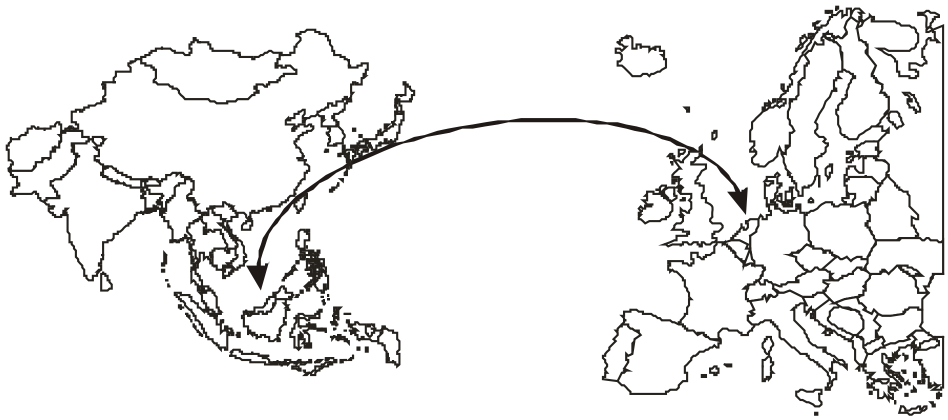
Project Number: **AM 3022**
Project Title: **CAPE**



FEASIBILITY AND RECOMMENDATIONS FOR EUROPE AND ASIA PACIFIC

FINAL REPORT

Contractual Date: 31 August 1998
Actual Date: 3 November 1998

Authors: Dai Davies, DANTE
Cathrin Stöver, DANTE

Abstract:

This Final Report of the CAPE (Connecting Asia Pacific to Europe) Study comprises an analysis of the Internet and research networking developments in Asia Pacific and Europe, an analysis of the potential and economics for co-operation and gives recommendations on how direct connectivity between Asia Pacific and Europe can be achieved.

Keywords:

CAPE, APAN, APII, TEN-34, TEN-155, direct connectivity

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PART ONE

1. INTRODUCTION

Today, more than half of the 2.5 billion persons under the age of 20 reside in Asia. In the last 25 years the economies in Asia have grown rapidly compared to Western standards. The economy of the Republic of South Korea for example had an annual growth rate of 11 per cent between 1980 and 1992, as compared to Britain's annual growth of 3.5 per cent in the same period. Undoubtedly, Asia is developing into the biggest global market place as well as becoming a major player in scientific and technological development and innovation.

The CAPE study's main objective is the analysis of the feasibility of a direct Internet connectivity between Europe and Asia Pacific to support current and future co-operative research of scientists at universities and research institutions in the two regions. The feasibility study comprises an evaluation of the status and developments in Internet and research networking in Asia Pacific and Europe as well as an analysis of current and potential demand and the cost implications of a direct connectivity. Special attention is given to the Asia Pacific Advanced Network (APAN)[1] and the Asia Pacific Information Infrastructure (APII)[2] initiatives. The study provides recommendations as to how the requirements of European researchers and their counterparts in Asia Pacific for direct connectivity can be met most efficiently.

Asia Pacific cannot be called a homogeneous region from a political, economic, societal or even religious point of view. In the wake of the regional currency crisis of the last months the picture concerning Internet or research networking developments becomes even patchier. While a country like Japan is likely to maintain substantial spending on its IT infrastructure, other countries have completely halted their broadband infrastructure projects or have cut their investments to a large extent.

Since Asia Pacific is not a homogeneous region we have segmented the region in order to give a better understanding. Based on the APAN initiative, the segmentation of the Asian Pacific region clusters the four APAN funding members Australia[3], Japan, South Korea and Singapore into the first group of developed countries. The other members of APAN such as Hong Kong, Indonesia and Thailand together with the non-member country Malaysia make up the second cluster of the developed countries. China and India can be considered as countries with potential. To obtain information on the status of the Internet and research networking in countries such as Sri Lanka, Bangladesh, Cambodia, Pakistan, Laos, North Korea and Myanmar is difficult. Many of these countries lack telephones to meet basic voice demands let alone service for the Internet. Internet connectivity is extremely

[1] APAN is a non-profit international consortium established in 1997. APAN provides an advanced networking environment for the research communities of its member countries and promotes international collaboration, see 2.2.13.

[2] The APII project is an international project to promote the Asian Pacific Information Infrastructure, see 2.2.13.

[3] Australia has very limited regional connectivity within APAN (see Fig.5); the study therefore focuses on Japan, South Korea and Singapore.

expensive and based on very low capacity satellite links to either the US or another more developed country in the Asian Pacific region.

The study therefore focuses on the status and developments in countries within the first cluster named in the segmentation, i.e. Japan, South Korea and Singapore and gives special attention to the APAN group. Status and developments in China, India, Indonesia, Malaysia, Thailand, Sri Lanka, Pakistan, Vietnam and Cambodia are also analysed to show the heterogeneity of the region.

The study has also investigated the broader societal implications of a direct link between research networks in Asia Pacific and Europe. Research collaboration will in the long run enhance competitiveness of the regions in a global market place. Collaboration will also give Europe a foothold in the ever growing Asian marketplace. The collaborating students of today will develop into the business partners of tomorrow. Not only researchers and the economies are likely to benefit from the direct connectivity. It is envisaged that such a link should facilitate distance-learning and -teaching programmes between the regions and access to digital libraries and databases.

The Internet is one of the major telecommunications developments of the 1990's. Its principle significance is its potential to create a ubiquitous data network that will match the voice telephony networks which have provided global service on an automatic basis for the last twenty years. Unlike telephony where technical leadership was shared between world regions, the Internet is indisputably dominated by the USA both from a service and from a technology perspective. The Internet undoubtedly has the potential to fulfil this role however there are significant issues surrounding quality of service and major distortions in the current US-centric commercial model that will limit its capability to achieve this goal.

The research and education community has always played a leading role in the development and implementation of Internet technology and services and the European research and education community has increasingly taken a significant role is this area without any commensurate benefit for Europe since the leading fora are all US based. Action needs to be taken so that other regions can balance the US dominance. Currently nearly all nations look to the USA.

The creation of regional networks such as TEN-155 and APAN offer the opportunity for technical co-operation and the creation of a development environment which can provide regional centres of gravity that will enable Europe to both contribute to Internet developments and to profit from them. Currently Europe lacks credibility as a regional Internet force. The recent discussions on domain naming which have focused on lobbying US government indicate precisely this point.

If Europe is to have a true influence in Internet developments not just in the area of research and development but more generally in the broader societal implications it needs to develop an independent technical capability. Co-operation in the field of research and development with Asia Pacific is an effective route to creating a more balanced Internet economy and thereby to enable Europe to gain a much stronger position in the emerging markets. Without a significant visibility as a technical leader European efforts to capitalise on development initiatives will solely benefit the USA.

This final report of the CAPE study is divided into two parts. Part One analyses the status and development of the Internet and research networking in Europe and Asia Pacific in general and highlights in particular the developments in Japan, South Korea, Singapore, China, India, Indonesia, Malaysia, Thailand, Sri Lanka, Pakistan, Vietnam and Cambodia as well as in the APAN network. Additionally, the first part of the CAPE study describes the potential for co-operation between the two regions. Part Two of the study focuses on the regional perspective of Asia Pacific, the economics of co-operation, supply options as well as conclusions of the analysis and recommendations. Appendices give an overview of the issue of settlements, prices and funding, the Asian Pacific countries and the turnover in telecommunications in the Asian Pacific countries in 1995.

2. The Internet and Research Networking in Europe and Asia Pacific

2.1. Status and Developments in Europe

Today's European research network TEN-34 was launched officially in May 1997 and interconnects the national research networks of all EU member states and also of the Czech Republic, Hungary, Norway, Slovenia and Switzerland.

The TEN-34 network topology consists of two subnetworks: one is an IP subnetwork with access points in Germany, Spain, Switzerland, the UK (each with 22 Mbps), Sweden (34 Mbps) and the Netherlands (45 Mbps shared between the national research networks of Belgium and the Netherlands). The second subnetwork is based on ATM VP (Asynchronous Transfer Mode Virtual Path) technology and links Austria, the Czech Republic, France, Germany, Greece, Hungary, Italy, Luxembourg, Slovenia, Switzerland and the UK. The two subnetworks are united at interconnection points in Geneva, Frankfurt and London. A satellite link connects the Portuguese national research network to Geneva.

A 45 Mbps transatlantic line from Frankfurt connects TEN-34 to the United States. Fig. 1 shows the topology of the pan-European research network TEN-34.

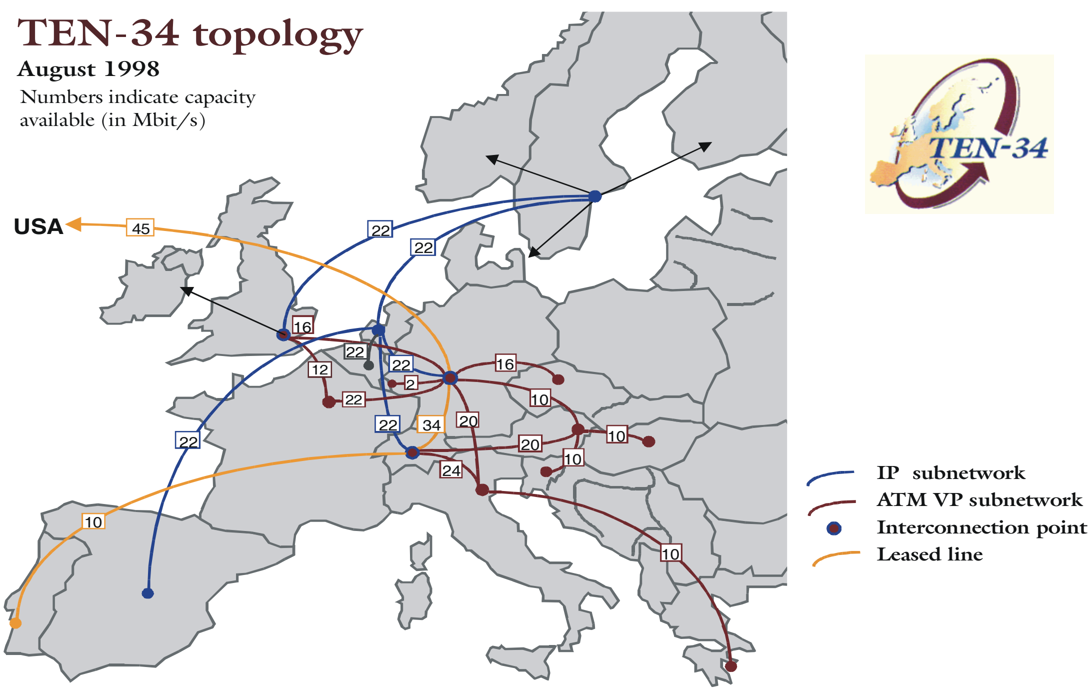

Fig. 1: TEN-34 Network Topology

It was always appreciated that TEN-34 would have a limited operational life and at the time of writing (July 1998) the planning for the successor network to TEN-34 is well under way. The development of TEN-155 as a successor to TEN-34 represents a major breakthrough as a consequence of the liberalisation of the international telecommunications market within Europe. Historically, it has been the case that international prices within Europe were similar to prices of links from individual countries to the USA, leading to the fallacious argument that pan-European connectivity was best organised via the USA. In the liberalised countries prices of connectivity offered to TEN-155 are between 500 and 1000 per cent cheaper than those on offer in 1997 when TEN-34 was created. Thus international costs within Europe are now very significantly lower than Trans-Atlantic costs to the USA. TEN-155 can effectively act as a cost efficient European collection and distribution network for traffic destined for other continents. Intercontinental telecommunications access to co-operative research and development needs to be considered on a Europe-wide basis. This also strengthens Europe's hand in the issue of co-funding of such facilities. The United States have in the recent past resisted the sharing of costs of telecommunications with Europe for co-operative research and development. A direct connection between Asia Pacific and Europe can firstly be seen as of benefit to research co-operation between the regions and secondly as a way of ensuring equitable sharing of costs by providing a commercial model. This model can act as a global example and will ensure that more general Internet development can proceed on the basis of a rational economic model.

2.2. Status and Development in Asia Pacific

This chapter gives a general introduction to the status and development of the Internet and research networking in the Asia Pacific region which is followed by a closer scrutiny of nine individual countries and the APAN and APII initiatives. These countries are the funding members of APAN namely Japan, South Korea and Singapore, as well as China, India, Indonesia, Thailand, Sri Lanka and Cambodia as examples for the region's heterogeneity. Fig. 2 and 3 show Asia's Internet connectivity.

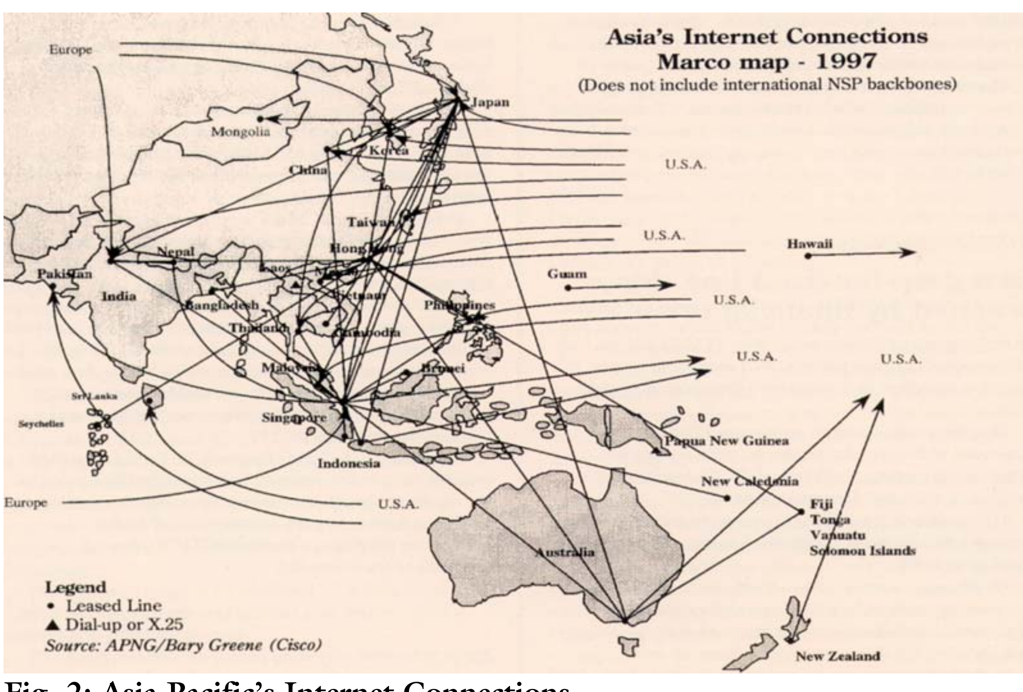

Fig. 2: Asia Pacific's Internet Connections

The Asian Pacific Internet has grown at unprecedented rates in the last couple of years. A recent study sponsored by the Asian Pacific Internet Association (APIA) (see Table 1) claims that the number of Internet users in the region grew to over 14 million by the end of 1997 and will exceed 130 million by the year 2005. Statistics gathered in the APIA study also show that Japan accounted for 60 per cent of the Internet user base at the end of last year with 8.8 million users of which approximately 35 per cent access the Internet from home according to the study.

It is expected that Internet traffic in the region will double each year amid a growing shortage of Trans-Pacific bandwidth.

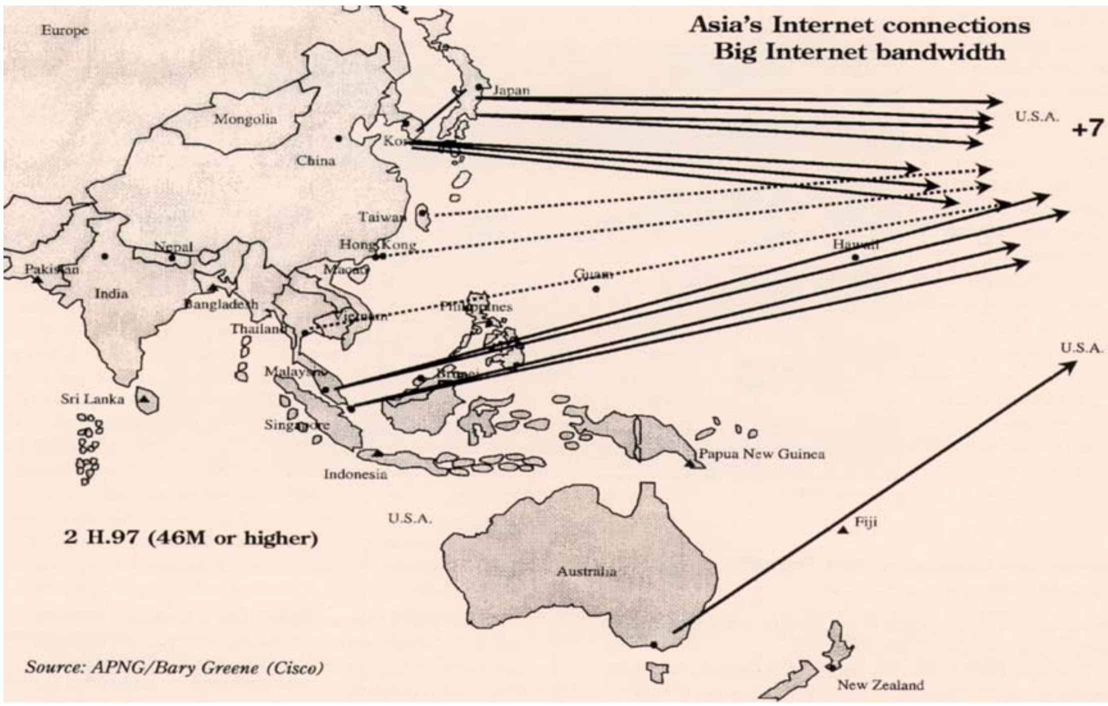

Fig. 3: Asia Pacific's Big Internet Bandwidth

A major problem of the Asian Internet is the consistent lack of content. The result of this lack is a perpetuation of the US centric nature of Internet traffic flows. Additionally, there is no economic driver for the use of the Internet within the region, resulting in poor usage of intra-regional links. At the same time competition between the regions is increasing, with several countries trying to establish themselves as *the* international hub in the region.

Spending on cross-regional Internet infrastructure has slumped with mounting economic pressure on the region's economies after the recent currency crisis. It is to be feared that Asian economies risk future economic prosperity by failing to maintain network infrastructure investment. Co-operations between carriers with regard to the building of an integrated regional backbone also appear to be receding. Hong Kong Telecommunications, the Telecommunications Authority of Thailand and Taiwan's Chunghwa Telecom Co. have for example abandoned their plan to invest in the A-bone regional internet project initiated by Asia Internet Holding's Co. (Tokyo). The operators prefer to build their own bilateral links instead.

Connectivity to the United States is still cheaper than connectivity within the Asian Pacific region. Connectivity to Europe is only slightly more expensive than the intra-regional connectivity. The relatively 'cheaper' connectivity to the US results in the bulk of intra-regional traffic still being routed via the US, not withstanding the problems of corruption of data and delays in transmission. To overcome the US centric nature of the Internet in Asia-Pacific, efforts have been made by a couple of regional carriers such as Hong Kong Telecom, Singapore Telecom and the Tokyo-based Kokusai Denshin Denwa Co. (KDD) to create a mesh of circuits within the region by signing bilateral agreements.

As is the case for intra-regional network infrastructure, spending for the internal development of an information infrastructure has in many Asian countries slipped from an annualised growth rate of around 100 per cent last year to flat or even negative growth in 1998. But the picture is clearly patchy: Indonesia's Project 21 (also called Nusantara 21), an ambitious project to invest US$14 billion for an Information Superhighway, has ground to a halt along with most other new telecom projects in the country, while the Telephone Organisation of Thailand has recently surprised analysts by resurrecting plans for a national multimedia backbone. Malaysia has repeatedly rejected suggestions of a slow-down on its Multimedia-Supercorridor project, despite obvious delays in broadband infrastructure deployment by Telecom Malaysia. At the same time low cost wideband Internet access is becoming more and more available in the city business districts of Hong Kong, Singapore, Japan and Australia.

The volume of data traffic continues to increase in Asia Pacific and has begun to clearly outstrip voice telephony. As seen in Table 1 below, Asia is also set to overtake America and Europe in Internet subscriber growth over the next seven years.

Table 1: Internet subscriber growth forecast

	1997 (millions)	2005 (millions)
Canada & USA	64	176
Europe	20	155
Asia Pacific	14	130
Rest of World	3	55
Total	101	516

Source: APTA May 18, 1998

2.2.1. Status and Developments in Japan

The market for telecommunications in Japan is the second biggest in the world after the USA. The overall value exceeded 10 billion Yen in the fiscal year 1996. Approximately 68 per cent have to be accommodated to the Type I[4] terrestrial net providers, 18 per cent to mobile service providers, 3 per cent to international suppliers and the remaining 11 per cent to Type II[5] providers. NTT (Nippon Telegraph & Telephone Corporation) clearly dominates the domestic market with 6.37 billion Yen market share, followed by the smaller carriers such Japan Telecom, Teleway Japan and TTNet.
Full deregulation of the Japanese market was achieved in the beginning of 1998, removing barriers between national, regional and local providers. However, the role of the Ministry of Post and Telecommunication (MPT) is likely to remain strong regulating the entry to the market of Type I[6] companies depending on demand and superfluous supply of infrastructure. The ministry regulates the market by numbers. Altogether there are more than 4000 telecom companies in Japan, of which app. 140 are permitted to offer Type I services, four international, three national and 21 regional services. It has been decided that NTT is to be reorganised in three separate companies, providing services for East and West Japan and a privatised company to offer national and also international services. This decision opened the domestic market for the international carrier KDD.

The Japanese National Centre for Science Information Systems (NACSIS) has been operating the Science Information Network (SINET) since 1986. SINET evolved from a packet switching network to an Internet backbone and most recently to an ATM switching network to provide general networking services for academic research purposes. Altogether 343 universities and research institutes and 16 research networks participate in SINET, with 237 universities and research institutions being connected to the operational network.

There are several Japanese ministries interested in co-operative research and development with the Ministry of Education, Ministry of Trade and Industry (MITI) and the Ministry of Post and Telecommunications all playing a role. The ministries are brought together by an Inter-ministerial initiative, which is managed by the Japanese Science and Technology Agency (STA). The Japanese STA was offered a cofunding agreement by the American National Science Foundation for a 45 Mbps link between Japan and Chicago to be used by the whole APAN community. This will upgrade the current 7.5 Mbps STA link.

In the context of APAN, AIII[7] and APII, Japan has widespread connectivity within the Asian Pacific region. There are 1.5 Mbps links from Japan to Australia, Hong Kong and Indonesia, a 2 Mbps link to South Korea, a 0.77 Mbps connection to the Philippines, a link to Thailand and a 8 Mbps link to Singapore. Connectivity is also planned between Japan and Malaysia and Japan and China.

[4] Type I providers own their own network infrastructure
[5] Type II providers have to rent infrastructure from Type I providers
[6] Type 1 providers own their own network infrastructure
[7] The AIII is the Asian Internet Interconnection Initiative, see 2.2.10

2.2.2. Status and Developments in South Korea

South Korea is quickly transforming into an IT society. Between 1991 and 1996 the number of PCs sold for domestic purposes has tripled, reaching 1.9 million PCs by the end of 1996. The National Basic Information System set the goal of reaching one PC per household and altogether 10 million PCs to be diffused to offices and homes by the Millennium. Currently, there are more than 7 million PCs in use, meaning that one out of four Koreans has access to a Personal Computer.

At the same time the market for telecommunications has been deregulated and liberalised. The monopoly of Korea Telecoms was broken in 1991. There are currently three international call carriers (KT, Dacom and Onse), domestic long distance and local calls are provided by both KT and Dacom.

National IT initiatives are the National Basic Information System, the National Administration Information System and the Korean Information Infrastructure. These initiatives are strongly supported by the government with a funding schedule and the National Computerization Board, which is under the executive office of the South Korean president, achieving effective co-ordination among government agencies. The aims of the National Basic Information System are to promote economic growth in the information age, to use IT to improve global competitiveness, to take the position of a developed nation in the 21st century, to improve the quality of life and to provide the initial markets for Korean IT industry. The National Administration Information System received a pre-assigned fund of $200 million for the initial period between 1987 and 1991. Table 2 describes the status of Internet usage in Korea.

Table 2: Status of Internet Usage in Korea

	1993	1994	1995	1996	1997
Host (thousands)	7	13	36	73	131
Domains	61	192	579	2,664	8,045
Users (thousands)	n/a	138	366	731	2,500

Source: National Computerization Agency, Korea

The Korean Information Infrastructure (KII) master plan foresees laying the foundation for building a national information network for the time between 1996 and 2000, which will be followed by the spreading of the usage of the information networks and the promotion of a higher level of information usage until the year 2010. To achieve this, projects aimed at accelerated usage of the information network in the public sector will be promoted, an information superhighway will be built, a legal framework is being developed and information security and standardisation is to be ensured.

The KII aim is to construct a high-speed government and public information network. KII-G will cater for the needs of public administration, research institutes and universities, whereas KII-P will suit the needs of industry and general public. The major players in Korean telecommunications, i.e. Korea Telecoms and Dacom construct KII. Altogether $ 580 million have been put aside for the period until 2010. The South Korean government aims at a supply-push model having the experience of a failed system by the National Basic Information System, which was due to insufficient demand.

In September 1997 based on a government initiative, Pubnet was introduced. Target customers of Pubnet are the government, education institutes and not-for-profit research centres. Pubnet provides access points in five major South Korean cities. Domestic Internet connectivity is based on 45 Mbps with a connection to the global Internet of 20 Mbps. Pubnet has exchange points with the Korean research network and education networks as well as with the government network. It is planned that the international bandwidth will be increased to 55 Mbps and that the current IP based connectivity will migrate to ATM. Pubnet plans to build a US access point in California to reach the wider Internet.

The education network KREN was initiated in December 1983 by Seoul National University connecting universities and educational institutes in Korea. The domestic connectivity is based on 45 Mbps; international connectivity is based on a 45 Mbps link to California.

Within the APAN and APII initiatives, South Korea is an exchange point providing connectivity to Japan and the United States with plans to connect to China, Taiwan and Singapore. APII testbed projects are ongoing between Korea and Japan and will start between Korea and China and Korea and Singapore in 1999.

The Ministry of Information and Communication in South Korea expressed an interest in connectivity with Europe on behalf of the APAN network. Alongside universities and research institutions they would like to see schools being able to profit from such connectivity and also to increase the usage of the link.

2.2.3. Status and Developments in Singapore

With regard to telecommunications, Singapore is leading the Asian Pacific markets. A pioneer spirit exists leading to technological and competitive advantages. It is the aim of the Singaporean government to transform Singapore into an intelligent island, which will meet all requirements to become *the* one major hub, i.e. a global centre for IT technology.

The only supplier of terrestrial services is the partly privatised Singapore Telecoms (SingTel). This monopoly position will, however, come to an end in the year 2000. A second telecommunication licence will be issued to Starhub, an alliance formed by BT, NTT and Singapore Technology.

Singapore's Broadcasting Authority is responsible for censorship of Singaporean Internet service and content providers. The authority currently bans about 100 sites. Censorship only applies for Singapore based commercial providers. Research traffic coming into Singapore will not fall under the censorship guidelines.

The complete terrestrial net in Singapore is digitalised which led to a quick introduction of multimedia services. Singapore has about 1.4 million direct exchange lines for approximately 3 million inhabitants. This figure includes 858,000 private lines, more than the 780,000 private households.

The latest and most ambitious multi-media initiative is the Singapore ONE (One Network for Everyone) concept. One-Net is a broadband (622 Mbps access capacity) ATM switching network connecting service providers, content providers, access network operators and large companies and organisations. One-Net is owned by a consortium comprising Singapore Communications Investments, Singapore Telecommunications, Singapore Cable Vision, Pacific Internet and Cyberway. Private households and companies are connected by direct ATM, ADSL, cable modem or wireless. Currently approximately 5000 households are connected to the Singapore One network via ADSL or cable.

SingAREN is Singapore's advanced research and education network. The network is funded by the national Science and Technology Board and Telecommunications Authority of Singapore and gets support from Kent Ridge Digital Labs (KRDL), National University of Singapore and Nanyang Technological University. Within KRDL, the SingAREN Technology Centre (STC) manages the network operations of SingAREN as well as providing technical services and consultancy for interoperability testing of broadband equipment and protocols and network equipment. SingAREN was originally set up to be a support network for Singapore One where new technologies could be tested. Its goal is to be the leading broadband network technology centre in the region for network research and development and testing, to facilitate the deployment of high impact broadband applications in Singapore and the region and to make Singapore a major node of the global Internet for research and education. SingAREN connects the two Singaporean Universities and other research and development institutions at 155 Mbps. Additionally, there is a 622 Mbps access capacity into ONE-Net.

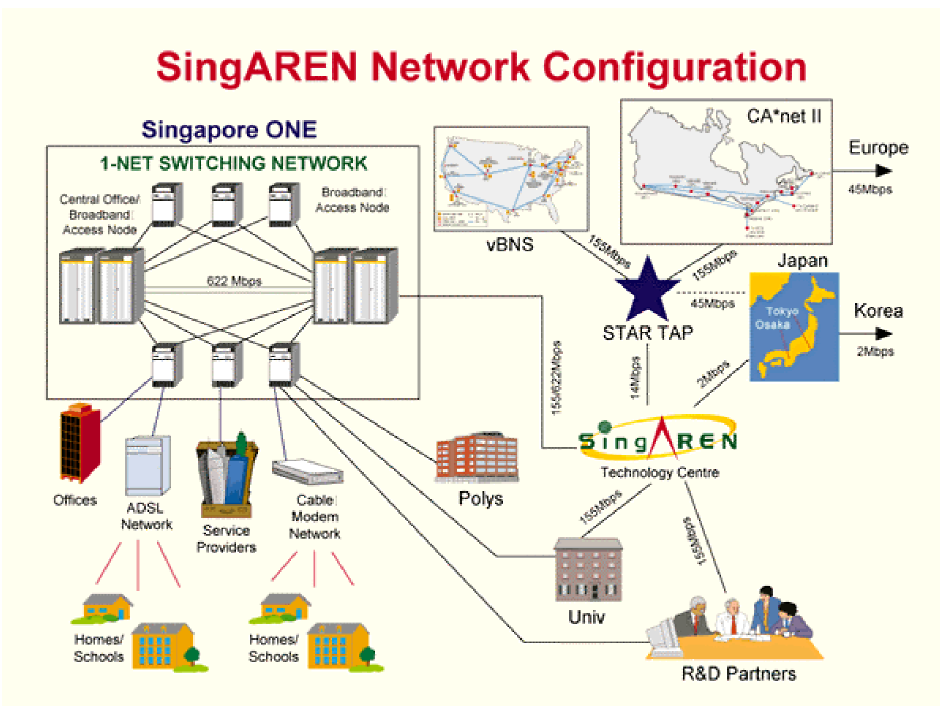

Fig. 4: SingAREN Network Configuration

SingAREN has a 14 Mbps link to STARTAP[8] where it shares a 155 Mbps into vBNS and CA*netII (Canada). There is a peering agreement with ESnet in place. SingAREN also has

[8] STARTAP is the Science, Technology And Research Transit Access Point in Chicago, USA.

a 2 Mbps link to Japan and from there a 2 Mbps direct connection to Korea. By the end of 1998 SingAREN will have 2 Mbps direct connectivity to Korea. These lines are Singapore's contribution to the APAN and APII initiatives. Fig. 4 shows the SingAREN network configuration.

From the commercial Internet point of view, Singapore has got two 45 Mbps lines to the United States which are to be upgraded to 155 Mbps (including the 14 Mbps for SingAREN). There is also 8 Mbps connectivity to Japan (plus the 2 Mbps for research purposes). In addition to the existing commercial links, Singapore plans to have 2 Mbps connectivity to Australia, Hong Kong, India, South Korea, Malaysia, China, Philippines, Taiwan and Thailand. These initial connections are for commercial Internet use and will be scaled up based on traffic demands. Europe will be connected with 2-4 Mbps for commercial traffic by the end of 1998.

2.2.4. Status and Developments in China

Economic growth and opening to the outside world has been going hand in hand in recent years in China. Although the Internet seemed for a while to be a major concern for the Chinese government, the government today actively promotes the construction of the Chinese Information Infrastructure (CII).

Commercial Internet projects have only started in China very recently, but the Chinese Ministry for Post and Telecommunications has developed very ambitious plans to link China into the global Internet community.

In mainland China there are 1075 universities and more than 2 million undergraduate students. However, no nation-wide education and research backbone was planned in China until 1993. As a consequence, each university or research institution had to look for its own connectivity. The first network to communicate with the global Internet was the China Academic network (CANET), which was established in 1988. In 1990 CANET was followed by CRN, the China Research Network and in 1993 by the Institute of High Energy Physics which had established full Internet connectivity to the United States by 1994.

In the end of 1993, the planning for the China Education and Research Network (CERNET) started. CERNET is envisaged to be the first nation-wide education and research network. It is funded by the Chinese government and managed by the Chinese State Education Commission. CERNET is to connect all universities and research institutions, but also high schools, middle and primary schools by the end of this century.

The CERNET backbone will consist of a digital data network provided by the Ministry of Post and Communication and will be used as the basic communication carrier. Data transmission rates start at 64 Kbps up to 2 Mbps. Four links to the global Internet will be established. Two links will be to the United States at 128 Kbps and 2 Mbps. CERNET has a direct 64 Kbps link to the German research network B-WIN (DFN). There will also be a link to HARNET in Hong Kong
Within the APII context, there is the plan to link China to the test bed projects to both Singapore and Korea by the end of 1999.

2.2.5. *Status and Developments in India*

Liberalisation of the Indian telecommunications sector started almost eight years ago. Although many drastic changes took place in the Indian telecommunications market especially since February 1998, the only visible signs for a successful liberalisation of the Indian telecommunications market so far have been mobile phones for the rich and a couple of public phones for the masses.

So far seven licences for basic telephone lines have been issued to operators offering basic telephone services in seven provinces of India. Most licences were issued only after yearlong legal battles and out-of-court settlements between the respective telecom operator and the Indian Department of Telecommunications (DOT). Having been granted the licenses, the basic service licensees have run into problems getting approval from local authorities for laying cables, alluding to demands for bribes by corrupt local officials. In June this year telecom operators suffered from the international sanctions on India following the execution of nuclear tests earlier in the year. None of the basic service licensees has so far launched its services.

In July 1998 the new Indian Communications Minister announced the set up of India Telecom as a public sector corporation which will take over the telecom operations of the DOT. The DOT will, however, remain responsible for telecom regulation, licensing and policy making. The government also announced the next round of bidding for basic telephone lines, as well as taking key decisions over the contentious issue of the country's Internet policy.

Originally, the Indian government had stated in November 1997 that "ISPs will have the freedom to use other international gateways to be leased by Videsh Sanchar Nigam Ltd (VSNL) or other gateways as necessary." In February this year, the Indian government, however, reversed their announced policy and decided that Internet service providers should not be permitted direct international connectivity with the global Internet. Again, this decision was overruled in July 1998, when telecom officials decided to abolish the monopolistic Internet gateway by VSNL and begun preparations for the incorporation of the DOT. Since then work on the issue has finally gone ahead at a fast pace in contrast to the indecisiveness and lack of political will that had characterised previous decision-making. Despite of the optimistic turn for the private Internet service providers they will probably still have to seek permission for direct international connections to the global Internet from the Ministry of Defence because of fears over national security. The Indian Communications Minister announced that the Indian government plans to make India a super-power in information technology.

2.2.6. Status and Developments in Indonesia

Deregulation in Indonesia started in 1995, when private and foreign suppliers were allowed to enter the Indonesian telecommunications market. However, the most profitable markets, i.e. Jakarta and Surabaya have remained under the control of the governmental PT Telkom.

Before the Asian Pacific financial crisis and the riots that shook Indonesia, the Indonesian government had very ambitious plans for connectivity of the islands. Originally, the plan was to invest US$ 14 billion in an information superhighway called "Nusantara 21". This project was ground to halt following the economic shake-up of the Asian Pacific region in 1998 which left the Indonesian currency devalued and created a foreign currency drain. The list of ambitious Indonesian telecom projects which have been delayed or postponed indefinitely has been growing since the beginning of 1998. In February the 1998 the government stopped the PT Telkoms DCS 1800 and PHS networks for Jakarta and Surabaya as well as a cellular expansion programme and the launch of a satellite aimed at providing international telephony across Asia along with Internet and multimedia services. Non-basic providers such as ISPs, radiopaging and public telecom bureau operators are in very tight financial circumstances and a number of them may collapse or merge as a result of the shrinking telecommunications market.

Following the riots and the change of presidency, the new Indonesian government announced in May a fairer and more transparent bid-process in the telecommunications market and was pushing for an early sale of 25 per cent of PT Telkom to draw in badly needed foreign investment to help reboot the economy. However, with the financial crisis not being solved and low foreign investment, the Indonesian telecommunications market remains unstable and shaken.

2.2.7. Status and Developments in Malaysia

Malaysia consists of Westmalaysia, the Malaysian Peninsula and Eastmalaysia on the island of Borneo separated by about 700 km of the China Sea. For this reason alone, the Malaysian government is obliged to invest enormous amounts of material and resources to secure the proper connectivity of the whole country. The long-term aim of the Malaysian government is to become a fully developed industrial country; telecommunications is seen as a pillar of the Malaysian service industry.

So far, Malaysia has not dared to go for full liberalisation of the telecommunications sector. Nevertheless, the main player in telecommunications, Telekom Malaysia Berhad (TMB) was privatised. TMB is the only company owning lines throughout the country, but there are smaller providers offering regional connectivity. The aim is to have 95 per cent fibre-optical cables by the year 2000. Currently, the Malaysian government is investing into the development of the Malaysian Domestic Submarine Cable System which is to connect Westmalaysia with the Eastmalaysian countries Sarawak and Sabah on the island of Borneo. Malaysia will also be connected to the international SeaMeWe3 cable.

Malaysia owns the satellites MEASAT I and II which makes the country the second country in the region (next to Indonesia) to own satellites. A third satellite launch is planned for the year 2000. Consequently, Malaysia had to abolish its former approach of the 'closed sky' and made Western news and influences available to the country.

The biggest project in the telecommunications sector is the creation of the Malaysian Multimedia Super Corridor (MSC), a high-tech park for information technology and telecommunications. The park is planned to be approximately 900 sqkm and is to embed the intelligent city Cyberjaya. The MSC is to attract companies in research and development, production and application of telecommunication technology. In the beginning of 1998, the Malaysian government announced that work on the MSC was ahead of schedule and untouched by the region's economic struggles. Analysts, however, believe that the corridor faces a significant challenge from Singapore's information technology initiatives, as well as a lack of skilled labour.

2.2.8 Status and Developments in Thailand

In 1996 telecommunications have been named top priority of the Thai government. However, basic telephone services are still very little developed with only about 10 lines per 100 inhabitants most of which in the area around Bangkok. The Thai telecommunications market is not yet deregulated and is controlled by the Ministry of Transport and Communication which also handles liberalisation reforms. Thailand promised to the WTO to open the market to foreign competition by the year 2006 and a masterplan foresees the gradual restructuring of the Telephone Organisation of Thailand (TOT) and the Communications Authority of Thailand (CAT). This plan, however, has been modified and rewritten several times in the last years and had its final redraft in March 1998 when the government proposed to start liberalisation in March 1999. The government's long term policy is to transform Thailand into a centre of telecommunication for Southeast Asia.

The Internet is gradually growing in Thailand. The main provider of Internet services is Internet Thailand, a subsidiary of the National Science and Technology Development Agency. In April 1998 the state-owned TOT announced the revival of plans for the installation of its costly multi-media network which came as a surprise in the shaken economic environment. While in the beginning of 1998, the government also pushed ahead with Thailand's biggest ever backbone project, planning to lay new SDH infrastructure by the year 2000, by July 1998 it was announced that public investment in telecommunications will drop by 15.3 per cent during the 1999 fiscal year which might affect the ambitious SDH project. The SDH infrastructure would support more than two million fixed telephone lines and would handle digital value-added services. The project is regarded as the last major deal likely to become available in Thailand during the current economic downturn.

2.2.9. Status and Developments in Sri Lanka

The telecommunications market in Sri Lanka is the most dynamic sector of the economy. The liberalisation of the market has been unmatched by any other country in South Asia and led to a variety of supply and services that India for example could only dream of. Nevertheless, the national Sri Lanka Telecom (SLT) is still the most important player in the field of terrestrial nets, whereas the private sector has especially grown in the area of value-added services.

For a long period of time, SLT was the sole supplier of basic telephone lines in Sri Lanka. The immense increase in demand in the recent years, however, showed the clear limits of monopolistic supply. It is planned that by the year 2000 SLT will lose its final monopoly in the area of local, national and international calls on terrestrial lines. Private suppliers already offer mobile connectivity and other value-added telecom services.

Internet Services are available in Sri Lanka. Providers are SLT, Lanka Communication Services, Elektroteks, Lanka Internet and Ceycom Global Communications. Both Lanka Internet and Ceycom Global Communications have ambitious aims and plan to base a direct Internet service for South Asia in Sri Lanka. Since India and Pakistan both only have limited use of satellite links, Sri Lanka could be an excellent off-shore location for services to these countries.

It is also planned to promote tele-learning and especially tele-medicine via the Internet. Many Sri Lankians search for possibilities to study abroad or to find the quality of teaching via the Internet. It is also planned to develop a tele-medicine network that will enable Sri Lanka with the help of video-conferencing, tele-diagnosis and tele-tips to reach global medicine standards.

Lanka Internet was launched in April 1995 and represented a significant development for Internet services in Sri Lanka. Before the launch, Sri Lanka's data-communication capabilities were primarily restricted to X.25 networks and in the domain of large multi-nationals and shipping companies. The arrival of the Internet, however, saw a dramatic change in the data-communications market. Despite the poor state of telephone lines, the eclectic collection of computer hardware and the high cost of the same, the Internet growth in Sri Lanka has been exponential.

In 1990 the Lanka Educational and Research Network (LEARN) was founded which is run from the University of Moratuwa in Sri Lanka.

2.2.10. Status and Developments in Pakistan

The privatisation and consequent liberalisation of Pakistan' telecommunications market has been delayed for the past two years due to economic and political disturbances in the country. Pakistan Telecommunication Company Ltd. (PTCL) will hold their monopoly position until 2002, but it is planned to privatise the company earlier. Pakistan has a national teledensity of about 2 per cent, comprising 2.5 million direct, operational exchange lines, with an installed capacity of 3.2 million. PTCL called for a request for proposal in late 1997 for the operations and maintenance of 160,000 public payphones in rural areas of Pakistan and is also considering offers for the installation of 270,000 new phone lines under a build-transfer basis.

PTCL is furthermore aiming to build a cellular subscriber base of 400,000 within four years of launching its GSM network. This aim, however, seems to be set a very high level, considering that Pakistan's three existing cellular carriers have struggled in the last four to seven years and none of them has surpassed the 100,000 subscriber mark.

Major expansion plans and new capital expenditure initiatives have been slowed down ahead of PTCL's privatisation. However, the construction of the first phase of a national Internet backbone capable of supporting 150,000 subscribers is still seen as a project to remain active, although the target to connect the subscribers by June 1998 has been pushed back to December 1998. PTCL has yet to sign a contract for the supply of equipment.

The industry regulator, Pakistan Telecommunication Authority, has been pushing ahead with the allocation of new value-added telecom service licenses. In March 1998, the regulator issued a request for proposals to license data communications networks and Internet service operations in Pakistan. Internet subscribers in Pakistan reached a combined base of about 70,000 nationwide by mid-1998. PTCL then claimed that Internet traffic was choking circuits and overloading their network. ISPs argued that this could not be the case since less than 1 per cent of the lines have been offered to Internet companies located mainly in Karachi, Lahore and Islamabad.

The Internet industry received another blow in 1998, when the government's excise department required ISPs to deposit central excise duties of up to 40 per cent on all charges received by them for providing Internet services. This came in addition to the already very high international communication costs, the competition with PTCLs subsidised Internet operation, limited availability of dial-in lines and international connectivity and was likely to further put a damper on Pakistan's Internet expansion. In the meantime, PTCL has announced a 20 per cent cut in international leased line charges for Internet operators and has reduced the charges for educational and research traffic by 50 per cent.

2.2.11. Status and Developments in Vietnam

Vietnam has been rated the world's second fastest growing telecom market by the ITU (International Telecommunication's Union). Liberalisation of the market has been slow due to political barriers. Vietnam Posts & Telecommunications Corp (VNPT) has shown little signs of wanting to abandon its dominant position and de facto monopoly apart from the sanctioning of one new player in the market, namely Saigon Postel, of which VNPT is the biggest single shareholder. In August 1998 the Vietnamese government approved a contract between Cable & Wireless and VNPT for the installation of 250,000 telephone lines around the capital Hanoi and Ho Chi Minh City after three years of ongoing discussions. Outside Hanoi and Ho Chi Minh City, VNPT is pushing ahead with its bid to extend rural phone penetration. In March this year, Japan's Overseas Economic Co-operation fund approved a loan to finance a rural telephone network covering 10 provinces. Vietnam's plans to install a new coastal communications system with British and Japanese loan aid are, however, falling behind schedule.

Vietnam currently has a set target teledensity of 5 to 6 per cent by 2000, which is likely to be adjusted to 4.5 per cent due to the delay of business co-operation contracts with foreign carriers. In the value-added services market, VNPT owns 70 per cent of the Internet market which corresponds to a subscriber base of about 4,900.

2.2.12. *Status and Developments in Cambodia*

Two Internet operators have started operating their respective networks in Cambodia in May and June 1997. The Ministry of Posts and Telecommunications Cambodia (MPTC) issued licences to CamNet, a joint venture between MPTC and the International Development Research Centre (IDRC- a Canadian public corporation that supports development projects around the world) and to the Telstra subsidiary BigPond Cambodia. Before the year 2002 no new Internet operator licences will be issued. The government, which originally feared the spread of pornography and 'false information', has over the last year developed into a strong proponent of the country's Internet developments.

Both providers connect to the global Internet via 128 Kbps satellite links. CamNet is connected to the Singapore Internet Exchange Point operated by Singapore Telecoms whereas BigPond is connected to the Telstra Internet backbone in Sydney.

After the evacuation of many foreigners at the outbreak of fighting in 1997 and considering the neglected state of Cambodia's information infrastructure, the Cambodian ISPs have found it difficult to attract customers. Costs for dial-up connectivity are still very high. Each ISP can count approximately 500 main account holders.

Due to its ties with the International Development Research Centre, CamNet has to provide subsidised access for Cambodia's research centres and universities.

2.2.13. *Status and Developments in the Asian Pacific Advanced Network (APAN)*

The Asian Pacific Advanced Network is a non-profit international consortium that was established in June 1997 to promote the exchange of research and development within the member networks. Primary funding members were networks based in Australia, Japan, Korea and Singapore. The USA and Canada are liaison members of the APAN consortium. DANTE on behalf of the European research networks has also been invited to become a liaison member of APAN. Fig. 5 depicts the APAN network topology.

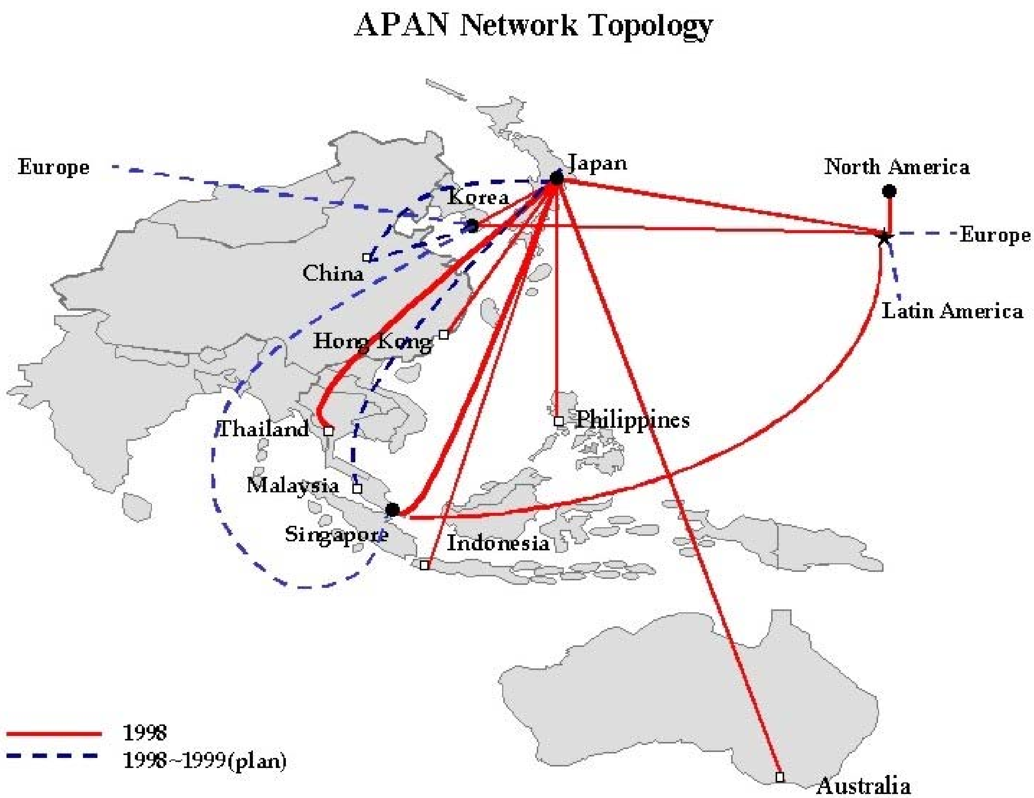

Fig. 5: Network Topology APAN

The APAN network has three exchange points in Japan, South Korea and Singapore. Japan currently has most intra-regional connectivity and also the highest bandwidth allocation into the United States at 45 Mbps. This link has been co-funded by the American National Science Foundation and makes Japan the major exchange point for research traffic to the United States in the region. Japan fully co-funds the link on behalf of the APAN consortium since no cost-sharing agreement could be formulated between the APAN member networks. The APAN system is based on balances of member countries input and output, with the member networks generally taking a very pragmatic view to the consortium. The balance of the member networks benefit seems very important for the success of the APAN consortium. A link from Japan to Europe, for example, could in the eyes of the other member networks unbalance the consortium and result in a very Japan-centric network topology not appreciated by the other member networks.

The Asian Pacific Information Infrastructure project is an international project to promote the development of the Asian Pacific Information Infrastructure (APII). APEC[9] member countries agreed to implement the APII co-operative projects at the APEC Ministerial Meeting on Telecommunications and Industry in 1995. The APII Test-Bed project is designed to test the interoperability and inter-connectivity of the APII through testbed and is to develop a wide range of applications. Currently, Korea-Japan test-bed projects are undertaken and Korea-Singapore and Korea-China testbed projects will start in 1999. The current 2 Mbps dedicated link (out of 45 Mbps total bandwidth) for APII testbed projects between Korea and Japan will be upgraded to 6 Mbps by the end of this year.

The APII Co-operation Centre exists since October 96 following the May 1995 resolution of APEC ministers of Telecommunications and Information Industry in Seoul to advance information infrastructure and establish the APII in the region and is based in Seoul, Korea. The APII CC is an affiliated organisation of the APEC Telecommunications Working Group and aims at co-ordinating the co-operation of APEC member economies in the region with an advanced telecommunications network. The centre supports various co-operative activities and provides assistance for APEC member economies to develop their information infrastructure and their connection to APII.

It seems that within the region, the APII has got a higher political status than APAN and is more frequently referred to by Asian Pacific politicians.

Another testbed project is the Asian Internet Interconnection Initiative (AI3 or AIII) aiming at testbed construction and a series of research activities using the testbed, which was initialised by the WIDE (Widely Integrated Distributed Environment) project which is a research consortium in the Internet areas of studies and JSAT (Japan Satellite Systems Inc.), a satellite communication company. The aim of the AI3 project is to share expertise on the Internet developments within Asia Pacific, especially on intra-Asian networking, to support co-operative work and improve the situation of major intra-regional traffic which is currently channelled through the United States. Research topics of the AI3 project include network design for the APII, new technologies for IP multi-casting over satellite communication channels and advanced routing methods for the effective use of channels. AI3 has been constructing earth stations in most regions in Asia Pacific, satellite connectivity, however, has not been established in most of the countries.

[9] APEC is the Asia Pacific Economic Co-operation which was founded in 1989 with the aim to promote liberalisation within the Asian Pacific region.

3. Potential for Co-operation

Many European research institutions and universities co-operate with partners in the Asian Pacific region. Co-operation takes place in all sorts of research fields and is currently limited to e-mail and WWW communication and large file transfers at odd hours due to traffic being channelled through the United States. A limited survey among European wide operating research institutions showed that an improvement in connectivity to Japan, Australia, India, Singapore, China, South Korea and Hong Kong was most important. Japan was the most named location for research partners within this small survey. It was also very obvious that European research institutions see connectivity to the lesser-developed countries in the area as less crucial. All respondents to the small survey clearly stated that their research efforts would clearly benefit from direct connectivity.

Research co-operation takes place in most research fields and is generally supported by the respective countries government or regional authorities. European national government officials see the reason for co-operation in research and development, education and science clearly in the possible economic offsprings. A research investment today will lead to a competitive advantage tomorrow. This general attitude becomes even more promising when major growing markets in the Asian Pacific region are involved.

The German BMBF, for example, funds co-operation between universities and research institutes and the exchange of scientists especially with the long-lasting partner China. Additionally, the BMBF supports for example GMD offices in Tokyo, a Fraunhofer institute in Singapore and a planned one in Kuala Lumpur and the office for Science and Technology in Shanghai for German research institutes in co-operation with Tongji University. The Deutscher Akademischer Austauschdienst has offices in New Delhi, Tokyo, Jakarta and Beijing. There are Humboldt associations in Japan and Korea. The British DTI stresses co-operation with South Korea; formal links between Korean and UK based universities exist in the areas of biotechnology and biomolecular sciences, Antarctic research, earth science, geology mining, engineering, computer software, aerospace, nuclear energy, ocean research, industrial technology and information and telecommunication technology.

Concerning research institutions, the list of co-operations is significant. INRIA, for example, has a joint laboratory with the Institute of Automation in Beijing, an Institute from the Chinese Academy of Science and co-operates in the fields of Information Technology, applied mathematics and telecommunications. Research co-operation also exists between INRIA and Hong Kong's University of Science and Technology. CERN has got a sister laboratory in Japan and well established contacts in China. The European Bioinformatics Institute (EBI) has extensive collaborations with the DNA Data Bank of Japan located at the National Institute of Genetics. DESY projects enjoy a significant participation from Japan, China, India and South Korea. The Research Institute for Particle and Nuclear Physics in Budapest co-operates with the University of Tokyo. The Japanese Communications Research Laboratory has ongoing collaborative projects with partner organisations in Germany, France, Italy and the UK. Research fields include information and communications, environmental science and material science.

Numerous collaborative projects involve European and Asian Pacific partners at university level. The following examples highlight the closeness of the already existing co-operations: Oxford University has recently signed an exchange agreement with Seoul National

University formalising the many informal exchanges and co-operations that have taken place in the last 15 years including projects in the areas of biology, biotechnology and molecular biology. Oxford University and Chungham National University in South Korea are undertaking a materials science project involving collaborative research into the behaviour of different forms of aluminium alloy and the joint supervision of PhD students. Seoul National University collaborates with Newcastle University on work in microbiology. The Royal Botanical Gardens (UK) and Yeungham University (South Korea) collaborate in biodiversity. The Japanese Science and Technology Corporation (JST) co-operates with the Louis Pasteur University in the area of supermolecules, with the Swedish University of Uppsala in biorecognition and with the German Max-Planck Institutes in ceramics and superplastics. The National University of Singapore has contacts for example with the University of Maastricht/Limburg in the Netherlands, the Norwegian School of Economics and Business, the Louvain School of Management, the University of Porto in Portugal, the faculty of Medicine in Lund, Sweden, the Technical University of Darmstadt in Germany and the National Institute of Polytechniques in Grenoble (France).

It is quite obvious that European research organisations do not yet have regional partners in Asia Pacific, but rather country specific partners. Within the APEC countries several initiatives have been started and endorsed to create regional Asian Pacific co-operations in various research fields. Following the example of EMBnet (a global network of European molecular biologists), the APBionet project was initialised. Currently there are fifteen APBionet centres in the Asian Pacific region. The aim of APBionet is to eventually sign an official co-operation agreement with EMBnet. Other research fields in Asia Pacific have followed the example of APBionet. The current plans involve scientific medicine and regional co-operation in agriculture.

The development of regional networking in Asia Pacific and Europe makes a direct connectivity between the two regions feasible and desirable. It will give researchers in both regions the possibility for closer co-operation through the development of joint applications, the exchange of large databases and files, the remote access to experiments and results and the use of multi-media applications. Today with traffic being routed via the USA, the usage of these applications is very limited, building an electronic barrier for close research co-operation between Europe and Asia Pacific.

PART TWO

1. INTRODUCTION

The CAPE study report presents an analysis of the state of the Internet in Asia Pacific with particular reference to the role of the Internet in supporting co-operative research and development between the two regions. Its general conclusion is that there are good reasons to provide a direct interconnection for this purpose. In addition to the material presented in the report a considerable amount of background information relating to the commercial and political context of the study was collected by DANTE. This supplementary report presents a brief summary of the information contained in the CAPE study report as well as the conclusions and recommendation which DANTE makes to the Commission for its consideration. The supplementary report adds a political dimension which analyses the costs of interconnection as well as considering the broader political benefits in the context of the global development of the Internet.

2. SUMMARY OF THE CAPE STUDY

The Internet is having a major impact in the Asia Pacific region. Unlike Western Europe where there is a relatively homogeneous pattern of development, developments in Asia Pacific are more varied. The more advanced economies have invested heavily in Internet technologies and have a thriving market in service provision. Others are just starting to adopt the concept in what remain monopolistic telecommunications markets. In the sphere of the research and education community, the creation of the Asia Pacific Advanced Network (APAN) represents the first regional approach to networking and compliments similar European initiatives in the shape of TEN-34 and TEN-155. These regional initiatives mean that it is now possible to address the issue of inter-regional connectivity without having to take account of a range of bilateral relationships between countries.

There is considerable existing inter-regional co-operation between scientists, engineers and researchers in a broad range of fields. The development of regional networking in Asia Pacific and Europe will facilitate closer co-operation. At present both Europe and Asia Pacific invest very heavily in connecting to the US Internet. In contrast, direct connection between the two regions is very limited. The nature of Internet technology means that traffic between Asia Pacific and Europe automatically flows via the USA which therefore has a dominant position in Internet networking. However, connectivity based on transit via the USA is both expensive, since it involves a link from each region to the USA, and of limited quality. The existence of direct undersea cable connections between Europe and Asia Pacific means that this physical routing is no longer necessary and certainly not optimal. Before the creation of APAN connections to Asia would have had to be made on a country by country basis but the development of regional networking means that it is feasible and realistic to explore the possibilities of direct interconnection between Asia Pacific and Europe.

The current investment in connectivity both from Europe and Asia Pacific to the USA, which today provides indirect inter-regional connectivity, inhibits the development of direct connectivity between the two regions. A direct connection would facilitate co-operation, provide a much needed balance in the development of the Internet as well as helping to rectify the serious commercial distortions which arise from connectivity which transits the USA.

3. Regional perspective on Asia Pacific

It is apparent that the Internet has a very significant position in a number of Asian countries, particularly in Australia, Japan, New Zealand, the Republic of South Korea, Singapore and Taiwan. These countries have especially built connectivity to the United States. Japan, for example, claims to have at least 1000 Mbps of Internet capacity to the USA and Australia has about 400 Mbps. In contrast, partly for geographic reasons and certainly for reasons of cost and content, there is very little intra-regional connectivity. The Asian Pacific perspective, however, is not so obvious. The APAN initiative is a rather loose and pragmatic commitment to sharing dedicated research links. APAN is based on a balance of benefits, since no cost-sharing agreement is yet in place. Within the Asian Pacific region, prices for connectivity are still extremely high and with growing economic pressure in the region, the likelihood of building new intra-regional research links has been reduced. Connectivity to Europe is only about one fifth more expensive than intra-regional connectivity.

In the particular context of research networking, the USA have encouraged the Japanese to act on behalf of the APAN community and have offered to co-fund a connection from Japan to STARTAP based in Chicago. Additionally, the US government has actively invited Japanese researchers to collaborate in research projects in the United States. Within the APAN community this step by the United States has left the remaining APAN funding members in fear of a Japan-centric Internet alongside a US-centric one. The decision where Europe should locate the regional hub in Asia Pacific should therefore be carefully thought through. With regard to connectivity within the region, Japan seems the first and logical choice of connectivity for Europe.

However, the Japanese are very pragmatic in their attitude towards APAN. Their main focus is on connectivity to the United States and they are willing to connect to Chicago as it was pointed out to them that it might make connectivity and cost-sharing with Europe easier. All the Japanese research networks participate in APAN with the Science and Technology Agency through IMNet (Inter-ministerial Network) taking the lead. It is quite clear that the resources dedicated to connectivity to the United States by the Ministry for Post and Telecommunications and the Ministry for Education are dedicated to the requirements of these ministries.

It is to be kept in mind that there is no fair cost retrieval within APAN. Japan co-funds the 45 Mbps link to the United States entirely on behalf of the APAN community. This agreement gave Japan the opportunity to receive co-funding from the United States. Nevertheless, the financial burden to Japan's Science and Technology Agency which is paying for the connectivity cannot be ignored. Additionally, the Science and Technology Agency in Japan is one of five different and competing ministries involved in the APAN initiative on behalf of Japan. To obtain a decision which of the Japanese ministries should take the lead concerning connectivity to Europe could be difficult and time-consuming.

The question for each of the Asian Pacific countries is therefore: Should the country host the European hub and open it up for APAN traffic? The responsible country would have to pay for the link to Europe on behalf of the APAN community. It would therefore have to make very sure that the country itself benefits to a large extent from the connectivity. The other countries would have to consider whether or not European connectivity is important enough for them to connect into the regional hub. But they could have their own connectivity to Europe at only a slightly higher price. For Asia Pacific the economic benefit would therefore only be obvious if Europe installed its hub in a country which already has got wide-spread connectivity within the Asian Pacific region.

The choice of hub location is limited to three countries. These are Singapore, South Korea and Japan. This is a consequence of the telecommunications services available today. There are now several direct cable connections existing or planned in the very near term between Europe and Asia Pacific. These include the SeaMeWe cables, FLAG and Project Oxygen, all of which will offer very high capacity between the regions and which could be used as a path for supporting connectivity. Each location provides good regional connectivity to APAN. The costs of connectivity are defined in Table 1 in the chapter on Supply Options. It can be seen from this table that the most cost-effective location is South Korea. The total potential cost of a connection is approximately 5.8 MECU per annum for a 34 Mbps link. This would need to be shared between Europe and Asia Pacific according to some agreed approach. It is recommended that a minimum commitment period for such connectivity is three years, since in order to encourage exploitation some reasonable continuity of service needs to be guaranteed.

4. Economies of Co-operation

The Internet was developed by the research and education community. Initially the USA drove this development. More recently European researchers and researchers in Asia Pacific have contributed to the world-wide development and deployment of the technology. The resulting networking services are the major factor in supporting co-operative research on an increasingly global scale. In Europe national research and education networks are connected together by the pan-European TEN-34 network, which will soon see its capacity increased fivefold to become TEN-155. In the Asia Pacific region a number of leading countries have recently formed a co-operation to interconnect their national research and education networks via the Asia Pacific Advanced Network initiative APAN.

From the European perspective, the economies of co-operation are quite obvious. European researchers would benefit from direct connectivity through their respective national research network. The national research networks would be able to divide the costs between themselves thus reducing the price for connectivity considerably. There is however a broader political and commercial context. Although the Research and Education community remains a significant user of Internet and the biggest single user group in terms of usage, a parallel market offering public services to the commercial and domestic markets is now becoming a significant factor in the overall picture. Again the commercial market started in the USA and it is becoming increasingly important in both Europe and parts of Asia Pacific.

An important aspect of Internet economics is the dominant position of the USA. Both commercial and research and education users have organised significant connectivity to the USA. The Asian Pacific countries are paying for the entire costs of connectivity to the United States, as well as for access costs in the USA. In the case of Asia Pacific the total cost is approximately US$ 1 billion. It is estimated that today this represents a subsidy to the USA of around $500M per annum. On the basis of the current Internet growth rate in the developed countries of the region 200-300 per cent per annum, this subsidy will grow to approximately $5B within the next four years. The Asian Pacific countries have already formulated serious arguments about the unfairness of this state of affairs and are pressing for fairer settlements with the United States. In the case of the European research and education community it is approximately US$ 50 million for this community alone. Although this connectivity is to the mutual benefit of the USA and the regions it is entirely paid for by the regions which in addition have to pay for access to the US Internet itself. It might have been possible to justify this arrangement in the early days of the Internet when the USA was far in advance of the other regions. Today, with the Internet a global activity, this arrangement represents a major commercial distortion and effectively means that the international connectivity of US Internet users is paid for by users in other regions.

The combination of the investment in US connectivity by both Europe and Asia Pacific, together with the fact that this connectivity automatically provides a transit route between Europe and Asia/Pacific is significant from a number of points of view. Firstly, it means that there has been to date little pressure for direct connectivity between Asia Pacific and Europe. Secondly, it has enabled the USA to postpone addressing the issue of equitable sharing of costs on intercontinental connections. Thirdly, given the very significant investment in connectivity to the USA, there has been a reluctance to spend yet more money on direct interconnection between Asia Pacific and Europe.

There are several challenges to be faced. The issue of fair sharing of costs in the Internet (settlements) is one that can no longer be ignored. Fair sharing of intercontinental costs on the basis of a reasonable recognition of mutual benefits is an issue between Asia/Pacific countries, Europe and the USA. Because of the more distributed geography of the region this issue has become significant for Asia Pacific earlier than for Europe. In Europe DANTE has been arguing on behalf of the European research and education community in favour of fair cost sharing of intercontinental costs. The issue of transit traffic acts as a diversion to addressing this problem. A strong commercial argument in favour of a direct interconnection between APAN and TEN-34/TEN-155 is that it would enable the two regions to develop fair and equitable settlement models in the context of research co-operation which could have broader application to the question of inter-regional settlements. Appendix 2 sets out some further thoughts on this issue.

5. Supply Options

A number of telecommunications companies (both European and from Asia Pacific) were approached to determine the potential costs of connectivity between Europe and Asia Pacific. In particular information was sought from KDD, Korea Telecom, Dacom, the Telecommunications Authority of Singapore, GlobalOne, BT and Unisource. This was done in the context of either a simple connection which could then be used for Internet connectivity or alternatively buying Internet service.

The current set of Internet connections between Asia Pacific and Europe are extremely limited. There are a number of small capacity links (less than 2 Mbps) mainly between Japan and Europe but nearly all Internet traffic between Asia Pacific and Europe transits the US Internet service provider networks in the USA. Both European and Asia Pacific Internet service providers have invested heavily in connectivity to the USA. The current state of interconnection arrangements in the Internet means that non-US Internet service providers have to pay both for the connectivity to the USA as well as for Trans-US connectivity in order to be able to interconnect with US Internet users. This is partly because of the dominant position of the USA in the Internet and partly because of the absence of any model for sharing costs. In this economic environment direct Asia Pacific Europe Internet connectivity is expensive and only KDD proposed Internet service as a way of connecting the two regions.

The other operators, together with KDD offered direct connections without any linkage to the provision of Internet service. The prices that we received were typically for point-to-point circuits, where there is an existing market between Asia Pacific and Europe and considerable investment in new inter-regional cable systems most notably FLAG and SeMeWe 3. The operators essentially see the provision of point-to point circuits as a "business as usual" transaction.

The South Korean Provider Dacom submitted a detailed plan how to connect the European research network to South Korea. Table 1 below gives an indication of the prices to be paid for direct connectivity between Asia Pacific and Europe. Prices have been obtained for Japan, South Korea and Singapore since these three members of the APAN community enjoy the most wide-spread connectivity within the Asian Pacific region. In order to determine the true value of the direct connectivity, it is recommended to secure the funding for at least a period of three years.

Table 1 : Prices for connectivity in KECU (excl. installation costs)

Speed	Japan		South Korea		Singapore	
	Mbit/year	Total/year	Mbit/year	Total/year	Mbit/year	Total/year
6 Mbit/s	531	3,187	256	1,536	358	2,153
34 Mbit/s	326	11,088	172	5,869	n/a	n/a
45 Mbit/s	302	13,612	n/a	n/a	236	10,623

6. Conclusion and Recommendations

There is considerable collaboration between researchers in the Asian Pacific region and Europe. Examples are the co-operative research projects in High-Energy Physics, Molecular Biology, Earth Science etc. At present, connectivity is provided on an ad-hoc basis mainly as a result of general purpose Internet connections between the different countries in Europe and the United States as well as the different countries in Asia Pacific and the United States. Research traffic between Europe and Asia Pacific is cleared through the United States resulting in corrupted data and delayed transmission. This arrangement serves neither region well. It reinforces the US dominance of the Internet and makes the political challenge of agreeing a fair and reasonable cost sharing mechanism with the United States more difficult.

The development of a regional network to support co-operative research and development in Asia Pacific in the form of the APAN network makes co-operation between Europe and Asia Pacific as a region a feasible and desirable proposition. In Europe, the existence of TEN-34 (preceded by EuropaNET) established an equivalent co-operation several years ago. The launch of the TEN-155 network, partly sponsored by the European Commission via the QUANTUM project, and the building of direct terrestrial cable connections between Asia Pacific and Europe, such as FLAG, SeaMeWe and Oxygen allow direct connectivity be implemented without the necessity of transiting the United States.

The alternative approach would be to consider a set of bilateral connections between Europe and specific Asia Pacific countries. For the APAN member countries, Japan, South Korea, Singapore, Hong Kong, Indonesia, Thailand, the Philippines and Australia, this approach gives no benefit. The APAN member countries have well established links within the APAN network as well as with other countries in the region. For those countries outside APAN today, most notably India and China, a direct connection would be useful but, considering the limited national and regional connectivity of these countries, connectivity with Europe is viewed as important but not a priority at this moment. It is anticipated, however, that the APAN network will be extended to Malaysia and China by 1999.

The recommendation is therefore to connect the European research network TEN-155 to the APAN network. With one single hub, 18 European countries and eight Asian Pacific countries will be able to participate in and benefit from direct connectivity between the two regions. This can be extended as further countries, most notably China join APAN.

Section 5 above indicates that the most cost-effective solution is to connect the APAN network to the European TEN-155 network via a landing point in South Korea.

The capacity that should be provided is very difficult to assess, since current direct traffic data is not readily available, but it is recommended that a minimum capacity of 34 Mbps should be provided. This represents a very limited capacity when compared with what is available between Europe and the United States or Asia Pacific and the United States. It is therefore proposed that the implemented connectivity should be based on ATM technology to facilitate upgrades should demand grow.

It is recommended to:

- establish a direct Internet connectivity between the European TEN-155 and the Asian Pacific APAN networks landing in South Korea;
- have a minimum commitment period of 3 years;
- base the funding of the connectivity on a fair sharing of costs;
- use ATM technology to facilitate future upgrades.

General References

APAN	http://www.apan.net
APII	http://www.apii.or.kr
TEN-34	http://www.dante.net/ten-34/
TEN-155	http://www.dante.net/ten-155/

ACRONYMS

ADSL	Asynchronous Digital Subscriber Line
AIII, AI3	Asian Internet Interconnection Initiative
APAN	Asia Pacific Advanced Network
APIA	Asia Pacific Internet Association
APII	Asia Pacific Information Infrastructure
APII CC	Asia Pacific Information Infrastructure Co-operation Centre
APBionet	Asia Pacific Biology Network
APEC	Asia Pacific Economic Co-operation
APNG	Asia Pacific Networking Group
APTA	Asia Pacific Telecoms Analyst
ATM	Asynchronous Transfer Mode
BT	British Telecom
BMBF	Bundesministerium für Bildung und Forschung (Germany)
B-WIN	Breitband-Wissenschaftsnetz (Germany)
CANET	Chinese Academic Network
CA*netII	Canadian Advanced Network
CAPE	Connecting Asia Pacific to Europe
CAT	Communications Authority of Thailand
CERN	Centre Européen pour la Recherche Nucléaire (Switzerland)
CERNET	Chinese Education and Research Network
CRN	Chinese Research Network
CII	Chinese Information Infrastructure
DANTE	Delivery of Advanced Networking Technology to Europe Ltd.
DESY	Deutsches Elektronen-Synchrotron (Germany)
DFN	Deutsches Forschungsnetz (Germany)
DOT	Department of Telecommunications (India)
DTI	Department of Trade and Industry (UK)
EBI	European Bioinformatics Institute
EMBnet	European Molecular Biology Network
GMD	German National Research Centre for Information Technology
GNP	Gross National Product
GSM	Global System for Mobile Communication
HARNET	Hong Kong Advanced Research Network
IDRC	International Development Research Centre
IMNet	Inter-Ministerial Network (Japan)
INRIA	Institut National de Recherche en Informatique et en Automatique (France)
ISP	Internet Service Provider
ITU	International Telecommunications Union
JSAT	Japan Satellite Systems Inc.
Kbps	Kilobits per second
KDD	Kokusai Denshin Denwa (Japan)
KII	Korean Information Infrastructure
KII-G	Korean Information Infrastructure – Government
KII-P	Korean Information Infrastructure - Public
KT	Korea Telecom
KRDL	Kent Ridge Digital Labs (Singapore)

KREN	Korean Research and Education Network
LEARN	Lanka Educational and Research Network
Mbps	Megabits per second
MECU	Million European Currency Unit
MITI	Ministry of Trade and Industry (Japan)
MPT	Ministry of Post and Telecommunications (Japan)
MPTC	Ministry of Post and Telecommunications Cambodia
MSC	Multimedai Super Corridor (Malaysia)
NACSIS	National Centre for Science Information Systems (Japan)
NTT	Nippon Telegraph and Telecom Corporation (Japan)
IP	Internet Protocol
IT	Information Technology
PC	Personal Computer
PTCL	Pakistan Telecommunications Company Ltd.
QUANTUM	Quality Network Technology for User-oriented Multi-media
R&D	Research and Development
SDH	Synchronous Digital Hierarchy
SINET	Science Information Network (Japan)
SingAREN	Singapore Advanced Research and Education Network
SLT	Sri Lanka Telecom
STA	Science Technology Agency (Japan)
STARTAP	Science, Technology And Research Transit Access Point (USA)
STC	SingAREN Technology Centre (Singapore)
TMB	Telekom Malaysia Berhad
TEN-34	Trans-European Network at 34 Mbps
TEN-155	Trans-European Network at 155 Mbps
TOT	Telephone Organisation of Thailand
UK	United Kingdom
USA	United States of America
US	United States
VNPT	Vietnam Posts & Telecommunications Corp.
VP	Virtual Path
VSNL	Videsh Sanchar Nigam Ltd. (India)
WIDE	Widely Integrated Distributed Environment
WWW	World Wide Web

Appendices

Appendix 1: Settlements

One of the difficult problems of telecommunications is the issue of fair sharing of cost. If a link between Asia/Pacific and Europe is implemented what are the benefits and how should the relating cost be shared? Currently, most Internet connectivity between the regions is cleared via the United States. Both regions pay the entire costs of connectivity to the USA as well as a premium to US Internet service providers for the provision of connectivity. This is manifestly unfair, a statement which is more strongly articulated in Asia/Pacific because of its more distributed geography. However, the same issues apply as far as Europe is concerned. In the specific context of co-operative research and development, the United States has promised limited cofunding on the basis that any connectivity is via the central US location of STARTAP in Chicago. This would effectively strengthen the US position as the world's Internet exchange point. The CAPE project represents an opportunity to rectify this situation by proposing a more equitable approach to cost sharing.

It is proposed that the cost of an Asia/Pacific - Europe link should be shared on the basis of an objective evaluation of the net benefit to each region. In general, the flows of traffic between regions are not balanced. The net exporter is generally providing information and therefore benefit to the other region. It is therefore suggested that the cost of a link be shared according to the ratio of the information flow from region to the other region. If Europe should be a net provider of information to Asia/Pacific it should pay correspondingly less towards the cost of the joint link. Safeguards should be agreed on to allow predictability of budgeting.

APPENDIX 2: OVERVIEW OF THE ASIAN PACIFIC COUNTRIES

Table 4: Overview of the Asian Pacific Countries (1995)

Country	Population (Mio.)	GNP per head ($)	Main lines per 100 inh.	Digital lines (%)	Mobile phones per 100 inh.	% of Mobile growth (1990-95)
Australia	18.5	17,890	51.7	84.0	12.77	65.6
New Zealand	3.7	13,190	47.4	98.0	10.80	48.3
Japan	125.7	34,630	48.6	72.0	8.15	63.7
South Korea	46.0	8,220	41.7	61.8	3.66	83.0
Singapore	3.0	23,360	49.6	100.0	9.77	41.8
Hong Kong	6.4	21,650	57.3	100.0	12.33	41.6
Indonesia	169.0	880	1.7	77.4	0.11	64.6
Thailand	60.2	2,210	6.6	83.0	1.83	76.6
Malaysia	20.5	3,520	17.1	92.5	4.34	58.7
China	1,224.0	530	3.4	38.0	0.30	188.0
India	970.0	310	1.1	66.0	0.01	n/a
Bangladesh	~ 118.0	230	0.24	22.0	n/a	n/a
Vietnam	74.0	215	0.6	100.0	0.03	n/a
Sri Lanka	~ 18.0	640	1.11	97.0	0.29	120.9

Source: bfai, Merryll Lynch, ITU

APPENDIX 3: TURNOVER IN TELECOMMUNICATIONS IN ASIA PACIFIC

Table 5: Turnover in Telecommunications in Asia Pacific in 1995

	Turnover in billion US$	US$ Per capita
Australia	11.5	637
New Zealand	2.1	582
Japan	93.6	747
South Korea	8.7	195
Singapore	2.5	850
Hong Kong	5.1	826
Indonesia	2.7	14
Thailand	2.0	34
Malaysia	2.1	104
China	13.6	11
India	3.3	4
Vietnam	0.1	2

Source: Asian Wall Street Journal, 10 June 1997