The e-City:
Singapore Internet Case Study

April 2001

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 This report is one of a series of Internet Case Studies. Additional information is available on the Internet Case Studies web site at www.itu.int/ti/casestudies.

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1. Country background

1.1 Overview

The Republic of Singapore, with an area of only 660 square kilometres, is located in Southeast Asia at the southern tip of the Malaysian peninsula. It is comprised of a main island and several islets. Singapore's northern neighbour is Malaysia, linked by a bridge crossing across the Johore Strait. On the south, is Indonesia. Singapore's strategic location at the crossing of many trade routes has contributed strongly to its history and economic development. The island is relatively flat, with a tropical temperature due to its proximity to the equator and abundant rainfall from its sea exposure. Less than two per cent of the land is used for agriculture. The rest is evenly divided between developed and undeveloped areas. The name of the country is derived from a Sanskrit word SingaPura (Lion City).

1.2 Demography

In June 2000 the population of Singapore was four million, of which 3.0 million were citizens, 290'000 were permanent residents and 755'000 were non-resident.[1] Average annual population growth from 1990-2000 was 2.8 per cent. The population is predominantly of Chinese descent (77 per cent), followed by Malay (14 per cent) and Indian (8 per cent) ethnic groups. Since independence, the Singapore government and Singaporeans themselves have committed to the policy, culture and practice of equal treatment of all races. Chinese (Mandarin), Malay, Tamil and English are all official languages, with English being the predominant language in business and government dealings.[2] Some 20 other languages are also used on the island <www.sil.org/ethnologue/countries/Sing.html>. In 2000, there were 923'000 resident households for an average household size of 3.7. The total number of occupied housing units was 964'138.

Figure 1.1: Map of Singapore

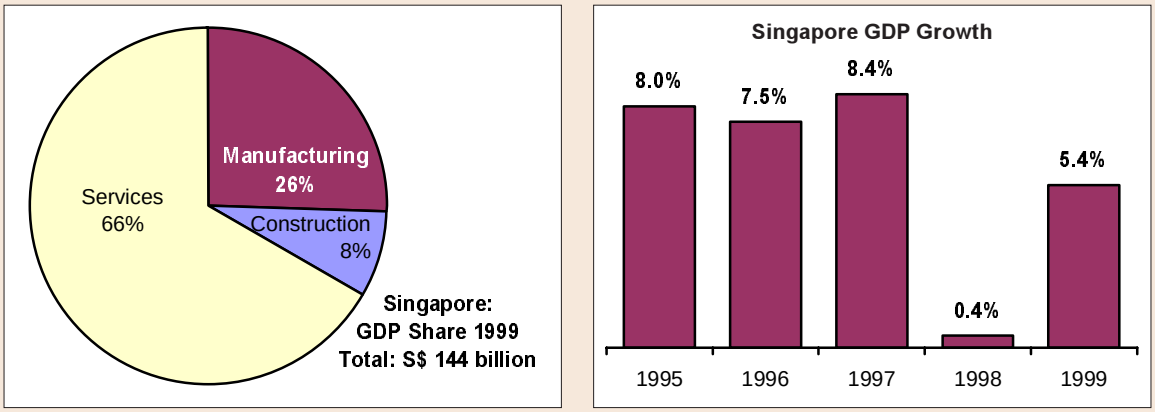
Source: The World Factbook 1999.

1.3 Economy

With a small domestic market, few natural resources, and a strategic location, Singapore has a long history as a trading nation. It leads the South

Figure 1.2: Weathering the storm

Singapore distribution of GDP, 1999 and GDP change over previous year



Source: Singapore Department of Statistics.

East Asia region in imports and exports per capita. Singapore has a service-oriented economy and its GDP per capita of US$ 24'210 ranks eighth in the world. The strength of the economy is shown by its ability to continue growing (albeit slowly) during the Asian economic downturn of 1997-98 (Figure 1.2). While these facts reflect a healthy, robust economy, they do not reveal the active planning role of the government, which, in combination with an atypical Civil Service policy, has had a profound effect on Singapore.

1.4 Human development

While Singapore enjoys the eighth highest GDP per capita in the world, it ranks only 24th on the United Nations Development Programme's Human Development Index (HDI). The HDI is a function of wealth, health, and education, and, while Singapore ranks high on GDP per capita and life expectancy, it is pulled down by a relatively poor performance in education. The mean years of schooling is 8.1 years and the literacy rate 94 per cent, both relatively low for such an affluent nation.[3] Table 1.1 compares Singapore's HDI to other economies in the Asia-Pacific region. Singapore is the highest-ranking South East Asian nation in human development, and ranks second in Asia after Japan.

1.5 Political

Singapore's recent history dates back to 1819 when Stamford Raffles established a British trading post on the island. Singapore became a Crown Colony in 1867, a situation that lasted until 1959 with an interruption during the Japanese occupation between 1942 and 1945. There was a strong independence movement, and elections were held for self-government in 1959. The People's Action Party (PAP) won the election and Lee Kuan Yew became the first Prime Minister of the State of Singapore. Lee pressed for a union with Malaya and when Malaysia was formed in 1963, it included Singapore. Singapore withdrew in 1965 and became an independent republic. The PAP has ruled continuously since 1965 and Goh Chok Tong became the country's second Prime Minister in 1990.

Table 1.1: Human Development Indicators

Singapore compared to selected Asia-Pacific economies, 1998

HDI Rank	Economy	Life expectancy at birth (years) 1998	Adult literacy rate (%) 1998	Combined school gross enrolment ratio (%) 1998	GDP per capita (PPP US$) 1998
4	Australia	78.3	99.0	114	22'452
9	Japan	80.0	99.0	85	23'257
20	New Zealand	77.1	99.0	96	17'288
24	**Singapore**	**77.3**	**91.8**	**73**	**24'210**
26	Hongkong SAR	78.6	92.9	64	20'763
31	Korea (Rep.)	72.6	97.5	90	13'478
61	Malaysia	72.2	86.4	65	8'137

Note: Adult literacy and school enrolment data for Singapore vary from that reported by national authorities. See endnote 3.
Source: United Nations Development Programme.

[1] Singapore Department of Statistics. "Singapore Census of Population 2000 – A Quick Count." *Press Release 17*. 31 August 2000.

[2] The adoption of English as Singapore's working language is credited with promoting harmony and adds to Singapore's competitive advantage. See Michael Richardson. "English Bridges Cultural Gap in Singapore." *International Herald Tribune*. 12 February 2001. <www.iht.com>.

[3] Literacy data reported by Statistics Singapore differs from that reported by the UNDP even though the year and concept used by both appear to be the same. Ministry of Education data on gross school enrolment also differ from the UNDP with the former reporting 86 per cent (compared to 73 per cent).

2. Information and Communication Technology markets

2.1 Telecommunication Sector

Singapore has one of the most advanced telecommunication networks in the world with very high levels of access. This has been possible due to the small size of the country—essentially a large city—as well as rising levels of income and government commitment to telecommunication excellence. The telecommunication market has been characterized by progressive liberalization from a state-owned monopoly provider to full competition (see Table 2.1).

2.1.1 Regulation and policy-making

Government ministries are responsible for overall policy with subsidiary statutory boards providing technical support and day-to-day regulation. The *Ministry of Communications and Information Technology* (MCIT) is responsible for overall transportation, postal services and Information and Communications Technology (ICT) policy. The *Info-communications Development Authority* (IDA) is the statutory board responsible for regulating and promoting postal and ICT services. IDA was created in late 1999 from the merger of the Telecommunication Authority of Singapore (TAS) and the National Computer Board (NCB).

The Ministry of Information and The Arts (MITA) was created in 1990. It is the public relations arm of the government. It also oversees the regulation and promotion of the broadcast, Internet content and print media, as well as the arts and heritage sectors. The Singapore Broadcasting Authority (SBA) is the statutory board responsible for broadcasting regulation, including Internet content.

2.1.2 Operators

Singapore's small size coupled with the recent introduction (April 2000) of full telecommunication means that there are only a handful of Facilities-Based Operators (FBO) in the country. Due to the small market and technical and financial constraints, it is unlikely that the number of FBOs will grow significantly. The country's FBOs include:

- **Singapore Telecom** (SingTel) <www.singtel.com> is the nation's incumbent operator. As in many countries, SingTel enjoyed a monopoly until recently. However, unlike many countries, the level of infrastructure development and quality of service was high with SingTel striving to measure up to international best practice. SingTel was partially privatized in 1993 and is a major international investor in its own right with over US$ 2.5 billion invested in 19 countries. Singapore Post, the country's postal service, is a subsidiary of SingTel. At end March 2000 SingTel's domestic network included 1.9 million fixed line subscribers and 1.1 million mobile cellular subscribers.

- **Mobile One** (M1) <www.m1.com.sg> was formed in August 1994 to bid for Singapore's second mobile cellular license. It was awarded mobile cellular and radio paging licenses in May 1995. Both services were launched on 1 April 1997 when SingTel's monopoly in these areas expired. M1 started with a GSM-900 system and introduced a CDMA network in June 1998. M1's shareholders are Keppel Group (Singapore's largest industrial conglomerate) (35%), Singapore Press Holdings (35%), Cable & Wireless (UK) (15%) and Pacific Century Cyberworks (Hongkong SAR) (15%). M1 had around 600'000 mobile cellular subscribers at 30 June 2000.

- **StarHub** <www.starhub.com.sg> won fixed and mobile

Table 2.1: Telecom liberalization milestones

Jun '94	Opening of pre-qualification tender for one more mobile phone and three more radio paging operators.
Nov '94	Opening up of VSAT provision and operation solely for intra-corporate business communications.
Dec '94	Liberalization of resale of public switched telecommunications services for existing resellers in hotel and service apartment sector.
May '95	Licensing of one more public cellular mobile telephone operator and three more public mobile radio paging operators to commerce services in April 1997 in competition with Singapore Telecom when its exclusive license for these services expire.
	Opening of tender for third IASP license.
Jun '95	Six bids for third Internet Access Service Provider (IASP) licence received.
Aug '95	Resale of international telephone services via customer-owned and operated Coinafons.
	Further opening up of resale of public switched telecommunications services, for any company, apart from existing resellers in the hotels and service apartment sector, to apply to TAS for licensing.
Sep '95	Liberalization of IDD/STD payphones.
	Licensing of 2 Internet public access providers, in competition with Singnet.
Oct '95	Resale of services by Internet public access providers permitted.
Apr '96	Announcement that TAS will license additional operators to provide basic telecommunication services from April 2002.
May '96	TAS advances the expiry of Singapore Telecom exclusive licence for basic telecommunications services to year 2000.
Sep '96	TAS decides to award up to two additional licences for the provision of public basic telecommunications services from 1 April 2000.
Dec '96	Resale of leased circuit services for intra-corporate communications permitted.
Jan '97	Announcement of PBTS license fees, the release of the Information Package and the start of the pre-qualifying tender on 1 March 1997.
	Removal of telecommunications service surcharge levied by hotels and service apartments.
Mar '97	Announcement that up to two additional PCMTS operators will be licensed by mid-1998 to provide commercial services by 1 April 2000.
Apr '97	Waiver of licence fee for mobile communications users.
	New paging operators, MobileOne, ST Messaging and Hutchison Intrapage, and mobile phone operator, MobileOne, commence operations.
Jul '97	Announcement of all three consortia which had submitted proposals for the pre-qualification tender submissions for the PBTS License to be short listed to participate in the main tender.
Aug '97	Briefing for the three pre-qualified consortia for the PBTS Licence(s) on the details of the main tender.
Sep '97	Lowering of mobile and paging licence fees.
	Announcement of 1 October 1997 as the opening date of the public tender for the licensing of up to two more PCMTS operators which would begin operation from 1 April 2000.
Nov '97	Liberalization of Very Small Aperture Terminals (VSAT) licence with 17 VSAT operators approved to operate VSAT for intra-corporate communications.
Apr '98	StarHub wins the Public Basic Telecommunications Services and Public Cellular Mobile Telephone Services licences. Another consortium, P2P, clinches the second PCMTS licence.
	TAS announces it will not award PCMTS licence to P2P as the consortium's local partners were not able to form the consortium according to the shareholding structure proposed in its tender submission.
Oct '98	The Internet access service provision market is further liberalized. Any interested party who meets the minimum criteria can apply to TAS for a public Internet Access Service Provider (IASP) licence.
Jun '99	The provision of International Internet Exchange Services is liberalized.
Jul '99	The transmission of Value-Added Network traffic over the Internet is liberalized.
Sep '99	The foreign equity limit on IASPs and IXSPs is lifted.
Jan '00	Announcement of full competition in the telecommunications sector being brought forward from 1st April 2002 to 1st April 2000.
Sep '00	IDA issued the Code of Practice for Competition in the Provision of Telecommunication Services ("Telecom Competition Code")
Jan '01	IDA approved the Reference Interconnection Offer (RIO) by Singtel. The RIO was effective 31 Jan 2001

Source: IDA.

cellular licenses in April 1998. It launched its fixed and mobile services (GSM 1800) on 1 April 2000. StarHub bought CyberWay, an ISP in January 1999 and rebranded it as StarHub Internet in December 1999. StarHub is owned by Singapore Technologies (34.5%), Singapore Power (25.5%), NTT (Japan) (22%) and BT (UK) (18%). At June 2000 it had 79'000 mobile subscribers and an estimated five per cent share of the international telephone market.

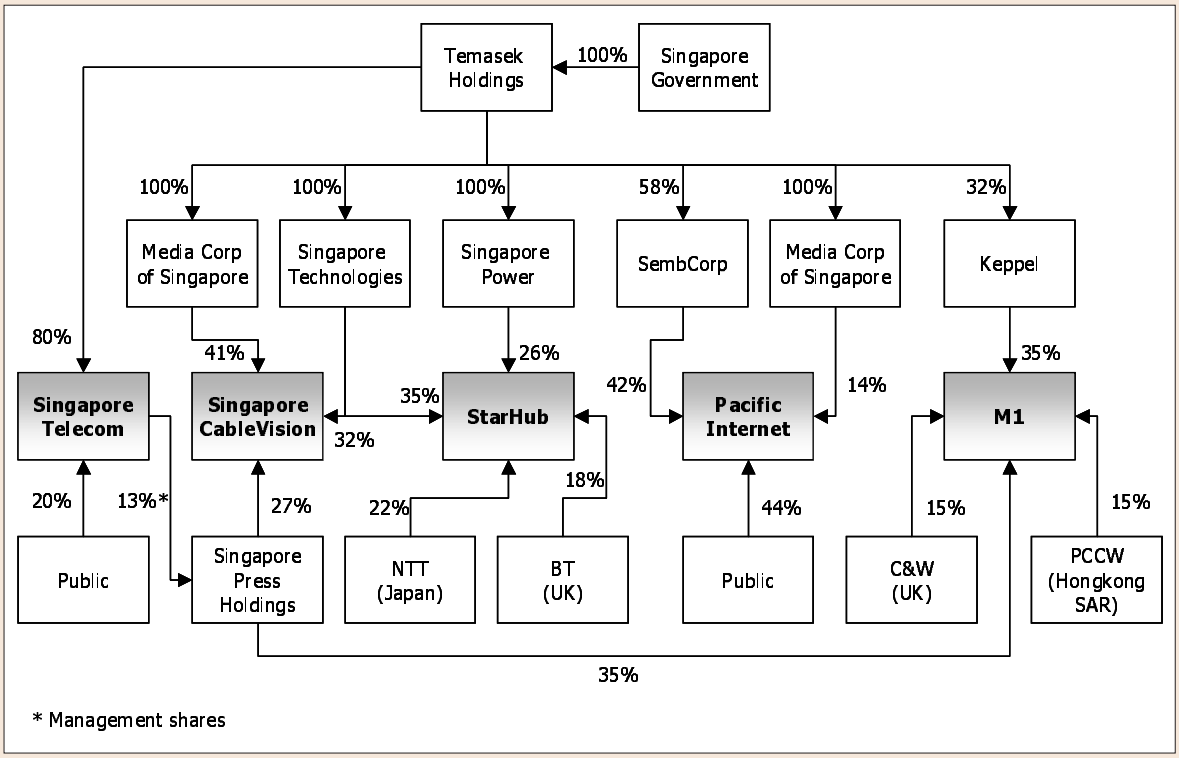
- **Singapore Cable Vision** (SCV) <www.scv.com.sg>, the island's cable television operator, obtained a facilities-based (fixed) telecommunication license in June 2000. It is expected to launch telephone service by the second quarter of 2001. It will leverage its cable television infrastructure to provide cable telephony, its third service after cable television and Internet access.

2.1.3 Market liberalization

IDA has tried to abide by a well-planned timetable in liberalizing the industry. However, rapid global changes have led the government to advance liberalization on several occasions. For example, SingTel initially had a monopoly on fixed-line and international services until 31 March 2007. In May 1996, this was changed to a duopoly to begin 1 April 2000. In January 2000 it was announced that the duopoly would be abolished and the market fully opened to competition in April 2000. The gov-

Figure 2.1: Singapore Inc.

Ownership of Singapore's info-communications industry, June 2000



Source: ITU compiled from company reports.

ernment has been successful in advancing the liberalization timetable by convincing incumbent license holders to accept the changes in return for financial compensation.[1]

Privatization

SingTel was partially privatized through two public sales of shares to the public in October 1993 and September 1996. Temasek, the Singapore government holding company, has also made sporadic sales of its holdings to institutional investors. In July 1999 Temasek held 79.74 per cent of the company.[2] Singapore's government holdings in the telecom sector go beyond SingTel as it has indirect stakes in all current operators through intermediary companies (see Figure 2.1).

Licensing

The provision of virtually any telecommunication service requires a licence issued by IDA.[3] There are two general types of licenses: facilities or services. Facilities-based operators require an individual license while services-based operators may require either an individual license or a class license (i.e., providers are assumed to have read the licensing guidelines and are automatically licensed but nevertheless should register with IDA). In general, individual licensees must pay an annual license fee equivalent to one per cent of annual revenue subject to the respective minimum sums as elaborated in Table 2.2 below, while class licensees pay S$ 200 (US$ 115) every three years. Though there are no pre-defined limits on the number of licenses, technical limitations (e.g., spectrum) and market considerations influence the issuance of facilities-based licenses.

Tariffs

IDA is responsible for approving telecommunication tariffs. There have been few changes to national fixed telephone prices, whose structure is quite straightforward. There are no national long distance tariffs, as calls placed and destined within Singapore are considered local. There are separate monthly telephone line rentals for residential and business subscribers. Local calls had been included in the flat monthly charge until December 1991 when a usage-based call charge was introduced (1.4 Singapore cents per minute peak and 0.7 Singapore cents off-peak). To compensate, fixed telephone residential monthly subscriptions were dropped from S$ 15.83 (US$ 9.13) to S$ 8.33 (US$ 4.8), and business from S$ 24.17 (US$ 14.24) to S$ 12.50 (US$ 7.21). A second change occurred in 1996 when the Goods and Service Tax (GST) was introduced, adding three per cent to telecommunication charges. No further changes to national fixed telephone charges have occurred. International call charges have been steadily declining. SingTel's average international price per minute dropped from S$ 2.05 (US$ 1.18) in 1996 to S$ 1.21 (US$ 0.7) in 2000.

Like fixed telephone prices, charges for entry level mobile cellular service have not changed dramatically despite the introduction of competition. The major innovation has been the introduction of free minutes with the subscription. Singapore has a Receiving Party Pays system for mobile so users must also pay for incoming calls. SingTel Mobile had seven different plans in January 2000 that ranged from S$ 25 (US$ 14.5) – 325 (US$ 187.4) per month, depending on the number of free minutes included.

Interconnection

Limited competition prior to April 2000 has meant that interconnection has not been much of an issue. Interconnection among facilities-based operators is required but left to commercial negotiations. IDA is prepared to facilitate the negotiations and can intervene if necessary. In addition, unbundling of network facilities is also required. IDA has issued a Code of Practice to assist with interconnection issues.

Universal service

According to the Info-communications Development Authority Act of Singa-

Table 2.2: Licenses

Status at January 2001

Licence	New licenses issued after 1 April 2000	Licence/Registration Fee
Facilities-Based Operators	16	
FBO designated as PTL		Initial Fee: None. Annual Fee: 1% AGTO Subject to minimum of S$ 250,000 (US$ 144'133) per year Licence Duration: 20 years, renewable for a further period as IDA thinks fit
Terrestrial telecommunication networks for telecommunication purposes		Initial Fee: None. Annual Fee: 1% AGTO Subject to minimum of S$ 100,000 (US$ 57'653) per year Licence Duration: 15 years, renewable for a further period as IDA thinks fit
Public cellular mobile telephone services		The licence fees and duration will be specified together with the approach to award licences. There will be a separate comparative exercise (tender or auction) by 3rd Quarter 2000.
Public mobile broadband multimedia services		
Public fixed-wireless broadband multimedia services		
Public radio paging services		Initial Fee: None Annual Fee: 1% AGTO Subject to minimum of S$ 1'200 (US$ 692) per year Licence Duration: 10 years, renewable for a further period as IDA thinks fit
Public mobile data services		
Public trunked radio services		
Terrestrial telecommunication network for broadcasting purposes only		Initial Fee: None Annual Fee: S$ 5'000 (US$ 2883) Licence Duration: 10 years, renewable on a 5-yearly basis
Satellite Uplink/Downlink for broadcasting purposes		
Services-Based Operators		
Services-Based Operators to be Individually Licensed		
SBO (Individual)	88	Initial Fee: None Annual Fee: 1% AGTO subject to minimum of S$ 10'000 (US$ 5765) per year
Live Audiotex services only		S$ 200 (US$ 115) every three-yearly
Services-Based Operators to be Class – Licensed		
SBO (Class)	102	S$ 200 (US$ 115) every three-yearly
Resale of public switched telecommunication services		No registration fee payable
Store and retrieve value-added network services (without the use of leased circuits)		No registration fee payable

Source: ITU adapted from IDA.

pore Act 1999, IDA is responsible for ensuring that "*telecommunication services are reasonably accessible to all people in Singapore, and are supplied as efficiently and economically as practicable*." It has a number of tools at its disposal for ensuring this, such as the right to impose price controls or obligate public telecommunication licensees to provide basic services to anyone in Singapore who requests it. Singapore has achieved a high level of universal telephone service. Exact figures on household telephone penetration are not compiled, probably because it is assumed that almost every family has a phone. A statistical calculation based on the number of residential telephone lines results in a ratio of over 100 per cent. This is due to the growing portion of homes with second fixed lines (some twenty per cent at March 2000). Mobile is also helping to enhance access to telephone services. At the end of 1998, over half of Singapore's house-

holds had a mobile phone. There is complete nationwide mobile coverage. That fact, coupled with the availability of prepaid cards, means that there is no infrastructure limitation to universal telecommunication access.

2.1.4 Network

Singapore has a well-developed domestic communication network with 27 telephone exchanges. The fixed network has been fully digitalized since 1994. The Singapore *One Network for Everyone* (ONE) backbone uses ATM technology over fibre optic cable at speeds of up to 622 Mbps. The island has five digital mobile cellular networks (two GSM 900, two GSM 1800 and one CDMA). A significant milestone occurred in July 2000 when the number of mobile cellular subscribers exceeded fixed telephone lines (see Figure 2.2).

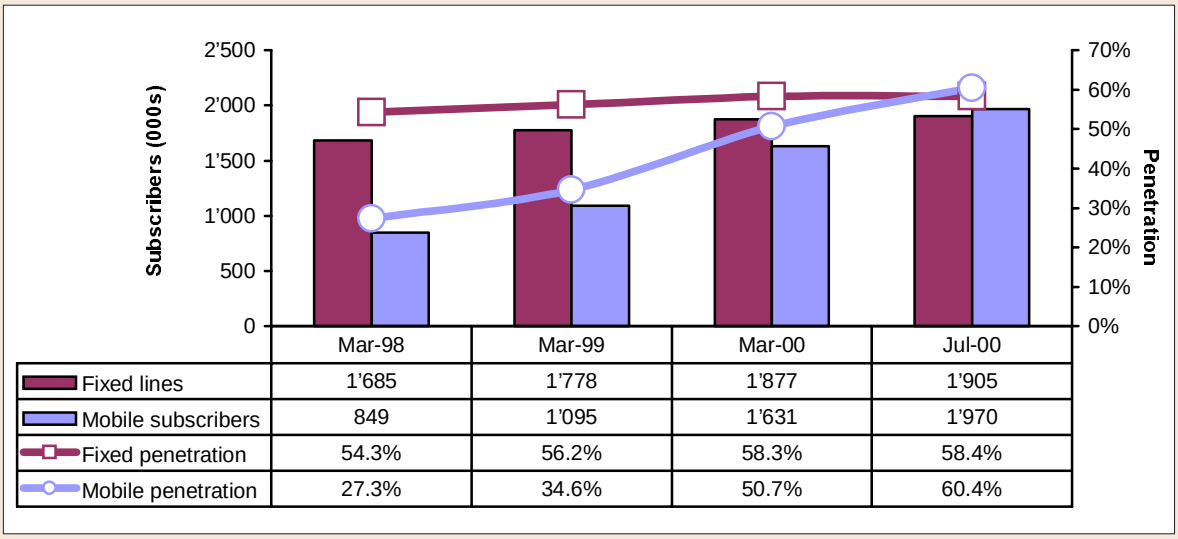
2.1.5 International service

Singapore has over 14'000 telephone circuits with international terrestrial links to Malaysia and submarine cable and satellite links to the rest of the world. Investments in regional submarine fibre cable systems include SEA-ME-WE 3, China-US and Japan-US. SingTel and nine other regional telecom operators are building a new 2.5 terabits per second optic fibre submarine cable to be completed in 2002. When finished, the Asia-Pacific Cable Network 2 will connect eight Asian economies and be the highest capacity submarine cable in the region. The country has three Intelsat satellite earth stations. In addition, Singapore launched its own satellite, ST-1, in August 1998. Its footprint covers most of Asia and is one of the most powerful in the region.

International telecommunication traffic has always been important for the island-state with a trade-oriented economy. Although revenues from international telephone traffic provide the largest proportion of SingTel's revenue, this share has declined to 34 per cent in 1999 from over 50 per cent in 1993 (see Figure 2.3). Yet overall profitability has not been affected due to growing revenue from other sources such as data and Internet services. There were 885 million minutes of outgoing international telephone traffic (excluding Malaysia) in the year ending 31 March 2000, up six per cent over the previous period.

Figure 2.2: Telephone subscribers

Fixed and mobile telephone subscribers (000s), Singapore

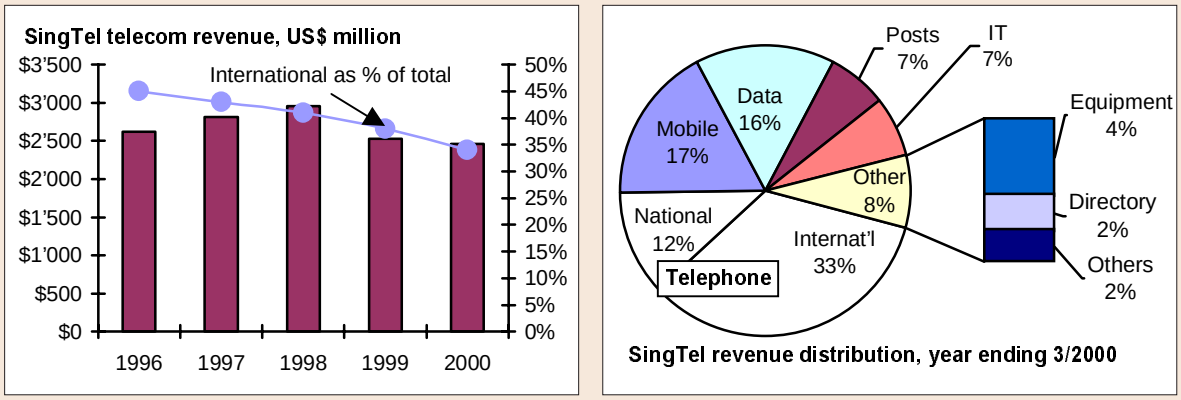


	Mar-98	Mar-99	Mar-00	Jul-00
Fixed lines	1'685	1'778	1'877	1'905
Mobile subscribers	849	1'095	1'631	1'970
Fixed penetration	54.3%	56.2%	58.3%	58.4%
Mobile penetration	27.3%	34.6%	50.7%	60.4%

Source: ITU adapted from IDA.

Figure 2.3: SingTel revenue

SingTel's revenue, 1996-2000, US$ million and distribution of revenue, year ending March 2000



Note: Years ending 31 March. Share of international revenue is based on total revenue.
Source: ITU adapted from SingTel data.

Box 2.1: Mobile Internet

The island's three mobile operators have been actively promoting mobile data and Internet access. All provide Short Messaging Service (SMS)—a sort of precursor to mobile Internet—including support for Chinese if users have the appropriate handset. M1 claims that its users send one million SMS messages a day.[4] Mobile Internet based on the Wireless Access Protocol (WAP) was initiated in the first half of 2000. M1 launched its *Mi World* service in February, SingTel's *e-ideas* service was commercially introduced in March and StarHub's *iPower* was available from April. The operators have been busy developing and signing up content providers for their mobile portals. Applications include online banking, stock inquiries, and news and sports results.

The mobile operators have begun developing faster mobile Internet services to boost GSM's normal speed of 9.6 kbps. M1's WAP service utilizes a special platform that provides 14.4 kbps allowing it to boast of Singapore's fastest service. In December 2000, M1 claimed to be the first to have launched General Packet Radio Service (GPRS) roaming. It builds on the world's first WAP roaming service with Hongkong (started in July 2000); roaming subscribers can access the *Mi World* portal at 36 kbps from Hongkong. Calls are routed over an IP network to get around international long distance rates. SingTel launched a fast wireless service in September using High Speed Circuit Switched Data (HSCSD). This provides a speed of 38.4 kbps. StarHub launched a GPRS trial at the end of October 2000.

The take-up of mobile Internet in Singapore thus far appears to be lukewarm compared to Japan's popular i-mode service. Hard data about the number of users is difficult to come by. StarHub claimed more than 10'000 WAP users at end September 2000 while SingTel Mobile stated it had 20'000 Mobile Office customers in early September. There are no published figures for M1 regarding mobile Internet customers. IDA's figure for mobile data services subscribers—which captures customers of Public Mobile Data licensees but does not include WAP users—was 11'700 at September 2000. Extrapolating from the available data, there were less than 50'000 mobile Internet users in September 2000 or about two per cent of the total mobile subscriber base. Resistance to mobile Internet is related to pricing and handset availability. All operators have waived WAP registration and subscription fees. Usage is charged on a basis of ten Singapore cents (5.8 US cents) per minute.

In October 2000, IDA announced the procedure for awarding third generation (3G) mobile licenses.[5] Unexpectedly, it has decided to use an auction system to award four licenses. The rationale was that an auction is the most objective way of awarding the licenses. The floor price at which the auction will begin has been set at S$ 100 (US$ 57) million. The auction will be held in April 2001.

2.2 Information Technology Sector

Singapore has a vibrant IT sector. The electronics industry, including computer equipment manufacturing, is large and the country is a major export base for big multinational companies such as IBM, Hitachi and Sun. Indeed, exports of Office Machines (which include data processing equipment) was some S$ 41 billion (US$ 23.7 billion) in 1999, more than a third of the country's total exports. There are around 93'000 people employed in the ICT sector in the country, growing at 10-12 per cent a year. Professional and industry associations include the Singapore Computer Society <www.scs.org.sg> and Singapore Information Technology Federation <www.sitf.org.sg>.

2.2.1 Computer market

There is a large selection of computer equipment available in Singapore with many retail outlets. There are even two shopping malls mostly devoted to computer products. Prices are reasonable with a Compaq iPAQ Desktop (Pentium III, 500 MHz processor) costing S$ 1'588 (US$ 915) in July 2000, around US$ 40 less than if purchased over Compaq's US web site.

According to IDC, some 427'000 personal computers were sold in Singapore in 1999, an increase of almost 30 per cent over the previous year.[6] It is estimated that there are around 1.7 million PCs in use on the island, resulting in a penetration rate of 44 per cent, the second highest in the Asia-Pacific region (after Australia). Singapore's household computer penetration stood at 59 per cent in 1999, up almost 20 per cent over the previous year.

2.2.2 The Internet market

Singapore was one of the first countries in Asia to get an Internet connection. This was the culmination of many years of connectivity experience with academic networks preceding the Internet. The pioneering network initiatives of the National University of Singapore (NUS) were critical, attesting to the importance of the academic sector in developing a sustainable Internet environment.[7] Networking activities date back to the early 1980s when Singaporeans obtained new-to-market personal computers and set up Bulletin Board Systems (BBS).[8] Some of these BBS had daily dial-up connections to the international FIDOnet for exchanging emails and files with users in other countries. In 1987, the NUS joined BITNET with the first email received from the City University of New York in January over a 4800 bps link. This was the first Asian link outside of Japan to the BITNET and is cited as a milestone in Singapore's early Internet lead over other countries. Another first took place in August 1990 when a 64kpbs Internet link was established between NUS and Princeton University in the United States. This was the first Internet site in Singapore and the Southeast Asian region. Full Internet connectivity for NUS was officially launched in April

Table 2.3: Singapore PC Market

	1997	1998	1999
PC sold (000s)	370	332	427
Estimated PC base (000s)	1'244	1'450	1'703
PCs per 100 people	33.3%	37.5%	43.7%
Percent households with PC	35.8%	41.0%	58.9%

Note: Estimated base derived from sales data.
Source: ITU adapted from IDC, IDA and national statistics.

1991. Other regional firsts for NUS include the first Gopher server in 1992 and the first World Wide Web server in 1993.

In 1992, TechNet was established to provide Internet connectivity for the island's R&D community, extending access beyond NUS. Technet was later 'commercialized' and became Singapore's second ISP known as Pacific Internet. SingTel launched public Internet services in July 1994 through its SingNet subsidiary. These two ISPs were joined by the then Cyberway, which launched service in March 1996. These three were the only companies allowed to provide Internet service until October 1998 when the ISP market was opened. By June 2000, there were 18 licensed ISPs in Singapore (see Table 2.4) although the original three retain the bulk of the consumer dial-up market with most of the newcomers either serving niche corporate markets[9] or not yet in operation.

ISPs are granted a license by IDA. The license is valid for a period of three years, renewable for another three years after that. The license fee is one per cent of annual gross turnover. In addition, ISPs are automatically granted a class license by SBA, which covers content issues; they are supposed to register with SBA within 14 days after commencing service.

IDA has been publishing Internet dial-up subscriber figures since January 1997. At June 2000, IDA reported 1.8 million dial-up subscribers, resulting in a penetration rate of 54.2 per cent. The number of subscribers rose substantially from December 1999 to March 2000, since the launching of free ISP service by StarHub in December 1999. This was followed by SingNet which provides each SingTel telephone subscriber with a free Internet account via the *mysingtel* portal. In addition SingNet has waived dial-up telephone usage charges for its Internet clients that subscribe to a monthly package. Growth has been flat since March 2000, with the number of Internet subscribers roughly equivalent to the number of telephone lines.

Table 2.4: ISPs in Singapore

Licensed ISPs, June 2000

ISP	Web site
1 1-Net Singapore	<www.1-net.com.sg>
2 AT&T Worldwide Telecommunications Services	
3 Cable & Wireless Network Services (Singapore)	
4 Circle Dot Com (S)	
5 Concert Global Network (S)	
6 Dataone (Asia)	<www.dataone.com>
7 Equant Singapore	
8 Global One Communications	
9 LGA Telecom	
10 Loral Cyberstar International Inc	
11 Pacific Internet	<www2.pacfusion.com/sg>
12 Singapore Telecommunication	<my.singnet.com.sg>
13 StarHub Internet	<www.starhub.net.sg>
14 Stt.com	<www.stt.com.sg>
15 Swiftech Automation	<www.swiftech.net.sg>
16 T.M.I. Telemedia International Hong Kong	
17 UUNET Singapore	<www.uu.net/sg>
18 Winstar Communications Singapore	

Note: These are licensed ISPs and not necessarily in operation.
Source: ITU adapted from IDA.

As a result of free access, figures for Internet subscribers are a bit misleading. Singapore is one of the rare countries where the number of regular Internet users is less than the number of subscribers. A number of recent surveys provide differing figures on Internet use on the island (see Figure 2.4). A 1999 survey provided by SCV based on a sample of 4'200 people states that roughly one third (31.4%) of the population used the Internet. A March 2000 survey put the active Internet universe at 404'000 users (10 per cent of population).[10] Yet another study, released in September 2000, stated that Singapore had the highest Internet penetration in Asia with 46 per cent of the population older than 15 accessing the Internet in the past month.[11] One explanation for these wide discrepancies is that some of the surveys only cover home use and thus would not cover Singaporean residents accessing the Internet from school or work.

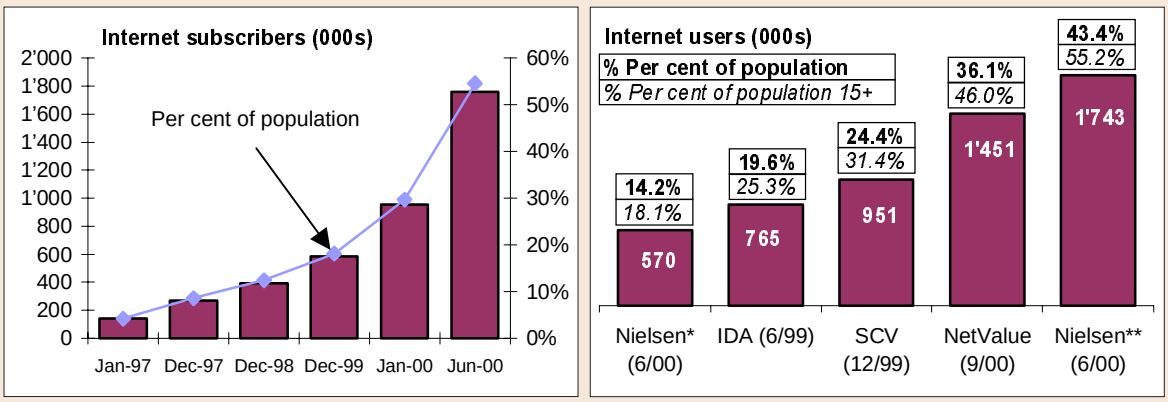
Singapore's high level of Internet development is reflected by its active promotion of high speed Internet access through the nationwide Singapore ONE network <www.s-one.gov.sg> (see Figure 2.5). Singapore ONE is a government-led initiative to develop broadband infrastructure and services. 1-Net provides the infrastructure for Singapore ONE.[12] The network is based on Asynchronous Transfer Mode (ATM) switching technology with fibre optic transmission speeds at up to 622 Mbps.

Broadband local access is available through two services. The first is cable modem access provided by Singapore Cable Vision. The second is SingNet's ADSL Magix service. Over 99 per cent of the island's households are passed by broadband infrastructure and there were 250'000 users in September 2000.[13]

Singapore's international Internet connectivity is, on a per capita basis, one of the highest in the world thanks to SingTel's Internet Exchange (STIX) <www.ix.singtel.com>. It is connected to over 30 countries with some 800 Mbps of bandwidth.

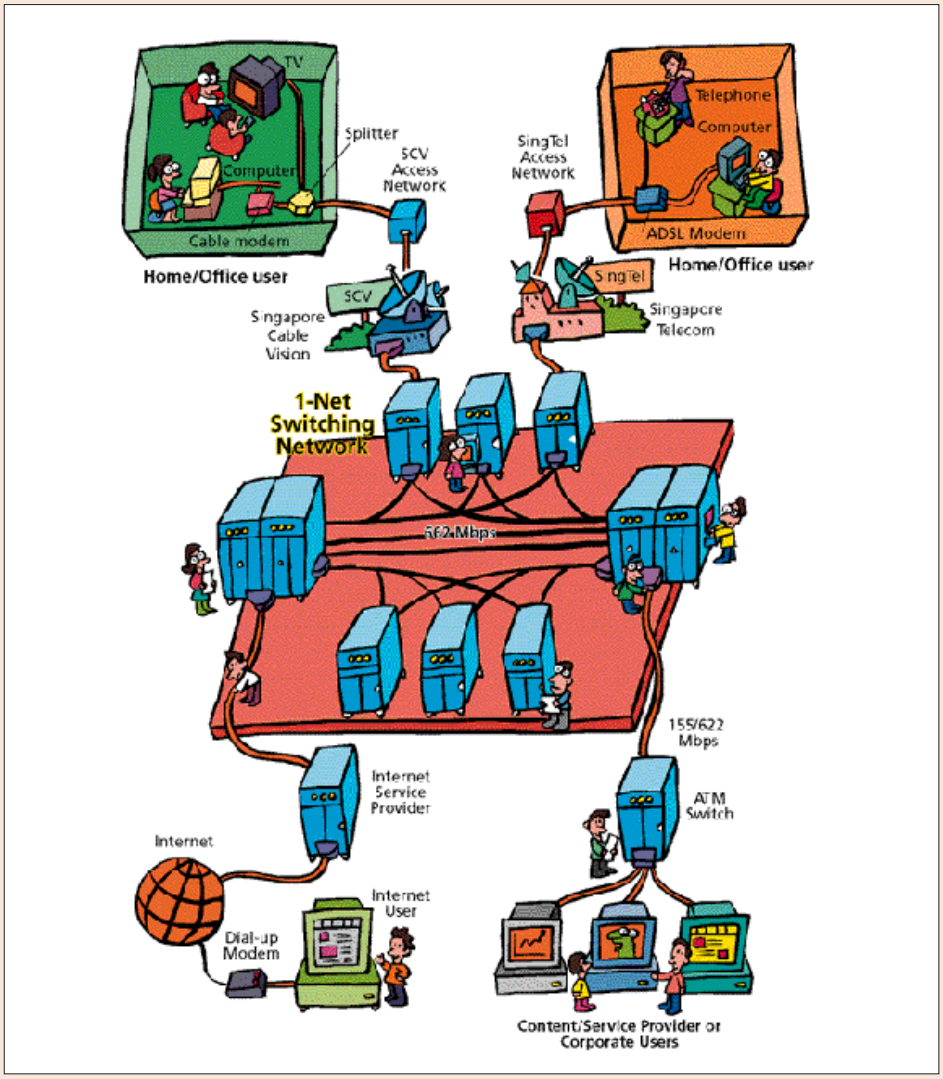
Figure 2.4: Internet market in Singapore

Number of Internet subscribers, 1997-2000 and
estimated number of users, various surveys, June 1999 - September 2000



Note: Left chart: 'Free' Internet access was introduced in December 1999. Right chart: Figure in parenthesis refers to date of survey. Nielsen* figure refers to home users accessing Internet in the last month. IDA refers to their household IT survey. SCV refers to Singapore Cable Vision survey. NetValue data is derived from percentage of 15+ Internet users. Nielsen** figure refers to the total Internet universe.
Source: ITU adapted from IDA, Nielsen, SCV and NetValue data.

Figure 2.5: SingaporeOne Network Infrastructure



Source: http://www.1-net.com.sg/images/aboutus/s-one/Network.gif, December 2000.

2.3 Mass media

There is a high level of technology adoption by Singapore's mass media. This includes not only the Internet but also other advanced broadcasting technology such as Digital Audio Broadcasting (DAB) and Digital Television (DTV). Virtually all of Singapore's newspapers and radio and television stations have web sites. Many have gone further by building portals, developing content or providing audio and video streaming. Singapore's relatively small market size encourages media companies to develop Internet properties with regional pull. This is aided by the perception that Singapore's media is more objective—particularly for Chinese language reporting—than other regional media. Despite the variety of newspapers and broadcast stations, they are all owned by two

companies. The country has recently partly liberalized the media sector by notably allowing the leading printed media company to get into broadcasting and vice versa.

2.3.1 Print

There are eleven local daily papers—six English, three Chinese and one each in Malay and Tamil. There are also about 190 foreign newspapers and more than 5'000 foreign magazines available in Singapore. Daily circulation for the local papers is over one million with the English language papers accounting for more than half. Seven of the papers are on the web, made easier by the fact that they are all published by *Singapore Press Holdings* (SPH) <www.sph.com.sg> (see Box 2.2).

Box 2.2: From printed newspapers to online ones

AsiaOne <www.asia1.com.sg>, a Singapore Press Holdings (SPH) dot-com spin-off, illustrates how Singaporean media companies are embracing the Internet. AsiaOne originated within SPH as a multimedia division and was listed in June 2000 when 13 per cent of its shares were sold to the public. AsiaOne hosts the online version of SPH's seven newspaper editions. It also has content on various subjects such as food, computers and health. Other services include call centre support for horoscopes, sports results, and polling over the telephone.

The main source of AsiaOne's revenue is online advertising. It believes this will grow due to increasing Internet usage and liberalization of the Singaporean media market, which will attract more advertizers. Other sources of AsiaOne revenue include e-commerce transaction services (being one of the largest online shopping malls with more than 200 cyber stores) and voice services. A successful business model has been to bring news online before it comes out in print. AsiaOne also provides free email accounts and sends out breaking news to subscribers. These methods keep users *sticky* to the site. AsiaOne has also reached out to mobile users through a WAP service that provides news headlines and restaurant listings.

AsiaOne claims to get an average of three million page views a day and ranks second in terms of time spent on Singaporean sites with an average of almost half an hour per session (see Table). AsiaOne also operates Zaobao Online, the Internet version of Singapore's leading Chinese newspaper. Zaobao is a Chinese language portal that packages the news content of Lianhe Zaobao and overseas Chinese newspapers with a host of web features and services aimed at Chinese-speaking audiences around the world.

Box Table 2.2: Singapore's top web sites

Ranked by time spent per person, July 2000

Property	Unique audience	Reach %	Time per person
1. MSN	238,014	43.38	0: 42: 33
2. AsiaOne	80,652	14.70	0: 28: 50
3. Yahoo!	278,629	50.78	0: 26: 26
4. Pacific Internet	158,823	28.94	0: 12: 51
5. Singapore Telecom	217,377	39.62	0: 11: 57
6. Lycos	131,304	23.93	0: 09: 02
7. Excite@Home	66,351	12.09	0: 08: 31
8. AOL Web sites	146,486	26.70	0: 07: 07
9. AltaVista	81,404	14.84	0: 06: 56
10. Microsoft	107,175	19.53	0: 04: 23

Note: The data cover home Internet users.
Source: ITU adapted from Nielsen//NetRatings.

2.3.2 Broadcasting

Singapore has a diverse broadcast scene, despite the fact that it has traditionally been government-owned. In 1994, the Singapore Broadcasting Corporation was corporatized as the Singapore International Media Group (SIM) whose subsidiaries include all the leading broadcasters: Radio Corporation of Singapore (known as MediaCorp Radio), Television Corporation of Singapore and Singapore Television Twelve. SIM underwent a restructuring in 1999 and has been renamed Media Corporation of Singapore.

Radio

There are 18 FM radio stations on the island of which twelve belong to *Radio Corporation of Singapore* (RCS).[14] RCS, now known as MediaCorp Radio, broadcasts in four languages, reaching about 2.5 million listeners a week. All RCS's stations are on Internet via its main web page <radio.mediacorpsingapore.com>.

The Internet has provided a way for new stations to overcome scarce FM frequency by developing web sites with audio broadcasts. For example, UTV Entertainment <www.utvi.com.sg> has webcasts with six video and two audio-on-demand channels over the broadband Singapore One net work. MediaCorp Radio also operates 20 NetRadio channels at <radioeastwest.com>.

Television

There are currently six free-to-air television channels on the island. They are Channel 5, Channel 8, Suria, Central, Sportscity, and Channel NewsAsia (CNA). Singapore's largest terrestrial broadcaster, Television Corporation of Singapore (TCS), now known as MediaCorp TV <tv.mediacorpsingapore.com> , owns and manages the entertainment channels, Channel 5, Channel 8, Sportscity, and the Malay entertainment and information channel, Suria, as well as the one specialized in programs for and on children, Indian- and arts communities, Central. Channel 5 and 8 offer viewers round-the-clock English and Mandarin mass entertainment and information programs respectively. Sportscity offers sports fans sporting action from around the world. MediaCrop News owns and manages CNA, which provides news and information on global developments with an unique Asian perspective. In September 2000, MediaCorp launched its second feed, Channel NewsAsia (International), to cater to viewers outside Singapore. MediaCorp TV also owns TVMobile, Singapore's first outdoor digital television channel, and MDigital, which promises viewers the interactive television experience of the future. In June 2000, the government announced that is was prepared to grant SPH licenses to run up to two free-to-air TV and two radio channels. Shortly after, SPH MediaWorks was formed and announced that it would start its commercial TV channels, TV Works and Channel U, by May 2001.

Singapore has a license fee system whereby all television set owners are required to pay an annual charge. License fees generated S$ 92 million (US$ 53 million) for SBA during its 1999/2000 fiscal year, accounting for 88 per cent of revenue. Ironically, despite a ban against chewing gum and strict littering laws, it seems that around 20 per cent of Singapore's households are evading license fees. Though television penetration is felt to be near universal, SBA had issued 758'683 licenses at December 2000, accounting for 82 per cent of the households in the country.

Singapore Cable Vision (SCV) was licensed in June 1995[15]. It was required to cable all homes on the island by 1 January 2000 in return for a 7-year exclusivity franchise. The S$ 600 (US$ 346) million hybrid fibre-coaxial network was completed in September 1999, three months ahead of schedule. SCV has a number of subscription packages offering up to 40 cable channels depending on the package chosen. SCV's entry package, the Basic Tier, costs S$ 33.94 (US$20) per month and includes free channels like the six local terrestrial stations, two Malaysian ones

Table 2.5: Mass media indicators

Indicator	Value	Source
Daily newspaper circulation Per 1'000 inhabitants	1,068,942 275	1999. Statistics Singapore.
Television licenses Households with license	758'683 82%	December 2000. SBA. 923'300 resident households per Statistics Singapore at June 2000.
Television households Households with TV	896'000 99%	1999. AC Nielsen. 1999. AC Nielsen.
Cable TV subscribers Households with cable TV	255'000 28%	2000. SBA

Source: ITU adapted from sources shown.

and SCV's Preview Channel. There were some 255'000 cable TV subscribers by December 2000 or just over one quarter of all homes.

Following a three-year trial period since 1996, SCV launched a cable modem service called MaxOnline, in December 1999. There were 38'000 MaxOnline subscribers in December 2000. The connection charge is S$ 51.50 (US$ 30) and the monthly fee is S$ 76 (US$ 44) (S$ 56 for existing MaxTV subscribers).

There is currently a ban on Direct-To-Home satellite reception.

[1] The compensation is based on the estimated loss of earnings from competition. SingTel was compensated S$ 859 million (US$ 495 million) and StarHub S$ 1'082 million (US$ 623 million) for moving forward the date of full competition from 1 April 2002 to 1 April 2000. See IDA. "IDA Announces Compensation to SingTel and StarHub." *IDA Media Release*. 11 September 2000.

[2] Temasek also owns a *Special Share* which ensures that no major changes can be made to SingTel without its prior written approval. Temasek's web site is http://www.temasekholdings.com.sg

[3] IDA's licensing and regulatory powers are granted under the 1999 Telecommunications Act.

[4] M1. "M1 SMS to rival networks now free." *Press Release*. 26 June 2000.

[5] IDA. "IDA Announces 3G Licensing Framework." *Press Release*. 20 October 2000.

[6] IDC. "Asian PC Market Surges to Over 14.1 Million Units in 1999, Says IDC." *Press Release*. 14 February 2000. http://www.idc.com.sg/Press/releases/PR-AP-PC_99.htm.

[7] Overcoming a sense of isolation has been put forth as a prime reason for the keen interest of Singapore's academic community to establish international computer connections.

[8] Much of the history of the Internet in Singapore in this section is based on Bernard Tan. "Origins of the Internet in Singapore (Part 1)." *'envision'* (Singapore Broadcasting Authority). January-March 2000 as well as a forthcoming draft of Part 2 provided to us by Dr. Tan.

[9] For example a number of the newly licensed ISPs such as Equant are global ISPs; their Singaporean operations are targetted at their global customers (many of which have their regional headquarters in Singapore). Others, such as DataOne, target the business community by providing value-added services in addition to plain ISP.

[10] See Nielsen/NetRatings. "Nielsen//NetRatings Announces First-Ever Multi-Country Internet Audience Measurement Results." *Press Release*. 4 May 2000.

[11] NetValue. "Asian Internet Users Come Out of the Closet." *Press Release*. 4 September 2000. www.netvalue.com/corp/presse/cp0013.htm

[12] 1-Net's web site is: http://www.1-net.com.sg/index.cfm. A network diagram is available at http://www.1-net.com.sg/images/aboutus/s-one/Network.gif and a schematic of the types of services is available at http://www.1-net.com.sg/images/aboutus/s-one/s1apps.gif. In September 2000, IDA announced that 1-Net's shareholders would sell their holdings to MediaCorp. See IDA. "Industry Players Divest 1-Net shares to Mediacorp." *Media Release*. 27 September 2000.

[13] IDA. "Singapore One Reaches a Quarter of a Million Users." *Media Release*. 18 September 2000.

[14] The AM radio frequency is not used.

[15] SCV's owners are Media Corporation of Singapore (41.3%), ST Telecommunications (32%), and Singapore Press Holdings (26.7%) and its web site is <www.scv.com.sg>.