
Global Communications Newsletter

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A Network GigaPOP for Singapore's Research and Education Community

By Lek-Heng Ngoh, Singapore

Singapore has some of the most advanced computer data network infrastructures in the world. It has three commercial Internet service providers (ISPs), and more to come with the recent liberalization of the ISP market. A nation-wide broadband infrastructure called Singapore ONE became available commercially in 1998. Companies, institutions, and households can now be connected readily to these information highways. To look beyond the current state-of-the-art broadband technologies, the Singapore Advanced Research and Educational Network (SingAREN) was set up in 1997 to promote R&D in these areas. With these networks, Singapore has indeed plugged firmly onto the global information highways, and stand to reap the many benefits and spin-offs these networks offer.

Multiple Networks

However, the existence of multiple broadband networks have somewhat complicated the roles each of them play. The picture can be confusing to potential users and subscribers of these networks. The current status is as follows:

Singapore ONE provides nation-wide commercial broadband access. 1-NET is responsible for the core backbone network while Singapore Telecom (SingTel) and Singapore Cable Vision (SCV) provide the access networks using ADSL and cable modems, respectively.

The ISPs provide commercial Internet services in Singapore. They do so through dedicated leased lines or other available access technologies, including Singapore ONE.

SingAREN is a government-funded project, with its own broadband network links. It provides next generation Internet access exclusively to the R&D community in Singapore and is linked with counterpart research networks internationally.

A Suboptimal Situation

From the operational standpoint, these roles are not mutually exclusive, resulting in inefficiencies in the use of network resources. The situation is particularly evident in the research and education (R&E) establishments, where all three networks are present. This has given rise to the following scenarios.

- Too many physical links (i.e., one per provider) to one organization and available raw bandwidth is not fully used leading to waste.
- Operationally, all these network services are not integrated within an organization. Instead each carries a specific "class" of traffic. This has resulted in low usage on some physical links and network congestion on others.
- Users have difficulty deciding which link to use to carry out certain tasks such as a videoconferencing trial.

- Fine-tuning on the required bandwidth for each of these services is not possible. Each service is purchased and used with its own terms and conditions.

Proposed Solution: A Network GigaPOP

To overcome the problems highlighted above, we propose that a GigaPOP be set up for the R&E community in Singapore. The basic concept involves the centralization of vital network services such as Internet access, Singapore ONE, IPv6 (internet protocol version 6), and intelligent routing, as well as bandwidth partitioning functions in one place. The most effective means are then provided for these services to be accessed by the respective connecting sites. A recent study carried out by SingAREN management on research networks in the United States, Canada, Asia, and Europe has provided strong support for setting up such a GigaPOP operation. Many research networks are operated by a small group of technically competent engineers serving the networking needs of their R&E communities. These GigaPOP operations are not-for-profit, i.e., they are either funded by government agencies, or self-supported through fees collected from membership subscription after a number of years of operation. Examples of these include the NC-REN in North Carolina, USA; OCRInet and RISQ in Canada; and DFN network in Germany. Some of these GigaPOP operators also function as ISPs, and even collaborate with other infrastructure providers (e.g., utility gas company) to gain the "right-of-way" of providing high-speed links.

Roles of ISPs and Network Operators

With this setup, the relationships between the various broadband network infrastructures will be much cleaner. More importantly, conflict between roles and functions can be avoided completely. This will lead to cost savings and better use of available resources. The situation is now as follows:

1-NET, SingTel and SCV will provide the commercial broadband "fat pipes" in Singapore, now used primarily to access Singapore ONE services. The same physical links can be used to provide access to SingAREN services, as well as commercial Internet traffic provided by the ISPs.

SingAREN will provide GigaPOP services to the R&E community on a not-for-profit basis, and support network and application R&D locally and internationally. These services are offered via either the S-ONE links or SingAREN's own dark fiber links. The S-ONE link is a preconfigured, stable broadband fat pipe suitable for application-level research and sustained testing. The SingAREN dark fiber link, on the other

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Original Regulatory System Reform of the Telecommunications Industry in China

By Liang Xiongjian and Zhang Wei, China

The telecommunications industry has been growing at a rapid speed for the last decade in China. In this process, customer demand is increasing, telecommunications technologies are evolving, and the telecommunications market is becoming more and more open. All of these changes require a suitable regulatory system. Under the old system, the Ministry of Posts and Telecommunications (MPT) had both government and corporate functions, which resulted in nonstandard market behaviors and unfair competition. All of this malpractice is hampering the development of the telecommunications industry in China. Therefore, it is very urgent to reform the old system.

Evolution of the Regulatory System Reform of China's Telecommunications Industry

In 1998, after a long period of argumentation and gestation, the Chinese government took a key step and made great achievements in the regulatory system reform of telecommunications industry.

Firstly, with the restructuring of government organization, the Ministry of Information Industry (MII), newly founded on the base of former MPT and the Ministry of Electronic Industry, replaced MPT to regulate the information industry. The functions of the new MII are set as follows: to rebound manufacturing of electronic and information products, telecommunications, and software industry; to boost the informational capabilities of the national economy and social services; to draw up industry plans, policies, and rules; to make overall plans of national telecommunications backbone networks (including local and long-distance telecommunications network), broadcasting and television networks and other private telecommunications networks; to rationally collocate all resources to avoid the reduplicate construction; to guarantee the information security.

Secondly, the divergence between government and corporation functions will be realized under the new regulatory system. Comparing with the functions of MPT ratified by the state council in 1994, we can find that the MII no longer has the functions of managing and operating the national public telecommunications network. It shows that the restructuring of government organization is definitely helpful for the divergence of government and corporation functions.

As the biggest telecommunications service provider in China, China Telecom used to be controlled and operated directly by the former MPT. Following the above divergence, China Telecom will become an actual corporation with the self-operating and self-assuming sole responsibility for its profits or loss and can engage independently in market competition. This change will have a significant impact on the telecommunications market and may be viewed as a positive signal for a mature market.

Thirdly, in stead of combining the operations of telecommunications section and the postal section, these two kinds of operations will be gradually separated. With the rapid development of telecommunications technologies and services, there are more and more differences in terms of marketing, operating and management between telecommunications and postal sections. The old cooperation system begins to tie down the development of telecommunications section. In this sense, the divergence of telecommunications and postal oper-

ations is necessary and was already finished by the end of 1998.

Influence of Regulatory System Reform upon China's Telecommunications Industry

It is no doubt that the system reform of China's telecommunications regulatory system in 1998 has had a significant effect. As the world's largest potential market, China is expecting to establish an united and efficient telecommunications regulatory body with coordinated operation, in order to ensure a fair, standardized, and orderly market environment for competition and set up telecommunications enterprises according to the demands of the modern market economy. By these means, it is hoped that the telecommunications industry will become a new growth point for the national economy and find its position in the international market.

Generally speaking, regulatory system reform is influenced by the divergence between government and corporation functions, which will guarantee that fair competition in the telecommunications market is standardized.

One of the purposes of the reform is to set up a marketplace of fair competition. Within this marketplace, enterprises will need to focus their attention on products, quality, price, and services that will satisfy their customers in order to survive and develop; hence, the competition of these enterprises will be promoted. On the other hand, the fierce competition will eliminate enterprises that did not perform well and then optimize the distribution of resources. This will improve the usage of resources and bring China's telecommunications industry new vitality and vigor in the forthcoming 21st century.

MII will regulate the manufacturing industry of electronics information products, the telecommunications industry, and the software industry, as well as macro-manage national public telecommunications networks, broadcasting, and television networks and various private telecommunications networks. It complies with the international trend of convergence of information services and provides many more opportunities for China's information industry in its future development.

As a result of the regulatory system reform, it will be much easier for the potential investor to enter the telecommunications market. There will be more enterprises which are interested in the provision of information services joining the competition in telecommunications market. These new comers will challenge the conventional enterprises and the customers will hopefully get more convenient telecommunications services with lower price and better quality.

China has not proposed a schedule for its telecommunications market opening, mainly because of some specific problems caused by the characteristics of China's telecommunications development. However, the regulatory system reform is now providing China an opportunity to solve these problems. By means of establishing new regulatory body, separating government functions from enterprises, dividing postal and telecommunications operation, and improving laws and regulations, China will gradually find its way out of the difficulties which have blocked the openness of its telecommunications market for a long time and merge the Chinese telecommunications market into the international one.

The Internet Technical Committee

By Henning Schulzrinne, Co-chair, InternetTC

This joint committee of the Internet Society and the IEEE Communications Society stimulates interdisciplinary technical exchange and the application of state-of-the-art communications and related technologies to Internet infrastructure and services. The InternetTC seeks to generate new technical insights from interaction between the Internet and public network communities, contributing to the emergence worldwide of a ubiquitous, multimedia, and high-performance Internet. The Committee sponsors and cosponsors workshops, organizes sessions at conferences of both Societies, and encourages submission of articles to their publications. The scope of the Committee includes evolution of the IP protocol; architectural and scaling issues; addressing, routing, and directory services; protocols and technologies in support of real-time media; dynamic control of quality of service; congestion control and admission policies; signaling and network management; access via diverse local and metropolitan networks; information retrieval and sharing; and international interoperability of services and applications.

The committee has been instrumental in sponsoring one of the new miniconferences (symposia), Global Internet, that are under the GLOBECOM conference umbrella. Global Internet, organized annually since 1996, has become a recognized venue for publishing papers in all areas of Internet technology and research, including routing, multicast, transport, mobility, multimedia, Web issues (caching, replication, performance) and network security. It attracts performance-oriented, architecture, and systems papers. Global Internet is selective in its choice of papers, with a decreasing acceptance ratio. For example, in 1998, less than a quarter of all submitted papers were accepted for presentation. Global Internet 1999 will be held in Rio de Janeiro.

The committee also sponsors sessions at ICC and has been a technical cosponsor for other events.

The committee was founded in 1996 and now has an active mailing list, itc@ieee.org, that reaches about 350 members, 210 of which are from the United States. Membership is split roughly evenly between those in universities and industrial/government research labs, while the others are distributed across about 30 countries. The mailing list is used to announce calls for papers and conferences, opportunities to help with conference reviews, research funding opportunities, open research and faculty positions, new technical reports, Web sites, and software of general interest to the Internet technical community.

The committee cooperates closely with the Technical Committees on Computer Communications and Gigabit Networking. The committees share a membership database containing about 900 members. The database makes it easier to locate colleagues for reviews, IEEE business or joint technical work. In the future, we plan to use the database for a number of ComSoc conferences sponsored by these committees, so that authors, technical program committee members, and reviewers do not have to retype e-mail addresses and other contact information.

The InternetTC maintains a Web page with resources, member directory, and the list of officers at <http://www.cs.columbia.edu/~hgs/InternetTC>. Information about the Global Internet symposium can be found there as well.

The InternetTC currently meets at INFOCOM, with meetings at GLOBECOM and ICC scheduled as needed. Membership is open to all those interested in the topics mentioned—simply subscribe to the mailing list through the Web page. Members can become more active by serving as the InternetTC conference representative, for example.

Report from the 1999 IEEE International Conference on Personal Wireless Communications

By Ram Gupta, India

The IEEE Aerospace & Electronic Systems, Communications Lasers & Electro-Optics, Society Chapter, India successfully held the “1999 IEEE International Conference on Personal Wireless Communications” at Jaipur during February 17–19, 1999. The response was overwhelming, with 187 participants from 21 countries in attendance.

There were 24 technical sessions with 101 papers, 4 exclusive tutorials and the Plenary and Panel discussion sessions during the Conference. The Plenary session was Chaired by Shri P. S. Saran, Member, Telecom Commission, Government of India. Nearly 90 percent of the technical papers were presented. This is an incredible achievement. To encourage participation from the semi-urban and rural areas of India, 38 complimentary registrations were granted to the colleges and universities around Jaipur. This will also ensure that the technical activities of IEEE and of the Chapter are known in the area around Jaipur. Fifteen complimentary copies of the proceedings and tutorials notes were given to volunteer students from the local engineering colleges who helped organize and ensure the smooth running of the Conference. 200 copies of the proceedings are being shipped to IEEE for wider circulation throughout the world.

ComSoc e-News

By Tom Chen, e-News Editor

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hand, allows for a wide range of flexible configurations and protocols to be tried and tested. For this reason it does not offer the same level of reliability as the S-ONE link, but its experimental nature makes it more suited for core network research.

Currently, users obtain commercial Internet services directly from ISPs. Under this proposal, they can obtain the service via the GigaPOP. This means that the ISP service will first come to the GigaPOP before going to the connecting sites. Additionally, the link can provide an effective alternate backup path for sites that are already served by an ISP, especially when their primary links are down or congested. It is important that commercial Internet service is available via the GigaPOP, because high-speed access to commercial sites can also benefit R&D projects directly. The GigaPOP can act as a service broker for R&E sites to obtain their commercial Internet services from the ISPs. With economies of scale, as well as the effect of aggregation and statistical multiplexing, the GigaPOP can expect to offer a more cost-effective commercial Internet service.

The proposed GigaPOP will therefore be the aggregation point for all the three network services, namely, commercial Internet, Singapore ONE, and SingAREN. Initially however, it will only play the role of an *aggregator* and not a *provider* of these services. For example, it will aggregate traffic for the Singapore ONE services that are connected via the 1-NET network. Similarly it should also play the role of aggregating Internet traffic from all connecting R&E sites.

Currently, SingAREN operates its own international links to provide next generation Internet access for its users. Under the proposal, the ISPs can provide the high-speed (R&D and commercial) international Internet access via their own leased lines to the SingAREN GigaPOP. This is provided all the

R&D requirements of SingAREN can be met. For example, the proposed setup should allow core R&D (e.g., IPv6, QBONE trials) to be conducted internationally between SingAREN sites and their international partners and not be limited to just trials on applications. This means that one or more ISPs can offer Internet services to the GigaPOP by providing dedicated overseas connections (physical or virtual). As some international R&D research infrastructures are separated from the commercial infrastructures (e.g., vBNS, CA*NET), the ISPs will work with SingAREN and these international partners to make sure that connections between these networks and SingAREN's GigaPOP are made.

Implementation

The proposed GigaPOP will operate its network in both the "production" and "R&D" modes. This means a suitable network configuration should be determined so that both production and R&D related activities can be supported effectively. As the names imply, the research node (to be at SingAREN's site at Kent Ridge Digital Labs) is where the R&D links terminate. This supports broadband R&D activities including demonstrating, testing, and developing of new protocols by the connecting sites. Research prototypes, access techniques (e.g., ADSL, SVC services) to be tried and tested before they are applied to the production POP will also be conducted here. Given its R&D role, this node will be able to access the same set of broadband services being provided by the production POP. However, this service provision should only be for R&D purposes and are nonpermanent. This part of the SingAREN network will also not provide the same level of reliability as the production POP. The production POP (to be at another SingAREN building site) on the other hand, will provide the aggregated GigaPOP functions as described in this article. When necessary, the production GigaPOP will also be used to support application level research and project demonstrations and vice versa. However, this should be treated with care to ensure that the reliability of the production POP is not compromised. All links terminating at this production GigaPOP are served through 1-NET's infrastructure.

The production POP on the other hand will be the entry point into the various SingAREN & ISP services. Other international traffic services such as caching, MBone, 6Bone, and QBone will also make their entry and exit via this node. This is also where traffic arbitration and route serving functions are provided. In order to maximize flexibility, the R&D and production POPs are linked physically via a R&D fiber link as shown.

Conclusions

The introduction of broadband networks to Singapore has happened at a very rapid pace in the last few years. With the availability of Singapore ONE and SingAREN and the accelerated pace of internet penetration, Singapore is now one of the most wired up nations in the world, well positioned for the coming knowledge based economy. The network GigaPOP will maximize the benefits of broadband networking to Singapore, specifically to the research and education community for which it was set up to serve.

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