POLICY FORUM: COMMUNICATIONS

Wiring Up the Island State

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As the World Wide Web becomes more information intensive in terms of text, data, and multimedia content, 56K (56 kilobits/s) modems will become a bottleneck to the telecommunications network and Internet growth. E-commerce and e-mail are also growing in popularity in today's competitive world. As all information (audio, video, or text) can be represented digitally, it should be possible to have a seamless framework for delivery. Nations that are strategically positioned to rise to the challenges of the emerging information society can capitalize on opportunities to improve their competitiveness. However, this will require investments in bandwidth (the rate at which a volume of information can be transmitted along a communication line). In the context of the foregoing, Singapore has recently established a nationwide broadband network (*1*). It was a great challenge!

The Broadband Network

Two independent networks constitute the nationwide broadband network, known as Singapore ONE (S1). One network is based on the Asymmetric Digital Subscriber Line (ADSL) and the other, on cable modem technology. The two networks are a consequence of the government's long-term intent for homes in Singapore to be wired up for the information age via two separate lines, telephone and cable. It is expected that the two lines will help to fuel the convergence of the telecommunications and broadcast media, as well as afford homes the choice of delivery platform for broadband content.

The ADSL technology upgrades conventional twisted pairs of copper wires in the telecommunications network to have the capability for broadband transmission. This requires the installation of a special modem at both ends of the telephone line, one at the home or office and the other at the telephone exchange. Auxiliary access networks perform data concentration, protocol conversion, multiplexing, routing, signaling, and network management. For the S1 network, users need to have a personal computer, fitted with an Asynchronous Transfer Mode (ATM) network interface card and an MPEG-1 card, and be connected to the ADSL modem. For Internet access, a bandwidth of 512K is available, whereas for S1 access, it is 2500K, both in a point-to-point network topology.

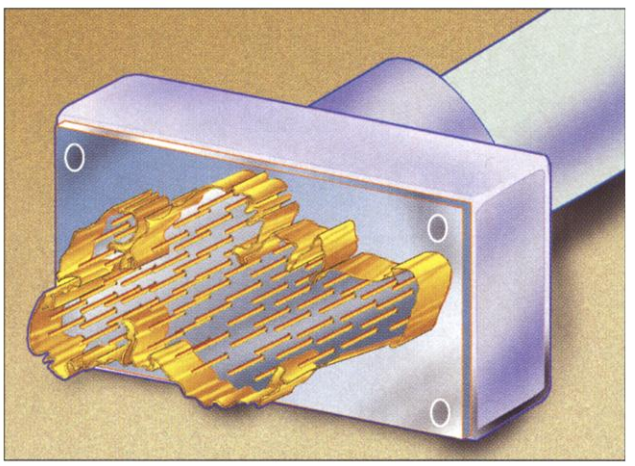
The cable modem relies on the cable television operator's network infrastructure, which is based on Hybrid Fiber Coaxial (HFC) cable technology. Its backbone is an optical fiber network, with the local loop to homes consisting of coaxial cables. The cable terminates in two sockets for cable television and broadband access. For broadband access, users need a personal computer fitted with an Ethernet network interface card and connected to the cable modem. Each modem offers up to 1.5 megabits per second (Mbps) downstream (from the service provider to the user) in shared network topology.

The ADSL and HFC access networks are integrated into the existing telecommunications infrastructure via an optical fiber backbone based on ATM technology. It is a high-speed, low-delay, multiplexing and switching technology that allows voice, image, data, and video to be transmitted simultaneously rather than through traffic-specific networks. It also has the advantages of being flexible, fault-tolerant, and highly scalable. Content providers, service providers, and corporations can connect directly to the ATM backbone, which is connected to the Internet grid via the Internet service providers.

Lessons We Have Learned

The Singapore government recognizes that policies geared toward deregulation of the telecommunications sector are crucial for revitalizing networks and spurring growth. This leads to opportunities for new players to enter the market and raise the level of competitiveness. A phased and managed approach was adopted until recently, whereby the focus was on facilities-based competition instead of services-based competition. Facilities-based competition was introduced to encourage new players to invest in an infrastructure that could support a range of innovative services. In the beginning, foreign companies were encouraged to form business alliances with local partners and to enter the market, but could have a maximum of only 49% equity. As of 1 April 2000, this restriction was lifted to help liberalize the telecommunications market in Singapore.

These policies have led to the emergence of two delivery platforms for the broadband network—the ADSL service of national telecommunications operator (Singtel) and the cable modem service of Singapore Cable Vision (SCV), a consortium in which U.S.-based MediaONE has an equity stake. This consortium has invested more than S$500 million (US$291 million) in wiring homes and offices in Singapore without any assurance of subscription income at the start. Additional companies are also allowed to offer broadband services.



Singapore's new interconnections.

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The long-term benefits of competition may not be realized if it is introduced too quickly or in an uncontrolled way (such as in a totally free market). The phased and sustained approach used until recently has progressively seen the privatization of Singtel in 1992 and the entry of new players in the service providers market for fixed-line, mobile phone, paging, and Internet access. An independent regulatory authority, now known as the Infocommunications Development Authority of Singapore, has established comprehensive guidelines on fair practice and conduct. The government has had a crucial role in enacting policies that support and encourage private sector initiatives such as fiscal incentives to help companies defray the cost of their initial investments through the sharing of risks; legislation on intellectual property rights, security, privacy, and protection in the digital domain; technology grants; and taxation incentives. These policies have helped to attract multinational corporations as investors; for example, Microsoft, IBM, Anderson Consulting, Bloomberg Financial Services, Hewlett-Packard, Sun Microsystems,

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Reuters, Oracle, and Motorola. Involvement of multinational companies is especially important for developing nations.

The establishment of the nationwide broadband network was a massive engineering exercise. With ADSL, the final throughput will be contingent on the quality of the copper cables, as well as the distance of the subscriber's line from the telephone exchange. All 27 telephone exchanges in Singapore have been upgraded to ensure that they are ADSL-friendly. Given Singapore's small land area and high population density, any subscriber's line is within about 4 km of the nearest telephone exchange. (This is an unusual feature of Singapore, a city-state, and suggests that for other nations, ADSL deployment is feasible for metropolitan areas.) Compliance with the minimum standard of not more than 20 dB loss at 120 kHz was set for the copper cables to ensure acceptable throughput (*2*).

For the cable modem service, cabling started in June 1995 and finished in October 1999. Again, Singapore's small land area and high population density made it somewhat easier to lay the cable network. Underground cabling was used in place of the traditional overhead cabling because this would lead to a more reliable network that was less prone to damage and breakdowns. In April 1999, Cable Labs (a U.S.-based consortium of cable operators for research and development) determined that cable modems should conform to the Data Over Cable Service Interface Specification (DOCSIS) standard. DOCSIS 1.0 cable modems were thus introduced in the second phase of trials that began in June 1999. Even though DOCSIS 1.0 still has a number of limitations such as inadequate quality of service and latency protocols, the general feeling is that it is currently the most suitable open platform for broadband access by cable. An open platform permits universal standards to be followed by manufacturers in the design of the cable modems, so that consumers will not be locked into any proprietary configurations.

About 10,000 users participated in the first phase of trials, which began in June 1997, and were involved in accessing and testing about 120 applications and services. Another 2000 households participated in the second phase of trials (starting in June 1999). At the same time, an engineering phase of testing explored several aspects of the system, including speed of access, validation of manufacturers' specifications for equipment, interoperability of systems procured from various vendors, and compatibility of new components with existing protocols and host software. In the engineering phase, we learned that adoption of internationally accepted standards for the various elements of the network is indispensable for ensuring interoperability.

The Challenges

Since its commercial launch in June 1998, the system has grown to about 100,000 subscribers for S1 services out of a total of about 620,000 regular users of the Internet. The official target is 400,000 by December 2001. We believe that aggressive marketing will make it possible to reach this target, given that 59% of households currently have personal computers, 95% of households have televisions, and the number of cable television subscribers is about 220,000. In April of this year, Singapore Cable Vision will be piloting a television-based Internet system, which would offer households Web surfing and e-mail services.

The government recognizes that tariffs for access are currently high: S$96 (US$56) per month for continuous cable modem service, and S$35 to S$120 (US$25 to US$70) per month for ADSL service, depending on the number of hours used. One reason for this is that telecommunication costs to the United States, which is the principal direction for Internet traffic, are also high. With the recent deregulation of the telecommunications market, there is likely to be increased foreign competition in providing international leased circuits to the United States. Access to the infrastructure is also likely to be opened up for other Internet service providers, thus stimulating further competition and helping to bring down prices.

Many local government ministries and other departments have begun moving onto S1 to provide the public, as well as businesses, more convenient services. The aim is to ensure that by the year 2001, most public services will be offered online. The government has spent S$150 million (US$87 million) on the S1 project and will be spending another S$150 million to increase mass usage. It has drawn up an ICT 21 master plan (*1*) to turn information and communication technologies into key sectors of growth in the economy and position Singapore as the information and communications hub in the Asia-Pacific region by 2005.

Compelling applications are the engine of growth for S1. There are six categories of applications now available to subscribers in addition to Web access, e-mail, and e-commerce: video conferencing, shopping, government services, learning, information, and six entertainment channels with programs in five local languages. To enlarge the subscriber base, other applications will need to be developed. More than 60 multinational companies and 140 local companies have committed more than S$300 million (US$174 million) to develop innovative applications for the broadband network. Some of the popular applications include online trading and video streaming.

Transformation of Science and Business

For science, the greatest benefit has been Internet access at high speed. Schools, libraries, and institutions of higher learning in Singapore, most of which have S1 access, are beginning to realize that the vast knowledge base of the Web is a powerful enabling tool for science students.

The IBM Emerging Technology Center was established in 1998 to use the S1 network as a laboratory to test high-bandwidth applications for a global market. Ongoing research includes advanced networking technologies, as well as an emerging Internet standard called multiprotocol label switching, which aims to enhance the performance and reliability of high-speed networks.

As few local companies have the technological know-how to fully exploit broadband applications for their needs, an Advanced Interactive Multimedia Center was established in March 1999 at the National University of Singapore. This center is providing technology assistance, as well as subsidy funding to help transform ideas into fruition.

Businesses are finding the S1 platform to be a secure and trustworthy node for e-commerce transactions. They are also finding it more productive for reengineering their operational and information management services. A secure electronic transaction system for credit cards was established in April 1997 for VISA and in June 1997 for Mastercard. In July 1997, NetTrust, Southeast Asia's first electronic certification authority, began to issue electronic identification certificates that can identify merchants and buyers. Currently averaging S$400 million (US$232 million) per month, e-commerce is expected to reach half of all businesses in Singapore by the year 2003.

The establishment of the nationwide broadband network is a far-sighted move to take Singapore into the next millennium. As Singapore prime minister, Mr. Goh Chok Tongas said, "It is the start of a whole new way of working, living and learning." (*3*).

References

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