

30 Years of Internet in HK – A Quick Look-Back at the First 20 Years

Che-Hoo Cheng

APNIC

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Disclaimers

- My personal viewpoints and observations only
 - Not my employer's
 - Not very objective
- Mostly what I witnessed personally so may not cover everything
 - Focused mostly on things of interest to HKNOG community
- May not be 100% accurate (Sorry!)
- Not in chronological order
- Not covering 2012 to present because people here would know more than me
- Cannot avoid naming names
- Not a lot to cover in fact and it is about history so it will be boring...

<https://kahoot.it>

**Quiz with 3 Prizes
at the End!**

Before Having Internet in HK

- Store-and-forward email service in universities starting late 1980's
- Name of HARNET started to be used under UPCC/JUCC for interconnecting universities
- UUCP over X.25 first
 - Usage charge involved
 - Weird email addresses with % & !
- Bitnet over IPLC later
 - 2.4Kbps to 9.6Kbps IPLC over satellite to Yale U from HKU
 - Bitnet over DECnet within HARNET using leased circuits
 - Store-and-forward messaging service supported as well
 - .HK used for email addresses was started but it was not Internet
- No real-time interactive services possible

The 30th Anniversary of Internet in HK



- The first Internet link in HK was set up by CUHK in **Sep 1991**
- 64Kbps satellite link directly to NASA Ames in California, US
 - Connecting to FIX-West
 - With used Proteon router donated by NASA
- Through PACCOM Project managed by U of Hawaii
 - With funding support from NASA, DoE & NSF of US
 - After AU (1989), JP (1989), NZ (1989) & KR (1990)
- CUHK paid for HK half circuit and PACCOM paid for US half circuit
- Real-time interactive services possible
 - Telnet, FTP & SMTP initially
- CUHK also took over the management of primary .HK domain name server from Harvard U in late 1991

The Proteon Router Used at the Beginning



Press Release by CUHK in Nov 1991

香港中文大學
THE
CHINESE
UNIVERSITY
OF
HONG
KONG

查詢電話
ENQUIRY
TELEPHONE
NUMBER
6035592



新聞稿 PRESS RELEASE

CUHK Connects to the World of Computer Communication

The Engineering Faculty of The Chinese University of Hong Kong has recently established a connection to the worldwide computer network, Internet. The connection is exclusive in the sense that it is the first high speed (64K b/s) computer communication link from Hong Kong to the Internet. The University hopes that the Internet connection will be extended to all local tertiary institutions so as to set up a Hong Kong-wide network.

The Internet connection is operated under the aegis of the Pacific Communication Community (PACCOM) which is an international consortium planning to develop a strong network for the Pacific Rim. As a member of the PACCOM, the Chinese University is able to access the Internet and participate in this international project. The connection is funded by a bilateral agreement between the U.S. community of the PACCOM and the Faculty of Engineering of the University, which requires each party to provide the respective 'half circuit' tariffs for the link.

By joining the Internet, the Faculty of Engineering has taken a great leap forward in developing academic and research exchanges with local and overseas educational institutions. The three major applications of the network (mailing utility, file transfer utility and remote log-on utility) enable academics and researchers of the Faculty to access a worldwide resources of information through computer communication. The information exchanged can be in all disciplines of human knowledge and in the form of text, voice, images and video.

A presentation of the Internet Connection organized by the Engineering Faculty will be held on Thursday, November 21 at 4:30 pm at Rm 222B of Lady Shaw Building at the university campus. Prof Omar Wing, Dean of the Engineering Faculty, will officiate at the presentation. Mr Eric Lo, Computer Officer of the Department of Information Engineering, will give a live demonstration of the use and functions of the Internet System to the members of the University and Polytechnic Computer Centre (UPCC) and the faculties of the Chinese University interested in accessing the link.

Internet is a network of networks originated from a small advanced research network of military usage in the United States more than twenty years ago and has grown tremendously when more and more academic and research organizations joined the network. Nowadays the U.S. National Science Foundation is responsible for planning, coordinating, developing and financing the major national network backbone which in turn is connected to regional mid-level networks. The connection from the Chinese University to the Internet is also through one of the mid-level network, BARRNET.

Today the Internet connection involves 4,000 networks with more than one million users. Apart from the U.S. continental, European countries, Australia, Japan and South Korea have already been connected to this global network.

November 18, 1991

Dear Editor,

You are cordially invited to send a reporter and/or a cameraman to cover the demonstration of the Internet Connection on Thursday, November 21, 1991 at 4:30 pm at Rm 222B of Lady Shaw Building of the Chinese University. Should you need further information, please feel free to contact me at 6035592.

Clara Lee (Mrs)
Information Officer

HARNET Took Over in Jul 1992

- Other universities started to use the Internet link via CUHK one by one after Sep 1991
- HARNET took over the management of the Internet link in Jul 1992 while CUHK maintained as the gateway
 - HARNET backbone changed to support IP
 - Ring topology first
 - Star topology later
 - Dual star topology was the ideal case but it was never materialized
- Outsourcing of HARNET operations starting 1997
- No more direct US circuit starting around 2004

The Birth of Commercial ISPs

- HKIGS & HK Supernet are the first two commercial ISPs in HK with direct 64Kbps link to US set up in late 1993
- HKIGS served its own customers as well as piggyback ISPs
- HK Supernet (set up by UST) served its own customers mainly
- Much more ISPs were set up in 1994
- Dial-up was the main access method for individual users
- Leased-circuit was the main access method for enterprises
- Shutdown of ISPs by HKP/OFTA due to PNETS license/charge issues in Feb/Mar 1995 made more people aware of Internet
 - Remember PNETS charge for dial-up service?
- And of course, there were Internet transit providers later in the game

Hong Kong Internet eXchange (HKIX)

- HK Supernet connected to HARNET via UST since the beginning (late 1993)
- HKIGS connected to HARNET via CUHK with T1 circuit in Sep 1994
- No interconnection between HK Supernet and HKIGS still
- CUHK saw the need and so set up HKIX in Apr 1995 to facilitate easy interconnections among ISPs for keeping intra-HK traffic within HK
 - A layer-2 network with support of co-located routers installed by participating ISPs
 - Started with just a thin coaxial cable (10Mbps Ethernet)
 - Evolved to Ethernet switch (Cisco/Kalpana EtherSwitch PRO16) in Dec 1995
 - Upgraded to Cisco Catalyst 5000 in Apr 1996
 - Also had route server (Cisco 2501) to facilitate multilateral peering

Hong Kong Internet eXchange (HKIX)

- Linkage Online and Global Link were the first 2 connections in Apr 1995
- HKIX did publicity only in Jul 1995 after 5 ISPs connected
- HKIGS migrated to new HKIX connection later in 1995
- HK Supernet connected in Oct 1995
- Netvigator connected on Day 1 in Apr 1996
- In Apr 1996, 26 ISPs connected
- Attracted all local ISPs to connect and gradually became a regional IXP to help keep intra-Asia traffic within Asia

History of Internet Development in Hong Kong

- Sep 91: CUHK set up a 64Kbps Internet link to US
- Early 92: Other Universities joined
- Jul 92: JUCC/HARNET took up the management
- Late 92: HARNET T1-Ring Backbone was set up
- Sep 93: HARNET-US link upgraded to 128Kbps
- Late 93: 2 commercial ISPs were set up with their own 64Kbps links to US
- 94: A few piggy-back ISPs were set up

History of Internet Development in Hong Kong

- 95: More ISPs were being set up;
Some had their own links to US
- Feb/Mar 95: Two incidences caused temporary
shutdown of several ISPs
- Apr 95: HKIX was set up by CSC of CUHK
- Sep 95: HARNET-US link upgraded to T1
- Oct 95: HARNET T1-Ring Backbone converted to
T1-Star
- 96: More ISPs being set up

History of Internet Development in Hong Kong

- Mar 97: HARNET-US link upgraded to E1
- Dec 97: First T3 link from HK ISP to US;
HARNET Backbone Converted to ATM;
HARNET-US link upgraded to 6Mbps
- May 98: Second T3 link from HK ISP to US
- Sep 98: HARNET-US link upgraded to 12Mbps
- Feb 00: First STM-1 link from HK ISP to US
- Aug 00: HARNET connected to G1 HK with 48Mbps
- Jun 01: First STM-4c link from HK ISP to JP
- 01: HARNET connected to Equant HK with 72Mbps
- Sep 01: First STM-4c link from HK ISP to US
- 02: HARNET connected to Equant HK with 96Mbps
- Oct 02: HARNET 45Mbps ATM to Internet2
- 03: HARNET connected to PCCW with 155Mbps
- 04: HARNET connected to PCCW with 240Mbps
- 05: STM16 pipes to Mainland/US (CAS & CERNET)

History of Interconnections in Hong Kong

- Late 93: HK Supernet connected to HARNET via UST; No local connections between HKIGS and HARNET/HK Supernet
- Sep 94: HKIGS together with its downstreams connected to HARNET via CUHK using a T1 link; Still no local connections between HKIGS and HK Supernet
- Early 95: More ISPs were set up. CSC/ITSC of CUHK saw the needs of setting up a local exchange point and started negotiating with individual ISPs.
- April 95: ISPs started to connect to CUHK and HKIX was established.
- Nov 04: HKIX2 announced
- Nov 04: Private interconnections of PCCW / Hutchison / NWT
- Jan 05: 74 ISPs connected to HKIX

.HK Domain Name Registration Service

- Under tremendous pressure by commercial ISPs to offer .HK domain names to public
- The public service started in 1994 using the name of HKNIC
 - 2nd level migrated to 3rd level - .com.hk / .edu.hk / .gov.hk / .net.hk / .org.hk
 - CUHK operated the service under JUCC with admin/accounting support from JUCC
 - HK\$200 one-off
 - With additional HK\$200 for every subsequent change
- HKDNR was spun off by JUCC to operate .HK in Jun 2001
- HKIRC took over HKDNR in Mar 2002
 - Recurrent charges
 - 2nd level and IDN offered to public

DNS Root Server Instances in HK

- First DNS root server instance in HK (F-Root) was set up in Nov 2003 with support of APNIC
- I-Root was added soon after
- Help improve DNS performance and resilience in HK
- Situation in early 2006 shown on the right



.ASIA TLD with Home in HK

- A then-new TLD targeting to serve the whole Asia region with HK as home
 - Not-for-profit limited-by-guarantee company registered in HK
 - With head office in HK
 - Members (organisations) from all over the region
- Preparation for application started in 2003
- It took 2+ years to get the initial approval by ICANN (Dec 2005) and another 10 months for contract negotiation before final approval by ICANN (Oct 2006)
- .ASIA service was successfully launched in Q1 2008

Many Submarine Cables to HK

- Riding on open telecom regulatory environment
- Good central location between East Asia and South East Asia
 - Also considered as gateway to China
- Major growth started in late 1990's
 - East Asia (JP/KR/TW) was the starting point
 - With SG followed soon after
- Major global Internet transit providers mostly have POPs in HK
- HK is indeed a submarine cable hub in Asia

Many Data Centres in HK

- Also riding on open telecom regulatory environment
- High industry growth mostly started in late 1990's
 - Chai Wan, Tsuen Wan/Kwai Chung, Taikoo Place and Central (!) were the starting points
- Having termination points of submarine cables could attract much more tenants, especially telecom players
- Later leveraging the proliferation of content providers and cloud providers
- HK is indeed a data centre hub in Asia

IXPs & Data Centres Are Natural Partners

- HK has other IXPs besides HKIX
- One IXP across multiple Data Centres
 - The same layer-2 broadcast domain
 - Power plant redundancy consideration
- Multiple IXPs in one Data Centre
 - Data centres may have their IXPs
- Healthy competition would be good
 - Customers have choices
 - Also for better resilience
 - As long as Keeping Local Traffic Local can be achieved, it is all good

Bandwidth Growth Gradually

- 2.4Kbps -> 9.6Kbps
- 64Kbps -> 512Kbps
- 1.5/2Mbps (T1/E1)
- 45Mbps (T3/DS3)
- 155Mbps (STM-1/OC-3)
- 622Mbps (STM-4/OC-12)
- 2.5Gbps (STM-16/OC-48)
- 10Gbps
- 100Gbps

Price Drop of Internet Transit

- ~US\$2K/Mbps in 2000 -> ~US\$100/Mbps in 2007
 - Volume matters of course
- Transit providers looking for keeping at least the same revenue from each customer in order to survive
- Charging Model: Fixed -> 95th Percentile
 - 90th percentile!
 - Average?

Submarine Cable Disaster in Dec 2006

- Due to Earthquake in South of Taiwan (Luzon Strait) on 26 Dec 2006
- Most cable systems going through Luzon Strait were cut then
 - FEA, FNAL/RNAL, APCN, APCN2, SMW3, China-US, C2C and EAC
- HK was almost isolated from Global Internet
- Restoration was done slowly and gradually
- Cable repair finally complete in late Jan 2007
- Lessons learnt:
 - Cable route diversity must be observed
 - Should not rely totally on cables of East routing which all go through Luzon Strait
 - Should be prepared to pay more for cables of West/North/South routing for better reliability
 - DNS infrastructure (root & TLD servers) in HK must be improved

APRICOT 1997 in HK

- The 2nd APRICOT ever
 - After APRICOT 1996 held in SG
- Held in Excelsior Hotel
- Attracted a lot of attendees from oversea Internet industry / community
 - A good knowledge-sharing venue
- Conference network set up by CUHK
- IXP showcase
 - But not set up by HKIX
- APNIC meeting was held as well

APRICOT-APAN 2011 in HK

- The first joint conference between APRICOT/APNIC and APAN
- Conference held in HKCEC in Feb 2011
- Workshops held in Cyberport one week earlier
- Still holds two records in APRICOT history
 - 1,200+ attendees
 - 10 x 10Gbps external connections for the conference network
 - 4K uncompressed video streaming from Japan
 - 3D video conferencing for remote viewing of real surgery
- HKNOG was established by the conference network team in Sep 2013 with support from APNIC

Where are those networks now?

- It is hard to keep track of all those mergers & acquisitions
- Where are the following networks now?
 - HKIGS / HK Supernet / HKT Netplus / Linkage Online / HKNet / Star Internet
 - And also <https://www.apnic.net/about-apnic/organization/history-of-apnic/apnic-founding-members/>
- We may be able to get some hints by tracking the ASNs
 - By looking at [Whois](#) (if still being kept) or [PeeringDB](#) / bgp.he.net (if still being used)

Key Success Factors

- *Open telecom regulatory environment -> Submarine cable hub in Asia + Data centre hub in Asia + Popular regional IXPs -> **Internet hub in Asia!!!***
 - Help keep intra-Asia traffic within Asia
 - Better Internet connectivity for HK & neighbouring economies
 - Attract even more business – snowball effect
- HK has to maintain its openness & internationalisation in order to be successful continuously

Thank You 🙏 &
Good Luck 🍀 !

<https://kahoot.it>

Quiz with 5 Questions
And 3 Prizes!