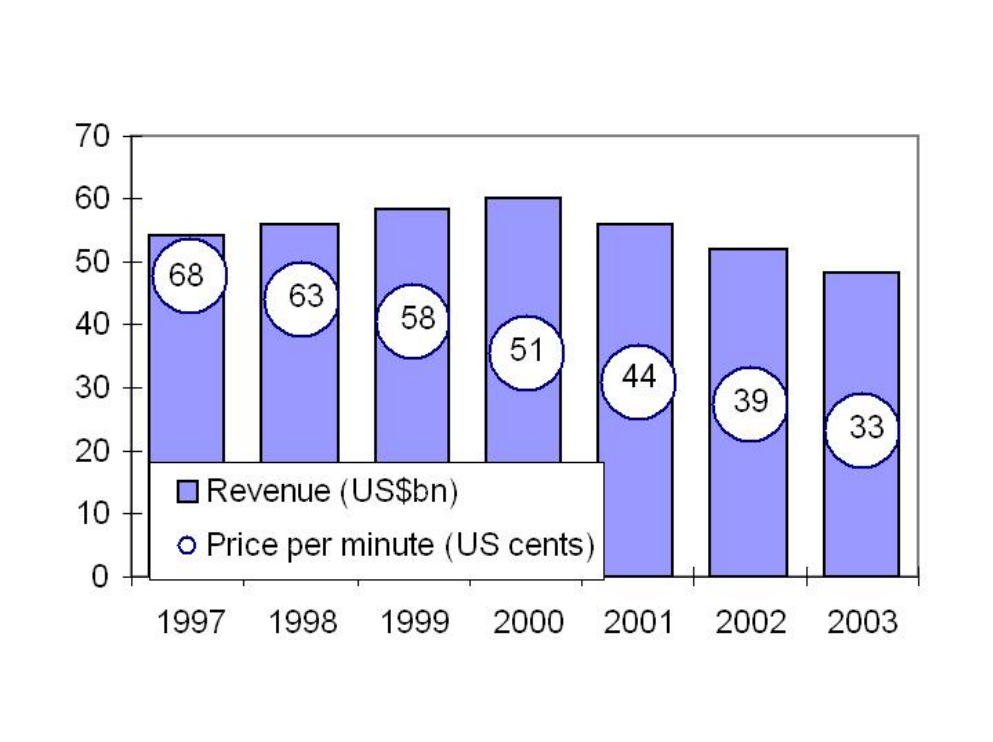
2.1.3 *International Efforts at Reforming the Accounting Rate System* [6]

In order to adapt the accounting rate system to the evolving global telecommunication environment, Study Group 3 of the ITU-T started an overall review of the accounting rate system as early as 1991. Work on accounting rates concentrated on:

- developing general principles and guidelines for the establishment of accounting rates;
- determining cost components to be included in the telephone accounting rates;
- developing appropriate costing methodologies; and
- establishing a transition period to avoid drastic changes, particularly for developing countries.

Based on these objectives, Study Group 3 developed ITU-T Recommendation D.140, which was subsequently adopted in 1992. It recommended cost-orientation, publication and the periodical review of accounting rates, specifying the cost elements to be taken into account. In December 1998, Study Group 3 approved a revision to ITU-T Recommendation D.150, agreeing on three new procedures for remunerating the party that terminates international traffic. The first, the termination charge procedure, allows governments or operators to establish a single charge for terminating traffic in their country, provided the charge meets certain multilaterally agreed criteria. The second, the settlement rate procedure, allows negotiation of cost-orientated and asymmetric settlement rates. The third procedure, between countries that have introduced liberalization, allows any other bilaterally negotiated commercial arrangement.

Figure 2: International Voice Traffic Trends
Revenue (USD billion) and price per minute (US cents)



Source: ITU World Telecommunication Indicators Database

In 1998, ITU-T Study Group 3 also agreed to establish a Focus Group in order to study a possible scheduled reduction of accounting rates. The Focus Group proposes “target rates” for countries in different teledensity bands on a periodic basis. Currently, ITU-T Study Group 3 also continues to study the adaptation of its recommendations to the changing market environment mainly through the periodic collection of data and its analysis.

To a large extent ongoing work by Study Group 3 concentrates on refining the costing methodologies and settlement procedures that are based on its current recommendations. Recently, however, focus has shifted towards an examination and analysis of mobile termination rates for international calls.

The topic of accounting rate reform has also been the subject of discussion at the World Trade Organisation (WTO) for some time. Most favored nation (MFN) status was not applied to accounting rates and no consensus on accounting rates was reached when its Members concluded negotiations on the General Agreement on Trade in Services (GATS) in 1994 largely because not all countries had embraced telecommunications market liberalization to the same extent at that point in time. Negotiations on how principles, such as non-discriminatory pricing, may apply to measures related to the accounting rates system have remained inconclusive while proposals that participants address these issues by scheduling market

access commitments on "termination services" have not so far been found acceptable. With less traffic flowing through the accounting rate system, the issue has become less controversial. Nevertheless, the secretariats of the ITU and the WTO continue to collaborate closely on ongoing reform efforts.

2.2 International Internet Interconnection

2.2.1 *Charging Arrangements for International Internet Interconnection*

2.2.1.1 IP Peering and Transit

Unlike in the PSTN world, where the costs of international calls are shared between operators, Internet Service Providers (ISPs) exchange IP traffic in two principal ways common to both international and domestic markets: peering and transit. (See Box 2.)

Box 2: Peering and Transit

Peering, also known as "Sender Keep All" or "Bill and Keep" is a zero compensation arrangement by which two ISPs agree to exchange traffic at no charge. This kind of arrangement makes sense where the two ISPs have roughly the same characteristics and traffic volumes, such that net financial burden from traffic flows between them is likely to be small.

The process by which an ISP qualifies for peering remains private. ISPs negotiate terms and conditions privately. They only rarely publicly disclose the criteria they use to qualify for peering. However, several Tier-2 ISPs have posted general qualifications for agreements to peer on their web sites. These conditions emphasize network coverage, volume of traffic, and 24 hour a day network maintenance capability. These criteria are probably more liberal than a Tier-1 ISP would require.

Transit is an arrangement in which larger ISPs sell access to their networks, their customers, and other ISP networks with which they had negotiated access agreements.

Under a transit arrangement, the sender pays the full cost of interconnection. Transit charges are set by commercial negotiation, and are generally not disclosed.

Internet transit access arrangements provide a much greater geographical access than telecommunications transit arrangements. In telecommunications, transit arrangements typically secure an indirect link to one carrier in one location (primarily because a small carrier is unable to secure a direct link). Internet transit arrangements typically provide access to a vast array of networks, not limited to one country.

At the extreme, one Internet transit payment arrangement with one major Tier-1 ISP can provide a small, remote ISP with access to the Rest of the World. This is because the Tier-1 ISP has ubiquitous access and so can provide extensive routing opportunities.

Source: ITU-InfoDev ICT Toolkit available at http://icttoolkit.infodev.org

The question of whether two ISPs enter into a peering arrangement, as opposed to a transit arrangement, depends largely on whether there is a balance of contributions and benefits between the two parties. Unlike the PSTN system, the determination of such a balance is more broadly based than just a measurement of traffic volume. Balance takes into account not only on a comparison of traffic volume but also factors such as customer base (customer loyalty, size of customer base, customer demographics), the range of ancillary services offered, the quality of onward connectivity and the technology used.

Traffic volume alone is never used as the only metric for determining the relative contributions to the cost of the connectivity between two ISPs. Such measurements are prone to abuse and misinterpretation. Moreover, the resources involved in measuring traffic are considerable with precise measurements difficult to obtain and results subject to debate. Nevertheless, traffic balance still represents one important factor into the calculation of balance for purposes of peering.

In many cases, even when peering arrangements are available, some ISPs may choose to pay for transit for a number of reasons. For many countries, the incremental cost of using high capacity links to the US together with the lower transit fees paid to US ISPs for global connectivity is in most cases less than the cost of

establishing separate routes to individual ISPs in different countries for purposes of peering, especially when the volume of traffic exchanged is low. There are also costs and other resources involved in negotiating peering arrangements with different parties. Peering requires routers and other related equipment which are installed at peering points. The more peers, the more equipment is required, and the higher the capital expenditure. As a result, in practice many ISPs have adopted a hybrid approach to interconnection - peering with a number of ISPs and paying for transit from one or more ISPs in order to have access to the backbone of the transit supplier as well as the peering partners of the transit supplier.

2.2.1.2 International VoIP Interconnection

On a technical level, there is no fundamental difference between the exchange of Voice over Internet Protocol (VoIP) packets and the packets of any other IP based service like email or IPTV. As a result, VoIP traffic is generally exchanged on the same basis as other forms of IP based traffic.

As opposed to IP based services such as email, however, VoIP interconnection with the PSTN remains a necessity as the vast majority of telecommunications users are still reliant on the latter. In most cases, major international VoIP service providers such as Skype or Yahoo terminate traffic on the PSTN through termination agreements with telecommunications operators who terminate traffic on their own network or through their termination agreements with a range of national operators. Not unlike commercial practices on the PSTN, VoIP service providers typically shop around for the best terms and conditions for international termination. Currently, VoIP service providers do not receive any compensation from PSTN service providers for terminating calls that originate on the PSTN. This may change as the balance between PSTN users and VoIP users shifts.

It is worthwhile noting that in recent years, VoIP service providers have started to enter into their own specific peering arrangements with other VoIP service providers. [7] While the essential aim of these arrangements is to reduce costs through settlement free peering, such arrangements also have the potential to guarantee or improve service quality. As NGN technologies like Multi-Protocol Label Switching (MPLS) gain in popularity as a means to mark certain packets as having delivery requirements other than the "best effort" standard of the public Internet, VoIP service providers that interconnect directly with other VoIP service providers can guarantee a certain level of end-to-end service quality for their services.

2.2.1.3 New Models for International Internet Interconnection

NGN's ability to provide different levels of quality for different IP-based services, however, has led a number of network operators to question the sufficiency of the current international interconnection regime when it comes to the delivery of traffic that requires more than "best efforts".[8] They advocate the establishment of an interconnection regime that would reflect the best of the PSTN and IP worlds in terms of the assurances of security and quality of the former and the cost-effective performance and flexibility of the latter.

As NGN deployment continues, operators owning network infrastructure have advocated the use of service control and application layers to distinguish specific high quality and secure services provided to their customers (such as VoIP or online games), from other services (such as emails or world-wide-web browsing) or from services destined for the customers of a different service provider. This would allow these operators to charge their consumers or service providers using their networks different prices that correspond to the level of quality and security demanded.

To some degree, the decoupling of service provision from the network made possible by NGN has also contributed to network operator dissatisfaction with the current interconnection regime. With service providers receiving larger shares of end-user generated revenues, network operators fear that they will eventually be reduced to just conduits through which more profitable services will flow. As a result, network operators seek to recover some of the perceived difference through differentiated charging for interconnection and/or by entering the downstream service provision market themselves.

In the US, these issues form part of a wider debate on "net neutrality".[9] While the term "net neutrality" has no precise definition, advocates of "net neutrality" generally argue that all network application needs should be met equitably. Any particular internet host, protocol, or application should not receive preferential treatment, except to ensure the correct operation of the network or protocol. In the US, attempts by network operators to introduce differentiated charging has provoked strong protest from service and content providers

without networks, such as Skype, Vonage and Google, who fear that such differentiation could lead to increased interconnection costs as well as anti-competitive behavior, in particular discrimination, when network providers enter into the same downstream service markets.[10]

While this issue is still largely localized to the US, it will inevitably enter into the international market as more network operators seek to provide services with quality and security assurances internationally. Already a number of large network operators such as NTT, BT and France Telecom have indicated that provided certain requirements are met, they would be prepared to open service and control application layers to selected international interconnecting partners in order to allow end-to-end quality of service and security guarantees.[11] Agreements such as these give rise to concerns from operators who may not carry the same weight as these incumbents. In the absence of countervailing influences, the international internet market risks a return to the questionable competitive environment of the late 1990s where market concentration in the hands of a Tier-1 ISPs led to high prices for international internet connectivity.

In order to prevent an unconsidered de facto determination of international NGN interconnection norms, it remains imperative for stakeholders in the market, from regulators to service providers, to take an active interest in the ongoing debate. Although international debate on "net neutrality" has not taken place on the same scale as in the US, international fora such as the ITU, APEC, and the OECD are currently examining the issue. For example, during the 33rd meeting of the APEC Telecommunications and Information Working Group (APEC TEL) in April 2005, the topic of "net neutrality" was raised at the regulatory roundtable for discussion.

2.2.2 *Market Developments in International Internet Connectivity*

2.2.2.1 A US-centric Internet

Historically, the internet started in the United States. When the internet was commercialized in the early 1990s, non-US participants had to connect to the US for access to content and for international delivery.[12]

Although internet usage spread globally towards the late 1990s, the US continued to host the bulk of the internet's major content providers. The vast majority of traffic is made up of file transfers, web browsing and multimedia downloads - uses that are driven by the need to access content. Given the concentration of content in the US, the vast majority of international links led to the US. In 1998, for example, in Europe, the maximum link between any two countries was under 450 Mbps, while U.S.-bound bandwidth was over 3.5 Gbps. In Asia, no two countries shared links of over 155 Mbps, while capacity to the US was around 2 Gbps. Around 75 percent of traffic originating from Europe and Asia went first to the US with a portion being routed back to the region.

For ISPs outside the US, international internet connectivity involved paying for the cost of the transmission link to the US as well as the cost of delivery within the US. In the 1990s, these backbone services were mostly bundled and sold by International Backbone Providers (IBPs), in particular Tier-1 ISPs with little price flexibility. Non-US ISPs were required to pay the entire cost of the transmission link (full circuit) to the US despite the fact that traffic flowed in both directions. In 1993, for example, the price of capacity from Australia was over USD100 000 per Mbps per month. Transit within the US also had to be purchased by non-US ISPs while Tier-1 ISPs enjoyed settlement free peering amongst themselves. Private peering with Tier1 ISPs was the goal for most non-US ISPs to reduce delivery costs. However requirements for peering were extremely onerous, necessitating multiple high-speed connections distributed throughout North America. Even when requirements were met, private peering with non-US parties took place only at US nodes and not at a notional mid-point between the two countries. As a result non-US ISPs had to continue to purchase transmission to the US at a high cost.

2.2.2.2 Increasing Competition

To a large extent the internet still remains US centric. With abundant capacity still leading to and from the US, it still remains more cost effective to deliver traffic to other countries via the US in many cases. Almost all of the top Tier-1 ISPs are headquartered in the US.

In recent years, however, a number of changes to the internet landscape have led to a sharp decline in the cost of international internet connectivity. A major factor has been the new found popularity of public peering at public Network Access Points (NAPs) or Internet Exchange Points (IXPs) where Tier-2 ISPs inside and outside the US could peer with each other.[13] This provided a viable alternative to transit services

obtained from Tier-1 ISPs. At the same time, competition for the provision of delivery in the US increased as the number of Tier-1 ISPs rose. From around three in 1996 there are currently nine ISPs commonly recognized as Tier-1: AOL Transit Data Network (ATDN), AT&T, Global Crossing (GX), Level 3, Verizon Business (formerly UUNET), NTT Communications (formerly Verio), Qwest, SAVVIS and Sprint Nextel Corporation. As a result, it became increasingly common for ISPs purchasing transit to have agreements with more than one Tier-1 ISP. Through multihoming, ISPs purchasing transit are able to direct their traffic through the Tier-1 providers that offer them the best deals.[14]

The construction boom in high capacity fiber optic cables has also greatly reduced international transmission costs. More importantly, fiber optic cables were deployed more evenly across the globe. Although the largest capacity increases were on East-West routes across the Atlantic and the Pacific, fibre optic submarine cables also became available between Asia and Europe via the Middle East, between South America and North America as well as along the West Coast of Africa to Europe. (See Figure 3) Some of these new cable systems are described in Section 3 below. The more even distribution of high capacity fiber optic cables both lowers transmission costs in the countries located along these routes as well as increases the potential for regional traffic exchange.

Figure 3: Submarine Cable Map, 2007

Source: TeleGeography research

As a result of these competitive pressures, transit prices have fallen sharply in recent years. For example, studies by Telegeography indicate that since 1993 the monthly price of a 155 Mbps port in New York City has fallen from USD 101 per Mbps in the second quarter of 2003 to USD 29 per Mbps in the second quarter of 2006, while the price of a comparable port in Hong Kong, China has fallen from USD 204 per month in

Q2 2003 to USD 69 per month in Q2 2006.[15] In some countries, falls in the cost of international internet connectivity have led to remarkable cost savings by ISPs. For example, in Australia, the international component represented 50 to 70 percent of ISP costs in the early 1990s. In 2004, this percentage fell to 5 to 15 percent of total wholesale costs.[16]

Although global prices for international internet connectivity have fallen steadily for a sustained period of time, a number of developing countries nevertheless continue to labour under the burden of crippling costs for international internet connectivity for a number of reasons such as geographic isolation and continued monopoly in the sector. These issues are discussed in the Section 3.

2.2.3 *Regulation and Reform in International Internet Connectivity*

While the backbone market for international internet connectivity has shown the effects of increased competition, recent trends towards consolidation still gives rise to competition concerns. Although regulatory intervention has been relatively restrained in the area of international internet connectivity, regulators in the US have remained watchful over possible anti-competitive behavior and the risks of market concentration in the backbone segment of the US market. In the US, for example, the market for "Tier-1" or national Internet backbone services was described by the US Department of Justice as "highly concentrated" in its filing against the WorldCom/Sprint merger in 2000. In particular, its filings cited concerns over the 53 percent control the merged entity would have over internet traffic in the US and the increased potential such an entity would have to raise prices and lower service quality[17].

Nevertheless, in the absence of an international competition policy framework, the potential for market concentration and abuse at the Tier-1 segment remains an area of significant concern to developing countries. Apart from sporadic, unilateral intervention from the US and possibly the EU, there are currently no international competition safeguards to prevent Tier-1 ISPs from exercising their market power to shift greater infrastructure and operation costs to the smaller ISPs in developing countries. As a result, there has been growing pressure at the international level for some form of oversight on the subject of international internet connectivity.

Since 1998, the ITU has studied the issue of charging arrangements for international internet connectivity. The objectives of ITU-T Study Group 3 at that time were to identify the differences between internet and the PSTN costing models. Members of ITU-T Study Group 3 agreed then that it was inappropriate to apply the existing PSTN costing model but disagreements persisted regarding whether the existing transit model resulted in equitable cost compensation between providers.

In June 2000, ITU-T Study Group 3 attempted to gain global agreement on a draft recommendation made by the Regional Tariff Groups to set out the principle for negotiating agreements to transmit international internet traffic that included the possible need for compensation between the providers carrying the traffic. However, this failed due to the resistance of a few developed countries and major ISPs who saw in the proposal an attempt to impose on the Internet a traffic-based settlement system similar to that of the PSTN which would preclude their freedom to negotiate interconnection agreements on their own terms. This was contrasted with the position of the majority of developing countries and Australia who believed that the principles of non-discrimination, cost-orientation and transparency should also apply to international interconnection. As importantly, they sought recognition for the possible need for compensation between the providers carrying the traffic because under the arrangements in place non-US ISPs were required to pay the full cost of transmission to the US regardless of the direction of traffic flow (full-circuit cost). At the time, it was estimated that non-US ISPs were subsidizing US Tier-1 ISPs up to USD 5 billion per year.

Given the lack of consensus, the Chairman of ITU-T Study Group 3 decided to submit the draft Recommendation directly to the Sector's governing body, the World Telecommunication Standardization Assembly (WTSA) where it was adopted with reservations taken by the US and Greece, and labeled as Recommendation D.50. (See Box 3)

In parallel, members of the Asia-Pacific Economic Cooperation (APEC) group also conducted discussions on the charging issue. This culminated in the adoption of the APEC Principles on International Charging Arrangements for Internet Services at the 4th APEC Ministerial Meeting on Telecommunications and the Information Industry in May 2000. (See Box 4.)

Box 3: Recommendation D.50

It is recommended that administrations involved in the provision of international Internet connections negotiate and agree to bilateral commercial arrangements enabling direct international Internet connections that take into account the possible need for compensation between them for the value of elements such as traffic flow, number of routes, geographical coverage and cost of international transmission among others.

Source: ITU

During the same period, Australia, Mexico and Columbia also raised the issue at the WTO. A proposal was made to give WTO members a role in promoting fair competition in International Internet Charging Arrangements in cases where there are dominant players or de facto monopolies. Australia proposed that 'internet delivery' be recognized as a basic telecom service ('packet-switched data transmission services'), making it subject to the basic telecom reference paper.

Following the adoption of ITU Recommendation D.50 at the WTSA, the assembly decided that there was a need for on-going studies on the issue. In the subsequent Study Period 2000-2004, ITU-T Study Group 3 continued to study the technical and economic developments related to international internet connectivity and it considered the need to provide further guidance on the general principles. Accordingly, in June 2004, ITU-T Study Group 3 adopted an annex to Recommendation D.50 which contained additional guidelines relevant to bilateral commercial agreements on the issue. ITU-T Study Group 3 also encouraged the international donor community to address the high cost of international internet connectivity for the least developed countries by supporting efforts such as regional traffic aggregation and capacity building. In the new Study Period 2005-2008, ITU-T Study Group 3 continues to study internet traffic flow methodologies for use in commercial agreements and the efficiency and cost of Internet connectivity around the world.[18]

Recently, debate on the issue of charging for international internet interconnection has been subsumed under the context of internet governance which was discussed during the first phase of the World Summit on the Information Society (WSIS), which was held in Geneva in December 2003. Its Plan of Action called for the reduction of interconnection costs through the creation of regional backbones and IXPs, and for Internet transit and interconnection costs to be "oriented towards objective, transparent and non-discriminatory parameters".[19] The Summit also requested the Secretary-General of the United Nations to create a Working Group on Internet Governance (WGIG) to work on the different issues concerning internet governance.

Box 4: APEC Principles on International Charging Arrangements for Internet Services

Internet connectivity is an essential element of the global information infrastructure that should be encouraged to strengthen the Asia-Pacific Information Infrastructure.

Governments need not intervene in private business agreements on International Charging Agreements for Internet Services achieved in a competitive environment, but where there are dominant players or de facto monopolies, governments must play a role in promoting fair competition.

Internet charging arrangements between providers of network services should be commercially negotiated and, among other issues, reflect:

- The contribution of each network to the communication;
- The use by each party of the interconnected network resources; and
- The end-to-end costs of international transport link capacity.

Source: APEC Principles on International Charging Arrangements for Internet Services available at: http://www.apec.org/apec/ministerial_statements/sectoral_ministerial/telecommunications/2000/annex_b.html

The WGIG presented a final report for consideration during the second phase of the WSIS, which included a number of recommendations on the issue of international interconnection charging. These recommendations were adopted by the second phase of the WSIS held in Tunis in November 2005 as part of the WSIS Agenda for the Information Society. (See Box 5)

Box 5: WSIS Agenda for the Information Society

Paragraph 50.

We acknowledge that there are concerns, particularly amongst developing countries, that the charges for international Internet connectivity should be better balanced to enhance access. **We therefore call for** the development of strategies for increasing affordable global connectivity, thereby facilitating improved and equitable access for all, by:

a. Promoting Internet transit and interconnection costs that are commercially negotiated in a competitive environment and that should be oriented towards objective, transparent and non-discriminatory parameters, taking into account ongoing work on this subject.

b. Setting up regional high-speed Internet backbone networks and the creation of national, sub-regional and regional Internet Exchange Points (IXPs).

c. Recommending donor programmes and developmental financing mechanisms to consider the need to provide funding for initiatives that advance connectivity, IXPs and local content for developing countries.

d. Encouraging ITU to continue the study of the question of International Internet Connectivity (IIC) as a matter of urgency, and to periodically provide output for consideration and possible implementation. We also encourage other relevant institutions to address this issue.

e. Promoting the development and growth of low-cost terminal equipment, such as individual and collective user devices, especially for use in developing countries.

f. Encouraging Internet Service Providers (ISPs) and other parties in the commercial negotiations to adopt practices towards attainment of fair and balanced interconnectivity costs.

g. Encouraging relevant parties to commercially negotiate reduced interconnection costs for Least Developed Countries (LDCs), taking into account the special constraints of LDCs.

Source: WSIS Agenda for the Information Society, Tunis, 2005 available at http://www.itu.int/wsis

To a large extent, the text of the Agenda echoes the declarations and recommendations made by APEC and the ITU on this issue. Although further study in this area is ongoing in ITU-T Study Group 3 at the moment, it appears likely that there will be no fundamental shift away from the principle of commercially negotiated internet transit and interconnection agreements towards the regulation of international internet interconnection practices for some time to come. Focus instead has shifted to the promotion and support of initiatives aimed at establishing regional high-speed backbone networks and IXPs. Some of these initiatives are described in the following chapter.

3 International Interconnection and Development: Between *Scylla* and *Charybdis*

Like the ancient mariners in Greek mythology seeking to avoid the two monsters Scylla and Charybdis[20] that line two sides of a narrow strait, developing countries find themselves navigating between the loss of international accounting rate revenue and the often high costs they bear for international internet connectivity. Current practices in charging for international interconnection and recent patterns in international PSTN and IP traffic play a large role in shaping the development telecommunications markets in developing countries. These factors impact the revenues carriers earn, the prices end-users pay and the availability of ICT access in the country in general. With more international traffic expected to migrate from the PSTN to NGN as the latter's deployment continues apace, many carriers in developing countries are caught between two trends: falling revenues from international voice services and high international internet

connectivity costs. It thus becomes increasingly important to ensure that developing countries are not penalized or left behind in the process.

The first part of this section looks at the effect of the decline in international call revenues from the PSTN on telecommunications development and some possible measures that can be taken to mitigate its effects. The second part of this chapter looks at the challenges developing countries face in relation to high international interconnection charges and some of the efforts that have been made to meet those challenges.

3.1 ICT Development and the Accounting Rate System

Under the accounting rate system, there was typically more international traffic flowing into developing countries than flowing out. For the most part, this was due to the fact that subscribers living in developed countries had more income and could thus afford to call their friends and relatives who lived in developing countries. Developing countries with large populations working abroad typically benefited from the accounting rate system.

During the heyday of the accounting rate system, income from settlement rates provided carriers in developing countries with the bulk of their revenue. In 1997, for example, in Africa, US settlement payments accounted for more than 80 percent of total telecommunications net incomes.

Since then, however, statistics from the FCC on international payments to foreign carriers indicate that settlement payments from the US have been reduced by more than three quarters. Currently, the average settlement rate paid by US carriers is only $1/15^{th}$ of what it was in 1998.This trend of falling settlement payments and the resulting decline in revenues has given rise to concerns regarding telecommunications infrastructure investment in developing countries. To some extent, revenue earned through settlement payments were used by many developing countries to fund universal service initiatives aimed at expanding telecommunications access.

Nevertheless, the correlation between revenues earned from settlement payments and telecommunications development has been put into question by a number of studies. With the introduction of its 1997 benchmark policy, the International Bureau of the FCC conducted a study to determine the impact of international settlement on telecommunications network build out in a number of countries. The study concluded that there was not a statistically significant relationship between the two elements.[21]

Taken as a whole, the benefits realized from maintaining the accounting rate system are likely to be outweighed by the monopoly regulation required to enforce this system. In the 2006 OECD paper on Internet Traffic Exchange: Market Developments and Measurement of Growth, the examples of Bangladesh, Sri Lanka and Nigeria were highlighted. These countries experienced decreasing settlements payments at the same time as unprecedented growth in access to telecommunication services, largely as the result of sector liberalization and competition.[22] For example, between 1995 and 2004, Sri Lanka's teledensity (fixed plus mobile) increased from 1.4 per 100 inhabitants to 16.6 per 100 inhabitants following the introduction of competition in fixed services in 1996 and the licensing of four cellular providers during the same period. Sri Lanka's growth also coincided with declining net settlement payments. Net incoming settlement payments from the United States fell from USD 42 per subscriber line in 1996 to USD 4 per subscriber line in 2003.

Despite the global decline in settlement rates, a number of developing countries still manage to continue to charge high rates through tight control of the international gateway. Although the decline in settlement payments can be slowed, this course of action carries significant risks in terms of the long term development of the telecommunications market in these countries. International call rates for end users in these markets typically remain high, as do internet prices.

In many developed country markets, increased demand for internet access through dial-up and broadband have generally supplanted operator revenues previously earned from settlement payments and high international call rates. While this success story has been duplicated by many developing countries, as the examples of some Asian and Eastern European countries have shown, this has largely not been the case in the least developed countries (LDCs). In these countries the cost of internet access remains prohibitively high due to a combination of factors ranging from the high cost of international internet connectivity to the lack of competition in the sector. As a result, usage volumes typically remain low, preventing operators from generating significant amounts of revenue from such services. In such cases, however, the answer does not lie in maintaining subsidies through settlement payments, which perpetuate market inefficiencies, but in the

development of alternative sources of revenue, such as internet access, by making ICT services more affordable and available.

Admittedly, LDCs face substantial hurdles in pursuing such a path, the high cost of international internet connectivity being one such obstacle. Nevertheless, domestic reform efforts and international support in terms of funding and expertise will reap greater returns by concentrating on removing these obstacles instead of focusing on maintaining an accounting rate system that was not conceived as a development tool.

3.2 ICT Development and International Internet Connectivity

Nearly every country today is experiencing rapidly growing demand for Internet connectivity, with ISPs offering faster local connections and users requiring greater volumes and more bandwidth-intensive types of Internet services. This growth places ever-increasing burdens on the transmission capabilities of developing country ISPs, which must struggle to upgrade obsolete equipment and secure greater amounts of international internet bandwidth to keep pace. In many cases, ISPs in developing countries use their transmission lines at 100% of capacity, resulting in dropped transmission of packets of data and a resulting compounded latency for completing Internet transactions.

Although the average price for international internet bandwidth has fallen dramatically over the past few years, a number of developing countries still labor under bandwidth costs that can be up to 100 times higher than in developed countries.[23] In most developing countries, studies indicate that around 20 to 35 percent of costs ISPs incur come from international internet connectivity. This percentage is usually far higher for LDCs and small island and landlocked states.[24]

Developing countries typically suffer from a combination of institutional and structural factors that lead to high bandwidth costs. These typically include low income levels that limit investment in ICT infrastructure, small markets that preclude economies of scale and lower unit costs, geographical isolation that entails the use of expensive satellite connectivity and monopolistic ICT markets that prevent competitive pressures from reducing costs. These factors are often exacerbated by poor traffic routing that often entails unnecessary international segments, such as the transiting of emails from the user of one ISP in the country via developed countries to send an email to the user of another ISP in the same country.[25]

In response, a wide range of international, regional and domestic measures have been deployed in recent years to meet these challenges. These range from domestic reforms that encourage competition to international efforts to support infrastructure expansion.

3.2.1 *Expanding International Internet Infrastructure*

Ensuring the availability of abundant international capacity is usually a good starting point in the pursuit of lower costs for international internet connectivity. In this respect, fiber optic cables have been long regarded as the medium of choice for routes that transport significant amounts of traffic. In general, countries that connect directly to international fiber optic cable routes tend to enjoy lower access prices as opposed to countries still reliant on satellite links for international connectivity. (See Box 6)

In its “Halfway Proposition” the African ISP Association (AfrISPA) also warns that while satellite communications in general and VSAT in particular have been promoted as a viable means of obtaining international internet connectivity, the cost of satellite capacity remains significantly higher than that of fiber optic cables. It also adds that “another danger also lies in the fact that when VSAT operators take traffic directly from end users in Africa to an International Backbone Provider’s (IBP) network they are actually "de-aggregating" traffic and compounding the problem”.[26]

Unsurprisingly, the number of undersea cables and the amount of capacity that has been added since the early 1990s has increased markedly on a global basis. Although growth has been concentrated on East-West routes in the Northern Hemisphere across the Atlantic and Pacific, high capacity cables have also been increasingly deployed along North-South routes like the SAT-3/WASC cable that connects the countries along the West Coast of Africa. Currently, deployment of the East African Submarine Cable System (EASsy), which will connect countries along the East Coat of Africa, is underway, filling in a large gap in the global undersea cable network.

Box 6: From Satellite to Cable in Nepal

According to announcements by Nepal Telecom (NT), the cost of internet access for end-users in Nepal is expected to drop by as much as 65 percent in 2007.

This saving has been attributed to the availability of cheaper international bandwidth made available through the East-West optical fibre link operated by the state owned Indian telecom company, BSNL. At the end of 2006, BSNL agreed to supply NT symmetric bandwidth as a cost of USD1800 per Mbps compared to the USD7400 being charged by international vendors that use satellite to make the transfer. NT will procure symmetric bandwidth of 8 mbps in the initial phase using optical fibre links at Biratnagar and Birgunj, which will later be increased to 155 Mbps.

Currently, the monthly price of a 64 Kbps leased line from NT is fixed at NPR18 000, while the monthly price of unlimited and dedicated internet access of 128 Kbps through ISDN dialup is fixed at NPR13600. These prices are expected to go down to as low as NPR6 000 and NPR4 500 respectively.

Source: eKantipur.com available at http://www.kantipuronline.com/kolnews.php?nid=93747

As demand for internet access increases and as ICT markets in larger developing countries grow, more developing countries have started to invest more in expanding their international internet connectivity. Indian telecommunications operators, in particular, have been particularly active in purchasing and building international internet infrastructure. Cable projects that have been bought, commissioned or constructed include SEA-ME-WE-4, which links countries from South East Asia all the way through to Western Europe, SAFE, which connects South Africa, Reunion, Mauritius, India and Malaysia, the Tata Indicom Cable which links the Indian city of Chennai to Singapore and the Bharat Lanka Cable which connects Sri Lanka to India. In December 2006, Reliance Communications announced that it would build the world's largest IP submarine cable network. Dubbed the FLAG Next Generation Network (NGN), the system would ultimately cover 60 countries and span over 115,000 km by December 2009.[27]

This proliferation has not been confined to developing countries in Asia. Kenya, a country that currently has no direct connections to international fibre optic links, is suddenly poised to reap the benefits of three. By November 2007, construction is expected to be completed on the East African Marine System (Teams) project, a fibre link from Mombasa to Fujairah in the UAE in which the Kenya Government will have a 40 per cent holding. At around the same time, Kenya Data Networks (KDN) has entered into a contract with Flag Telecom to construct a fibre optic link that would connect Mombasa, Nairobi and Busia in Kenya to an undersea junction in the waters of Yemen. KDN expects it to be operational in the first quarter of 2008. Telkom Kenya and KDN are also members of the EASsy consortium that, although dogged by controversy, is nevertheless still expected to become operational sometime in 2008.

Despite the growing appeal of high-capacity undersea cable projects, governments and operators in developing countries have to consider the commercial and political challenges that often accompany such projects. For example, despite the obvious need for the EASsy undersea cable, disputes over pricing, access and governance has led to extended delays in its deployment and increasing doubts as to its eventual utility as a tool to reduce the cost of international internet access in that part of Africa. (See Box 7)

Despite the difficulties it faces, the EASsy project will nevertheless serve as a reference point for cable system projects that involve multiple stakeholders: governments, operators and development funding institutions (DFIs). Given the significant costs involved in deploying such infrastructure, it may be worthwhile to examine the use of similar models to overcome investment hurdles in other developing countries, especially small island or landlocked LDCs, that still reply on expensive satellite links for international internet connectivity.

Box 7: Not so EASsy

The EASSy project was first proposed at the first East African Business Summit convened in Nairobi in November 2002. As the East African region was exclusively reliant on satellite links for communications, it was felt that the construction of a 9 900 km fibre optic system linking Mtunzini in South Africa to Port Sudan in Sudan was necessary to improve connectivity. Landing points would be located at Mtunzini (South Africa), Maputo (Mozambique), Toliary (Madagascar), Dar es Salaam (Tanzania), Mombasa (Kenya), Mogadishu (Somalia), Djibouti (Republic of Djibouti) and Port Sudan (Sudan). It was envisaged in 2002 that EASSy would cost USD 300 million and would be completed by June 2005. A number of difficulties, however, caused significant delays in the projects implementation.

Negotiations have been complicated with three sets of parties involved: the EASSy Consortium members, who are mainly incumbent operators, development funding institutions (DFIs), such as the World Bank, and the Governments of the countries affected. Debate has focused largely on the access model upon which the cable system would be used. It has been the view of the World Bank, as well as some government stakeholders, that EASSy would deliver better value to its users if it was built and run along the Open Access model, whereby non-investors in the system would be able to access capacity at rates comparable to those which investors in the system pay. EASsy Consortium members, however, exhibited a distinct preference for ownership and control over the cable system to remain closed to them, allowing them to charge those that wish to access it a cost-plus-premium fee.

While there is now broad agreement over the use of an Open Access model, the details of its application are still being discussed. In addition, issues of pricing, participation and governance still remain. In the area of pricing, the high level of debt necessary for the financing of the cable system has led to concerns that eventual prices for access are likely to be high with a higher than expected range of USD 1,500-USD 1,700 per Mbps likely. On governance, there is also some confusion over the question of who will be represented on the board of EASsy's Special Projects Vehicle (SPV). Suspicion still remains in the private sector that governments will get involved in what was essentially supposed to be a commercially run and private sector led initiative.

Source: Balancing Act available at http://www.balancingact-africa.com

At this point, may be useful to recall the role the International Telecommunications Satellite Consortium (INTELSAT) played in the growth of global communications in the 1960s and 1970s.[28] Formed in 1964 by governments and operators, it assures telecommunications connectivity for all countries across the globe until the present (currently through the International Telecommunications Satellite Organisation (ITSO)). While there may not be the need for such an initiative now given the resources available to the private sector to deploy fiber optic cables, there may nevertheless still be scope for the organization to provide development-funding assistance targeted particularly at supporting infrastructure deployment for small island or landlocked LDCs either through informal cooperation between DFIs or even through a global connectivity fund specially set up for the purpose.

3.2.2 *The Role of Sector Reform*

The problems afflicting developing economies have been the subject of research in a number of ITU Internet Case Studies.[29] In most cases, the lack of competition in domestic ICT markets often makes it difficult for developing countries to benefit fully from the drop in prices and increase in capacity in the global market for international internet connectivity. For many African countries, for example, the international gateway and international leased line services remain in the hands of monopolies with no competition on rates, while a lack of trust between ISPs had resulted in a shortfall of national and regional IXPs. Consequently, prices remain artificially high.

The availability of capacity between countries can translate into cheaper prices only where there is effective competition for the provision of access to those facilities. Case examples highlighted by the OECD (2006) illustrate this point. A fiber optic SAFE cable provides transmission capacity between South Africa and Mauritius, however, at the end of 2004 a 1 Mbps connection to Europe cost an ISP in Mauritius USD 5,000 per month with global transit included in this price. To purchase the same amount of capacity between

Mauritius and South Africa, at the same date, with no peering or transit included, cost USD 11,500 per month. As a result, because of such monopolistic pricing practices the two geographical neighbors, benefiting from a state of the art fiber optic cable operating between them, continue to exchange internet traffic via North America and Europe.

The failure of the SAT-3/WASC cable to lead to competitive pricing because of monopolistic pricing has also been stark. Even though the high capacity fiber optic cable connects Senegal, Cote d'Ivoire, Ghana, Benin, Nigeria, Cameroon, Gabon, Angola and South Africa, in all these countries for which trace routes were available, ISPs exchanged traffic via Europe or North America and in some cases both of these continents.

In such cases, international capacity is typically owned or controlled by the incumbent, either through regulations or business practices that restrict competition. For example, the incumbent operators that belong to the SAT3/SAFE consortium have monopoly access to that capacity. Although the first phase of the fiber cable in connection with SAT3/WASC project was completed in 2002, the investors in that cable enjoy a legal monopoly over it until June 2007.

Ultimately, the price reductions that can be passed on to the domestic market depend on the level of competition. Members of a cable consortium may sign non-compete clauses preventing them from offering access to the cable facility at competitive rates while local ISPs may still be forced to buy international leased circuits and international internet connectivity from the incumbent at prices far above cost.

Experience shows that the liberalization of the international facilities market has resulted in competitive prices for international connectivity in many developed and developing countries.[30] This eventually results in increased competition, greater infrastructure investment and lower end-user prices. For example, in India, liberalization in the international facilities market has led to an expansion of international connectivity and a corresponding decrease in prices. There the average cost of international capacity on various routes fell between 60 percent to 90 percent, depending on capacity purchased, in the period between 2000 and 2005. As was highlighted in the preceding section, international capacity to India also expanded sharply following liberalization. This has enabled India to strengthen its position in the provision of call centers and other back office services.

In countries where satellite links play a large role in providing international internet connectivity, the liberalization of VSAT markets and the lowering of licensing requirements, especially licensing fees, can also reduce the high costs of accessing international internet connectivity. In Nepal, for example, prices dropped to the lowest in the region when the country liberalized its VSAT market in 2000.

Apart from competition in terms of access to international facilities, it is also necessary for regulators in developing countries to ensure that there is a competitive environment in the rest of the domestic ICT market. As was noted above, the cost of international capacity is only one component of the costs that make up end-user prices. Telecommunications access costs and ISP costs usually account for a far greater share of end-user prices. These can typically be lowered by facilitating increased competition in the domestic internet access segment of the market.

Licensing requirements for ISPs can be lowered or simplified to allow easier entry into the market. Countries requiring formal regulatory approval for ISPs tend to have fewer Internet users and hosts than countries that do not require such approval.[31] At the same time spectrum management policies can be re-tooled to foster the use of new wireless technologies that decrease the cost of infrastructure deployment. Regulators also need to pay particular attention to interconnection and interconnection related issues, such as unbundling and the market for domestic leased-lines. In order for effective competition to be established, new entrants also need to interconnect with the incumbent's network quickly at cost-oriented prices. In the migration to NGN networks, issues such as quality of service and non-discriminatory access to content become increasingly important.

3.2.3 *Facilitating Regional Traffic Aggregation and Exchange*

In negotiations involving the purchase of transit for international internet connectivity, lower prices and better conditions are usually available to ISPs who purchase capacity in large volumes. ISPs in developing countries typically generate low amounts of traffic, precluding them from such opportunities as well as from possibilities for peering. In the absence of local and regional infrastructure for the exchange of internet

traffic, developing country ISPs often have to pay for international transit to deliver local and regional traffic, an effect described as “tromboning”. As a result additional costs are incurred and transmission latency is increased.

3.2.3.1 The role of IXPs

The development of regional and local Internet Exchange Points (IXPs) has been strongly advocated as a good way to aggregate traffic and facilitates traffic exchange in order to reduce international internet connectivity costs and bring about service improvement.

An IXP is a shared switching facility that allows ISPs to exchange internet traffic with each other. It uses a centralized hub and spoke network typology that allows ISPs to hand off traffic directly to other connecting ISPs, and to aggregate traffic for long haul transmission. IXPs also offer traffic switching and routing flexibility allowing IXPs to manage traffic more efficiently. For example, for African ISPs “tromboning” adds 200 to 900 milliseconds to each transmission. This degree of latency is a major obstacle to the introduction of new services such as VoIP, IPTV, streaming audio and video, video-conferencing, telemedicine and teleeducation. With a local IXP in place, adjacent ISPs can route traffic to each other’s networks in 5 to 20 milliseconds. IXPs also allow outbound traffic to be aggregated at the regional level. This lowers the ratio of outbound traffic to inbound traffic allowing developing country ISPs to negotiate for better rates for international transit or to even negotiate for peering. Given sufficient traffic aggregation, Internet Backbone Providers (IBPs) may be drawn to establish points of presence at such regional traffic aggregation points. This improves the quality of international connectivity and shifts a greater burden of international transit costs to the IBPs.

In the 1990s, ISPs in countries in Asia faced high costs for international internet connectivity from high transit charges exacerbated by “tromboning” via the US. Towards the end of the millennium, Asian ISPs started to establish local and regional IXPs to facilitate peering. As much of the traffic was local in many Asian countries, largely due to language reasons, local peering resulted in an increase in international connectivity quality and a lowering of prices. In the process, IBPs realised that in order to maintain similar levels of quality and compete for business, they had to establish points-of-presence at local or regional peering points in Asia, lowering costs even further for Asian ISPs.

The benefits of local and regional traffic aggregation and exchange have been similarly recognized by African ISPs in their “Halfway Proposition”. The Halfway Proposition is a strategy that borrows from the experience of Asia and adapts it into a realistic strategy for Africa. It aims to “articulate the root causes of high connectivity costs in Africa and to map out a strategy of how to tackle the problem”. (See Box 8)

3.2.3.2 Challenges Faced by IXPs

While the benefits of local and regional traffic aggregation and exchange are clear, there are nevertheless significant obstacles that stand in the way of establishing and operating IXPs in developing countries.

Most of the effort in establishing an IXP is in building the necessary support. It requires extensive coordination between different stakeholders which usually include the incumbent operator, other ISPs and the regulator.[32]

There is often strong resistance to IXPs on the part of monopoly or incumbent operators. They often view IXPs as a threat to their market dominance and as an avenue through which competing services such as VoIP can be introduced. From the experience of establishing IXPs in developed countries, incumbents typically oppose the establishment of IXPs by controlling basic telecommunications infrastructure in such a way that independent ISPs are unable to compete. For example monopolistic ownership arrangements surrounding the present SAT-3/WASC cable prevents cost effective access to an IXP. As a result, instead of using fibre optic cables, where available, AfrISPA members use satellite networks to provide some direct connectivity between African IXPs.[33]

Box 8: The Halfway Proposition

In October 2002, the African Internet Service Providers Association (AfrISPA) presented its "Halfway Proposition" to the Conference of African Ministers of Finance, Planning and Economic Development that was held in Johannesburg, South Africa.

The Proposition notes that the current burden of international Internet connectivity is unfairly placed on countries in Africa and that the existence of reverse subsidies amounting between USD 250 and 500 million per year is the single largest factor contributing to high bandwidth costs.

Instead of pursuing an accounting rate solution to the problem, the Proposition advocates a self-help, private-sector led strategy. This strategy is driven by two underlying philosophies that focus on the aggregation of traffic within Africa and the creation of "Digital Arteries" that would carry traffic more efficiently both regionally and internationally. As part of the strategy, the Proposition argues for the creation of national and regional IXPs and the deployment of high capacity Fibre Optic Digital cables in and out of the continent

The Proposition also identifies the necessary partners and their roles in the implementation of the strategy. ISPs in AfrISPA would cooperate in establishing National IXPs, African governments and regulators would ensure the removal of regulatory obstacles, and organisations like the New Partnership for Africa's Development (NEPAD), the African Telecommunications Union and the African Union would promote the need for regulators and policy makers to pursue policies that will facilitate the objectives of the Halfway Proposition. Finally, G8 donor governments were called on to provide grant funding in support of the proposition.

Source: AfrISPA available at http://www.afrispa.org/Initiatives.htm

Official governmental and regulatory support for the establishment of IXPs is an important prerequisite to success. However, in the initial phases of telecommunications development, governments or regulators in developing countries often side with the monopoly or incumbent operator. Developing countries are often so heavily dependent on revenues from the monopoly or incumbent operator that they are often reluctant to sanction activities which might erode revenues and threaten telecommunications development goals. Often, unfamiliarity with the technical and economic aspects of IXPs also causes regulators in developing countries to take a slow and cautious approach to their establishment. (See Box 9)

In some cases, there can also be resistance from the competitive ISPs themselves. Established ISPs secure in their market position usually fear the effects of making connectivity cheaper for their competitors. As such, competing ISPs must be made to understand that an IXP will not tilt the competitive playing field in favor certain ISPs. In addition, ISPs in adjacent countries must be made to understand the value of routing their traffic to the IXP, rather than attempting to develop their own facility.

Success in establishing an IXP, however, is no guarantee of operational success. Challenges faced in establishing an IXP often continue far into the future. Monopolistic practices of incumbent operators often frustrate cost-effective connection to IXPs while ISPs in competition with each other often lack sufficient trust to cooperate effectively. The OECD (2006) report highlights the plight of India where although four IXPs exist, they are underutilized for a number of reasons.[34] In mid-2005, about 30 of India's approximately 180 ISPs connected to the IXPs. Some Indian ISPs still exchange traffic on the West Coast of the US via IBPs despite the availability of domestic IXPs. The lack of trust and cooperation among competitors has been highlighted as a particular stumbling block to the use of IXPs in India. In India, ISPs operating at multiple locations across the country refrain from announcing all their routes as they believe others may enjoy a "free ride" on their backbone. At the same time, access to domestic leased lines is expensive for small ISPs when compared to transit. Without direct connections to the IXPs two relatively small ISPs, who are customers of the same upstream provider, may not be permitted to peer.

Box 9: Establishing an IXP in Kenya

The experience of the Kenyan ISPs in attempting to organize and launch an IXP provides a good example of the practical barriers that confront the establishment of IXPs in Africa.

Prior to Kenya's, there was no IXP on the African continent outside South Africa. In early 2000, TESPOK, the association of Kenya's competitive ISPs began to organize a neutral, non-profit IXP for its members. After nearly a year of preparatory work the KIXP, located in Nairobi, was launched in late November 2000.

Fearing the loss of a significant portion of its international leased-line revenue, Telkom Kenya filed a complaint with the Communications Commission of Kenya (CCK) arguing that the KIXP violated its exclusive monopoly on the carriage of international traffic. Within two weeks, the CCK concluded that the KIXP required a license, and ordered that it be shut down as an illegal telecommunications facility. In response to the CCK's closure order, the Kenyan ISPs argued that the KIXP was a closed user group, and therefore would be legal under the Kenyan Telecommunications Act. Also, they noted that the local exchange of domestic Internet traffic does not contravene Telkom Kenya's international monopoly, as all international traffic would continue to flow over its international links.

After nearly a year of intensive efforts, including public pressure, threats of litigation, and private diplomacy, TESPOK finally received the approval of CCK in the form of a license, granted in November 2001. The CCK's licensing order represented a turn-around in its thinking, stating: "An IXP is not an international gateway but a peering facility that enables ISPs to exchange local traffic. The Internet is expanding very fast and since Telkom Kenya has demonstrated that it has some apparently insurmountable difficulty in rolling out Internet facilities, it would be in the best interest of the market to allow other companies to offer IXP services in the country." In February 2002, TESPOK re-launched KIXP.

Source: Andrew McLaughlin, “Internet Exchange Points Their Importance to Development of the Internet and Strategies for their Deployment – The African Example”, May 2004, Global Internet Policy Initiative

As the history of IXPs in developed countries illustrate, many of these challenges can be eventually overcome by improving facilities based competition. Nevertheless, to overcome ISP mistrust and suspicion, IXPs will need to continue to dedicate sufficient resources to outreach and promotion in order to educate competing ISPs as to the benefits of traffic aggregation and exchange.

4 Conclusion

For some time, developing countries have found themselves to be caught in the middle of two trends: the decline of the accounting rate system and the growth in demand for international internet connectivity. Although these trends were established long before NGNs were discussed, the ongoing transition to NGN networks is likely to accelerate the effects felt by developing countries as a result of these trends.

While the decline of the accounting rate system appears unstoppable, development concerns over its demise can be addressed by increased international support and concerted domestic sector reform aimed directly at making access to ICT services more affordable and available. A large part of this effort must be directed at lowering the high cost of international internet connectivity faced by many developing countries.

In order to ensure affordable international internet connectivity prices for developing countries, ongoing international efforts to ensure a competitive international market for internet connectivity must continue. At the same time, local and regional traffic aggregation and exchange initiatives require continued multi-stakeholder support. More importantly, domestic sector reform efforts have to ensure that bottlenecks do not arise from monopolistic practices in the local market.

However, in some developing countries, particularly small island and landlocked ones, domestic and regional efforts alone are often insufficient to overcome structural problems related to geography and market size. In such situations, the international donor community has an important role to play in complementing sector reform efforts by providing funding support for infrastructure and capacity building projects. Only

through such a multi-pronged holistic approach can development issues related to international interconnection be successfully addressed.

[1] More information describing the international Accounting Rate System is available on the ICT Regulation Toolkit at http://www.ictregulationtoolkit.org/en/Section.2145.html

[2] Available at http://www.itu.int/ITU-T/itr/ and http://www.itu.int/pub/R-REC/en

[3] An SDR is a value based on a basket of key international currencies. See http://www.imf.org/external/np/exr/facts/sdr.htm

[4] See, for example, Arbinet at http://www.arbinet.com/

[5] See Report of the meeting of Working Party 2/3 (Geneva, 19-27 June 2006) available at http://www.itu.int/ITU-T/studygroups/com03/index.asp

[6] The history of accounting rate system reform at the ITU is available at http://www.itu.int/ITU-T/studygroups/com03/accounting-rate/index.html

[7] See for example Global Crossing and Stealth VPF announced at http://www.voip-news.com/news/global-crossing-voip-peering-102306/

[8] Best effort refers to a network service that attempts to deliver messages to their intended destinations but which does not provide any special features that retransmit corrupted or lost packets. Thus, there are no guarantees regarding delivery.

[9] For more information on the net neutrality debate in the US, see http://news.com.com/2009-1028_3-6055133.html

[10] For more information see http://www.savetheinternet.com/

[11] See Total Telecom Via Thomson Dialog News Edge, No Signal, Sep 2006, available at http://voipservices.tmcnet.com/news/2006/09/01/101500.htm

[12] See, for example, http://www.isoc.org/internet/history/brief.shtml for a brief history of the Internet.

[13] Tier 2 ISPs have networks with a limited geographical coverage. They buy capacity from Tier 1 ISPs to carry traffic outside their network coverage area.

[14] "Multihoming" refers to a computer host that has multiple IP addresses that are connected to different networks. Addresses with different prefixes can be used to force traffic to be routed through different providers.

[15] Global Internet Geography 2007 available at http://www.telegeography.com

[16] John Hibbard, John de Ridder , Dr George R. Barker and Professor Rob Frieden, "International Internet Connectivity and its Impact on Australia, Final Report on an Investigation for the Department of Communication Information Technology and the Arts", May 2004, Canberra, Australia

[17] US v. WorldCom and Sprint Corp. available at http://www.usdoj.gov/atr/cases/f5000/5051.htm

[18] SG 3 has established two closely-linked Rapporteur's Groups to study this area in depth. Firstly, SG 3 has established the Internet Traffic Flow Multi Factors Rapporteur's Group ("TFMF"). The TFMF Group is studying the aspects of Traffic Flow Methodology inclusive of Multiple Factors that come into play when such analysis is performed. Closely linked with the work of the TFMF group is the second Rapporteur's Group addressing this area of World Access and the Internet. Study Group 3 currently has the continuation of the original Rapporteur's Group on International Internet Connectivity ("IIC"). The IIC Group is now tasked to conduct further studies on the relevant technical and economic developments. ITU-T regional tariff groups (Africa, Asia and Oceania, Latin America and the Caribbean regions) are also deeply involved in the study of International Internet Connectivity

[19] See paragraphs 9 j) and k of the WSIS Plan of Action available at http://www.itu.int/wsis

[20] In Greek mythology, Charybdis was a sea monster, taking the form of a monstrous mouth. She lies on one side of a narrow channel of water. On the other side of the strait was Scylla, another sea-monster. Sailors attempting to avoid Charybdis will pass too close to Scylla and vice versa. The phrase *between Scylla and Charybdis* has come to mean being in a state where one is between two dangers and moving away from one will cause you to be in danger of the other.

[21] Cowhey P., FCC benchmarks and the reform of the international telecommunications market, Dec 1998, Telecommunications Policy Volume 22, Number 11.

[22] Paltridge S., Internet Traffic Exchange: Market Developments and Measurement Of Growth, OECD, Apr 2006, available at http://www.oecd.org/dataoecd/25/54/36462170.pdf

[23] International Development Research Center of Canada (IDRC), Open and Closed Skies: Satellite Access in Africa, 2004, available at http://www.gvf.org/database/regulatoryDB/africaskiesindex.cfm

[24] Antelope Consulting, DFID Internet Costs Study. The Costs of Internet Access in Developing Countries: Overview Report, 2001, available at http://www.antelope.org.uk/internet_costs.htm#internet_costs

[25] See, for example, ITU-IDRC Via Africa, creating local and regional IXPs to save money and bandwidth, 2004 at *http://www.itu.int/ITU-D/treg/publications/AfricaIXPRep.pdf*

[26] AfrISPA, "Halfway Proposition" available at http://www.afrispa.org/Initiatives.htm

[27] For more information, see http://www.flagtelecom.com/index.cfm?channel=4328&NewsID=27318

[28] See http://ww2.intelsat.com/aboutus/index.aspx for more information.

[29] See http://www.itu.int/ITU-D/ict/cs/

[30] See, for example, OECD, Internet Traffic Exchange and the Development of End to End International Telecommunication Competition, March 2002 available at http://www.oecd.org/dataoecd/47/20/2074136.pdf

[31] See ITU Trends in Telecommunication 2004: Licensing in the Era of Convergence

[32] Supra Note 25.

[33] AfriISPA, .Africa Online and Transtel Selected as Regional Carriers by AfrISPA., Press release, 7 April 2005 available at http://www.afrispa.org/NewsDetail.asp?ItemID=9

[34] Supra note 22.