Chapter 6: The international arena

"The Internet is the most important development in connectivity this decade. It changes the way everyone conducts business, and by the end of the century if you are not connected, you will not be in business. Ultimately, international companies will use the Internet like they use the fax machine." Peter Dawe, Managing Director, Pipex, Cambridge, England.

As interest in the Internet begins to build in the United States, a useful question to ask is, "Is the Internet a phenomenon local to the United States?" The answer is, "No." International interest in the Internet is also rising. The developmental path countries are following is similar to that followed by the United States with one key difference. Awareness and applications of the Internet have grown over almost three decades. Other countries — notably Japan, Britain and France — are moving along a similar path, but more rapidly. America invented the Internet, but other countries will leverage the technology in useful and maybe surprising ways.

In countries less developed than those among the economic leaders, the Internet has become an essential communications medium for academic and research institutions. A 1993 study noted, "Frequent users are the more active, productive scientists. Scientists who use the network more also produce more papers, [and] receive more professional recognition from their peers."[I] A strong desire for connectivity exists, and it is the top talent who are working to establish Internet links. The payoff for academics and researchers on the Internet is the promise of grants, jobs and lucrative patents or licensing deals, creating an important factor in getting technical resources behind Internet connectivity.

In most countries, the existing telecommunications infrastructure often supports dial-up connections that operate at transmission speeds insufficient for large file transfer. Nevertheless, most countries have either a direct Internet connection located at a major university or research institute, or a dial-up electronic mail connection. Not surprisingly, commercial interest in the Internet is growing, but in many countries, access is not yet available. Costly international dial-up connections can be made. The Internet's success comes from its wealth of information and its potential.

Interest in the Internet recognises no frontiers. Although the Internet is an American creation, the concept of transparent connectivity is a powerful one. Over the next

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[I] Quoted in an article about global electronic mail by Jacques Leslie, 'Mail Bonding,' Wired, March 1994, page 46.

Top 20 Internet users ranked by % growth of data exported			
Country	**Bytes In 1992**	**Bytes In 1993**	**% Change**
Malaysia	8,639,200	378,790,150	4,285
Latvia	5,572,300	177,485,500	3085
Croatia	10,700,300	330,553,900	2989
Cyprus	892,000	16,546,050	1755
Ecuador	26,412,250	339,659,250	1186
India	67,451,200	847,665,200	1157
Slovenia	60,047,450	539,228,750	798
Thailand	81,941,600	610,994,800	646
Estonia	52,993,950	327,406,450	518
Belgium	743,887,450	4,343,549,900	484
Poland	405,100,900	2,020,308,650	399
Czech Republic	388,436,450	1,911,759,300	392
Taiwan	10,697,082,050	50,498,282,750	372
Hungary	225,805,000	975,560,600	332
Korea	2,760,107,900	11,590,573,800	320
Spain	1,032,180,250	3,918,076,050	280
Italy	7,313,011,250	27,034,603,750	270
Ireland	556,944,300	1,968,757,150	253
United Kingdom	25,692,645,600	89,975,928,550	250
Mexico	2,632,411,900	8,662,436,050	229

three to five years, demand for Internet connectivity will continue to grow. As nations achieve access to electronic mail and other basic network services, users begin to want more advanced services. Although demand is likely to remain unmet in many nations with weak economies, users throughout the world will seek access to the global community. Thus, successive waves of Internet usage will sweep through the system as countries add capacity and usage expands from academic users to the commercial user community.

The challenge this poses to the loose federation of systems that comprise the Internet are significant. Certain Internet sites in the US are now overloaded. Bottlenecks can easily occur at numerous points in a system. Technical solutions are available, but regardless of price, many nations and their institutions cannot afford the investment in infrastructure.

Commercial enterprises such as American Telephone & Telegraph (AT&T) and other large telecommunications companies want to expand their markets. One possible solution to a single country's inability to pay for an infrastructure within its borders is to participate in a regional or continental consortium. Nippon Telegraph & Telephone (NTT) has invested in Thailand and other Pacific Rim countries.

% rank by growth of total networks			
Country	Internet-capable networks at end 1992	Internet-capable networks at end 1993	% Change
Ecuador	1	25	2,400
Iceland	2	22	1,000
Estonia	3	29	867
Thailand	2	18	800
Hungary	7	59	743
Luxembourg	1	8	700
Belgium	10	45	350
Israel	21	80	281
Poland	14	50	257
Mexico	15	50	233
Chile	8	26	225
Kuwait	1	3	200
Brazil	29	86	197
Norway	35	94	169
Ireland	13	34	162
Czechloslovakia	30	75	150
Slovenia	6	15	150
Finland	55	134	144
United Kingdom	210	511	143
Hong Kong	8	18	125

But the most dramatic proposal has been to ring the continent of Africa with fibre optic cables.

Africa's Internet connections are located at the major universities in the principal countries. AT&T has proposed encircling the continent with high-bandwidth fibre optic cables, requiring an estimated 20,000 miles of fibre to ring the continent. The cabling scheme would permit seamless linkages to cables to Japan, Europe and other locations and the new system would work with existing telephone systems in Africa. AT&T is also actively involved in similar projects in Eastern Europe and Asia.

The estimated cost for this project is $1.5 billion, and AT&T has suggested that a consortium of African nations pay for the cable. No firm timetable for the cabling has been announced, although preliminary announcements project the system will be operation in 1997 or 1998.

Current usage of the Internet, according to *Matrix News*, a newsletter reporting on significant Internet happenings, is from users in the US. Viewed from a different

Top 20 countries ranked by percentage increase in total data transfer in 1992 and 1993

Country	Bytes into country in 1992	Bytes out of country in 1992	Total data transfer in 1992	Bytes into country in 1993	Bytes out of country in 1993	Total data transfer in 1993	Percent change
Croatia	10,700,300	13,197,050	23,897,350	330,553,900	1,172,196,700	150,275,060,062	6,188
Latvia	5,572,300	32,254,050	37,826,350	177,485,500	1,284,443,050	1,461,928,550	3,765
Malaysia	8,639,200	69,900,700	78,539,900	378,790,150	2,201,545,150	2,580,335,300	3,185
Cyprus	892,000	3,708,550	4,600,550	16,546,050	109,153,750	125,699,800	2,632
Thailand	81,941,600	201,939,400	283,881,000	610,994,800	4,037,458,900	4,648,453,700	1,537
Slovenia	60,047,450	343,082,150	403,129,600	539,228,750	4,061,504,200	4,600,732,950	1,041
India	67,451,200	295,934,100	363,385,300	847,665,200	2,538,671,800	3,386,337,000	832
Hungary	225,805,000	1,086,950,550	1,312,755,550	975,560,600	6,336,459,550	7,312,020,150	457
Poland	405,100,900	1,954,616,200	2,359,717,100	2,020,308,650	8,031,578,050	10,051,886,700	326
Estonia	52,993,950	501,633,150	554,627,100	327,406,450	1,953,164,200	2,280,570,650	311
Korea	2,760,107,900	12,296,256,400	15,056,364,300	11,590,573,800	44,734,797,000	56,325,370,800	274
Japan	11,345,748,450	21,685,828,900	33,031,577,350	31,805,727,350	75,710,017,000	107,515,744,350	225
Mexico	2,632,411,900	7,868,792,750	10,501,204,650	8,662,436,050	24,739,838,300	33,402,274,350	218
Netherlands	19,216,791,000	28,391,685,750	47,608,476,750	60,895,282,750	72,458,646,900	133,353,929,650	180
Iceland	831,002,450	665,233,650	1,496,236,100	1,168,116,050	2,747,382,650	3,915,498,700	162
Belgium	743,887,450	7,133,347,400	7,877,234,850	4,343,549,900	16,001,005,550	20,344,555,450	158
Hong Kong	1,514,783,450	11,521,138,900	13,035,922,350	4,705,501,600	28,806,130,150	33,511,631,750	157
Spain	1,032,180,250	5,648,103,300	6,680,283,550	3,918,076,050	13,243,121,100	17,161,197,150	157
Canada	71,822,744,850	185,690,038,650	257,512,783,500	190,742,070,200	462,861,900,750	653,603,970,950	154
Czech Republic	388,436,450	3,918,944,400	4,307,380,850	1,911,759,300	8,824,203,050	10,735,962,350	149

Countries ranked by % growth of data exported via Internet in 1992–93			
Country	**Bytes out in 1992**	**Bytes out in 1993**	**% Change**
Kuwait	22,600	1,291,724,200	5,715,494
Croatia	13,197,050	1,172,196,700	8,782
Latvia	32,254,050	1,284,443,050	3,882
Malaysia	69,900,700	2,201,545,150	3,050
Cyprus	3,708,550	109,153,750	2,843
Thailand	201,939,400	40,387,458,900	1,899
Slovenia	343,082,150	4,061,504,200	1,084
Ecuador	144,902,800	1,446,883,900	899
India	295,934,100	2,538,671,800	758
Hungary	1,086,950,550	6,336,459,550	550
Iceland	665,233,650	2,747,382,650	313
Poland	1,954,616,200	8,031,578,050	311
Estonia	501,633,150	1,953,164,200	289
Korea	12,296,256,400	44,734,797,000	264
Japan	21,685,828,900	75,710,017,000	249
Venezuela	709,127,800	2,403,955,050	239
Mexico	7,868,792,750	24,739,838,300	214
Netherlands	28,391,685,750	72,458,646,900	155

angle, about 30 percent of the estimated 20 millions users, or about 6 million users, are from outside the US. The majority -that is, more than 80 percent of non-US usage — is concentrated in Australia, Germany, Canada, the United Kingdom, Sweden, The Netherlands, France, Switzerland, Finland, Norway and Japan.

In terms of the amount of data transferred, the US in 1993 accounted for more than 16 terabytes of information. In contrast, the United Kingdom, the largest European Internet user in 1993, accounted for three terabytes of data transfer, and Japan, the largest Pacific Rim Internet user, moved about two terabytes of data. (A terabyte is a trillion bytes of information. A single CD-ROM in IS0 9660 format can hold about 650 megabytes of data or more than 1,000 floppy diskettes. A terabyte is 1,099,511,627,776).

Looking at the 1993 usage data in terms of the net change in data transfer into and out of a country, it is significant to note that strong gains were made by countries that are generally viewed as having modern infrastructures. Countries showing a strong growth in data transfer include Taiwan, the United Kingdom, Ireland, Italy and Belgium. That strong gains have been made by countries with a strong

commitment to commercial interests — for example, Thailand and India — is expected.'

When one looks only at data transferred from one country to other countries, the greatest change appears in two nations that were sites of military conflict, Kuwait and Croatia. Other strong exporters of information include some countries one might not perceive as information producers; namely, India, Korea, Japan and Hong Kong. Looking at Internet usage in terms of information imports or data transfers in the list reflects strong growth in certain Pacific Rim countries (to be expected) and strong growth in new Eastern European entities (somewhat less expected).

Based upon these figures provided by the Internet Society, the international arena is robust. See the tables in this chapter. However, at the moment and for most practical purposes, the Internet phenomenon remains peculiarly American; by the year 2000, however, the Internet usage patterns will shift so that the percentage of US usage will decrease as more countries expand their Internet connectivity.

1. Factors influencing Internet usage

The popular journalists describe a global information highway that supports a wide range of electronic information products and services. Only in countries with highly-advanced telecommunication systems will Internet access support image- or video-enabled applications.

Today's Internet usage is based upon the need for rapid, low-cost messaging services. But as additional applications become feasible from a cost and technology standpoint, usage patterns change. Thus, the US will continue to be a dominant usage centre, particularly as image-enabled and videoconferencing applications emerge. Other countries are likely to follow a similar developmental path at a pace dictated by each country's circumstances.

Internet usage is directly linked to several factors:

- Population
- Penetration of access technology; that is, personal computers or work-stations, communications software and modems and file servers
- The availability of telecommunication lines
- Access to those lines.

In certain countries where governmental control over telecommunications resides with a single or a small number of licensed entities, the political environment plays a significant role in the telecommunications infrastructure itself. Within the last six years, significant steps have been taken in Britain and Canada to provide telecommunications customers with a choice of providers. In Toronto, Canada's largest

[1] Usage information was downloaded from the Network Information Centre. The United States is excluded from all charts except the aggregate usage summary in order to highlight Internet activity in other countries.

city, Internet access is available from UUNET and a handful of other providers. Within 24 months, the number of providers will increase by a factor of two or three in response to strong demand from the commercial market. In Japan, the privatisation of the Nippon Telegraph & Telephone Co. has created a more competitive environment for certain types of lines. International calls from Japan to other countries, for instance, often cost less than comparable calls from other countries. However, telephone service for point-to-point calls are about twice as expensive as comparable service in the United States.

Many countries adopt policies that provide 'administrative guidance' or 'direction' to the type of telecommunications infrastructure built, the fees associated with different levels of services, and the access certain types of users have to those services.

In general, more commercially-oriented or competitively-informed policies appear to encourage wider usage of the Internet and other high-bandwidth communications services. Not surprisingly, countries such as Australia, Germany, The Netherlands and Canada are moving forward at a more rapid pace than countries that have different social, political and commercial agendas.

With the rapid developments in satellite and wireless network technology, it is inevitable that the need for a hard-wire telecommunications infrastructure will diminish in certain situations. Will China build a US-style infrastructure? The answer seems to be that wireless technology may provide an alternative. Thus, many countries that one might categorise as sub-par when measured against the telecommunications infrastructures of the United States, Western Europe or Japan, are likely to be able to achieve rapid gains as advanced technologies become more widely available and less expensive.

Internet usage in developing countries will parallel in some ways the growth in the US, albeit on a compressed time scale. What took the US 30 years to accomplish, may be reduced to three to five years. A second wave of growth will ripple through the Internet when countries without a hard-wire telecommunications infrastructure adopt satellite and wireless technologies on a broader scale. Some countries may give Internet connectivity a higher priority which will accelerate international growth.

Can the Internet survive with double-digit monthly growth for five years? This question cannot be answered because the Internet has yet to be tested in such a high-use environment.

Will standards emerge that permit seamless linkages to the Internet? The TCP/IP protocol has become the *de facto* standard for global wide-area networking. Most countries support to some degree the standards promulgated by the ITU (the International Telecommunications Union), which has more than 170 member nations. The Comité Consultatif International de Telephone et Télégraphe

(CCITT), now referred to as ITU-T, is the standard body under ITU that establishes recommendations for data communication.'

2. Regional activities

2.1 Western Europe

The three sectors fuelling the Internet's growth in Europe are the computer industry, financial services and publishing. The three best known Pan-European initiatives are RACE, ESPRIT and IMPACT which date from the 1980s. There are, however, dozens of Internet initiatives springing up.

France Telecom in conjunction with Deutsche Telekom, British Telecom, Telefonica in Spain, Italy's STET/ASST and Sweden's Telia, has embarked on a programme to build GEN, the Global European Network. The concept is to help lay the foundation for METRAN, the Managed European Transmission Network. The objective is to support data transmission at rates of up to 155 Mb/s across Europe. European-based providers of the Internet Protocol plan to set up neutral interconnection points, called Global Interconnection Exchanges, in Paris and Stockholm. GIXs will give new service providers automatic access to other Internet providers and users and keep entry costs low.

More recently, the European Internet Protocol Backbone (EBONE) began operations in 1992. The backbone consists of five principal server sites: Amsterdam, London, Geneva, Montpellier and Stockholm.

There are three links — Stockholm, London and Geneva — to the United States. Following the model of the Internet in the US, an EBONE Action Team (EAT) has engineering responsibility for the backbone and has worked out plans for implementing the backbone in Western Europe, routing packets and implementing new services.*

EBONE has an ongoing project to create a separate organisation to act as a clearinghouse of network services. Whether this project will develop into a direct provider of services, or function as a purchasing centre for other vendor's services and resell them, is difficult to pinpoint. Different network service options are possible. EBONE could market its own value-added services or broker the services of other providers, reselling them to European research and development groups and other entities.

A new dial-up Internet service spanning 12 European countries is also underway. The EUnet, which claims to be one of Europe's largest Internet access providers, has also introduced its Traveller service, designed to give travelling Internet user

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[1] The various standards documents are available on the Internet. To receive standards documents, send electronic mail to the auto-response mail server at *teledoc@itu.arcom.ch.*

[2] Information in the Regional Activities' summary is drawn from 1992, 1993 and 1994 issues of *The Internet Society News* unless otherwise noted.

access to their own machines and the Internet from dial-up telephones in Western Europe. There are 12 local dial-up access points in participating countries.

Customers pay the local country's domestic telephone charges, not international charges. Users pay a one-time sign-up fee of ECU 30. A fixed monthly rate of ECU 30 includes three free hours of connect time. For each additional connect hour, the user pays ECU 10.

New users receive password, telephone numbers for each country where the service is available and technical information about telephone and power plug compatibility. The service was initially available in Austria, Belgium, Finland, France, Germany, Hungary, Ireland, The Netherlands, Norway, Switzerland and the United Kingdom with more planned.

2.2 Eastern Europe

Internet connectivity is accelerating in Eastern Europe. Czechoslovakia and Poland are among the most networked in the region, and each has more than 200 connected hosts. Bulgaria, Estonia and Hungary also have Internet Protocol connectivity, and each nation has more than 20 connected hosts.

Within the next two to five years, virtually every country in Eastern Europe will have full Internet connectivity available at major academic and research sites. Commercial access to the Internet, however, remains limited.

A common problem to Eastern European countries is saturation of available telecommunications links. Funds and technical resources to upgrade existing lines are not readily available. Until the infrastructure is enhanced, connectivity options are unlikely to grow and demand will outstrip supply for the foreseeable future.

The strongest advocates of Internet connectivity are researchers. The support for Internet access is, in most countries, led by the national academic network organisations. Most countries have Internet access from major universities. However, in many locations only dial-up electronic mail is available over low-speed telephone lines.

Albania. Currently an electronic mail connection exists between the University of Tirana and the Internet. The gateway and relay function resides in Italy at CNUCE in Pisa.

Estonia. Estonia works closely with NORDUnet, a Scandinavian service provider in Sweden. A 64 Kb/s satellite link links Tallin and Stockholm, and Tarto and Stockholm. BaltNet, the Baltic backbone network, provides links to other Internet sites. Medium-speed dial-up connections are available between Tallin and Helsinki. Inside Estonia, dial-up Internet links exist between the Institute of Cybernetics and the University of Technology, and Tartu University.

Latvia. An international 14.4 Kb/s Internet Protocol line connects the Institute of Informatics and Computer Science of the Latvian University in Riga to the Institute of Cybernetics in Tallin, Estonia. This line is part of the Baltic backbone network

(BaltNet). Other networks active in Latvia have only dial-up connections; a dial-up bulletin board system (FidoNet) link exists to Tallin and Helsinki. Within Latvia, X.25 service is available from Latpak and Sprint. Standard UNIX file transfers are available from Latvian partners of RELCOM, based in Moscow.

Bulgaria. A switched international X.25 connection connects the Bulgarian EARN node in Sofia to Linz (Austria). A dial-up connection over public X.25 connects the Bulgarian EUnet via the backbone node in Vama to the Internet via the EUnet node in Heraklion (Greece).

Russia. Dial-up connections between Helsinki, Finland and Amsterdam, The Netherlands on the one hand, and Moscow on the other hand, connect the RELCOM network with several former Soviet republics to the Internet.

Currently the services consist of electronic mail and Network News. Dial-up links to service providers in Amsterdam are available. A dial-up 14.4 Kb/s Internet Protocol link has been established between Moscow and AlterNet, a US service provider. Only limited Internet access is permitted. There is a 4.8 Kb/s leased line between Moscow and DESY in Hamburg, Germany. This link provides Internet services to several research institutes in Moscow. Existing IP links to the former Soviet Union have full Internet service to certain European sites.

RELCOM has expanded access to electronic mail to more than 2,000 sites in the former Soviet Union. Usage of electronic mail is doubling every six months. RELCOM sites include St. Petersburg, the Ukraine, Siberia and other regions. RELCOM links about 60 regional centres. Several of these centres connect more than 500 sites. The rapidly growing volume of international mail traffic makes the need for a medium speed IP channel to Europe urgent.

The first EARN node began operations in Moscow in 199 1. An electronic mail gateway is operating but full Internet access is not available. A Freenet service is now operating in Moscow but it provides only limited Internet connectivity.

The Czech Republic. A 64 Kb/s Internet Protocol link between Prague and Linz (Austria) is in operation, and it supports full Internet connectivity. There is a second link operating at dial-up speeds of 14.4 Kb/s between Bratislava (Slovakia) and Vienna.

An upgrade of this link to 64 Kb/s is planned. Both links connect into the upcoming national academic backbone networks CESNET (Czech Educational and Scientific Network) and SANET (Slovak Academic Network). These networks are co-operating to create a backbone infrastructure to connect major research institutions across the two countries. Internet connectivity is available in the major cities.

Poland. Dedicated, dial-up and satellite links are available. A 9.6 Kb/s Internet Protocol connection is in place between Krakow and CERN in Geneva, Switzerland. Public X.25 services began in 1992 and connections are available principally on switched or leased lines. Leased lines are shared between EARN and Internet Protocol traffic operating at medium speeds.

The Polish network is co-ordinated by an organisation called NASK (National Academic and Research Network). This organisation includes Poland's EARN representatives. A National Network Operation and Monitoring Centre plans to build a backbone operating at 64 Kb/s. Internet user training and support are available from NASK.

2.3 North Africa

The Tunisia-based Institut Regional des Sciences Informatiques et des Télécommunications (IRSIT) provides three nodes to the Internet and wants to help set up other international nodes in North African countries. The focal point of IRSIT's efforts is universities and research and development organisations. Proposed partners in the expanded network include Algeria and Morocco.

2.4 Latin America

In this region, Internet connectivity is available at most of the major academic institutions. In the Caribbean and Central America, the user populations may still be low (except for Puerto Rico and Costa Rica), but infrastructures are in place which indicate that further developments can be expected in the coming months.

In Mexico, both academic and commercial access is available. MexNet serves 400 North American clients and 50 in Mexico.'

2.5 Pacific Rim

In general, with the exception of Australasia, Internet connectivity is limited to academic and research institutions.

In Singapore, the 'intelligent island,' Internet access is closely monitored by the government with access available from a single network. The National Computer Board adopted what is known as *Information Technology* 2000, a plan to transform Singapore into Asia's information technology centre. A number of government-authorised networks link commercial enterprises, government agencies and external networks. In addition to supporting access to international networks, the Singapore approach provides a platform (TechNet) on which paperwork moves in electronic form. The government does not permit direct access to the Internet without appropriate approvals and authorisations. Because Singapore has taken a firm stand on print information flow, Internet's free flows of information are seen by some in the government as a potential threat. The strong commercial orientation of Singapore is setting the stage for broader business access to the Internet as part of the nation's aggressive commercial posture.[2] Connection fees have been reduced to stimulate greater usage of TechNet and Internet access. Business considerations appear to be a significant factor in Singapore.

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[1] Andrew Levison, 'Latin America Online,' *Database,* December 1993, pages 14-28.
[2] Mary Cronin, *Doing Business on the Internet,* New York: Van Nostrand, 1994, pages 68-69.

Estimated demand for internet access in selected Caribbean basin entities		
Country	1993 Customers	Estimated 1994 demand
Costa Rica	900	2,500
Cuba	800	9,500
Dominican Republic	50	1,000
Nicaragua	100	1,000
Puerto Rico	2,400	3,000

In Taiwan, Hong Kong and Thailand, interest in commercial access to the Internet is growing rapidly. Japan's activities are closely monitored and are likely to be emulated by other Pacific Rim countries in the near future.

In China, access is available from major research institutions. Technology is spreading within the nation. However, Internet access is limited and demand exceeds supply. The technical infrastructure varies from advanced in the major universities to almost non-existent in remote provinces. The size of the nation and the hunger for connectivity represent a two-edged sword for the government. Connectivity is essential for expanding commercial, scientific and technical activities. However, access to information is likely to accelerate certain processes beyond the institutions' and infrastructure's ability to adapt. From a marketing perspective, China represents a potentially significant market for a range of hardware, software and telecommunications services.

The Pacific Rim will become increasingly important as the infrastructure in the individual countries advances. The growth in capability will be uneven with the commercially-successful nations taking the lead.

3. Selected country Internet activities

The purpose of this brief review of selected countries is to provide a snapshot of the type of telecommunications infrastructure for Internet connectivity that is in place, under development, or planned.

3.1 Canada

Canada has announced *Access Canada,* an agency to spearhead the construction of the information highway. The government sees Access Canada as co-ordinating the millions of Canadian dollars spent on electronic information and telecommunications. It would co-ordinate the delivery of government services electronically as well as various types of network services. Access Canada would be jointly controlled by the government and the private sector.

The proposal is an outgrowth of expanded investment in electronic information produced in Canada. *Canarie*, the Canadian Network for the Advancement of Research, Industry and Education, is building a high-speed backbone to expand Internet services to academic and research institutions.

Both Access Canada and Canarie focus on a home-grown approach to the information highway. One of the priorities of the Canadian networking initiative is to use the technology to address cultural diversity issues. Canada has distinct ethnic groups that are becoming increasingly vocal about their need for language-specific services. The idea is that when Canadians go online, they can learn about the diverse Canadian culture.

The new initiative will work closely with the provinces. Ontario, Quebec and Saskatchewan are moving aggressively to provide Internet connectivity to libraries, schools at all levels and commercial enterprises. Sasktel, the principal telecommunications provider in Saskatchewan, has announced $30 Canadian per month Internet connectivity. Educators are discussing use of the Internet in distance learning and aboriginal course material distribution, since commercial publishers do not provide course material in certain languages such as Cree.

Government officials believe that an investment in advanced network technology will spur job growth and provide citizens with universal access to information.

3.2 France

France is one of the world's leaders in interactive communications. The decade-old Minitel videotex service has become a visible reminder of electronic information access in that country.

Edouard Balladur, the Prime Minister, commissioned an official report on electronic superhighways prior to introducing new telecommunications legislation in parliament. Government officials anticipate that significant investments will be required to develop robust interactive information services.

With regard to high-bandwidth Internet services, France Telecom has funded a project to permit videoconferencing, video transmission and LAN interconnection. The commercial launch is targeted for 1995, at which time France plans to have more than 17,000 kilometres of fibre optic connecting major commercial centres.

France is also participating in PEAN, the Pan European ATM Network. This is a pilot project set up by 18 European telecommunications providers. Nodes will be located in Austria, Belgium, Denmark, Finland, France, Germany, The Netherlands, Norway, Spain and Sweden. The proposed network will support such high-bandwidth applications as video and image data transmission. PEAN members will install ATM technology and conform to the standards and recommendations of the CCITT/ITU, ETSI (European Telecommunication Standard Institute) and technical specifications from Eurescom in Heidelberg, Germany.

France Telecom has started another project with Telecom PTT Switzerland called Betel (Broadband Exchange over Trans-European Links), and applications running include distance learning via videoconferencing and sharing supercomputers for scientific computing tasks.

3.3 Germany

Germany has one of the most extensive fibre-optic networks in the world. The country is playing a pivotal role in virtually all of the multi-nation and trans-border telecommunications activities in Europe. Within Germany, officials see the high-bandwidth network linking research centres, businesses, and eventually homes. ISDN is available in certain large cities and will be available for general use by 1996.

Deutsche Bundepost Telekom has joined with France Telecom to develop business-oriented networking services. In addition to Internet Protocols, the service will provide a range of networking services, including those tailored for small businesses. A single backbone will link the two countries. The network will be jointly owned and will eventually employ more than 4,000 people and have a turnover of ECU 1.5 billion before the end of the decade. The principal advantages of such a network include uniform network infrastructure and a one-stop shop for network services. Service will be provided to other European countries as well.

3.4 Japan

Internet connectivity has been available for more than a decade to users of Japan's academic and research network, NACSIS. Corporate and individual connections have been less widely available.

For academic Internet access the Widely Integrated Distributed Environment (WIDE) provides a demonstration of large scale distributed systems technologies. Initially, WIDE connected several campus networks. However, it has expanded in the last several years to link more than 50 different organisations. WIDE has funding from the government and about two dozen Japanese companies.

WIDE links the user organisations to six nodes using 64-192 Kb/s leased lines. The WIDE backbone handles traffic from other research organisations. These include the Japan University Network (JUNET) and the Japan Academic Inter-University Network (JAIN). WIDE also provides connectivity to Todai's TISN (the University of Tokyo's International Science Network), NACSIS Science Information Network (SINET) and BITNET-Japan.

NTT, Japan's largest common carrier, has a high-bandwidth network that is almost 70 percent fibre. Digital links are available in most major cities. ISDN is readily available with more than more than 230,000 basic-rate ISDN and 3 100 primary-rate circuits.

Commercial Internet access is now available from InterCon Systems Group, an Internet network service provider based in the US in Virginia. InterAccess believes that it is the first commercial provider of trans-Pacific Internet access. InterCon was granted permission by the Japanese government for international data traffic.

InterAcces is based on a 128 Kb/s frame-relay dedicated line between InterAccess Japan and the Virginia-based affiliate. Three levels of service are now available. For ¥315,000 per month plus a setup charge of ¥60,000, organisations get a 19.2

Kb/s link. For T1 speeds of 1.5 Mb/s with installation and technical support, the cost is ¥1,565,000 per month plus a setup fee of ¥100,000.

Other groups are seeking approval to offer Internet access to commercial organisations as well. One is the Internet Initiative Japan (IIJ).

Japan's strategic objective is the Next Generation Communications Infrastructure. At some point before 20 15, all homes and offices within Japan will be linked with high-bandwidth fibres. Cost estimates prepared by NTT require annual investments of about $18 billion per year through 2014. The total cost exceeds $410 billion.

Applications of the Japanese information highway are likely to focus on professional and business uses. Japan's deregulation of telecommunications has fostered increased competition among Japanese companies. Cable television businesses can now offer communications services as well as broadcasting. Non-Japanese telecommunications companies and carriers will face lower barriers to entering the Japanese market. One American Regional Bell Operating Company is rumoured to be planning a cable-based experiment in Yokohama with Japanese partners. The US giant TeleCommunications, Inc. has teamed with Suginami Cable Television to test an interactive service.

3.5 South Africa

This country has an academically-based Internet network. The Foundation for Research Development (FRD) provides a gateway for connections from its Uninet, the national academic and research network.

The principal use of the link is the exchange of electronic mail. About 500 megabytes of messages are exchanged each day with the United States. South Africa is one of the few candidates in the continent to contribute to regional economic development and Internet use.

The nation's information technology sector is more developed than in such other countries as Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe.

Rhodes University supports low-bandwidth connections from other African countries to the Uninet and its Internet gateway at Rhodes University.

The principal challenges in South Africa is to expand access to the service from its present user base drawn from the economically-advantaged stratum of the society and upgrade the technological infrastructure.

3.6 United Kingdom

The Joint Network Team (JNT) is the national organisation in the United Kingdom that provides a broad ranges of services and support to the academic community. JNT is a funding agent for the Information Systems Committee of the Department for Education's University's Funding Council, with other funding contributions

being made by other bodies including the Research Councils and the Polytechnics and Colleges Funding Council.

Its principal services include the JANET X.25 service and the JANET IP service. Virtually all major universities and Research Council locations are connect by 2 Mb/s links. Sites are linked to the X.25 server as well as other network services.

In collaboration with the National Science Foundation in the USA, a 768 Kb/s link between the United States and the United Kingdom is available. The link also connects to other networks in Europe. At some point, when funds become available, the link will be upgraded to a higher bandwidth and extend the links to cover as much as one-third of Europe. The United Kingdom JNT was one of the first groups to back the EBONE concept.

A service known as SuperJANET is also available. It is an advanced communications network for advanced research and is approximately 1,000 times faster than JANET. The network will support data throughput of up to 140 Mb/s per second, and provides support for advanced inter-networking applications, including video-conferencing. SuperJANET uses fibre optic technology. Applications available include high performance computing, distance learning, electronic publishing, library document distribution, medical imaging and multimedia information services. More than 50 sites are linked. The service complements the Joint Academic Network (JANET) which connects more than 200 sites.

Funding to link the British Library Document Supply Centre with other sites has been provided. SuperJANET will use broadband technology increasingly based on ATM, which is proposed for use in other high-bandwidth network applications, including the US National Research and Education Network (NREN) and the French academic Network, Renater. Pilot projects for SuperJANET include networking of images of rare manuscripts and the development of an electronic journal with full-page imaging.

Commercial links to the Internet are available as well. One of the best known is Pipex (Public Internet Protocol Exchange Ltd.), which began operations in 1992. Pipex offers Internet connectivity to London's business and financial communities. The firm plans to open additional offices in Britain and in other European countries. Within months of beginning operations, the firm had more than 150 customers for its Internet service.

Like most Internet access providers, Pipex plans to work with commercial organisations to make appropriate use of Internet connectivity. In countries where Internet-related knowledge is not widely available, Pipex wants to work with established network service providers to include Internet access. Pipex has begun discussions in France, Germany, Ireland, The Netherlands, South Africa and Zambia.

The British arm of EUnet had sales of just under&l million for 1993. Forecasts for 1994 call for 100 percent growth. EUnet Europe operates in 27 countries and now serves around 100,000 people in about 10,000 organisations. More than 12,000 of its users are in the United Kingdom.

4. Outlook 2000

The Internet's growth does not only apply to the United States. It represents a path to access. Once connected, a broad range of electronic information services is available throughout the world. By 2000, non-US Internet innovation seems likely to loom large as the world moves toward the Total Network.

4.1 Some thorny issues

In the next few years, a number of issues must be resolved. Political barriers do remain, although state-owned monopolies are embracing standards that support Internet Protocols. In many countries, competition is increasingly seen as one way to shift some of the burden of investment from the public sector to the private sector. But low-cost access to communication services has been the primary fuel for the Internet's growth. If the costs are prohibitively high, access to the Internet will be limited to the wealthiest nations, institutions and individuals. In an environment of connectivity, access becomes one key to success. Without that key, nations can find it more and more difficult to participate in routine activities.

There is considerable variability in the telecommunication infrastructures within nations. However, at some point in the future, technology will permit Internet connectivity. Without continued investment in their telecommunication infrastructures, nations will find themselves unable to provide the level of access and support for advanced services users want. It is possible that wireless technologies will provide a solution at costs lower than those associated with physical cables. Unfortunately such solutions are five or more years in the future and unlikely to provide a quick, easy solution for many poorer nations.

At present, the interest in the Internet takes many forms. These range from the efforts of certain nations to be connected to the Internet for electronic mail, to Japan's programme to build its own information highway. For many European nations, the goals are to expand access and bandwidth. Even for the wealthiest nations, the developmental path from basic connectivity to advanced videoconferencing and database services is difficult and costly. The path for the United States required several decades to traverse, and the falsely romanticised information highway that has captured the attention of journalists and entrepreneurs has raised expectations for cheap, high-speed connectivity to electronic information services far beyond electronic mail. When expectations rise to unrealistic heights, disappointment is often a consequence.

International access to the Internet will advance with the most affluent nations moving rapidly and the less affluent moving more slowly. An optimist would argue that technology will provide nations with a low-cost solution to connectivity. One less inclined to believe in low-cost technical solutions would point to the gap between countries with more advanced telecommunications infrastructures and those without. At the end of this century, the world may be stratified along lines etched in economic reality by access to the Internet.

4.2 Rapid progress detectable

Stepping back from the thorny issues of parity among nations and the political and social consequences of economic disparity, it is clear that when nations, organisations, or individuals have the money, rapid movement along the Internet developmental curve will take place. Among the reasons, more rapid progress can be made today are:

- The US, acting as a large-scale Internet laboratory, provides technical solutions and working applications of services that users want, need and use.
- The declining cost of many technologies results in their becoming more widely affordable and thus available.
- Newer technologies are becoming more flexible, scalable and extensible. Change becomes less expensive and easier than before.

However, all countries, including the United States, must wrestle with what might be called *the next step.* As users become more aware of the benefits and uses of Internet-like services, demand for more robust applications is inevitable. Although less costly and difficult than a few years ago, moving to a higher bandwidth in Africa or installing the infrastructure for wireless telecommunications in Taiwan has significant cost and policy implications.

The European Internet linking the economically-advanced nations will achieve critical mass in five years. At that time, demand for Internet access will mirror growth and usage patterns in the United States since 1993.

Japan will experience similar demands for Internet services on roughly the same time scale, but the Pacific Rim will lag behind Europe by three to five years due to numerous social, political and economic factors.

It is not clear how Internet connectivity will come to many of the poorer nations and regions in the world. The answer depends in large part upon the availability and cost for advanced wireless telecommunications technology.

International networks have been described as electronic cocktail parties for professionals, and as digital neighbourhood taverns for computer users. These networks will become more and more powerful and necessary as information resources and as primary communications tools. So far, only large international businesses or those located in countries providing commercial access to the Internet have made use of the web of networks. Low-cost access seems to be a key factor in expanding Internet usage outside of the academic and research communities in many countries. Low-cost, remote access using wireless technology could open the floodgates for many commercial users now unable to obtain access.