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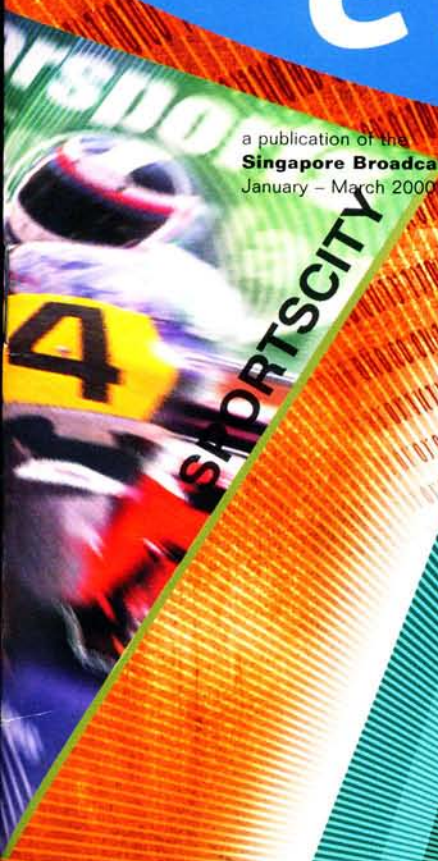

Broadcasting in the New Millennium

PAGi – Empowering Parents

Origins of the Internet in Singapore

WWW Origins of the Internet in

The Internet is undoubtedly one of the pivotal developments driving society and the economy today. Most of us who use the Internet today hardly spare a thought as to how we in Singapore have been able to be ahead of other countries in the region and Asia. Indeed, Singapore did gain access to the Internet much earlier than most countries in the region. This head-start has undoubtedly given us a strong advantage in the Knowledge-Based Economy stakes. In this article, we recall some of the events which led to the early adoption of Internet by Singapore in relation to the rest of the region.

The advent of personal computers such as the Apple II, the Radio Shack TRS-80 and the Commodore PET gave the man in the street the computer access which made the amazing growth of the Internet possible today. The proliferation of computer bulletin boards (BBSs) in Singapore in the 1980s can also be regarded as a precursor to the Internet. I remember that such a BBS was operated by an expatriate as the first and only BBS in Singapore, and it closed down when its SYSOP or system operator left the country. It was to be several years before the next BBS would be set up.

The many BBSs which operated right into the '90s provided dial-up email, newsgroups, file transfer, interactive games and even rudimentary chat rooms. These BBSs became extremely popular among our teenagers and sowed the seeds of the Internet youth culture of today. Some boards which had access to FIDOnet, the international BBS network, also gave their users international email access through a number of gateways (usually through a once-a-day dial-up connection) from FIDOnet to the international computer networks which were already in operation.

International Computer Networks

Of course by this time, the Internet, or ARPAnet as it was still known (after ARPA, the US Advanced Research Projects Agency), was an international network which already served the scientific and technological research community, mostly in the US. The story of the origins of the Internet has already been related in several books[1,2,3] and articles, and I will not repeat it here, except to mention that the key figures in its early history were Larry Roberts of ARPA who worked out much of the early networking concepts for ARPAnet; Leonard Kleinrock of UCLA who set up the first working ARPAnet node; Bob Kahn who organised the first public Internet demonstration in 1972; and Vinton Cerf who (with Bob Kahn) designed and implemented the TCP/IP (Transmission Control Protocol/Internet Protocol) protocol which replaced the Network Control Protocol (NCP) used by the ARPAnet till then.

In addition, there were also several other networks, which had been set up to serve different communities. Some of them, such as JANET (Joint Academic Network) in the UK, were country-specific, while others, such as CSNET, served special interest groups such as the computer science community. Usenet was a large and influential news discussion network serving the Unix community which used the Unix to Unix CoPy (uucp) mail protocol of the Unix system. Of these other networks, BITNET was one of the most important as it had a large number of academic sites which were able to enjoy inexpensive access to the Internet via certain sites serving as gateways between BITNET and the Internet.

BITNET

In October 1985, when I had just started my first term as Dean of Science at the National University of Singapore (NUS), I was sent to Austin, Texas, to attend the EDUCOM conference. EDUCOM is a consortium of universities, mainly in the US, which deals with computer and networking issues in higher education. EDUCOM was also important as the body which had set up and which maintained BITNET. Though one would have thought that the "BIT" in its name stood for the basic unit of digital

By **ASSOC PROF BERNARD TAN**
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Singapore (Part 1)

information, it actually stood for "Because It's There". However, it was also erroneously believed to mean "Because It's Time", perhaps because BITNET came in time to enable many universities and other institutions to enjoy international networking in an inexpensive manner.

There is no doubt that BITNET, with its wide and increasingly international reach, played a key role in the development of the Internet (then known as ARPANET) into the transnational phenomenon it is today[2]. The simplicity and cheapness of a BITNET connection depended on the fact that it used the built-in NJE store-and-forward networking protocol which was an integral part of the widely used IBM VM operating system. IBM mainframes were widely used in academia and industry in the US, so BITNET gave researchers in these institutions a cheap way to enter international networking, as several gateways already existed between BITNET and the Internet, as well as the other international networks. Indeed, prior to BITNET, IBM itself had been using the NJE protocol for its internal VNET network.

At the time of the EDUCOM conference in 1985, over 600 computers in the US, Canada (the Canadian branch of BITNET was known as NetNorth), Europe (the European branch of BITNET was known as EARN, or the European Academic Research Network) and Japan were already connected to BITNET. As many academic computers used DEC VAX computers, the IBM NJE protocol soon became available as an emulation on VAX computers, enabling them to connect to BITNET as well.

NUS joins BITNET

When I returned to Singapore after the conference, I sent a report[4] to the Vice-Chancellor, Prof Lim Pin, and the Director of the NUS Computer Centre, Dr Thio Hoe Tong, recommending strongly that NUS join EDUCOM and get connected to BITNET, as "Joining BITNET would put NUS right into the mainstream of academic com-

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Received: by CUNYVM (Mailer X1.23) id 8610; Tue, 13 Jan 87 09:27:09 EST
Date:     Tue, 13 Jan 1987 09:07 EST
From:     Bill Rubin <WGRCU@CUNYVM>
Subject:  Welcome to BITNET!
To:       <aawai@nusvm>, <ccethio@nusvm>, <tbernard@nusvm>, <angkh@nusvm>
cc:       Victor Viggiano <VICCU@CUNYVM>, Ben Yalow <YBMCU@CUNYVM>, Ben Klein <BSKCU@CUNYVM>

Well, we finally succeeded. As we just discussed on the phone, I would like to use the
'PORT' code that is included in RSCS version 2 release 2 as this will make things easier
for us operationally. However, we cannot do this until we set up passwords for the node
and/or line. I'm not totally sure whether both are required, but for safety, let's use
both. As we agreed, the password we will use will be 'BITNET'. (Note that these passwords
are required by the RSCS code for security, so no one else can dial in with your nodename
and receive your files).

To implement these passwords on your side, and since we have to swap the MODE=

If you do not receive this mail by tomorrow morning, I'll leave the  to get this to work,
here is what your PARM statement for us should look like:

PARM CUNYVMV2 MODE=SEC TLPASS=BITNET TNPASS=BITNET

I will include a corresponding PARM statement on our side. system the way it was today,
and we can implement these changes tomorrow (Wednesday).

Bye,
Bill Rubin
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The first email sent through BITNET on 13 January 1987 from the City University of New York (CUNYVM) to the National University of Singapore (NUSVM).

WWW Origins of the Internet in Singapore (Part 1)

puting and networking activities in the US and Europe, and would significantly lessen the feeling of isolation from our counterparts in the developed world". Prof Lim Pin immediately saw and understood the advantages of joining BITNET and must be credited with the vision and daring to have acted swiftly to bring Singapore into the international networking community. Dr Thio, who also knew of BITNET and who also enthusiatically supported Prof Lim's move to link NUS to BITNET, then quickly activated his Computer Centre team on the necessary technical procedures to connect NUS to BITNET.

Dr Thio, who was at that time in the US on sabbatical leave, made contact with EDUCOM's Director of Networking, Dan Oberst, to discuss the technical details of the NUS connection to BITNET. It was soon decided that the NUS connection would be made via the BITNET node CUNYVM at the City University of New York (CUNY). CUNYVM (many BITNET nodes have the -VM ending to reflect their VM operating system origin) was in fact one of the first two BITNET nodes, because the founder of BITNET, Ira Fuchs, was Executive Director of the CUNY computing centre. The other founding BITNET node was Yale University, which communicated with CUNY through a leased line on a pair of 9600 bps modems on 5 May 1981 to establish the first BITNET link.

Working hard throughout 1986, the NUS team led by Dr Thio and Dr Loh Wai Lung, his Assistant Director in charge of networking, assisted by their CUNY counterparts, achieved sporadic contact between NUS and CUNY by late 1986[5]. Meanwhile, Dr Thio and I attended the EDUCOM Conference in November 1986 held in Pittsburgh to strengthen our links with EDUCOM. The first official email from CUNYVM to NUSVM, the NUS BITNET node, was transmitted through a 4800 bps dial up link on 13 January 1987, which is the official date, according to EDUCOM, on which NUS joined BITNET (See page 19). By mid-February, a 4800 bps leased line had been installed, and this was subsequently upgraded to 9600 bps in January 1988. This was not only the first Singapore BITNET node, but also the first such node in the whole of Asia outside Japan and Israel, including Australasia[6].

The importance of BITNET

With BITNET, those of us who had been using the internal campus email service, which was mainly based on the existing IBM mainframes, could now begin to enjoy the benefits of international email. I must have been one of the earliest members of NUS to use the BITNET email system, using my then email ID which was TBERNARD at NUSVM, but which later became BTGTAN at NUSVM. I did many interesting experiments with BITNET, such as trying to get the IBM PROFS email system to mesh with the BITNET RFC822 email protocols (Mailer was the mail transport server used by VM to send and receive BITNET email), and using gateways to send email from NUSVM to other networks. I sent and received email to and from the then uucp node nus-cs at the NUS Department of Information Systems and Computer Science, using a route through the uucp node tataelxsi at the Science Park. I also sent and received mail to and from the JANET network in the UK, communicating with an NUS colleague then in the UK on sabbatical leave (I even wrote a VM EXEC program in REXX to facilitate the use of the VM mail EXECs.)

The importance of the BITNET link on 13 January 1987 to Singapore's IT development cannot be understated, for it marked Singapore's entry as a fully fledged member of the international networking community, a move which led directly to our present status today as a major Asian Internet node. It is true that some BBS operators had previously been able to send email via FIDOnet, and that a uucp link may already have existed through a node at the Tata Elexsi office in the Science Park next to NUS. However, it was the NUS BITNET link to CUNY which truly paved the way for the introduction of the Internet to this part of the world, and which gave Singapore a significant headstart over the other countries in the region which we have still been able to maintain.

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THE Origins OF The Internet IN SINGAPORE

(Part 2)

by Assoc Prof Bernard Tan
Chairman, National Internet
Advisory Committee

Assoc Prof Tan continues to chart Internet's rapid development in Singapore and takes stock of how the technology has contributed to what is a vibrant and dynamic IT landscape today.

The National University of Singapore (NUS) made very good use of BITNET, not only for its staff members to interact with their colleagues overseas, but also to organise international conferences as well as to communicate with external examiners and visiting professors. Though BITNET did not support functions like remote login, FTP or direct access to Usenet newsgroups, one could obtain digests of Usenet groups through BITNET email distribution lists as well as participate in the LISTSERV email discussion groups which already covered a wide variety of topics. For example, as I was (and still am) a keen Macintosh user, I was delighted that I could for the first time access the Usenet Mac Digest, which was a compilation of the current Usenet Macintosh user group postings, by subscribing to the M-USENET distribution list available through LISTSERV.

Though the BITNET email capability was reliable only with text or ASCII transmission, due to the inability of some gateways to pass through anything except ASCII characters, computer files of any sort could be obtained from remote sites by email requests, which resulted in the files being sent as large email messages in ASCII format. These ASCII files could then be decoded into binary files if necessary. For example, I was able to access the well-known info-mac Macintosh archives through a BITNET server known as MACSERVE which was located at the Princeton University BITNET node, PUCC. In the same way, I now had access to the rich resources available in the many archives on BITNET by getting the files in these archives sent to me by email.

Using the built-in TELL command in the VM operating system, it was possible for two VM users on BITNET to have a real-time on-line text conversation. I remember clearly having such a chat with Dan Oberst, who was at the EDUCOM Networking Centre at Princeton University, in which Dan suggested that we find a way for me to send *satay* (roast meat) to him through BITNET (Dan had been in this part of the world before.) Hence though BITNET's functionally was quite limited compared to today's Internet, it was still amazing to us what we could achieve through this new doorway to the international community which BITNET had opened for us.

NUSNET AND THE INTERNET

In the meantime, NUS was upgrading its existing campus computer systems, then based on IBM and VAX mainframes, by using a new optical fibre backbone to link up all the existing campus networks, into a true campus-wide network to be known as NUSNET which would be linked to the Internet. The NUS Computer Centre staff under Dr Thio and his new assistant director in charge of networking, Dr Tommi Chen, worked hard to establish the necessary TCP/IP protocols with the Internet node at Princeton University. By this time, the backbone of the Internet was NSFNET, established by the National Science Foundation to provide a high-speed TCP/IP backbone to which all the existing networks could link i.e. to perform "internetworking" by connecting many networks together. ARPAnet itself was shut down in June 1990, having down its job of establishing TCP/IP in 1983 as a viable protocol for internetworking.

By the time NUSNET went into operation in August 1990, the 64k bps Internet link between NUS and Princeton was fully functional, making NUS the home of the first Internet site in Singapore and the region. International networking, though still largely confined to the academic and research community, was experiencing rapid and widespread growth[1]. NUSNET was subsequently launched[2] by the then Senior Minister of State for Education, the late Dr Tay Eng Soon, as a campus-wide network with full Internet connectivity on 11 April 1991. This meant that we at NUS were now, in addition to the email and other simple services offered by BITNET, able to enjoy facilities such as file transfer protocol (FTP) and remote login (Telnet). Other educational establishments in Singapore were subsequently persuaded to link to the Internet via NUS, and to share the costs of the 64k bps line.

BITNET and Internet coexisted in NUS for some time before all the services on BITNET were finally migrated to the Internet. It was wonderful to be able to retrieve files from overseas sites directly through FTP, instead of having to go through the BITNET routine of first requesting and then receiving an index of the archive where a required file was believed to reside, then sending a request for the file itself, receiving the file by email, and finally decoding the file from ASCII form into binary form if it was an executable file. The problem of knowing where on the Internet a desired file resided was solved by the Archie sites, which kept archival lists of nearly all the files available on the Net. One could login to any of these Archie sites and if the file one wanted was in the Archie archive, one could find out which sites had that file and then obtain it through remote FTP. The Archie sites were predecessors of the search engines such as Altavista now commonly used on the Web.

Remote login through Telnet meant we could use overseas computers directly, and also use our own NUS computers if we were on leave

Dr Tommi Chen (extreme left), Dr Thio Hoe Ting (second from left), Prof Lim Pin (third from left) and Dr Tay Eng Soon (second from right) at the official launch of NUSNET on 11 April 1991

overseas, so that we could retrieve our email remotely and even run our programs on the NUS computers while out of Singapore. It was also a joy to be able to access the Usenet newsgroups and to participate in Usenet discussions directly, which had not been possible in BITNET. Later on, the Gopher protocol made the direct accessing of resources on remote sites much easier through a menu system which facilitated jumping to other sites. Gopher was therefore a direct predecessor of the World Wide Web and its hypertext links.

TECHNET

NUS, through Dr Thio Hoe Tong and Dr Tommi Chen, then entered into discussions with the National Science and Technology Board (NSTB), SingTel and the Ministry of Trade and Industry on how to extend the benefits of the Internet to the rest of the R & D community outside of academia. (I had also discussed with Dr Su Guaning, then Director of the Defence Science Organisation or DSO, the possibility of linking NUS and DSO.) These discussions and the support of Prof Lim Pin subsequently resulted in the launching of the first national R & D network in 1992, which became known as Technet. Technet allowed R & D workers in academia, government and industry to collaborate more effectively with each other, and was another proof that the Internet was a serious and important tool which had vast possibilities beyond the R & D community.

NUS continued its trail-blazing role by establishing the first Gopher server in the region in 1992, and the joint-first World Wide Web server in the region in 1993. This was www.nus.sg, pioneered by Dr Chen's successor, Dr Tan Tin Wee, who is still very active in the Singapore Internet scene. The other joint-first Singapore web site, was, I believe, set up by another Singapore net pioneer, Jek Kian Jin, who is now in Silicon Valley and is very involved in the Internet start-up scene there.

It was only a matter of time before the Internet would burst its limited boundaries within the R & D community and become available to the public at large in Singapore. SingTel established SingNet, Singapore's first Internet Access Service Provider (IASP), in 1994 with the help of Technet. Technet itself was sold to a consortium comprising of Sembawang Media, ST Computer Systems and Singapore International Media in 1995 and was transformed into Pacific Internet or PacNet, Singapore's second IASP. The rest, as they say, is history[3].

In 1989, BITNET merged with another important computer network, CSNET, to form CREN, or the Cooperation for Research and Education Networking. Eventually, the BITNET protocols were phased out, and its succesor BITNET II became an integral part of the Internet, by allowing the BITNET protocols to ride on TCP/IP and take advantage of the bandwidth afforded by the Internet links. Though BITNET has passed into history, its contribution to the growth and development of the Internet has been widely acknowledged. As Neil Randall has pointed out[4], "... that same Internet would not have existed...were it not for the success of BITNET and the US and around the world."

NUS - THE CRADLE OF INTERNET IN SINGAPORE

In today's surge of excitement over the Internet, the Web, e-commerce and dot-com startups, it may be appropriate for us to pause and ponder over what might have happened if NUS had not taken its bold steps into BITNET in 1986 and the Internet in 1990. Singapore's prominent position in the Internet world today might not have come about, and our present efforts to establish ourselves as a key e-commerce centre would have been delayed by several critical years. It is therefore appropriate for all Internet users today to remember and recognise the vision and foresight of the Vice-Chancellor of NUS, Prof Lim Pin, as well as the enthusiasm and dedication of Dr Thio Hoe Tong and his team at the NUS Computer Centre, in enabling NUS to become the cradle of BITNET and the Internet in Singapore and making our country's present position as a leading Internet force in the region and the world a reality today.

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