

INTERNET DIFFUSION

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Glossary

Adoption of an innovation is a micro process that focuses on the stages through which an individual passes when deciding to accept or reject the innovation.

ARPANET (Advanced Research Projects Agency Network), developed by ARPA with support from the United States Department of Defense, can be considered as the origin of all the networks, including the Internet. Arpanet lines were considered super fast for their time, *56 kilobits per second*. ARPA and DARPA are used interchangeably, as the agency has used both names over the course of its existence.

Diffusion of an innovation is a macro process concerned with the spread of the innovation from its source to the public.

Interface Message Processors (IMPs) are the packet switches developed by the Defense Advance Research Project Agency (DARPA) in 1968.

Information and communications technologies (ICTs) include technologies that facilitate the capturing, processing, storage, transfer, and presentation of information.

Internet host refers to a computer system connected to the Internet — either a single terminal directly connected or a computer system that allows multiple users to access network services through it.

Network Control Protocol (NCP) was the initial ARPANET host-to-host protocol developed by Network Working Group (NWG) in 1970.

NSFNET (National Science Foundation Network) was the first backbone for the U.S. portion of the Internet. It was originally conceived as a way for researchers to submit jobs to supercomputers located at various universities around the U.S.

Transmission Control Protocol/Internet Protocol (TCP/IP) was designed to meet the needs of an open-architecture network environment. **TCP** verifies the correct delivery of data from client to server. TCP adds support to detect errors or lost data and to trigger retransmission until the data is correctly and completely received. **IP** is responsible for moving packets of data from node to node. IP forwards each packet based on a four-octet destination address known as the IP number. IP operates on gateway machines that move data from department to organization to region and then around the world. In the future, IP is projected to move to six-octet addressing.

ABSTRACT

This chapter provides an overview of the global diffusion of the Internet and examines the factors that shaped and are continuing to shape the diffusion dynamics. The diffusion pattern of an innovation such as the Internet is a function of economic, political, cultural and geographical factors. In addition, business models vis-à-vis the cost to access the Internet also influence the diffusion of the Internet. Since social systems worldwide differ significantly in terms of these factors, diffusion patterns of the Internet also vary widely. Among the factors hampering the faster diffusion of Internet in many countries are low income levels, authoritarian governments with distaste toward the openness of the Internet, sociocultural environments that are incompatible with the Internet, and terrestrial and topographical barriers to landline networks. As a result, developing countries account for disproportionately fewer numbers of Internet users and Internet hosts worldwide, creating a global digital divide.

INTRODUCTION

Since the 1970s, the number of countries connected to the Internet has increased steeply from 60 in 1993 to 214 in 2000 (see Figure 1). Despite this growth, the Internet has a highly asymmetric global distribution (e.g., Kshetri 2001). There were 40 million people worldwide using the Internet regularly in 1995 (Media Metrix 2000). This jumped to 131 million by the end of 1999 (Pastore 2000) and to 606 million by September 2002 . An estimate by Angus Reid Group (2000) suggests that that there will be one billion Internet users by 2005.

Figure 1 about here

Internet is the fastest diffusing Information and Communication Technology (ICT) innovation to date. For instance, it took just 10 years for the Web-based Internet to reach 50% of American homes, compared to 52 years taken by electricity and 71 years by telephone (Thierer 2000). It took only three years for the Internet to reach 50 million users. By contrast, it took 38 years for radio and 13 years for television to have 50 million users (Bell and Tang 1998). During 1999, the number of Internet users increased by one million every month (McLaren 1999).

Figure 2 about here

The global distribution of Internet penetration and use, however, is far from uniform (see Figure 2 and Figure 3). Developed countries account for a disproportionately high number of Internet users worldwide: 61.7% of the world's

Internet users live in North America and Europe, for instance, but they account for less than 20% of the world's population. As of May 2002, less than 0.1% of Africans had access to the Internet compared to 52.2% of North Americans. Similarly, as of 2000, developing countries with 84% of the world's population had fewer than 6% of world's Internet users (Futurist 2000). The discrepancy is even greater for the number of Internet hosts worldwide: North America and Europe account for almost 90% of Internet hosts while Asia-Pacific with over 60% of the world's population and 31% of the world's Internet users contribute only 8% of the total number of Internet hosts worldwide .

Figure 3 about here

There are, however, some encouraging signs. For instance, Internet users worldwide grew by 30% in 2001 and one third of the new users were from developing countries (UNCTAD 2002).

Since the Internet is a “new product”, an analysis of the pattern of its spread worldwide and within a given country from the perspective of innovation diffusion and adoption literature could provide valuable insights into the factors driving the diffusion dynamics (Takacs and Freiden 1998). Diffusion and adoption patterns of an innovation are functions of several elements including characteristics of the *innovation* itself, the *channel of communication*, the nature of the *social system*, and *time* (Rogers 1983).

Since social systems around the world differ in terms of several dimensions, diffusion patterns of the Internet vary widely across countries. In this chapter, some of the key differences in Internet diffusion pattern around the world would be highlighted.

In the chapter, we examine the global diffusion of the Internet and the factors influencing the diffusion dynamics. The remainder of the chapter (a) provides a brief historical overview of global Internet diffusion, (b) discusses the global diffusion patterns of the Internet, (c) integrates theories from diverse perspectives that help explain the diffusion and adoption phenomena, (d) discusses the factors that are likely to shape the global diffusion of the Internet, and (e) provides some conclusions.

INTERNET DIFFUSION: HISTORICAL OVERVIEW

The Internet passed through various stages to arrive at the present situation. The first wide area network (WAN) was developed in 1965. It took another four years for the first two hosts in the ARPANET to be connected. The graphical format of Internet as we know it now emerged in the 1990s.

Internet Diffusion Prior to 1980¹

President Eisenhower's request for funds to create the Advanced Research Projects Agency (ARPA) within the U.S. Department of Defense in 1958 laid the foundation for the Internet. The packet switching theory first published by Leonard Kleinrock of MIT in 1961 was a major step towards computer networking. In August 1962, J.C.R. Licklider, also of MIT, proposed the "Galactic Network" concept. The Galactic Network concept provided a remarkably prescient view of contemporary Internet – it envisioned a set of globally interconnected computers through which data and programs could be accessed from any site. In October 1962, Licklider became the head of the computer research program at Defense Advanced Research Projects Agency (DARPA). He also convinced his successors at DARPA of the importance of the networking concept. Under a military

contract, Paul Baran of Rand Corporation wrote key memoranda in the early 1960s outlining the “survivability” of a distributed, packet-switched network, even under conditions of a major nuclear attack. As Rand Corporation states in its historical notes²:

All of the nodes in this unusual network would have equal status; be autonomous; and be capable of receiving, routing, and transmitting information. Under Baran’s concept of distributed communications – now called packet switching – each message would be broken into a series of short, fixed-length pieces, and each would be sent as an individually addressed packet that would find its own way through the network by whatever route happened to become available, jumping from node to node until it reached the final destination. If parts of the network were destroyed, the self-sufficiency of each node plus the data within the packet allowed the node to seek alternative ways of moving the packet along.

Next, it was necessary to make the computers ‘talk’ to each other. In 1965, MIT researchers Thomas Merrill and Lawrence G. Roberts were able to connect the TX-2 computer in Massachusetts to the Q-32 in California. This was the first wide-area computer network. In 1966 Lawrence G. Roberts, who had joined DARPA, put together his plan for the ARPANET.³ Kleinrock’s Network Measurement Center at UCLA was selected to be the first node on the ARPANET in September 1969. In October 1969, Stanford Research Institute (SRI), about 350 miles to the North of UCLA, provided a second node and the first host-to-host message was sent from Kleinrock’s laboratory to SRI. Two more nodes were added at University of California at Santa Barbara and University of Utah. Four host computers were connected together into the initial ARPANET, the forerunner of today’s Internet, by the end of 1969.

¹ This section draws from Leiner et. al. (2002).

² See <http://www.rand.org/history/baran.html>

³ It is interesting to note that independent of the U.S. efforts, Donald Davies of the National Physical Laboratory (NPL) in U.K. proposed development of a nationwide packet communications network, based on a packet size of 1024 bits – the same packet size that Paul Baran had proposed in the U.S.

The number of computers connected to the ARPANET grew rapidly after 1970 (See table 1). In December 1970, the Network Working Group (NWG) finished the initial ARPANET host-to-host protocol, called the Network Control Protocol (NCP). As the ARPANET sites completed implementing NCP during the period 1971-1972, the network users finally could begin to develop applications. In 1972, electronic mail was introduced. Bolt, Beranek and Newman (BBN), a consulting firm started by MIT professors Richard Bolt and Leo Beranek and their student Robert Newman, sent the first person-to-person email using the @ symbol in the address. To meet the needs of an open-architecture network environment, Bob Kahn and Vint Cerf developed the Transmission Control Protocol/Internet Protocol (TCP/IP) in 1973. TCP/IP proved remarkably resilient and enduring as a means of managing data communications networks.

Table 1 about here

Starting from the mid-1970s, computer networks grew rapidly. ARPANET expanded internationally by connecting to University College of London (England) and NORSAR (Norway) in 1973. Most of the early networks, however, were closed communities of scholars. There was virtually no pressure for the individual networks to be compatible and hence they were not.

Internet Diffusion During 1980-90

Various developments in the 1980s facilitated the diffusion of the Internet. The number of Internet hosts grew by 500 folds in this period, from 200 in 1980 to 100,000 in 1989 (Table 1). In 1980, Tim Berners-Lee wrote the program known as “Enquire Within” which was a predecessor to the World Wide Web (WWW). Other developments include

IBM's announcement of the first personal computer in 1981 and foundation of Cisco Systems in 1983.

The ARPANET host protocol changed from NCP to TCP/IP on January 1, 1983 to meet the needs of an open-architecture network. In the November of 1983, the domain name systems (DNS) such as .edu, .gov, .com, .mil, .org, .net, and .int were created. Symbolic.com became the first registered domain on March 1, 1985. In 1985, the National Science Foundation (NSF) also decided that TCP/IP would be mandatory for the NSFNET program.

Internet Diffusion after 1990s

The Internet was opened to the public in the early 1990s. Major technological developments such as Tim Berners-Lee's creation of the World Wide Web (WWW), development of Mosaic Web browser in 1993, Sun Microsystems' release of Java, and release of Windows 1995 further facilitated the diffusion of the Internet (Webopedia 2002). As a result, the Internet grew significantly in the 1990s, in terms of the number of hosts, number of users, and global coverage. The number of Internet hosts increased from 200,000 in 1990 to 104 million in 2000. By 1990, major countries across the world such as Australia (AU), Germany (DE), Israel (IL), Italy (IT), Japan (JP), Mexico (MX), Netherlands (NL), New Zealand (NZ), Puerto Rico (PR), United Kingdom (UK), Argentina (AR), Austria (AT), Belgium (BE), Brazil (BR), Chile (CL), Greece (GR), India (IN), Ireland (IE), Korea (KR), Spain (ES) and Switzerland (CH) were already connected to the NSFNET (Goldstein 2000). Several smaller and less developed countries were gradually connected to the Internet.

Future Scenarios

Along with the exponential growth in the number of Internet users worldwide, newer means to access the Internet keep appearing. In particular, Internet access by mobile and broadband technologies is experiencing rapid growth worldwide. For instance, by 2009, cellular phone subscribers in the world are expected to outnumber fixed line subscribers (ITU 2000). Furthermore, over 25% of e-commerce is estimated to take place over handheld sets by 2005 (Shaffer 2000).

The number of broadband subscribers worldwide is estimated to cross 46 million by the end of 2002 (High-Speed Internet Access 2002). The annual worldwide broadband growth rate for the period 2002-04 is projected to be in the range of 61% to 150% (Lammers 2001). Whereas cable modem service is gaining popularity in the U.S., Digital Subscriber Line (DSL) has become the main broadband access technology outside the U.S. Other broadband access technologies such as satellite broadband, fiber-to-the-home, and fixed wireless service accounted for 5% of the worldwide broadband market in 2002 (Communications Today 2002).

GLOBAL DIFFUSION OF THE INTERNET

Starting with just a few countries in 1990, the number of countries connected to the Internet crossed 200 by mid-1998 (WIPO 2000) and 214 in 2000. The diffusion pattern of the Internet, however, varies widely across the world. Table 2 details the global distribution of the number of Internet users in September 2002. North America, where the Internet originated, has over 182 million users accounting for 30% of the world's users but only 5.6% of the world's population. Europe, with its early connection to the ARPANET, currently has the highest number of Internet users (over 190 million). Asia-

Pacific, with over 60% of the world's population, is experiencing some of the most rapid growth in recent years and is expected to double its number of Internet users by 2005.

Table 2 about here

Internet Diffusion in Africa and the Middle East

In the Middle East region, Israel was a pioneer in connecting to the Internet – in 1989, along with selected, key European and Asian nations. African and other Middle Eastern nations came to the Net much later. By connecting with the global network in 1993, South Africa and Tunisia became the first African countries to join the Internet (Tripod.com 2002). By 1998, all African countries except Congo had Internet connection (CITI 2000; Tripod.com 2002). South Africa dominates this region's Internet market⁴ followed by Israel, Egypt, United Arab Emirates, and Saudi Arabia (Table 3).

Table 3 about here

According to the State of the Internet Report 2000 of the U.S. Internet Council, Internet diffusion in Africa has been hampered by factors such as poverty, low computer penetration, illiteracy, lack of trained personnel, disinterest and a failure to understand the benefits of Internet access (CITI 2000).

Internet Diffusion in Asia Pacific

Internet is growing very rapidly in the Asia-Pacific region. The number of Internet users in this region is expected to increase to 374 million by the end of 2005 (Rao 1999).

⁴ In discussing ICTs in Africa, Ya'u (2002) tellingly points out that "of the 157,325 Internet hosts in Africa, 144,445 are in South Africa, leaving less than 10,000 for the rest of Africa."

Japan, South Korea, Taiwan and New Zealand dominate the region's Internet market so far (Table 4). China and India, however, are the fastest growing Internet markets in this region (Javalgi and Ramsey 2001; Kshetri 2002). Each is expected to have more Internet users than the U.S. by 2010 (Nua Internet Surveys 1999b).

Table 4 about here

Internet Diffusion in Europe

Most of the European countries introduced the Internet much earlier than their counterparts in Asia, Africa, and Latin America. For instance, University College of London (England) and NORSAR (Norway) were connected to the ARPANET as early as in 1973. Similarly, Germany (DE), Italy (IT), Netherlands (NL), and United Kingdom (UK) were connected to the NSFNet in 1989 and Austria (AT), Belgium (BE), Greece (GR), Ireland (IE), Spain (ES) and Switzerland (CH) were connected in 1990 (Goldstein 2000). Germany and the U.K. dominate the Internet market of this region (Table 5).

Table 5 about here

Internet Diffusion in Latin America and the Caribbean

Compared to North American and European economies, the Internet is a relatively new phenomenon in Latin America and the Caribbean. The region, however, is experiencing phenomenal growth in the number of Internet users. A survey conducted by Nazca indicated that use of the Internet tripled in this region between 1995 and 1997 (Tudor 1999). The networks in most of the Latin American economies were established during

1995-99 (Hahn 1999). By connecting to NSFNet in 1989, Mexico became the first country in Latin America to connect to the Internet (Goldstein 2000). As table 6 indicates, big Latin American economies such as Argentina, Brazil, and Mexico dominate the Internet population in the region.

Table 6 about here

Internet Diffusion in North America

North America, the original locus of the Internet, accounts for disproportionately higher numbers of Internet hosts and Internet users compared to the rest of the world. By 1999, the U.S. had over 98 million Internet users and 40 million hosts (Euromonitor 2001b). Canada, similarly, had over 11 million Internet users and 1.4 million Internet hosts by 1999 (Euromonitor 2001b). These numbers have been growing rapidly, and reaching saturation levels.

Unconnected Pockets

Most of the countries that connected to the Internet very late, connected in very limited ways, or did not connect at all did so not because of economic reasons but because of political or religious reasons. Commenting on Internet-free countries in 1996, Maslen (1996) made the following observations:

In June 1996, just twenty countries remained with absolutely no e-mail or Internet connection: Afghanistan, Bhutan, Burma, Burundi, Congo, Gabon, Guinea Bissau, Iraq, Liberia, Libya, Mauritania, North Korea, Oman, Rio Muni, Rwanda, Somalia, Syria, Western Sahara, Yemen, and Zaire. ... Of these countries, more than half are in Africa, in most cases only recently (fifty years or less) free from colonial rule.... Many of these countries are not wealthy, but there are surprising exceptions. Libya, Western Sahara, Oman and Gabon are relatively affluent, so their abstention from the Internet cannot be explained in purely economic terms. Politics, economics and international diplomacy have always been involved in the spread of the Internet. Sixteen of these twenty 'unwired' countries are Islamic, or

have large Islamic populations. ...At least six Internet-free countries have been involved in destructive internal or external conflicts in the last ten years... Iraq, Libya, North Korea and Somalia (a fifth of the no-Internet countries) have all been on poor (or hostile) diplomatic terms with the United States ... [There is also] a definite (two-way) correlation between countries' levels of democracy and Internet connectivity. Sixteen of the twenty unconnected nations possessed very low levels of democracy.

THEORIES OF DIFFUSION AND ADOPTION OF INNOVATIONS

A deeper and richer understanding of the multifaceted and complex processes of diffusion and adoption of the Internet requires an integration of theories from diverse perspectives such as political science and international relations, sociology, marketing, communications, information systems, and geography.

Theoretical and empirical evidence suggests that politics and government policy play important roles in the diffusion of modern ICTs. Diffusion theories that relate diffusion pattern with political structure in a country argue that a technology is not equally compatible with all types of political structures. These theories, for instance, predict that authoritarian governments have relatively less favorable attitudes towards developing interpersonal means of communications such as the telephone and the Internet (e.g., Groth and Hunt 1985; Kshetri 2001; Kshetri and Dholakia 2001). Groth and Hunt (1985), for instance, postulate that Marxist governments allocate relatively smaller proportion of resources for the development of interpersonal communications means. The unfavorable attitude towards the Internet has hampered the growth of Internet in countries with authoritarian regimes such China, Cuba, and Syria.

Diffusion of innovations also entails "interaction between life-experience and history" (Erben 1993) and hence theories from sociology may help explain some aspects of the diffusion dynamics. For instance, the cultural imperialism hypothesis (Tomlinson

1991) – western control of mass media combined with human desire to improve their lives leads consumers from developing countries to imitate the developed ones – could help explain the role of global media in the diffusion of modern ICTs in developing countries. Similarly, the technology-society compatibility (Gatignon and Robertson 1985; Rogers 1983) theories could help explain why a particular technology is more compatible in certain societies than others. Past research has found that the ‘country-level effects’ or the ‘societal effects’ (Kshetri and Dholakia 2002; Zaheer and Zaheer 1997) have strong influence on technology adoption behavior of firms and individuals in a country.

Since diffusion of innovation requires an understanding of “people, hardware, software, communication networks and data resources that collects, transforms, and disseminates information” (O’Brien 1996), theories from information systems are well suited for explaining such aspects of the diffusion and adoption phenomena.

Diffusion and adoption of ICTs entail decisions at various levels (individual, organization, national, international) about allocation of scarce resources (Andrews 2002). Economic theories help explain how individuals, organizations and governments make decisions regarding the allocation of resources in ICT investment. Basic demand and supply theories are helpful in explaining the varied distribution patterns of the Internet across countries. For instance, income can be expected to be positively associated with the demand of modern ICT products (Gatignon and Robertson 1985; Rogers 1968, 1983).

Geography and geopolitics are important aspects of international business in general (As-Saber, Liesch and Dowling 2000) and global diffusion of innovations in particular. Geopolitical theories help in answering questions such as, “... Why are things

located where they are? How do different places relate to each other? How have geographic patterns and relationships changed over time?” (Baerwald 1996, p. 23). Geopolitical variables include population (Cohen 1963) as well as characteristics of populations such as skills, educational qualifications, productivity, and the cost of labor (As-Saber, Liesch and Dowling 2000; Baerwald 1996). Literacy rate and English language skills are other geopolitical factors likely to influence the diffusion of innovations. Such skills are associated with the availability of information and the proficiency required to use a new technology or the ‘inter-relatedness’ among users and producers of the technology (Cassiolato and Baptista 1996). The diffusion of a technology is negatively related to the disparity between the skills needed to use the technology and the consumer’s existing knowledge (Gatignon and Robertson 1985). High illiteracy rates have hampered the adoption of the Internet in less developed countries. Geopolitical variables such as geographical distance between adopting units (Gatignon and Robertson 1985) influence the level of terrestrial barriers and hence the diffusion of the Internet. Origination of the Internet in the U.S. is one of the major factors responsible for the disproportionately higher number of Internet users in North America. Furthermore, high-bandwidth backbones were created first in North America, followed by Europe, and the data traffic to other regions was constrained by low-bandwidth connections.

FACTORS IMPACTING THE DIFFUSION OF THE INTERNET

Economic Factors

Economic factors such as income level, availability and price structures of ICT products and services, and bandwidth and supporting infrastructures influence the diffusion of the

Internet (Kshetri 2001). The cost of a PC as a proportion of GDP, for instance, is 5 per cent in high-income countries compared to about 300 per cent in low-income countries (ITU 2001a). In January 2001, the price of the cheapest Pentium III computer was US\$ 700 (UNDP 2001b), an amount much higher than the average per capita GDP of most developing countries. Similarly, monthly Internet access charge as a proportion of per capita GDP in 2001 varied from 1.2 percent in the U.S. to 118 per cent in Sierra Leone (ITU 2001a).

Economic factors influence the means used to access the Internet. Many people in developing countries who cannot afford PCs, can access the Internet through public kiosks and cafes at much lower rates (e.g., Kirby 2002). Paging networks are popular in China because of the higher costs of computer and the fixed Internet access (Ebusinessforum.com 2000). In Japan, the popularity of NTT DoCoMo's i-Mode services, and the government's effort to lower the cost of data flow over the mobile network, accelerated the growth of mobile Internet (Stout 2001).

Finally, bandwidth availability is a determinant of Internet adoption and diffusion. In general, it is very low in developing countries. For instance, 50 percent of the worldwide bandwidth capacity is in North America compared to 3 percent in the Middle East and Africa (Frontline.net 2001). Lower bandwidth results in longer time to transfer data and hence low relative advantage of Internet use. Moreover, the lack of intraregional infrastructures in developing nations of Asia, Africa and Latin America means that even Internet communications with neighboring countries have to be routed through the U.S. or other industrialized countries in Europe, further increasing the costs. When high

bandwidth is available and reasonably priced, as in South Korea, it becomes a driver of rapid Internet diffusion.

Sociocultural Factors

The degree of compatibility of the Internet and its various uses with the values and norms of a social system (Rogers 1983) influences its diffusion patterns in that social system.

An examination of the ‘values’ and ‘culture’ inherent in the Internet, thus, helps predict the degree of acceptance or rejection of the Internet in a society. An important component of the value system is related to skills required to use the Internet. Literacy and computer skills are almost the prerequisites to Internet use. A large proportion of the population in developing countries is illiterate and still higher proportion lacks computer skills.⁵

Moreover, Internet tends to favor the English-speaking population because most of the software and interfaces used in the Internet are in English. Also, a large proportion of the WWW content is in English language. For instance, a survey conducted in 1998 found that about 85 per cent of the texts on the WWW were in English (Nunberg 2000), which decreased to about 80 percent in 1999 (Nua Internet Surveys 1999a).

Internet’s asynchronous nature and impersonal style of communications tend to make it incompatible with the cultures of some societies. For instance, in Japan personal correspondence is normally handwritten to show respect and courtesy (James 1998).

Another component of the Internet’s value system has to do with the place of origin of the core technology as well as the bulk of the content. The Internet originated in

⁵ Some attempts to overcome the literacy and language barriers are under way. One such attempt is the creation of the Simputer (Sterling 2001), “a small hand-held device designed for the rough conditions of rural India. It operates – without a keyboard – through touch, sound and simple visual icons. It translates English-language Web sites into local Indian languages, reading the content aloud to illiterate users.”

the U.S. and most of the content available on the WWW originates in the western countries. Many people in the East, thus, tend to doubt the integrity of information originating from the Western world and view the use of English as a vehicle for executing an electronic “Pax Americana” (Shabazz 1999).

Geopolitical Factors

National institutions can take measures to influence an innovation as well as its diffusion. As discussed in the previous section, then U.S. President Eisenhower took initiatives to create the Advanced Research Projects Agency (ARPA) within the U.S. Department of Defense in 1958, thereby laying the foundation for the Internet. Similarly, measures taken by the National Science Foundation (NSF) in 1985 to make the TCP/IP the mandatory protocol accelerated the diffusion of the Internet.

Political support strongly influences the diffusion pattern of the Internet. Investments in modern ICTs alone will not bridge the digital divide in the absence of such political support (Koss 2001). Internet diffusion in several countries, especially the developing ones, has been hampered by political factors such as authoritarian governments’ concern about the flow of information on the Internet, tariff/non-tariff barriers to ICT products, and unfavorable regulatory environments that negatively influence the telecom markets (Kshetri 2001). The Internet has been described as “the greatest democratizer the world has ever seen” (Pitroda 1993, p. 66). It is, thus, incompatible with most of the authoritarian regimes. Threatened by free flow of information on the Internet and the possible negative impact on their “right to rule”, authoritarian regimes such as those of Malaysia, China, Singapore, Syria, and Cuba have opted for several mechanisms to control the Internet. For instance, the Chinese

government closed 150,000 unlicensed Internet cafes following a deadly fire in a Beijing Internet cafe and the remaining cafes are required to install software that prevents access to up to 500,000 banned pornographic sites or sites with “subversive content” (BBC News 2002). Similarly, a recent study conducted by Harvard Law School found that a central array of proxy servers in Saudi Arabia filters and blocks “sexually explicit” content (Hermida 2002).

Authoritarian regimes are also slow to enact laws to recognize digital and electronic signatures (DES) (Kshetri and Dholakia 2001). Many democratic governments lack DES laws as well. By the end of 2000, for instance, only about 45 nations in the world had laws recognizing DES (Stephens 2001). Lack of DES laws has hampered the use of the Internet for commercial and government services in several countries.

Tariff and non-tariff barriers and regulations in telecom markets are hindering e-commerce development in some developing markets. Many developing countries tend to treat ICT products as luxury items and impose import duty, surtax, value added tax, sales tax, etc., making these products expensive and unobtainable (UNCTAD 2000).

Measures Taken by International Agencies

Several international institutions have launched ICT-led initiatives to accelerate the diffusion of the Internet (Kshetri 2001, 2003; Shadrach 2002). First, international agencies have helped *introduce* the Internet for the first time in developing countries that lacked the infrastructures for the Internet (Brown et. al. 1976). In this way, the international agencies are breaking the “hierarchical pattern” (Gatignon and Robertson 1985, p. 858) of Internet diffusion – a pattern of slow trickle-down of innovations from the rich to the poor. The United Nations Development Program (UNDP) introduced the

Internet in more than fifteen countries by connecting them to the global network (UNDP 2001). Similarly, the World Bank initiated the Information for Development Program (InfoDev) in 1995 to promote projects emphasizing the use of ICTs for economic and social development. This program has a special emphasis on the needs of the poorest in developing countries.

Second, some international agencies are helping to *reduce the gap between skills required for Internet use and existing skills* of potential users in developing countries. By early 2001, for instance, UNDP had trained over 25,000 organizations and helped create over 40,000 websites for governments and civil society stakeholders (UNDP 2001).

Third, international institutions are influencing national governments to *increase the level of competition* in the telecom sector, which has resulted in the availability of higher quality ICT products and services at lower prices. In 1997, 60 developing countries made commitments to the World Trade Organization (WTO) to introduce competition in the telecom sector. Similarly, 13 developing countries also signed the Information Technology Agreements (ITA) under the WTO to eliminate customs duties on seven broad categories of ICT products.

Fourth, international institutions are facilitating the Internet *adoption by small and medium sized enterprises* (SMEs), which otherwise may be reluctant to adopt the Internet. The United Nations Conference on Trade and Development (UNCTAD) launched the Global Trade Point Network (GTPN) in 1992. Its objective is to facilitate Internet adoption by SMEs, especially for accessing global markets. As of 2000, its electronic trading opportunity (ETO) system connected more than 20,000 trade organizations worldwide.

Fifth, international institutions are *influencing national laws, regulations and policies*, and are making them more conducive to the use of the Internet for various purposes. The UN Commission on International Trade Law (UNCITRAL) undertook a major initiative leading to the adoption of the Model Law on E-Commerce. Many countries around the world have enacted new Internet laws by taking UNCITRAL model law as the guideline. The World Intellectual Property Organization (WIPO) member states also approved the establishment of WIPOnet, which provides basic, secure Internet connectivity and services to the intellectual property offices. Similarly, International Chamber of Commerce (ICC) has developed a model contract for privacy and transborder data flows. The Organization for Economic Cooperation and Development (OECD), in a similar manner, has developed action plans to address issues related to authentication, certification, consumer protection, and privacy in the use of the Internet (Kshetri 2001).

The differences in social systems across the world have been selectively summarized in Table 7 to show the influence of several factors shaping the diffusion dynamics of the Internet. It is quickly evident that countries with the lowest Internet penetration levels also have the highest restrictions on civil liberties (e.g. Sierra Leone, Pakistan and Cuba). It is possible to overcome some of the barriers to Internet penetration created by restricted civil liberties through high literacy levels, as in the case of China and Singapore. In addition to an open society and high literacy, economic resources are also necessary. Countries with the highest Internet penetration levels also have the highest levels of per capita income (e.g. USA, Finland). Finally, socio-cultural factors such as English language skills explain some of the differences in Internet penetration between Australia and Japan.

Table 7 about here

SUMMARY AND CONCLUSIONS

In this chapter, we provided an overview of the global diffusion of the Internet and examined the factors that have shaped and are continuing to shape the diffusion dynamics of the Internet. The diffusion pattern of an innovation such as the Internet is a function of economic, political, cultural, and geographical factors. Since social systems across the world differ significantly in terms of these factors, diffusion patterns of the Internet also vary widely across nations. Low levels of income, authoritarian governments' distaste toward the Internet, sociocultural environments that are incompatible with the Internet, and terrestrial barriers have hampered the rapid diffusion of the Internet in developing countries. As a result, developing countries account for a disproportionately lower number of Internet users and Internet hosts worldwide. Enlightened public policies, forward-looking corporate strategies, and concerted efforts by international agencies are of value in extending the reach of the Internet to all parts of the globe.

Table 1: Growth in the number of Internet hosts

Year	No. of hosts	No. of hosts (In millions)	Remarks
1965	2	--	TX-2 and Q-32 connection.
1970	4	--	ARPANET project had a backbone of 4 computers.
1972		--	E-Mail introduced
1973		--	TCP/IP developed
1975	100	--	
1980	200	--	“Enquire Within”, predecessor of WWW, developed
1985	2,000	--	TCP/IP mandatory for NSFNET
1986	5,000	--	
1987	10,000	--	
1989	100,000	0.1	
1990	200,000	0.2	NSFNET succeeded ARPANET
1993	2,700,000	2.7	Mosaic Web Browser developed
1994	5,800,000	5.8	
1995	14,000,000	14.0	Windows 95
1996	22,000,000	22.0	
1997	30,000,000	30.0	
1998	43,000,000	43.0	
1999	72,000,000	72.0	
2000	104,000,000	104.0	

Source: ITU (2001b); Schwimmer (2002), Webopedia.com (2002), and authors’ research.

Table 2: Geographical distribution of the Internet users worldwide (September 2002)

World Region (% of world population)	Number of Internet users (% of world users)	Remarks
North America (5.6% of world population)	182.67 million (30.2% of the total Internet users in the world)	Enjoys many advantages. The place of origin of most Internet technologies.
Europe (13.5% of world population)	190.91 million (31.5% of the total Internet users in the world)	Early connection to ARPANET proved to be of great value.
Asia-Pacific (60.2% of world population)	187.24 million (30.9% of the total Internet users in the world)	Some of the most rapidly growing Internet markets located here.
Latin America (8.3% of world population)	33.35 million (5.5% of the total Internet users in the world)	Except Mexico, Internet entered late, but is growing very fast.
Africa/Middle East (12.4% of world population)	11.43 million (1.9% of the total Internet users in the world)	Israel was a pioneer. Sub-Saharan Africa was very late. South Africa dominates.
World (Total)	605.60 million	Expected to reach a billion or more by the end of the decade.

Sources: Kshetri and Dholakia (2002),

http://www.nua.ie/surveys/how_many_online/index.html, authors' research

Table 3: Internet users (IU) and Internet hosts (IH) in Africa and Middle East (1999)

Country	IU (1999)	IU per 1000 people (1999)	IH (1999)	IH per 1000 people (1999)
Algeria	4000	4.0	158	0.005
Angola	15400	1.2	12	0.0009
Botswana	30000	18.8	790	0.5
Burkina Faso	3200	0.3	211	0.02
Burundi	700	0.3	54	0.008
Cameroon	8000	1.3	6	0.0004
Cape Verde	250	12.5		
Central African Republic	900	0.3	8	0.002
Cote d'Ivoire	15000	1.3	254	0.02
Djibouti	1300	2.2	6	0.009
Egypt	350000	4.4	3025	0.04
Ethiopia	10000	0.1	78	0.001
Ghana	18000	1.0	211	0.01
Iran	250000	1.5	293	0.004
Israel	946000	171.1	143230	23.4
Jordan	85300	17.5	518	0.07
Kenya	52000	1.5	926	0.03
Kuwait	95000	50.7	8536	4.5
Lebanon	210000	63.6	4291	1.3
Lesotho	1000	0.5	19	0.009
Liberia	400	0.2	1350	0.5
Libya	6800	1.2		
Madagascar	5300	0.3	122	0.007
Malawi	7000	0.7	1	0.00009
Maldives	3000	10.0	160	0.5
Mali	1900	0.2	1	0.00009
Mauritania	160000	61.6	21	0.008
Mauritius	45000	39.1	776	0.7
Morocco	160000	5.7	2719	0.09
Mozambique	17000	0.9	254	0.01
Namibia	14000	8.3	5175	3.05
Niger	1400	0.1	36	0.003
Nigeria	12000	0.1	820	0.007
Oman	35000	14.2	668	0.27
Qatar	40000	67.9	20	0.03
Rwanda	450	0.1		
Saudi Arabia	230000	11.0	638	0.03
Senegal	12750	1.4	320	0.03

Seychelles	4500	57.0	7	0.09
South Africa	1899000	47.6	165600	4.1
Sudan	3400	0.1	1	0.00003
Swaziland	4200	4.3	300	0.3
Syrian Arab Rep	17000	1.1	1	0.00006
Tanzania	9500	0.3	250	0.007
Tunisia	78000	8.2	30	0.003
Uganda	35000	1.7	776	0.03
United Arab Emirates	350000	146.0	35000	14.6
Yemen Republic	10000	0.6	30	0.002
Zambia	12000	1.3	400	0.04
Zimbabwe	35000	3.0	1585	0.1

Source: Euromonitor (2001a, b)

Table 4: Internet users (IU) and Internet hosts (IH) in Asia-Pacific (1999)

Country	IU (1999)	IU per 1000 people (1999)	IH (1999)	IH per 1000 people (1999)
Armenia	4500	1.3	1788	0.5
Australia	5000000	267.3	950400	50.8
Azerbaijan	1378	0.2	522	0.1
Bahrain	36000	59.4	866	1.4
Bangladesh	2400	0.02		
Bhutan	25500	0.2	54	0.02
Brunei	20000	62.1	2390	7.4
Cambodia	2450	0.2	90	0.008
China	7000000	5.5	25882	0.02
Hong Kong	1500000	220.5	99600	14.6
India	2500000	2.5	24518	0.02
Indonesia	1360000	6.5	22399	0.1
Japan	20458000	162.1	2337880	18.5
Kazakhstan	40000	2.4	1776	0.1
Kyrgyz Rep	5024	1.1	2500	0.5
Lao PDR	26300	5.0		
Macao	75000	160.6	150	0.3
Malaysia	1200000	55.0	57422	2.6
Mongolia	3600	1.4	25	0.009
Nepal	30000	1.3	168	0.007
New Zealand	800000	209.0	145000	37.9
Pakistan	100000	0.7	6192	0.04
Philippines	380000	5.1	16330	0.2
Singapore	1200000	340.7	73810	21.0
South Korea	10106000	215.5	276468	5.9
Sri Lanka	40000	2.1	550	0.03
Taiwan	4790000	216.6	509850	23.1
Tajikistan			148	0.02
Thailand	650000	10.7	28860	0.5
Turkmenistan			300	0.1
Uzbekistan	25000	1.1	472	0.02
Vietnam	25000	0.3	34	0.0004

Source: Euromonitor (2001a, b)

Table 5: Internet users (IU) and Internet hosts (IH) in Europe (1999)

Country	IU (1999)	IU per 1000 people (1999)	IH (1999)	IH per 1000 people (1999)
Austria	1650000	201.8	259500	31.7
Belarus	10000	1	1578	0.2
Belgium	1840000	181.2	365155	36.0
Bulgaria	210000	25.4	14935	1.8
Croatia	400000	89.3	10457	2.3
Cyprus	60000	77.1	8334	10.7
Czech Republic	550000	53.5	116750	11.4
Denmark	2100000	397.6	417200	79.0
Estonia	250000	177	34062	24.1
Finland	2088550	404.3	483000	93.5
France	7200000	122.2	702625	11.9
Georgia	8750	1.7	1107	0.2
Germany	12300000	149.7	1721150	20.9
Gibraltar	1801		379	0.0
Greece	1480000	139.3	34515	3.2
Hungary	450000	44.7	139000	13.8
Iceland	135000	135	31250	31.3
Ireland	500000	155.1	76526	23.7
Italy	9100000	158.7	579900	10.1
Latvia	150000	62.8	25081	10.5
Lithuania	140000	38	18819	5.1
Luxembourg	75000	176.1	10831	25.4
Macedonia	45000	22.4	1853	0.9
Malta	40000	103.6	2849	7.4
Moldova	25000	5.7	2040	0.5
Netherlands	4100000	260.6	871000	55.4
Norway	2000000	450.2	342925	77.2
Poland	1950000	50.3	178160	4.6
Portugal	800000	81	70000	7.1
Romania	385000	17.2	38791	1.7
Russia	5400000	36.7	230176	1.6
Slovakia	1000000	185.8	32045	6.0
Slovenia	490000	246.4	26335	13.2
Spain	3625000	91.5	460500	11.6
Sweden	3950000	444.2	416900	46.9

Switzerland	1700000	231.5	301350	41.0
Turkey	1200000	18.3	70865	1.1
Ukraine	262500	5.2	29663	0.6
United Kingdom	15200000	258.8	1956150	33.3

Source: Euromonitor (2001a, b)

Table 6: Internet users (IU) and Internet hosts (IH) in Latin America and the Caribbean (1999)

Country	IU (1999)	IU per 1000 people (1999)	IH (1999)	IH per 1000 people (1999)
Argentina	520000	14.2	132000	3.6
Barbados	12000	44.6	88	0.3
Belize	20000	85.8	260	1.1
Bolivia	42000	5.3	689	0.09
Brazil	6800000	40.3	376425	2.2
Chile	425000	28.5	451510	30.3
Colombia	450000	11.6	25110	0.6
Costa Rica	150000	38.6	3587	0.9
Cuba	50000	4.5	120	0.01
Dominica	48000	738.5		
Ecuador	16500	1.3	1935	0.2
El Salvador	50000	8.2	1250	0.2
Guatemala	100000	9.1	1233	0.1
Guyana	3500	5.0	72	0.1
Haiti	4000	0.5		
Honduras	27000	4.3	129	0.02
Jamaica	100000	39.2	386	0.2
Mexico	2100000	21.6	197750	2.0
Nicaragua	25000	5.1	865	0.2
Panama	52500	18.8	816	0.3
Paraguay	20000	3.8	2121	0.4
Peru	400000	15.0	5987	0.2
Surinam	10854	25.2	1	0.002
Trinidad	40000	31.1	3013	2.3
Uruguay	320000	96.9	22706	6.9
Venezuela	500000	20.9	13842	0.6

Source: Euromonitor (2001a, b)

Table 7: Internet Penetration and related indicators for selected economies in the world

Country	Internet Penetration			Factors Influencing Internet Penetration			
	No. of Internet users per 1000 (1999)	No. of Internet hosts per 1000 (1999)	Rank Order of Internet Penetration (within region)	GNP per capita (\$, 2000)	Pop. ('000), (2000)	Civil Liberty Index (2000)	Literacy rate (% , 2000)
Africa and Middle East							
Israel	155.1	23.5	1	16310	5842	2	95.7
United Arab Emirates	146.0	14.6	2	17276	2369	5	74.6
South Africa	47.6	4.2	3	3020	43421	2	84.6
Sierra Leone	1.5	0.0	4	130	5233	5	31
Asia-Pacific							
Singapore	340.7	21.0	1	24740	4152	5	91.8
Australia	267.3	50.8	2	20530	19165	1	99
Japan	162.1	18.5	3	34210	126550	2	99
China	5.5	0.0	4	840	1261832	6	82.8
Pakistan	0.7	0.0	5	470	141554	5	44
Europe							
Finland	404.4	93.5	1	24900	5167	1	99
Slovenia	246.4	13.2	2	10070	1928	2	99.6
Portugal	81.0	7.1	3	11060	10048	1	91.4
Romania	17.2	1.7	4	1670	22411	2	97.9
Latin America and Caribbean							
Uruguay	96.9	6.9	1	6090	3334	2	97.6
Argentina	14.2	3.6	2	7440	36955	3	96.7
Bolivia	5.3	0.1	3	1000	8153	3	84.4
Cuba	4.5	0.0	4	1700 (ppp)	11142	7	96.4
North America							
USA	351.7	145.6	1	34260	275563	1	99
Mexico	21.6	2.0	2	5080	100350	4	90.8

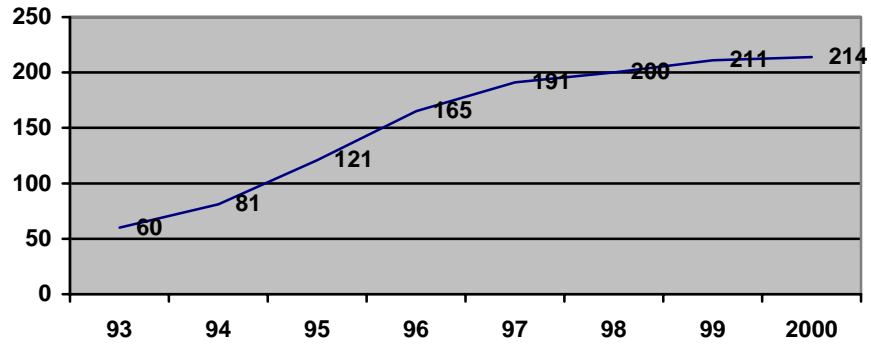
Notes: 1. ppp stands for purchasing power parity

2. Civil liberty index: 1 represents most free and 7 represents least free.

Sources:

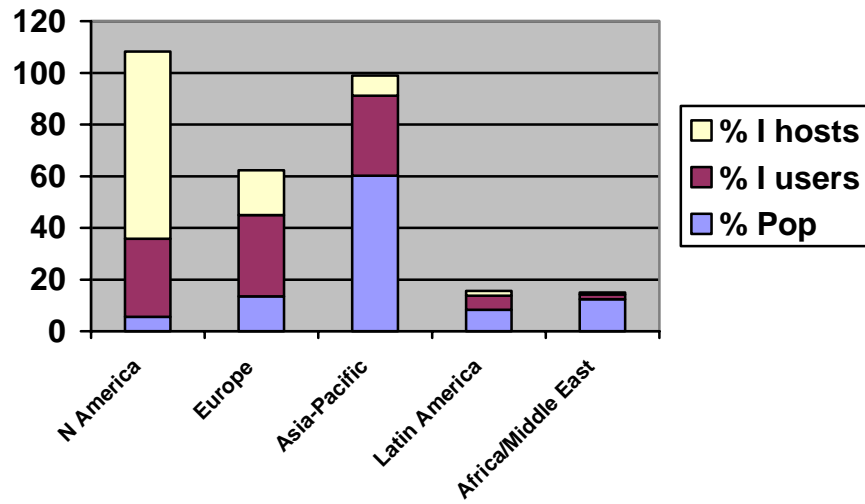
http://www.lyd.org/english/economic_freedom/percapita_income_troughout.pdf,
<http://www.odci.gov/cia/publications/factbook/geos/cu.html#Econ>, European Marketing
Data and Statistics, Freedom House, International Marketing Data and Statistics,

Figure 1: Number of countries connected to the Internet



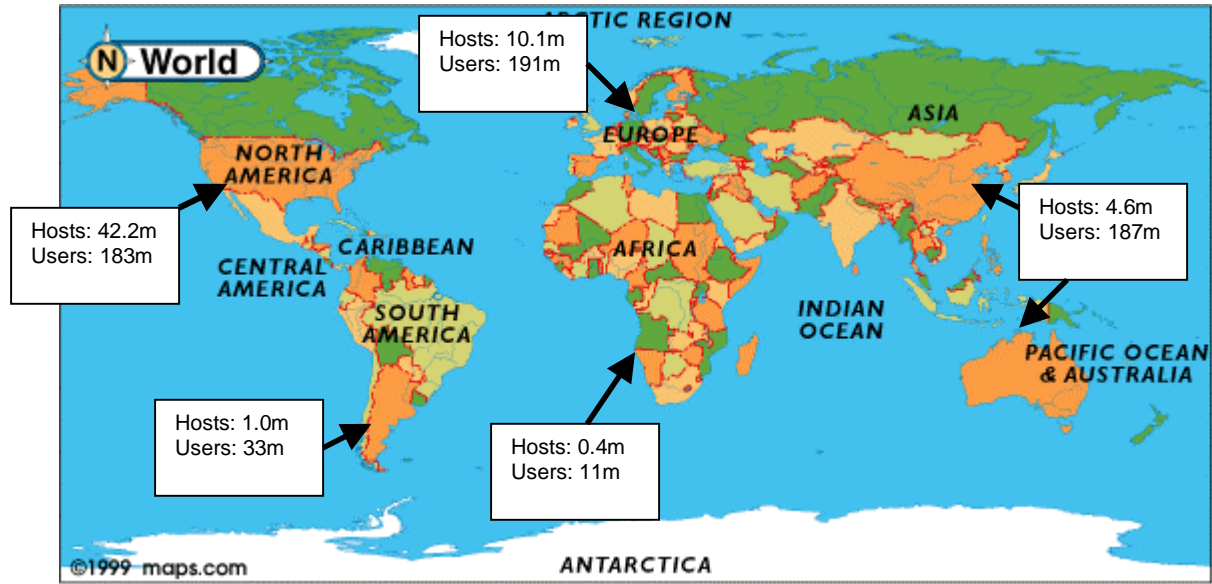
Source: ITU (2001b)

Figure 2: Uneven distribution of the Internet worldwide



Sources: Kshetri and Dholakia (2002),
http://www.nua.ie/surveys/how_many_online/index.html, authors' research

Figure 3: Global distribution of Internet hosts and Internet users



Note: Internet user data are for September 2002 and Internet host data are for the year 1999.

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