



On the IT Strategic Development for Pacific Neighbourhood Institutions

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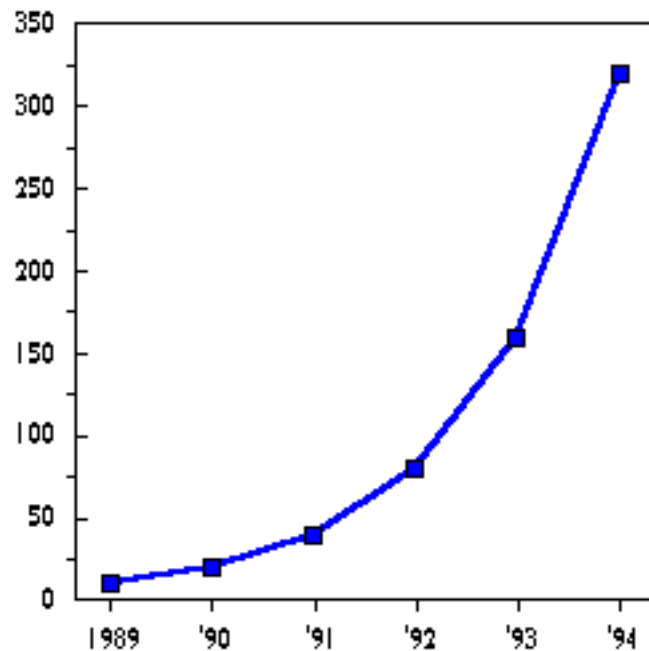
Why IT Strategy?

- Information Technology (IT) is strategic by nature since it could be energy-efficient, enabling leapfrogging, etc.
- Learning to deal with **constant change** will be the key to success.
- Just following up the potential “mainstream” technology is difficult to catch the best timing to invest on and employ the technology.
- It is important to **optimise** with limited academia resources for most of the PNC countries.
- Therefore, it requires **thinking differently** in a proactive way.
- 3 aspects of IT to consider: High-Performance Networking, Advanced Servers, Mass Storage. (Tripod Principle)



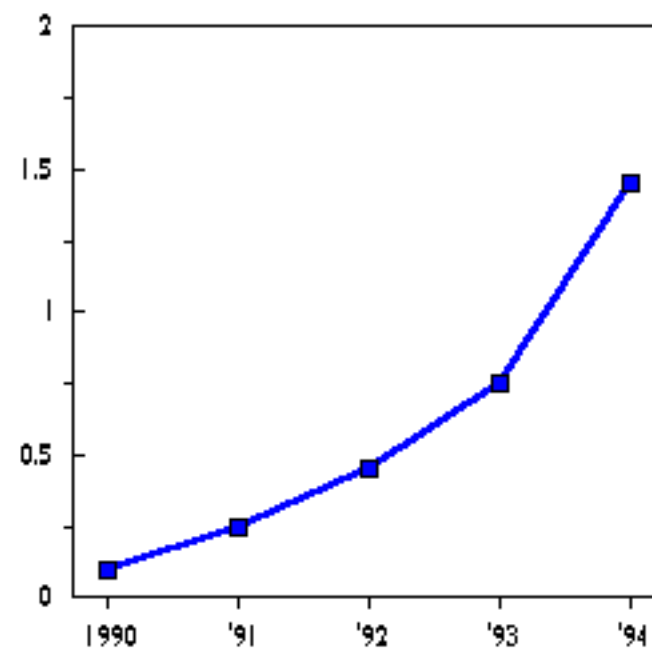
Computing and Storage Technology

Rel. Proc. Speed per \$



10,000 Cost Perform. Declined since 1975

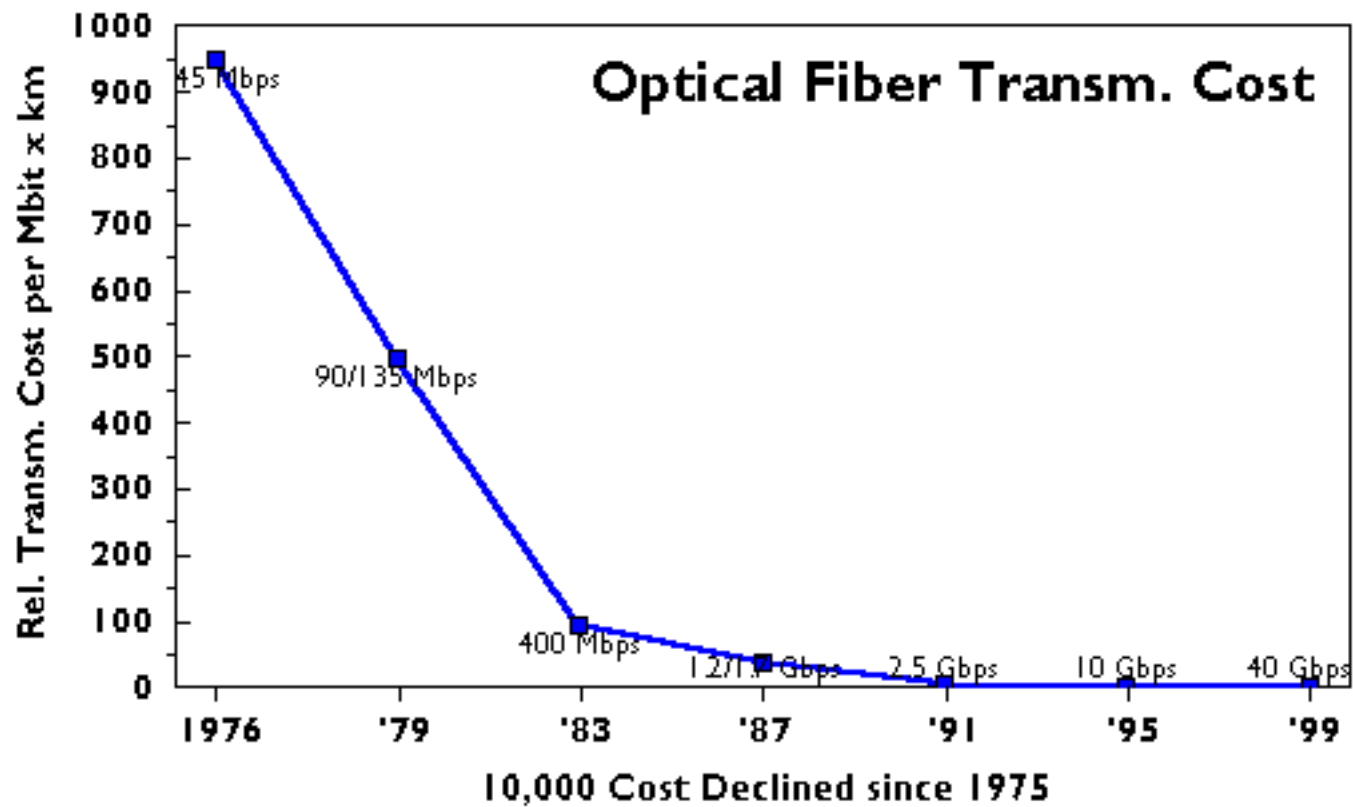
Rel. Disk Sto. per \$



15 Times Cost Reduced per Byte in 4 yrs.



Communication Technology





From MegaTrend to TeraTrend

- MegaFlop to TeraFlop, MegaByte to TeraByte, MegaBit to TeraBit (?)
- Internet creates unprecedented global interaction with **tens of millions** of hosts, **hundreds of millions** of users; WWW contents estimated by IBM Lab. snapshot to be **8 Trillion Byte** according to a recent newspaper report.
- Commodity Computing
- Impact of Object-Oriented programming paradigm and Object management system. (Don't forget basic problem solving skill!)
- Convergence of IT: The progress of technology will slow down due to lack of investment instead of the physical and technological limits.
- Computer, Communication and Contents merges to be **"bit" industry**; the contents of Internet is becoming the Digital Library/Museum.



Characteristics of New IT

- Alan Kay, the inventor of PC and GUI, argues that Gutenberg's Bible is not the printing revolution but the modern handy size of books, in other words, the media propagation triggers the revolution not the substance.
- He also emphasises that computers are media not tools, in analogous to the concept that network computers are information outlets from the Internet.
- The power of the network of dumb components.
 - 200M computers now, Andy Grove of Intel says 500M in yr. 2002; but 6 Billion non-computer chips now, 10 Billion by 2005.
- **Connectionism** --- The future direction of IT (PNC)
- **Criticality** ---- The growth model, lily pond.
- **Scalability** --- The nature of technology problem
- We shall have **Digital Life** provided by **Bit Industry** with voice, data, video, and contents.



Networking Technology Timeline (1)

- 1835, Samuel F. B. Morse invents telegraph (1/2 mile).
- 1876, Alexander Bell invents telephone.
- 1961, T1 invented.
- 1969, Arpanet starts with 50 kbit/s, 4 hosts.
- 1972, First e-mail prog on Arpanet.
- 1973, Robert Metcalfe & David Boggs build first Ethernet, 2.944 Mbit/s over coax.
- 1974, Vint Cerf & Bob Kahn publish TCP/IP.
- 1977, Hayes introduces first modem, 300 bits/s for \$280.



Networking Technology Timeline (2)

- 1981, 3Com ships first 10 Mbit/s Ethernet card for \$950.
- 1982, First VSAT service and PC LAN.
- 1983, First commercial router, cellular phone networks, computer virus infections, IEEE 802.3 Ethernet standard.
- 1984, Internet hosts exceed 1000
- 1986, NSFnet, first ISDN service.
- 1987, Internet hosts top 10,000, ANSI FDDI spec.
- 1988, Robert Morris, Jr. cripples Internet by worm virus; CERT (Computer Emergency Response Team) established.
- 1989, Internet hosts 100,000. IETF established.



Networking Technology Timeline (3)

- 1990, Arpanet officially renamed to Internet, reaches 300,000. Tim Berners-Lee & Robert Cailliau propose World Wide Web.
- 1991, NSF lifts commercial restriction on Internet, also CIX (Commercial Internet eXchange) established.
- 1992, First ATM switches, \$5000 per port.
- 1993, Marc Andreessen & Eric Bina develop Mosaic graphical browser for WWW.
- 1994, NSF announces 4 NAPs: Chicago, New York, San Francisco, Washington, D.C.
- 1995, Sun introduces Java.
- 1996, First gigabit Ethernet switch and adapter. Large-scale Internet outages.
- 1997, First nationwide 622 Mbit/s packet over Sonet service.



NGI: Next Generation Internet

- The NGI Vision announced by President Clinton and Vice President Gore on October 1996.
- In the 21st Century, the Internet will provide a powerful and versatile environment for business, education, culture, and entertainment.
- Sight, sound, and even touch will be integrated through powerful computers, displays, and networks.
- People will use this environment to shop, bank, entertain, work and visit with each other whether at home, at the office, or on travel, the environment will be the same.
- Benefits of this environment will include a more, a greater choice of places to live or work, easy access to lifelong learning, and better opportunity to participate in the community, the nation, and the world.



Global Commercial Trend

- Privatisation and Deregulation of Information Infrastructure
 - to introduce competition
- Globalisation of enterprise
 - Merger and acquisition in manufacture sector; global alliance in service industry.
- Dick Cheney, The success of global alliance relies on:
 - Complimentary in nature, goal alliant, risk sharing, long-term, trust.
- Reduction of transaction cost, fierce competition among economical bodies.

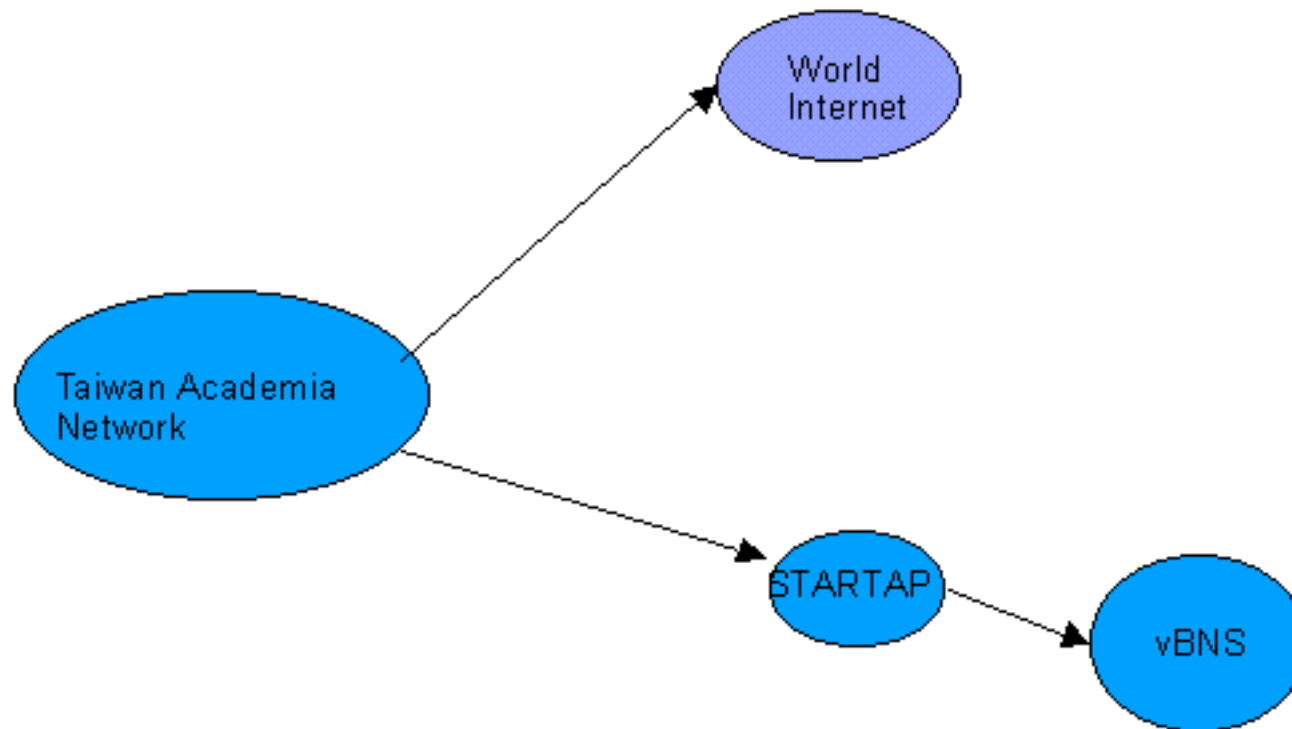


The Impact of IT Teratrend to Developing Countries

- Opportunities:
 - Leapfrogging, end of geographical border, globalisation of small and medium size enterprises, improve quality and efficiency of public sector, participating public affairs and democratisation.
- Challenges:
 - Difficulties of building advanced information infrastructure.
 - The information and telecom density for the developed countries could be 20 to 30 times higher than less developed ones
 - The sources of IT developing funds.
 - It would require 60 Billion US\$ per year according to World Bank.

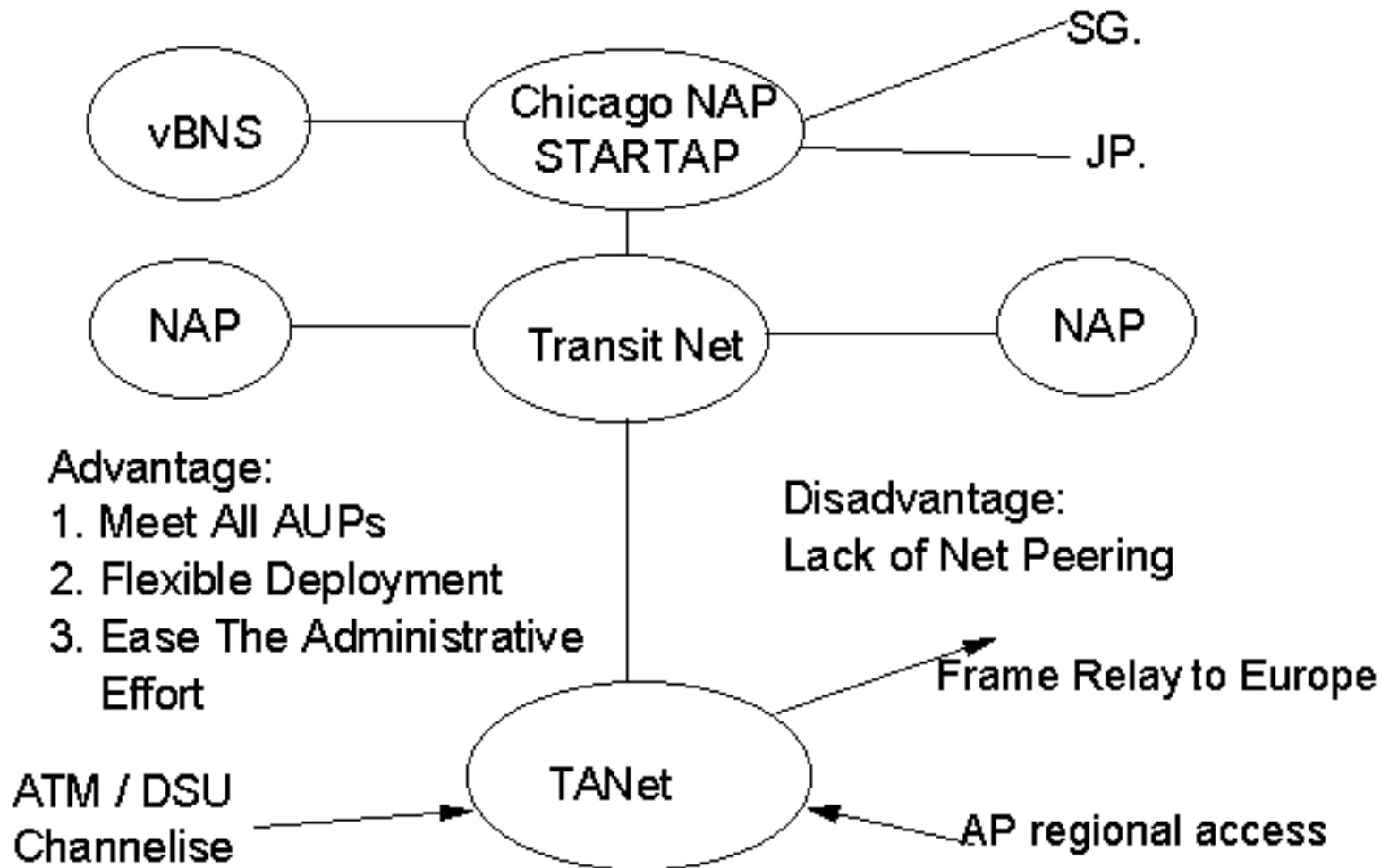


TANet2 International Backbone



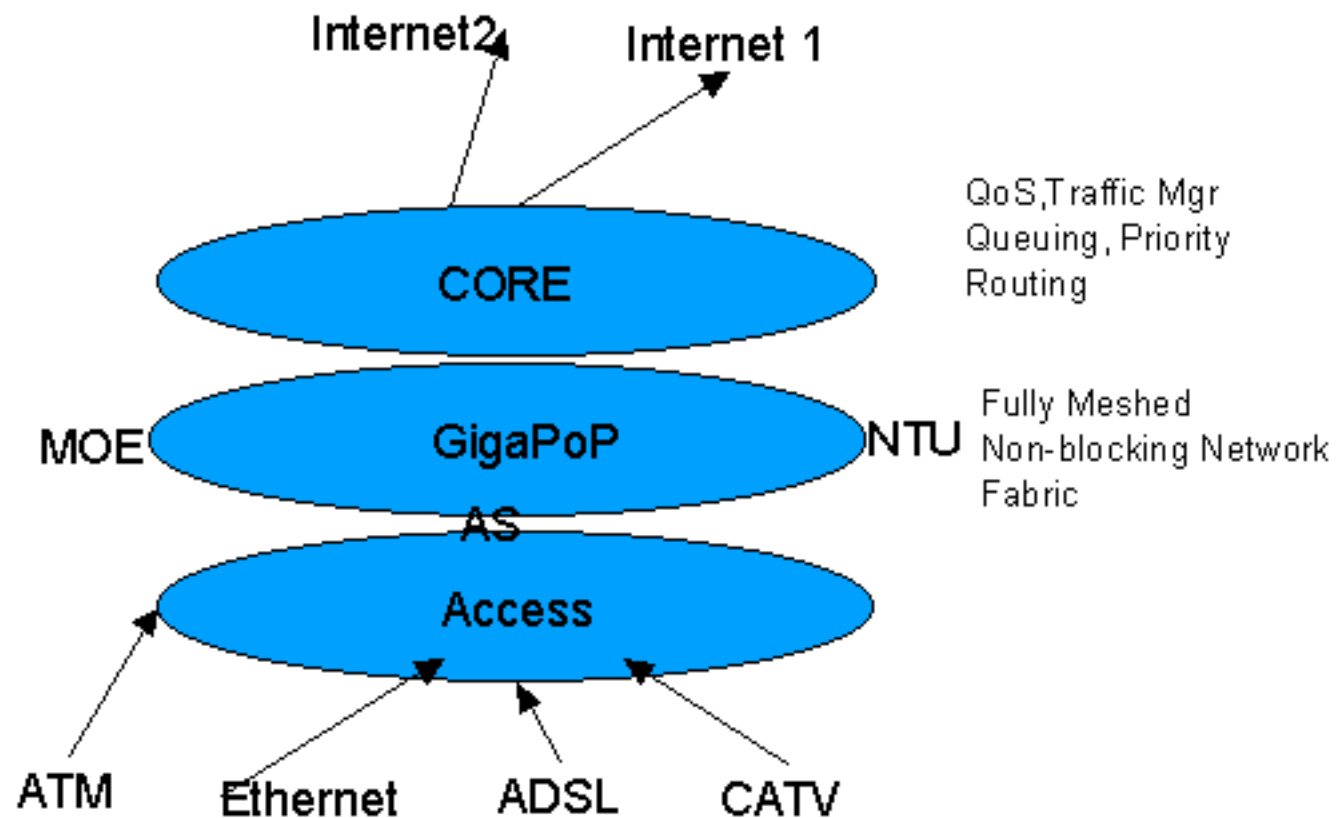


TANet2 International Backbone





Taipei GigaPoP Architecture





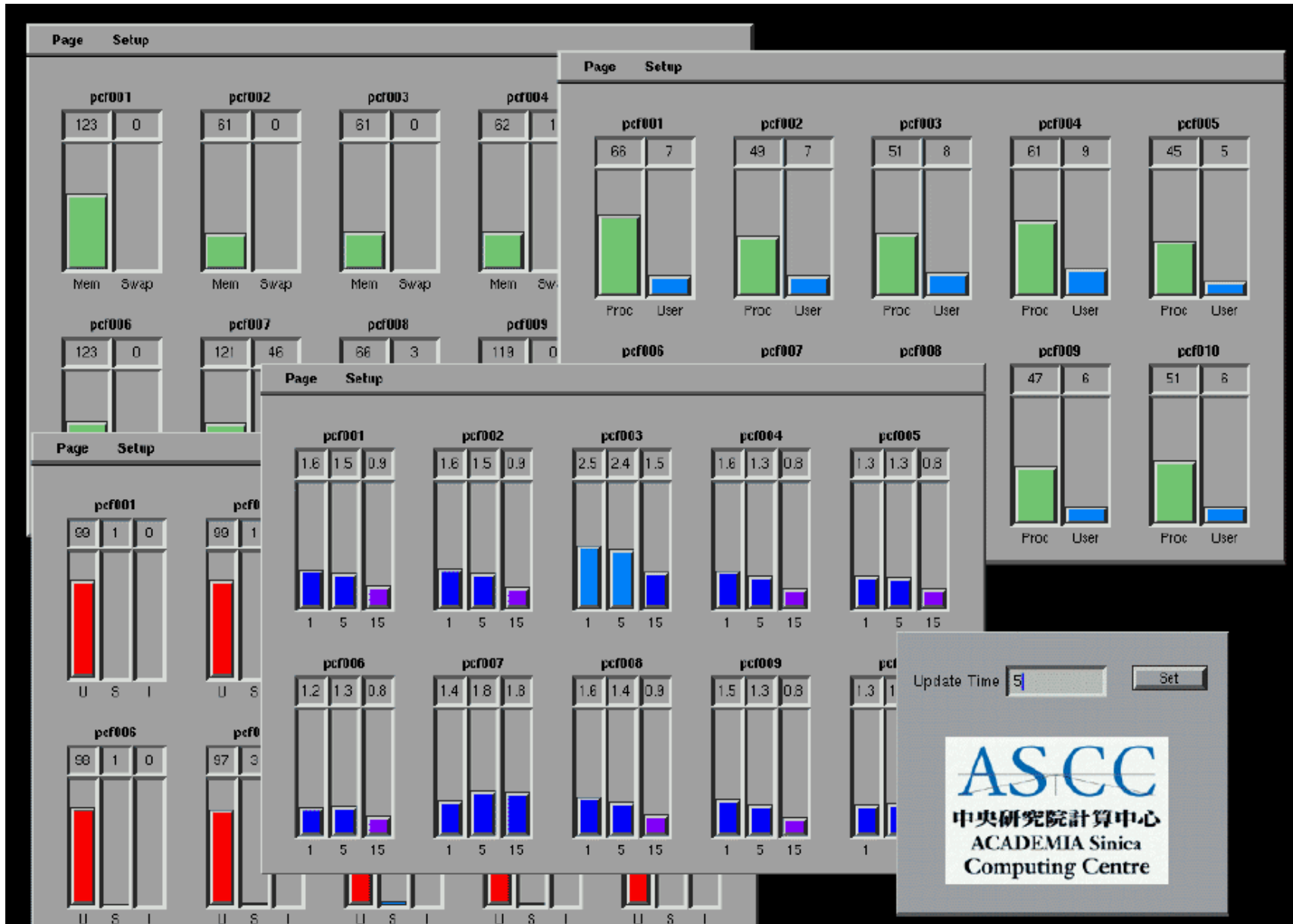
PC Farm

- PC Farm is a cluster of networked PC/Wkstn running (usually) free Unix-like OS, such as Linux, on each node.
- The purpose is to make users feel the cluster system is like a **single system** with good **load-balance** and **scalability**.
- In a **commodity computing** world, PC Farm is an important vehicle for solving research problems cheaply, however, to acquire the knowledge and experience of putting **complex Software/Hardware** together will also let you build advanced Network and Information servers.
- Why Linux-based PC Farm is so reliable and performs well?



ASCC PC Farm (pcf.sinica)







Global Roaming

- Roaming concept extends the local network beyond its own infrastructure, regional service provider immediately becomes a national as well as international provider.
- Roaming mechanism now provides only login, logout time and traffic amount information good for telephone and dialup services.
- Mirror + Roaming DL/M servers on appropriate sites as close as possible to the real Global Internet Backbone. DL/M must be mapped upon real Global Internet Backbone.
- Borrowing Roaming concept **without Accounting** from communication and dial-up services for DL/M server-design could be exciting.



IT Strategy Proposals for PNC (tentative)

- High-Performance Network:
 - TAnet2 International Backbone could become the bridge between PNC Asia-Pacific backbone and PNC America-Pacific backbone
- Advanced Servers:
 - Linux clustered computer system (PC Farm) would be strategic to PNC academia institutes.
- Global (PNC) Digital Library/Museum:
 - Mirror + Roaming mechanism should enable a sharable global PNC DL/M.



Principles for the Fair Use

- Higher education's legitimate right to use copyrighted works must be protected.
- Freedom of access to the information, regardless of its format, is essential for the creative and learning processes.
- Higher education's right of fair use in the electronic era must continue unencumbered by terms of licenses or transaction fees.
- Higher education has an obligation to educate its constituencies about intellectual properties and about the lawful uses of copyrighted material.

--- CETUS, The Trustees of California State University



Principles for the Conduct of Science

- Science is an investment in the public interest.
- Scientific advances rely on full and open access to data.
- A market model for access to data and other technical information is unsuitable for scientific research and education.
- Publication of data is essential to scientific research and the dissemination of knowledge.
- The interests of database owners must be balanced with society's need for the full and open exchange of ideas.



Conclusion

- IT is an enabling technology for creating a life-long learning community.
- Inquiry-driven learning approach, problem-solving capability, team work both require the proper use of IT.
- The PNC Vision also requires IT strategy to fullfill.
- Will IT contributes positively to the future survival of mankind?



Intellectual Property Right (IPR)

- The time has come not for marginal changes but for wide-open thinking about designing a new system (of Intellectual Property Rights) from the ground up. --- Lester C. Thurow
- However, would opening up the system to fundamental change be equivalent to opening Pandora's box where every ones are potential losers.
- This is Revolution v.s. Evolution issue.
- What is legal or illegal in terms of current copyright laws is not the major concern for the future well-being of mankind.
- Only the TeraTrends that may be instrumental to Man's future must be scrutinised.