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TITLE: CHALLENGES TO THE NETWORK - INTERNET FOR DEVELOPMENT

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Abstract:

This document contains the executive summary of the above-mentioned publication (Geneva, 1999), as well as the glossary, list of abbreviations and acronyms and data notes.

Delegates interested to read the entire publication may obtain this at the bookshop located in the entrance hall of the ITU Tower (article 13610, also available online).

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Contact point: Timothy Kelly, Strategic Planning and External Affairs Unit (General Secretariat)

GLOSSARY[1]

Bandwidth The rate, measured usually in bits per second, at which data can be carried through a transmission circuit.

Bandwidth on Demand

Capability of an end user or network device to access available network capacity at a rate as required by the application being utilised for a specified period.

Banner A banner is most often used as an advertising image that usually spreads across the width of the Web page. Advertisers sometimes count banner "views", or the number of times a banner graphic image is downloaded over a period of time.

Best Effort The service model for standard Internet service. In the face of congestion of a network interface, packets are discarded without regard to user or application until traffic is reduced.

Bit ("Binary Digit")

A bit is the primary unit of electronic, digital data. Written in base-2, binary language as a "1" or a "0".

Byte (1) A set of bits that represent a single character. A byte is composed of 8 bits.

(2) A bit string that is operated upon as a unit and the size of which is independent of redundancy or framing techniques.

Cache A local temporary store of information.

Certificate Authority (CA)

A trusted third-party organisation or company that issues digital certificates used to create digital signatures and public-private key pairs. The role of the CA in this process is to guarantee that the individual granted the unique certificate is, in fact, who he or she claims to be. CAs are a critical component in data security and electronic commerce because they guarantee the identities of parties exchanging information.

Circuit Switched Connection

A temporary connection that is established on request between two or more stations in order to allow the exclusive use of that connection until it is released.

Connectivity The capability to provide, to end users, connections to the Internet or other communications networks.

Cookie A mechanism for a Web server to store and retrieve information from a client (browser). The cookie is generated by the server and sent to the client. When it is accepted, the next time the client connects to the service, the client's computer automatically sends this information back to the server.

Digital certificate (also, digital signature)

An attachment to an electronic message used for security purposes. The most common use of a digital certificate is to verify that a user sending a message is who he or she claims to be, and to provide the receiver with the means to encode a reply.

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[1] The main sources of terms listed in this Glossary are the Internet Rapporteur's Group established by ITU-T Study Group 3 (see document COM3-D73) and PC Webopaedia at <http://webopedia.internet.com>. However, other terms have been added to facilitate comprehension of the way in which they are used in the text.

Domain Name The registered name of an individual or organisation eligible to use the Internet. Domain names have at least two parts and each part is separated by a dot. The name to the left of the dot is unique for each top-level domain name, which is the name that appears to the right of the dot. For instance, the International Telecommunication Union's domain name is itu.int. "ITU" is a unique name within the gTLD "int".

Domain Name System (DNS)

Databases located throughout the Internet that contain Internet naming information, including tables that cross reference domain names with their underlying IP numbers. When an end user enters a domain name, the network converts the domain name of its destination into the corresponding IP number, and the IP number is used for routing purposes.

Electronic Data Interchange (EDI)

Electronic Data Interchange (EDI) is the computer-to-computer exchange of business documents between companies, using a public standard format. Rather than preparing paper and sending it through the mail, or using other communications methods such as fax, EDI users exchange business data directly between their respective computer systems.

Encryption The translation of data into a secret code. Encryption is the most effective way to achieve data security. To read an encrypted file, one must have access to a secret key or password that enables it to be decrypted.

End user The individual or organisation that originates or is the final recipient of information carried via the Internet (i.e., the consumer).

Exchange point Points within a network at which IP packets are exchanged between ISPs.

Extranet An extranet is an intranet that is partially accessible to authorised outsiders, through the use of passwords.

Gateway Any mechanism for providing access to another network. This function may or may not include protocol conversion.

Half-Circuit A component of an international circuit that originates or terminates between countries and terminates or originates at a theoretical midpoint between countries.

Host Any computer that can function as the beginning and end point of data transfers. Each Internet host has a unique Internet address (IP address) associated with a domain name.

Internet The collection of interconnected networks that use the Internet protocols (IP).

Internet Backbone

The high-speed, high capacity lines or series of connections that form a major pathway and carry aggregated traffic within the Internet.

Internet Content Provider

A person or organisation, that provides information via the Internet either with a price or free of charge.

Internet Service Provider (ISP)

ISPs provide end users, and other ISPs, access to the Internet. ISPs may also offer their own proprietary content and access to online services such as e-mail.

Intranet An intranet is a network, based on TCP/IP protocols, accessible only by the organisation's employees, or other authorised users. Intranet websites are similar to other websites, but are surrounded by firewalls that prevent unauthorised access.

IP numbers An IP number (also referred to as Internet address number) are the addresses of hosts or other intelligent devices on the Internet. All servers and users connected to the Internet have an IP number.

Leased line A leased line is the transmission capacity reserved for the exclusive use of a customer. It is also referred to as a dedicated or private line.

Local Area Network (LAN)

A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

Mirror site A host which duplicates the contents of another host in the same or another network.

Network Access Point (NAP)

(1) Point at which the dedicated Internet backbone lines are reached.

(2) A point at which ISPs connect with one another. NAPs serve as data interchange points for backbone service providers. NAPs and Metropolitan Area Exchanges (MAEs) are generally spoken of at the beginning of 1999 as public Internet exchange points (IXPs).

Node A designation of one of the basic concepts of SDL. A switching node is a point at which switching occurs.

Online Service Provider (OSP)

A company that provides customer-only content to subscribers of their service. Most OSPs now offer Internet access, but their main feature is the privately maintained network that is only accessible to their customers. This network is not part of the Internet, although some OSPs are currently making some content available on the Web.

Online Service and Software Companies

Companies which operate Internet sites whose principal function is to provide services in electronic form, including transactions with third parties, sales and support for its products and software which can be down loaded by end users for a fee or without charge.

Packet An information block identified by a label at layer 3 of the OSI reference model.

Packet-Switching

The function of handling, routing, supervising and controlling user packet data, as required, by an exchange.

Peering The exchange of routing announcements between two Internet Service Providers for the purpose of ensuring that traffic from the first can reach customers of the second, and vice-versa. Peering takes place predominantly at IXPs and usually is offered either without charge or subject to mutually agreed commercial arrangements.

Point of Presence (PoP)

A Point of Presence is a node offering users dial-up access to the Internet via a specific telephone number. The greater the number of Points of Presence, the higher the likelihood that they users can connect using a local telephone call.

Portal Although an evolving concept, the term portal commonly refers to the starting point, or a gateway through which users navigate the Web gaining access to a wide range of resources and services, such as e-mail, forums, search engines, and shopping malls.

Protocol A set of formal rules and specifications describing how to transmit data, especially across a network.

Push and Pull media

Terms which describe alternative modes of operation between Internet Content Providers and Internet users. For pull media, a user typically "pulls down" data from a website, for instance using http. For push media, a Internet Content Provider typically "pushes" data to pre-subscribed users at regular intervals, for instance by e-mail.

Query A message sent by a search engine or database to find a particular file, Website, record, or set of records in a database.

Routing Policy An expression of how an ISP will choose to direct traffic on or off network. For example, ISPs may choose to route traffic with preference to certain paths or through other ISPs depending on the commercial relationships between the parties.

Router Specialised computers that take incoming packets and compare their destination addresses to internal routing tables and, depending on routing policy, send the packets out to the appropriate interface. This process may be repeated many times until the packets reach their intended destination.

Secure Electronic Transaction (SET)

SET (Secure Electronic Transaction) is a protocol used to ensure the security of financial transactions on the Internet. It is supported by Mastercard, Visa, IBM, Microsoft, Netscape, and others. With SET, a user is given an electronic wallet (digital certificate) and a transaction is conducted and verified using a combination of digital certificates and digital signatures among the purchaser, a merchant, and the purchaser's bank in a way that ensures privacy and confidentiality.

Secure Sockets Layer (SSL)

SSL (Secure Sockets Layer) is a programme layer created by Netscape for managing the security of message transmissions in a network. SSL uses a public-and-private key encryption system, which also includes the use of a digital certificate.

Server (1) A host computer on a network that sends stored information in response to requests or queries.

(2) The term server is also used to refer to the software that makes the process of serving information possible.

Telecommunications Facility Provider

An entity that supplies underlying transmission capacity for sale or lease and either uses it to provide services or offers it to others to provide services.

Teletrade Teletrade or teleporting refers to business use of private telecommunications networks and increasingly the Internet to redeploy both high-skill and clerical/accounting jobs to developing countries.

Transmission Control Protocol/Internet Protocol (TCP/IP)

The suite of protocols that defines the Internet and enables information to be transmitted from one network to another.

Throughput The effective transmission rate through the network from one end point to another. A measurement of throughput will necessarily be impacted by the slowest link in the path of transmission as well as current traffic volumes on each of these links on the path from start to the end.

Uniform Resource Locator ("URL")

The standard way to give the address or domain name of any Internet site that is part of the World Wide Web (WWW). The URL indicates both the application protocol and the Internet address e.g.,: <http://www.itu.int>.

Webcasting A group of emerging services that use the Internet to deliver content to users in ways that sometimes closely resemble other traditional communication services such as broadcasting.

Website / Webpage

A website (also known as an Internet site) generally refers to the entire collection of HTML files that are accessible through a domain name. Within a website, a webpage refers to a single HTML file, which when viewed by a browser on the World Wide Web could be several screen dimensions long. A "home page" is the webpage located at the root of an organisations URL.

Whole Circuit A circuit that connects points in different countries where a single entity owns the circuit in its entirety or owns, leases or operates two half-circuits in combination.

World Wide Web (WWW)

(1) Technically refers to the hypertext servers (HTTP servers) which are the servers that allow text, graphics, and sound files to be mixed together.

(2) Loosely refers to all types of resources that can be accessed including: HTTP, Gopher, FTP, Telnet, USENET, and WAIS.

LIST OF ABBREVIATIONS AND ACRONYMS

AOL	America Online
APNIC	Asia-Pacific Network Information Centre
ARIN	American Registry for Internet Numbers
ARPAnet	Advanced Research Projects Agency Network
ATM	Asynchronous Transfer Mode
CAGR	Compound Annual Growth Rate
CD-ROM	Compact Disk - Read-Only Memory
CERN	European Laboratory for Particle Physics
DARPA	(US) Defense Advanced Research Projects Agency
DNS	Domain Name System
EDI	Electronic Data Interchange
E-Mail	Electronic Mail
EU	European Union
FTP	File Transfer Protocol
GNP	Gross National Product
gTLDs	Generic Top Level Domains
http	Hypertext Transport Protocol
IAHC	International Ad Hoc Committee
IANA	Internet Assigned Numbers Authority
ICANN	Internet Corporation for Assigned Names and Numbers
IP	Internet Protocol
ISO	International Standardisation Organisation
ISP	Internet Service Provider
ITU	International Telecommunication Union
IXP	Internet Exchange Point
LAN	Local Area Network
NAP	Network Access Provider
NSF	National Science Foundation
OECD	Organisation for Economic Co-operation and Development
OSI	Open Standards Interconnection
PC	Personal Computer
PICS	Platform for Internet Content Selection
PoP	Point of Presence
PSTN	Public Switched Telephone Network
PTO	Public Telecommunication Operator
RIPE	Réseaux IP Européens
RPC	Remote Procedure Call
RSVP	Resource Reservation Setup Protocol
RTP	Real Time Protocol
SET	Secure Electronic Transaction
SSL	Secure Sockets Layer
TCP/IP	Transmission Control Protocol / Internet Protocol
UDP	User Datagram Protocol

WHO World Health Organisation
WIPO World Intellectual Property Organisation
WTO World Trade Organisation
WWW World Wide Web

DATA NOTES

Country groupings

A number of economic and regional groupings are used in the report. Economic groupings are based on Gross National Product (GNP) per capita classifications used by The World Bank. Economies are classified according to their 1994 GNP per capita in the following groups:

- *Low income* — Economies with a GNP per capita of US$ 725 or less;
- *Lower-middle income* — Economies with a GNP per capita of more than US$ 726 and less than US$ 2'895;
- *Upper-middle income* — Economies with a GNP per capita of more than US$ 2'896 and less than US$ 8'955;
- *High income* — Economies with a GNP per capita of US$ 8'956 or more.

The classification *Major Economies* is also used in the report, and this classification is further divided into:

- The 15 Member States of the *European Union*;
- The 14 *Other Organisation for Economic Cooperation and Development (OECD) Economies*;
- 16 *Major Non-OECD Economies*, which are Argentina, Brazil, Chile, China, Hongkong China, India, Indonesia, Israel, Malaysia, Philippines, Russia, Singapore, South Africa, Taiwan-China, Thailand, and Venezuela.

A number of regional groupings are used in the report. The main regional groupings are *Africa, Asia, Americas, Europe* and *Pacific.* The following sub-regional groupings are also used:

- *Arab States*—Arabic-speaking economies;
- *Asia-Pacific*—the combined economies of Asia and Pacific;
- *Economies in Transition*—Albania, Bosnia, Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovak Republic, Slovenia, The Former Yugoslav Republic of Macedonia and Yugoslavia as well as the former Soviet Union;
- *Latin America and the Caribbean*—Central (including Mexico) and South America and the Caribbean;
- *Least Developed Countries*—the 48 economies recognised by the United Nations General Assembly as being accorded special priority for the purpose of granting assistance;
- *North America* —Canada and the United States;
- *Sub-Saharan Africa*—the countries of the African continent south of the Sahara desert but excluding South Africa.

Data notes

- Billion is one thousand million.
- Dollars are current United States dollars (US$) unless otherwise noted. National currency values have been converted using average annual exchange rates.
- Growth rates are based on current prices unless otherwise noted.
- Thousands are separated by an apostrophe (e.g., 1'000).

- Totals may not always add up due to rounding.
- Numbers shown in italics are estimates.

Additional definitions are provided in the Technical Notes.

EXECUTIVE SUMMARY

The advent of the Internet has been variously described as being as important for society as the development of the personal computer, the telephone or even the printing press. Yet, it is difficult to explain to those that have never used the Internet how it has the power to change lives, to create new businesses or to bring far-flung families closer together. For those who have started to use the Internet, and have gone beyond the initial frustrations associated with using any new technology, the Internet can do all these things and more.

But what can the Internet do for those regions of the world that have traditionally had only limited access to information and communication technologies? In theory, it can widen and enhance access in developing nations because it offers a relatively cheap, versatile and technically efficient service that complements standard telephony. Furthermore, the Internet can allow businesses from developing nations to "leapfrog" into the development mainstream because Internet commerce will allow them to sell their wares and their services directly to customers. The Internet also offers considerable promise in facilitating the delivery of basic services, such as health and education, which are unevenly distributed at present. In this utopian view, the Internet is a way of levelling the playing-field and rendering the traditional disadvantages of the developing world—distance from markets, under-invested basic infrastructure, under-utilised capacity etc.,—less onerous.

But how realistic is this viewpoint? As with other new technologies, the Internet has the potential to support development activities, but, at the same time, it poses serious challenges and threats to pre-existing institutions. Is there, for example, a possible "cost" of the Internet for the public telecommunication operators (PTOs) of developing countries? In situations where resources are limited, are hospitals or schools in developing countries justified in paying for an Internet connection?

This report explores the current and likely impact of Internet development in a number of areas of social and economic concern, such as commerce, health, and education. It also analyses the features that makes the Internet different from existing communication services as well as its current diffusion status around the world. Finally, the report explores the Internet's potential impact on the PTOs of developing countries and highlights some of the regulatory challenges posed by the unique nature of this new and revolutionary technology.

1. What is so special about the Internet?

To address the question of what makes the Internet special, it is useful to consider a closely related question: what makes the Internet different from other telecommunication services, such as those which run over the public switched telephone network (PSTN). There are arguably a number of differences.

Underlying technology*:* Both the Internet and the voice telephone network run over the essentially the same wires but the equipment attached to those wires, and the use made of them is different. On the Internet messages are broken down into digital "packets" of data which means that the wires can be used much more efficiently, to carry a much higher volume of information, at a lower cost.

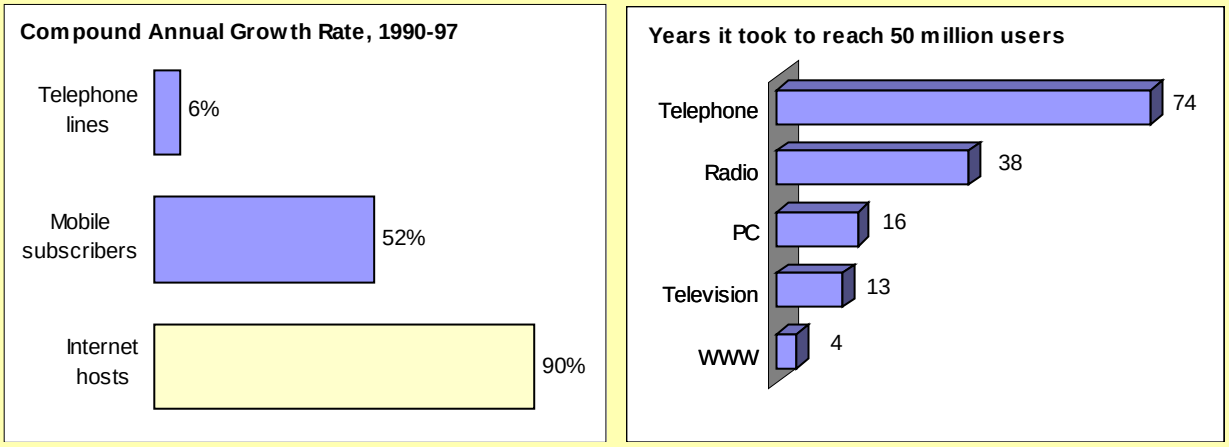
Pricing: The PSTN has traditionally been priced on the basis of usage. By contrast, the dominant pricing principle for the Internet is flat-rate pricing. The model for wholesale pricing differs too. A service provider terminating a particular telephone call receives a fee for doing so. By contrast, on the Internet, there is almost no flow of cash on an end-to-end basis. On the telephone network, developing countries are net recipients of financial flows, but on the Internet they make net outpayments, for carriage of their traffic.

Traffic flows and value flows: In most telephone calls, the traffic flow is approximately even between the caller and the called party. But with web-browsing, the traffic flow is highly asymmetric with the main flow being towards the party which originated the call, who also gains most value from the call.

US-centric: Whether measured by the location of Internet users, websites or the direction of traffic flows, the United States takes the lion's share of the Internet. This is reflected too in the policy-making process in which all major decisions have been, until now, been effectively set by the United States.

Pace of diffusion: While it took the telephone close to 75 years to reach 50 million users, it has taken the World Wide Web (WWW) only four years to reach the same number (see Figure 1). On the supply side of the equation the number of international carriers grew to more than 1'000 in 1998, but this is still a long way behind the estimated 17'000 Internet Service Provider (ISPs) that have mushroomed around the world.

Figure 1: Internet growth: No longer exponential, but still mightily impressive
Internet host computers and growth rate, January 1990 - July 1998, and compound annual growth rates, 1990-97



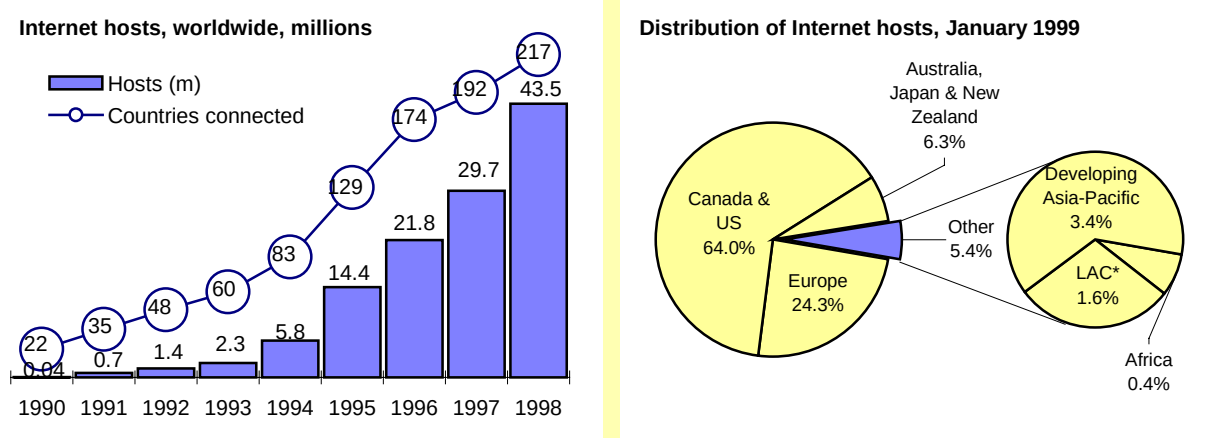
Note: For the left chart, the latest data is valid for mid-1998, not end-year. The growth rate shown are annualised rates.
Source: ITU World Telecommunication Indicators Database, Network Wizards, Compaq, RIPE.

2. Internet in developing countries

On a global scale, Internet growth has been little short of phenomenal. The network has increased from 213 host computers and several thousand users in August 1981 to more than 43 million Internet hosts by January 1999 (Figure 2, left chart) supporting an estimated 150 million Internet users. Perhaps even more impressive is the number of countries connected to the global network. From just over twenty in 1990, there were more than 200 nations connected by July 1998. Though these figures are impressive, a closer look at Figure 2 (right chart) reveals the great disparities in Internet hosts between high and low income regions. For example there are more hosts in Finland than all of Latin America and the Caribbean, there are more hosts in three highly developed countries of the Asia-Pacific region (Australia, Japan and New Zealand) than all the other countries in the region combined and there are more hosts in New York than in all of Africa.

Figure 2: Growing but still unequal

Installed base of Internet hosts, January 1991 - January 1999, and distribution by region, January 1999



Note: In the left chart, data refer to January of the following year. A new method was used to calculate Internet hosts from January 1998 onwards. Data were adjusted, based on the new methodology, from January 1995. * LAC = Latin America and the Caribbean.

Source: ITU. Internet host data adapted from Network Wizards <http://www.nw.com > and RIPE <http://www.ripe.net>. Countries connected data sourced from Internet Society.

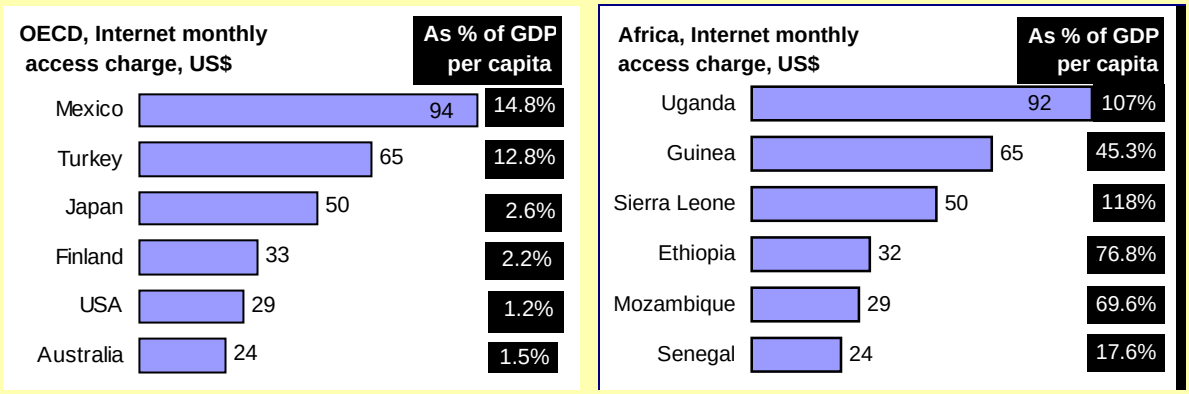
The majority of Internet hosts are in developed countries, suggesting that wealth and education are major factors driving Internet diffusion. Profiles of Internet users confirm that they are, on average, wealthy and educated as well as young, urban, and male.

What are the barriers to increased Internet usage? The precise ranking of different obstacles differs, according to the level of economic and social development, but users around the world are unanimous in finding the ***price of Internet access*** to be a major constraint. Internet access prices for end users can be broken down into three components: hardware/software, Internet access provision and telephone service charges. In relative terms, the costs to get connected are much higher in developing countries. While prices may not differ drastically in absolute terms, there is a large gap between high and low income countries when costs relative to per capita income are considered (Figure 3).

A shortage of ***infrastructure***, notably of telephone lines, is a further big obstacle to increasing Internet access in developing countries. The high visibility of the Internet and the growing awareness of the importance of Information and Communication Technology (ICT) for socio-economic development is driving policy changes aimed at increasing the supply of telephone networks. Countries are tackling this problem through a variety of options including granting incumbent operators more freedom to reinvest their earnings and attracting fresh investment from the private sector by selling shares in state-owned telephone companies, and/or by allowing new market entrants.

Availability of ***content***, in an appropriate ***language*** also affects the diffusion of the Internet. After all if you cannot find content in your language and you do not read other languages, how can you use the Internet? According to research by the Internet Society, more than 80 per cent of web pages are in English, though only 57 per cent of Internet users have English as their mother tongue. One notable aspect is that the countries with the highest levels of access include a large number of islands. Overcoming physical and psychological isolation appears to be a major factor driving Internet usage. This may be good news for developing countries, which have often argued that they are economically isolated and suffer from a shortage of information.

Figure 3: Absolutely similar, relatively different
Monthly Internet access prices for the OECD, August 1996 and Africa, July 1998, US$

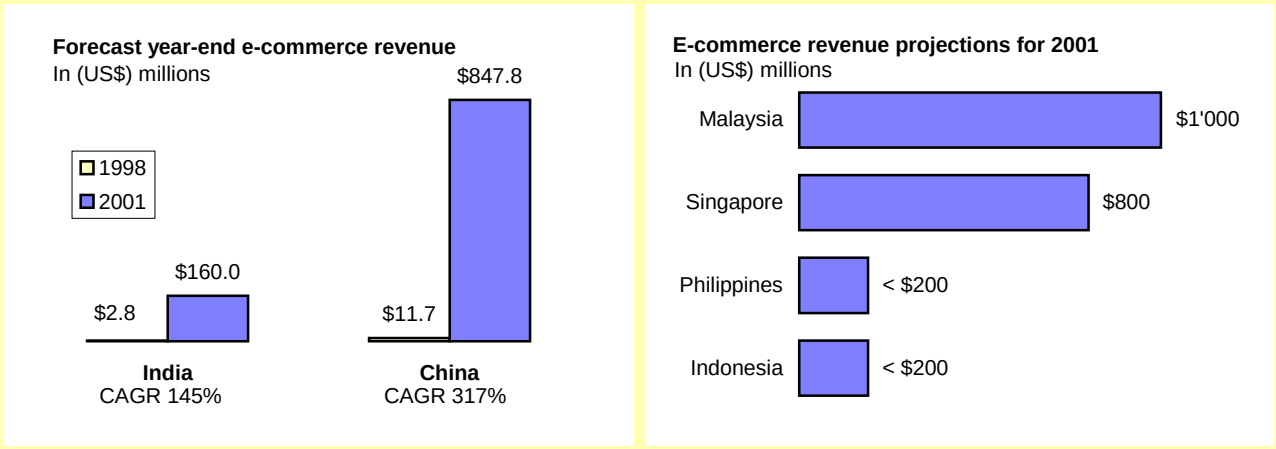


Note: Monthly access charge includes telephone call charges.
Source: OECD Communications Outlook 1997 and Mike Jensen.

3. Internet for electronic commerce

The concept of electronic commerce (e-commerce) is not new. However, the rapid rise of the Internet has made the potential of e-commerce more promising. It is now widely stated that the Internet and e-commerce will transform traditional business and consumer life. By one estimate, Internet-based sales reached US$ 43 billion in 1998. Many analysts expect online business to be worth more than US$ 300 billion early in the next decade while the more optimistic estimates range between US$ 1 trillion and US$ 3 trillion. Growth rates are also expected to be particularly high in Asia (Figure 4).

Figure 4: E-commerce revenue projections in Asia
1998 and 2001, selected countries



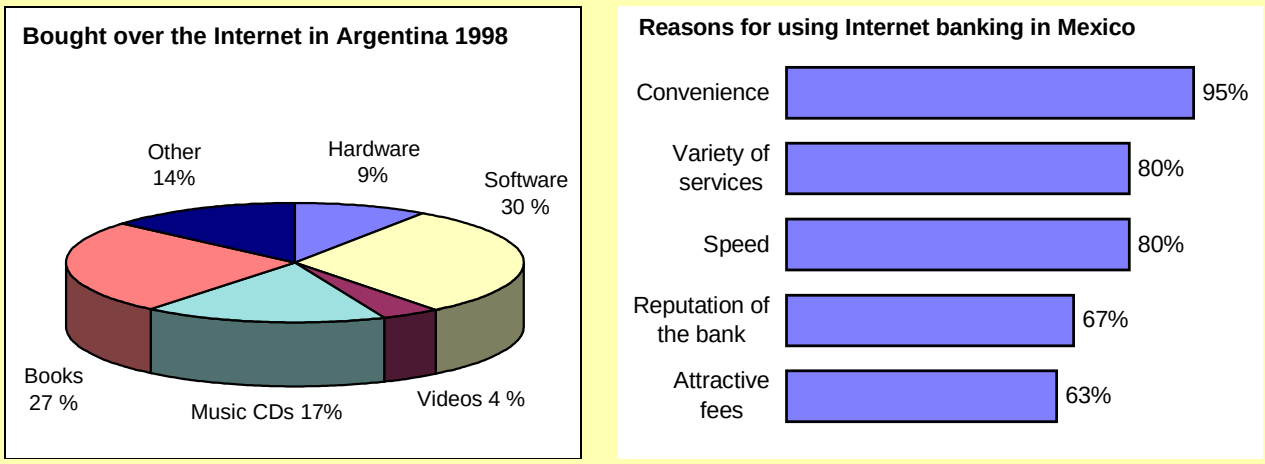
Note: IDC's revised projections for China's e-commerce revenues in 2002 total US$ 1.87, while South Korea is expected to generate US$ 2 billion.
Source: Left chart IDC, Market Forecast for Internet Commerce. Right chart IDC, as reported by CommerceNet.

The Internet enhances the possibility for developing and emerging economies to participate in the emerging digital economy. Internet-based electronic commerce is likely to promote economic growth and welfare in developing countries significantly. New export opportunities should attract new foreign and domestic investment and thereby enhance growth. Most large industrial companies

in developing countries already use the Internet, and what is perhaps surprising is that a growing number of small and medium-sized firms are also becoming users.

Internet commerce has not penetrated all economic sectors equally. Sectors that were expected to grow by more than 150 per cent in 1998 include: computer hardware and software, real estate, publishing & information services, finance, and Internet services. Tourism which is an increasingly important source of growth for developing countries, also looks set to be boosted by electronic commerce. Analysts estimate that the travel industry accounted for some 20-30 per cent of total online revenues in 1997. Online travel sales are expected to grow to almost US$ 9 billion by 2002. Financial services is another area of great potential growth in the online world and Internet banking is already available in many developing countries enabling customers to pay bills, check account balances, or transfer funds (see Figure 5, right chart).

Figure 5: Online shopping in Argentina and online banking in Mexico
What people buy over the Internet in Argentina and why they use Internet banking in Mexico

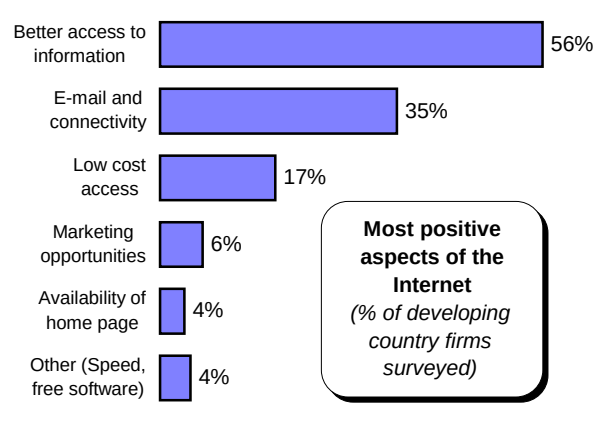


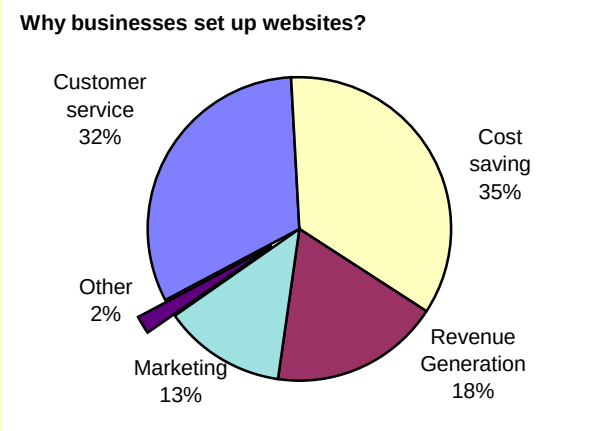
Source: Secretaria de Comunicaciones de Argentina and Grupo TeleLink, S.A. de C. V.

What does Internet commerce mean for firms? The benefits of e-commerce are certainly compelling. Internet commerce can substantially improve productivity by lowering transaction and production costs, facilitating market entry, improving customer service, extending geographical coverage and enabling a new potential source of revenue (Figure 6).

Although Internet commerce potential appears promising, many challenges still remain. Barriers to Internet commerce are to some extent the same as those for Internet use in general. But several of the challenges are specific to electronic commerce, and they include the need for a legal and financial framework for Internet transactions and the provision of market access and trade logistics. Developing countries aiming to promote electronic commerce would have to work, on the short term, on the both fronts—i.e., improving communication infrastructure and accessibility and adjusting the legal, financial, and logistic conditions to the new requirements of online trade. In the longer term, they would have to certainly address some of the underlying conditions for global commerce to flourish—such as improved education and computer skills.

Figure 6: What is good about the Internet? The corporate view
From the perspective of firms in developing countries (left chart) and global corporate interests (right chart)





Source: Left chart, International Finance Corporation (IFC). Right chart; Computerworld.

4. Internet for health

A young and healthy athlete was brought to the hospital in a critical situation. He was suffering from high fever, weakness and serious infection. Laboratory tests confirmed that the infection was *necrotising fasciitis* (commonly known as the "flesh-eating bacteria"). Urgent amputation of the leg seemed the only possible solution to stop the process and save his life, until one of the physicians recalled seeing an article that referred to new ways of treating limbs infected with *necrotising fasciitis*. After a quick consultation in MEDLINE—one of the most important medical database on the Internet—the doctors were able to find and retrieve the article and apply the procedure and treatment recommended. The young man was able to save both his life and his leg, and is back in athletics.

Of the 52 million deaths worldwide during 1996, over 40 million of them were in the developing world. More than 12 million of them were children under the age of five, most of which died from preventable causes. Many of these deaths could have been avoided and several of the problems faced by health professionals could be overcome if the adequate information was at hand when needed. But, information poverty is one of the most serious obstacles facing health professionals in the developing world.

For decades, developing nations have been well aware that meeting basic human needs—such as health and education—is not only essential to the well being of their population, but also a prerequisite to any economic development effort. The Internet, due to its peculiar technological and economic features—efficient digital technologies that can deliver in an interactive and asynchronous fashion data, text, images, and video at a low cost—brings new hope to developing nations.

In most developing countries, given the poor infrastructure and inadequate computing at both homes and public institutions, the likelihood of patient/doctor and/or patient/Internet-site consultation is slim. What is instead viable, and could have a major impact on health services provided in developing countries, is consultation among health professionals over the Internet and health professionals to Internet-site consultation.

In Ginnack, for example, a remote island village on the Gambia river—two nurses, Rosemary Sturdy and Marlous Kok, combine a digital camera and a laptop to diagnose ailments and keep

various sickness at bay in the local community. Sturdy and Kok use the digital camera to take pictures of visible signs, download them to the laptop and take them to Banjul for examination by a doctor. If the physician needs further evaluation of the images, he/she sends them over the Internet to Global Synergy in the UK where they are forwarded to specialists from around the world for a diagnosis. Compression software today allows shrinking a typical X-ray image by a factor of 30:1 without loss of information. With this level of compression the image can be sent without any difficulty through any existing telecommunication network.

Information poverty is one of the most serious obstacles facing health professionals in the developing world. A typical medical school in the United States subscribes to more than 11'000 periodicals, while similar institutions in developing nations may have access to less than five percent of that figure. Furthermore, medical knowledge is evolving rapidly. Historically it has taken up to five years for new knowledge to trickle down, even to those in the general profession who are reasonably well connected to international flow of information. Beyond the capital city and large urban centres of developing nations the time lag can, of course, be substantially longer. The Internet cannot only significantly shorten this time-lag, but it can also open up a whole new range of information resources to health professionals in developing nations.

Poor sanitary conditions in many developing countries contribute to the emergence and spread of infectious diseases. WHO's information system on disease events occurring worldwide links all major partners in international response for epidemic control. The use of the Internet for the exchange of outbreak information ensures that crucial information can be rapidly and widely disseminated to public health officers, ministries of health and health professionals in the field. *Meningococcal meningitis*, for example, occurs in seasonal epidemics in a group of 17 sub-Saharan countries known as the 'meningitis belt'. During the dry meningitis season, daily reporting of cases is required to monitor an emerging epidemic. When a certain threshold is reached, mass vaccination is required. The information exchange via the Internet not only allows monitoring of the disease evolution, it also provides essential communication support for planning and mobilisation of vaccination teams to be deployed in affected areas.

The future of health services over the Internet depends heavily on overcoming a number of infrastructural, regulatory, economic barriers. For developed countries issues such as privacy and confidentiality, licensing, malpractice liability, service payments and reimbursements are of high importance. In developing countries, instead, regulatory matters are still far from being a pressing issue in their health agenda. For many of them, having access to the necessary communication infrastructure at a reasonable cost, and taking the initial steps to set up telemedicine pilot projects are of most importance. The ITU has been active in supporting developing countries achieve both of these goals (see Table 1).

Table 1: Networking health in developing nations
ITU's Telemedicine Pilot Projects

Country	*Project*	*Implementation date*
Ukraine	Medical Information System for Ukrainian National Emergency and Trauma Centre in Kiev	Oct 97
Mozambique	Teleradiology link between hospitals in Maputo (capital) and Beira (second largest city)	Jan 98
Malta	Telemedicine link between the islands of Malta and Gozo.	Mar 98
Ukraine	Mobile telemedicine services for victims of the Chernobyl nuclear accident	Mar 98
Georgia	Telemedicine link through Internet for second opinion between Georgia and Switzerland.	Sep 98
Bhutan	Telemedicine link between Central Hospital in Thimphu and a small rural hospital	Oct 98
Myanmar	Teleradiology link between Yangon General Hospital and the hospital in Mandalay	Feb 99
Senegal	Telemedicine network between several hospitals	Mar 99
Russia	Telemedicine network between several hospitals	Mar 99

Source: ITU.

5. Internet for education

Education and training are primary determinants of a country's prospect for economic and human development and international competitiveness. One of the valuable lessons derived from the Asian economic miracle is that the level of education is one of the single most important factors to explain high economic growth in the past decades. Yet, in 1996, almost 1.5 billion children and adults in the world were illiterate.

Distance education provides learning opportunities to students that, for a number of reasons—geographical distance to centres of education, work schedule, limited financial resources, and the like—would otherwise be excluded from the educational system. From a national perspective the strategy allow for a considerable increase in the number of educated people—with positive effects on the overall national economy. Furthermore, at the University level distance learning raised the hope of diminishing, or halting, the brain drain that most developing countries suffer when their best educated people move abroad for training and some 50 per cent of them never return. For the overall educational system of a nation, distance education promised to increase economies of scale and reduce infrastructure costs.

In recent years the number of distance education programs in developing countries have been growing at a dramatic pace. So much so, that the six largest distance learning universities in the world are located in developing countries (see Table 2).

Table 2: When the Prof. is elsewhere
Largest distance learning universities in the world

Country	Institution	Established	Students	Budget (US$ m.)	Faculty
Turkey	Anadolu University	1982	577'804 [95]	30	1'260
China	China TV University System	1979	530'000 [94]	1.2	31'000
Indonesia	Universitas Terbuka	1984	353'000 [95]	21	5'791
India	Indira Gandhi National Open Univ.	1985	242'000 [95]	10	13'652
Thailand	Sukhothai Thammathirat Open Univ.	1978	216'800 [95]	46	3'536
Korea	Korea National Open University	1982	210'578 [96]	79	2'840
France	Centre Nat. d'Enseignement à Dist.	1939	184'614 [94]	56	4'800
UK	The Open University	1969	157'450 [95]	300	8'191
South Africa	University of South Africa	1873	130'000 [95]	128	3'311
Iran	Payame Noor University	1987	117'000 [95]	13.3	3'665
Spain	Univ. Nac. de Educación a Distancia	1972	110'000 [95]	129	4'600

Note: [Date] refers to the year for which the data is available.
Source: <http://www.open.ac.uk/ou/news/vc/botsfig2.hmtl>

The results of distance education, however, have been mixed. In a significant number of cases outcomes have been rather disappointing largely due to: (a) inadequate learner support; (b) a sense of isolation due to the lack of interaction with other students; (c) a focus on correspondence-type programs; and (d) long delays in feedback to students needs. With the rise of the Internet, the distance learning experience has been completely transformed and many of these barriers overcome. The Internet constitutes a virtual classroom in which intense interactivity and the sharing of resources and information constitutes its essence.

For most developing countries migration to an electronic-based education has come at a difficult time. In most nations the state—that has traditionally been the main financier of education—is facing severe fiscal constraints and retreating from its former direct participation. But, as national states scale back their financing two other types of institutions are increasing their financial participation in the sector: multilateral lending agencies and private sector firms. Some of these private institutions in the developing world have not only the required cash to bring the power of computing and networking to their educational services, but have also been quite successful in raising funds in the stock market, as the example of the Education Investment Corporation (Educor) of South Africa, illustrates. The group—which has investments in education and personnel placement—has been experiencing a booming growth in recent years. The education arm employs more than 4,000 faculty to teach to 300,000 students registered in its 160 branches. In June 1996 company shares were floated on the Johannesburg stock exchange. Educor's turnover more than tripled from December 1996 to the end of 1997, while operating profits rose by 78 per cent in the same period. The market capitalisation of Educor already exceeds US$ 433 million.

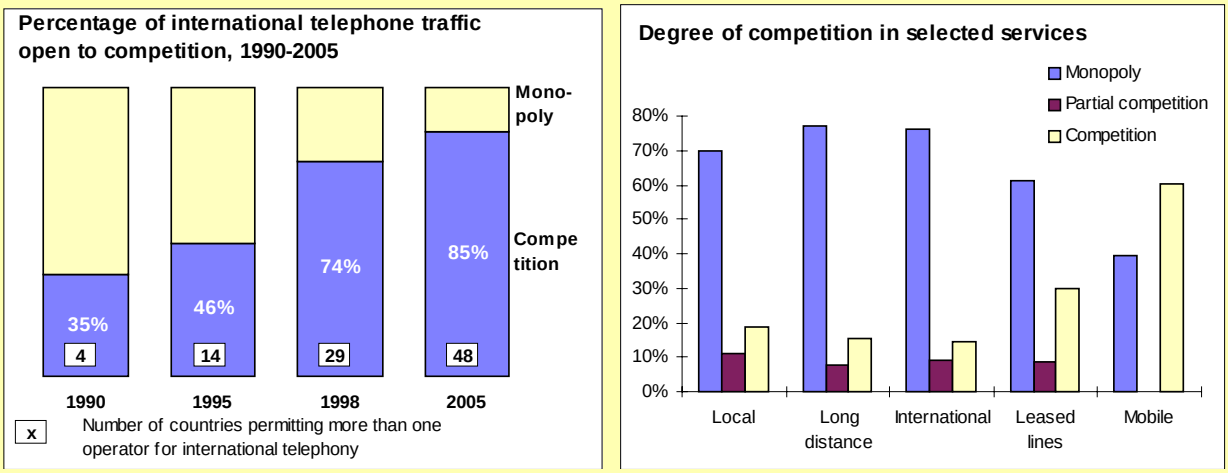
The above experiences show that setting up Internet distance education programmes in developing countries is not only conceptually viable, but also practically feasible. Building the required communication infrastructure is generally the easiest and in the long run the cheapest part of the process. What it seems to be much more difficult to achieve—in terms of time and cost—is the sustained production and supply of content. For a number of developing countries the "content challenge" might be even larger due to the fact that: (a) content for distance education programs has characteristics unique to the online nature of the service delivered; and (b) content needs to be suited to local educational needs. In spite of the "content challenge", the Internet seem to be set not only to boost traditional educational services around the world, but also to transform the way in which we understand and experience the learning process.

6. Internet for public telecommunication operators

Few parts of the once near-monopoly telecommunications market are now sheltered from the reach of competition. The twin forces of globalisation and technological change mean that even in those countries which have not yet licensed additional operators to compete, domestically and internationally, against an incumbent PTO, the influence of competitive markets is keenly felt (see Figure 7). But competition to PTOs in developing countries is coming from a surprising source. They won't necessarily have been competition to come in the form of small, local start-up companies, perhaps attached to a university or a non-governmental organisation. And yet this is frequently the nature of ISPs, at least in their early years. One of the distinguishing features of the Internet is that the barriers to market entry are relatively low. This matters to PTOs because it means that it becomes possible for lots of new, small companies, without an established user base to defend and investment schedule to depreciate, to enter the market.

Figure 7: Competitive markets set the rules

Percentage of international traffic open to competition, 1990-2005, and percentage of economies permitting competition, by service, 1998



Note: In Left Chart, the percentages for 1998 and 2005 are based only on those countries which have made specific commitments under the World Trade Organisation's Basic Telecommunications Agreement. Thus they most likely reflect underestimates of the true market picture.
Source: ITU Direction of Traffic and Regulatory Databases. ITU "General Trends in Telecommunication Reform, 1998, Vol. 1".

The Internet business also lends itself very easily to being combined, or bundled, with other services. Thus the typical ISP may already be established in a related field, such as software distribution, local cable/satellite TV, video rental. But of the many services offered, the one which presents the biggest dilemma to PTOs is Internet Telephony. On the one hand, it promises to reduce the price of international telephone calls for the citizens of the country. But on the other hand, Internet Telephony could be viewed as a Trojan Horse, which threatens to undermine the pricing structure of the incumbent PTO and undercut its profitable business in originating and terminating international calls. In so doing, Internet Telephony might threaten the ability of the PTO to invest in extending the domestic network and meeting its Universal Service Obligations (USOs).

Internet Telephony does indeed prevent a major challenge to developing country PTOs but one which they would be better advised to embrace rather than to ignore. The fact that Internet Telephony is still in its infancy and occupies only a tiny percentage of total international telecommunications traffic means that developing countries have some time to prepare a strategy to

deal with it when it becomes a real threat, as it surely will. Some elements of the strategy might include the following:

- Ensuring that settlement rates are, to the extent possible, aligned with cost trends so that the margin which Internet Telephony traffic enjoys over incoming PSTN traffic is minimised;
- Minimising the gap between settlement rates with different correspondents and renegotiating any remaining sender-keeps-all arrangements to remove any possible 'backdoor' for Internet Telephony traffic;
- Negotiating with foreign PTOs to share the cost of international leased lines used for Internet traffic;
- Developing regulations and policy documents explaining clearly the status of Internet Telephony and, as appropriate, establishing a timetable for full liberalisation of the market;

7. To regulate or not to regulate?

Perhaps no issue divides the Internet community as much as that of Internet regulation. To some, the Internet is simply a new method of communicating and doing business and, as with all such advances, the regulatory framework will need to be adapted and altered. To others, the Internet is a new frontier that was expressly created to operate and function without government interference.

Regulation of Internet ***content*** is one of those areas in which the public in some countries have been strongly against. On the other hand, there appears in some cases a legitimate concern as to, at a minimum, the appropriateness of certain content which is transmitted over the globally-accessible, and thus influential, Internet. In dealing with this matter, some national administrations are developing policies which mix restrictive legislation with the promotion of industry self-regulation. In Malaysia, for instance, new legislation been debated in Parliament prohibits ISPs from distributing "content which is indecent, obscene, false, menacing, or offensive in character with intent to annoy, abuse, threaten or harass any person". Nevertheless, a "content forum" (which may be an industry body) will be established to prepare a "content code", including "model procedures for dealing with offensive or indecent content", "restrictions on the provision of unsuitable content" and "methods of classifying content."

Copyright law and policy is an important component of the debate over content. Copyright laws attempt to balance a number of interests. On the one hand, the creators of works and the holders of rights to intellectual property are entitled to incentives and compensation for use of their works, and for protection against unauthorised uses. On the other hand, the distributors and users of created works seek affordable and easy access to copyrighted material. Historically, it has been the view of some observers in developing countries that the existing copyright regime protects the interests of the developed countries while unfairly restricting the flow of information and works to poorer countries and their citizens.. Proponents of this view have been particularly reluctant to continue and extend the traditional copyright approach to the Internet, since they view the Net as perhaps the last and best opportunity to ensure equitable access to the information needed for social and economic development.

Privacy over the Internet, another issue that usually falls under the surveillance of regulators, seems to be more of a concern to developed countries than to developing ones. Infrastructure deficiencies, poor network performance, and the cost of services seems to override privacy concerns in many developing nations.

A common theme that runs through any discussion of Internet regulation is that of ***jurisdiction***. In the face of a global phenomenon, procedures that avoid disputes concerning the reach of national laws take on a new dimension and also challenge the potential effectiveness of Internet laws. The global nature of the Internet, and the fact that ISPs, content providers, users and servers, often located at different places around the world, are brought together momentarily by an "electronic encounter", renders it problematic for the courts of one country to exercise jurisdiction over an Internet party that is located in another jurisdiction. In spite of this, national courts have shown some willingness to extend their jurisdiction into various aspects of the Internet for sites located in a different jurisdiction.

Finally, while the Internet has often been viewed as the very essence of a free and open market, recent trends towards concentration indicate that maybe ***competition policy*** authorities will need to take a closer look. In the backbone market, the top three providers control more than 70 per cent of the market while the market leader in the retail service provision business, AOL, has more members than its top ten competitors worldwide added together. While the Internet may indeed be "special", it is not immune from the tendencies towards oligopoly that exist in all industries.

8. A policy toolkit for Internet development

What comes next? While predicting new trends on the Internet is always a hazardous business, the next logical step in the evolution of the Internet is almost certainly towards true multimedia, including real-time video, audio, animation effects and interactive applications such as telephony or video-telephony. The bandwidth requirements to support multimedia applications are an order of magnitude greater than even those necessary to support web-browsing. But nevertheless, one can already see the potential demand for this new type of service.

But this stage in the evolution of the Internet, if indeed it does come to pass, potentially carries the seeds of destruction of the usefulness of the Internet for other purposes. In terms of bandwidth requirements, the impact of multimedia applications will be to web-browsing what web-browsing was to email. In other words, unless there is a radical improvement in the performance of the Internet and the capacity of its backbone networks, then multimedia traffic could bring other applications to a grinding halt. The 'tragedy of the Internet Commons' is that one person's rotating .GIF file, is another person's 'world wide wait'. If bandwidth were universally available, sensibly priced, and in abundant supply, then this would not be a problem. But bandwidth continues to be a scarce and expensive commodity, particularly in the developing world. Unless sensible policies are developed to price bandwidth and Internet access appropriately, then a multimedia Internet will remain an inaccessible dream.

What steps should policy-makers in developing countries take to ensure that the benefits of the Internet are as widely distributed as possible?

To promote the industry

- Demonstrate support for Internet applications at the highest levels of government;
- Promote an active public awareness campaign;

To build infrastructure

- Increase private sector participation;
- Open up the basic telecommunications market to a wider range of players and investors;

To expand access to infrastructure and services

- Permit special tariffs designed to promote Internet services, such as lower prices for a second line, or unmetered local calls for a fixed rate;
- Promote the use of Telecentres and other means to extend access to under-served communities;

To promote growth of Internet access market

- Promote competition in the Internet service provision market;
- Monitor, and if necessary intervene, to ensure that leased line prices, especially for international service, are cost-oriented;

To promote production of local content

- Create and enforce a legal framework to protect intellectual property and copyright;
- Consider providing grants and demonstration projects to aid local content production at initial stages;

To stimulate usage

- Ensure reasonably priced access for schools, universities, libraries and other public service institutions;
- Provide all citizens with a virtual e-mail address.

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