Educational Research Journal《教育研究學報》, *Vol. 18, No. 2, Winter 2003*

SARS Hits IT in Education: How We Lived Through It and What We Have Learned

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There was little significant academic activity visible on our campus in spring 2003. SARS launched a surprise attack on Hong Kong and the rest of the world in what is usually the busiest months of the academic season, when professors wrap up their classes and students rush to complete their year-end projects and immerse themselves into preparing for their examinations. Classes were suspended. People were hesitant to meet in large or small groups. Lectures, tutorials, discussion groups and most academic activities simply disappeared. But the information and communication technology (ICT) services on campus had not stopped. Perhaps not that obvious to many people, ICT was the lifeblood when the giant was sleeping, one of the

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crucial elements that kept the University functioning. And then, when the epidemic was finally under control, the non-stop ICT services facilitated our recovery in little time. This paper documents what challenges we encountered, what we have done, and what we have learned.

The Centre

Information Technology Services Centre (ITSC) of The Chinese University of Hong Kong (CUHK) is a central unit that offers a full spectrum of ICT services to the entire university. With 140 staff (out of which there are over 60 professional and over 70 technical staff) grouped into seven sections, the ITSC is destined to serve the community of some 17,000 students and 5,000 staff in CUHK.

ITSC is responsible for a wide range of ICT services: from the campus backbone network, central e-mail and WWW servers, and high performance computers, to departmental LANs, microcomputer support and hardware maintenance; from institutional management information systems and academic information systems to office automation and electronic filing systems; and other services such as online teaching and learning, a campus-wide smart card system, information and network security projects and services, IT training to staff and students, and various community services.

The Unprecedented Crisis

SARS struck Hong Kong hard in the spring of 2003. Beginning in March, the virus took its erratic and lethal hop around Hong Kong. For more than three months, effects of SARS outbreak rippled across different areas of the city. The education sector and our University were no exception.

Like all the other educational institutions in Hong Kong, all classes in CUHK were suspended during the SARS crisis. Students were advised not to come back to school until the situation was under control, while those

living in hostels were free to stay but were advised to avoid group activities.

In terms of ICT services, the ITSC had to immediately cope with a community which had all plans obstructed, but was still eager to learn and to teach, and was in desperate need of information and communication services.

Teaching and Learning Continued on Asynchronous Learning Platform

ITSC had implemented a suite of hardware and software for an asynchronous online learning platform five years ago (see Appendix). Among these, the WebCT system supports functions including courseware posting, discussion forums, real-time text chat, online quizzes, and an assignment drop box. At the time of the SARS crisis, the system already hosted more than 1,000 active courses, although most of them served only as supplements to classroom lectures. The class suspension compelled many teachers to turn to WebCT to continue their teaching activity.

Before SARS, most teachers only used WebCT to deliver lecture notes and to hold discussion forums. But the severe incident aroused their interest in looking at the more advanced functions. Some requested instructions for distributing and collecting assignments when students were mostly at home, while some requested our assistance in setting up online quizzes and examinations.

The "assignment drop box" function in WebCT is preferable to assignment delivery by e-mail since the former can automatically keep track of the status of individual submissions, handle multiple submissions and record submission times. Also, the online quiz function of WebCT supports many question types such as multiple choice, short question, long question and matching. Except for long questions, the system can mark a quiz automatically, and reveal the comments and results to the student immediately. These functions were well received and some teachers even decided to use them for take-home examination papers.

Teaching and Learning in Real-Time

Maintaining a connection between the teachers and their students was apparently not sufficient. During the class suspension period, we received a number of requests to provide a real-time video/audio-based teaching solution. The requesting teachers all had legitimate reasons. Some examples are:

- A course designed for on-the-job nurses offered by the Department of Nursing had to proceed as scheduled, since the students had already taken leave from their work and they would not be able to take breaks again in the foreseeable future (see Irene Wong's story in this issue).
- A professor of an accounting course was in Canada when he had to start a class in CUHK. Since travel by air was highly discouraged and regular classes were already suspended anyway, he requested our help in setting up an online lecture environment so that he could teach in Canada and his students could attend anywhere online;
- The mode of attendance of a college-based Putonghua language learning camp originally scheduled for summer 2003 had to be changed as face-to-face lectures were not recommended. However, since direct communication and immediate interaction between teachers and students were essential in a language class, the course administrators decided to pursue the possibility of conducting the course online with real-time video/audio exchange.

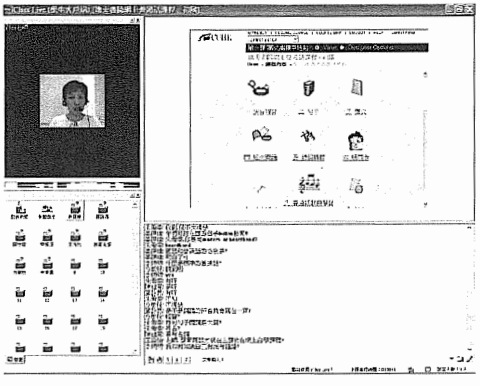
Before the SARS incident, a synchronous learning platform had never been a high priority because its application is (a) restrictive—both instructor and students have to be available at the same time, and (b) resource intensive—needing a powerful computer, high bandwidth, audio and video set up, and attentive support. As such, no readily available solution was in place when the requests came up.

Within a short time, ITSC resolved to serve the requests by existing systems. For the first two examples above, a real-time lecture broadcast using our Real Streaming server and a text-based chat room within WebCT

were set up. The teacher, equipped with video camera and encoding software (see Appendix), broadcast his/her image and voice while the students viewed the lecture simultaneously somewhere online. Through the WebCT chat room in another window, the students could post questions and feedback to the teacher and the rest of the class. The teacher could then respond either through the text chat room or directly through the real-time video. The users found the setup simple and manageable. Being confident that the solution would have a general applicability, ITSC later acquired additional software which supported the streaming of lecture video together with synchronized PowerPoint slides.

The third example above, however, required a two-way exchange of video and audio instead of text alone (as Figure 1 demonstrates). A synchronous online learning platform known as iClass (see Appendix) was identified and adopted as a free pilot solution, with the vendor's permission. Besides supporting audio and video exchange, iClass provided synchronized slide and webpage display, application sharing, whiteboard, hand-raising, online examination, survey and text-chat. Some 50 students enrolled in the two Putonghua classes based on iClass, although the final online attendance in late July was not really satisfactory as SARS was gradually under control. The experience we gained, though, was invaluable.

Figure 1 Photos Showing How Teacher and Student Interacted Inside the Virtual Classroom.



Capacity of IT Infrastructure Challenged

The demand for information and the need for continued communication had driven the network traffic to record highs. While classes were suspended, students spent considerably more time on the net checking university announcements about class suspension/resumption and infection statistics, reading the latest news from the media, chatting with friends, playing online games, etc. We observed significant growth in usage of the WWW server and e-mail service, as well as in the Hong Kong Internet Exchange (HKIX) which CUHK operates.

WWW and e-mail services

While the university administration and various units turned to the network as the only means to disseminate official notices and updates, students and staff were active tossing around private messages and friendly tips to avoid SARS infection. Intermittent delays in the response of the campus-wide e-mail server at certain times were reported. Although not obvious to many users, our system support colleagues knew very well the kind of pressure we were dealing with. Had we possessed a system fast enough to deliver one e-mail to one mailbox within one second, it would still take more than six hours to disseminate one single mass mail to the community of 22,000 users. And at the same time, we could not ignore other mail delivery and retrieval activities.

With the help of the university-led SARS Task Force, ITSC managed to create consolidated web links for academic and administrative announcements, student activities, student services, college announcements, and information for exchange students. Instead of each unit sending its own mass mail, the university community was asked to periodically check the latest information on the Web. Also, a SARS-related e-mail digest was created to group multiple messages into a single e-mail. These measures effectively cut down the resource needed for the mail server to send and maintain many mail messages in individual users' mailboxes. The users also

then checked for new mail less frequently. The overall system response was thus improved.

Hong Kong Internet Exchange (HKIX)

HKIX is a cooperative project initiated, coordinated and operated by ITSC of CUHK. The goal is to interconnect the Internet Access Providers (IAPs) in Hong Kong so that everybody can exchange intra-Hong Kong traffic locally without routing through overseas. Internet Exchange is a very important concept for the Internet after the old NSFnet Backbone faded away. All IAPs have to be interconnected to maintain full connectivity to the whole Internet. Although most IAPs in Hong Kong have their own links to the United States, they have to interconnect together locally in order to enjoy faster and less expensive message exchange and local website access. CUHK initiated the HKIX Project in 1994 to achieve this situation.

A sudden jump in the HKIX traffic recorded in March and April 2003 caused some consternation. Local Internet traffic among IAPs increased by 50% over normal seasonal and long-term trends. Apparently, the surge was caused by the sudden increase in the communication needs of the whole society in virtual isolation. In this period, people used the network to read news from the media, look for government announcements, and exchange all sorts of messages such as hygiene tips, Chinese medicinal prescriptions, and even horror stories about the disease.

Although the increased network traffic posed no real threat to smooth operation, it did sound an alarm about whether the HKIX infrastructure could withstand capacity needs of even bigger magnitude. We had survived the live broadcast of the 1997 Hong Kong handover events (CUHK and Radio Television Hong Kong hosted the Internet broadcast), the launching of live commentary of NBA matches, the live results update of the Olympic Games, the live broadcast of government and legislature events on weekdays, etc. Some of these local events had a direct impact on HKIX while the overseas events only had an indirect consequence.

Since we continuously monitor the performance and traffic volume, it is fair to say that we can cope with traffic growth if it occurs in a gradual trend, which might take place over months or even weeks. Rapid change over a few days, however, is more problematic. Adding stronger network hardware and asking IAPs to upgrade their links, together with switching over to the new set up, cannot be done in a matter of days. Consequently, we are now more vigilant about any unforeseen or unpredictable incident and events that might bring sudden surges in local Internet traffic.

A Direct Impact on ITSC

In ITSC, a suspected SARS case (which later turned out to be a false alarm) of a staff member triggered the establishment of a "clean team" as a precaution. Some IT facilities and services (such as backbone and departmental networks, central e-mail and World Wide Web, online learning platforms, major administrative information systems, central computational and file store systems, etc.) offered by ITSC were deemed critical, and smooth operation needs to be maintained at all times. The University could not afford their interruption in the event of any of our staff members being suspected of having contracted SARS and needing to be quarantined.

Some 30 staff (out of the 140) from various sections were quickly identified and assigned to a "clean team". The team was relocated to a student computer laboratory at Chung Chi College campus, taking advantage of its existing network and computer facilities. All members of the clean team were advised not to have physical contact with the rest of the staff until the situation was under control. Hence, face-to-face meetings and discussions, and social occasions like lunches and sports, had to be stopped. Communication was maintained through telephone, video conferencing and e-mail.

The clean team was set up under the presumption that if the larger team (or part of it) could not function because of infection and quarantine, the clean team could take over and continue to service all the critical functions, albeit at a minimal level. The identification of these critical services was, however, based on executive hunch rather than a scientific survey. At a time

when everybody else was busy with disease prevention activities and making all sorts of rearrangements, a survey or consultation was simply not feasible.

Although we were lucky that none of our members in the original team was infected and the clean team finally did not need to take over the duties, the set up of the clean team was nevertheless a contingency plan we had never thought about before.

An Undesirable Yet Valuable Experience

The SARS incident must have taught most IT people in Hong Kong (and certainly that includes management) an overt and lively lesson in crisis management. For IT people, this subject is traditionally referred to as *disaster recovery planning*—what we should do when hardware fails, application system crashes, electricity is out, or when a fire or earthquake occurs. The concept has been broadened in recent years into *resilience management*, covering restoration of business from, say, malicious computer hacking, or a terrorist attack.

The SARS experience does introduce new paradigms and "solutions" for business continuity. Instead of simply establishing backup sites with redundant network capacity to house extra computer systems and duplicate archival of storage media, we now realize that we should also spend considerable effort in the office environment. An office space that is spacious, hygienic and comfortable enough to house a team of staff seems more a necessity than a luxury. We have become more sensitive and concerned about the health of our colleagues, as well as ourselves. With the painful experience of splitting the Centre into two teams and the potential risk of putting one in quarantine, we have a genuine need to think about the backup of human as well as technical resources.

Though not entirely impossible, it is difficult to meet a one-on-one backup strategy where at least two persons know how to do a particular job. Given the huge number of jobs versus a small number of staff, it wouldn't be possible to split these two staff into two separate teams. Instead, a more

feasible approach would therefore be to prioritize all the current functions and develop redundant skills for the most critical business functions. Management now needs to consider carefully which specific functions would have to be sacrificed if the epidemic strikes again.

With regard to the demand in IT resources, we are now more watchful, not only on the trends of network and system usage statistics, but also on events that could trigger abrupt increase in local network traffic or campus system services. We will continue to advocate the "pull-type" information dissemination (individual users retrieving from the Web), instead of the "push-type" (message sender sending massive e-mail to all the recipients). And whenever e-mail is inevitable, we recommend only short messages with hyperlinks to the details. To support our teachers, we will encourage and actively assist them to prepare a soft copy version of their lectures and teaching materials. For those who have already produced an online version of their course, we would support them in experimenting with the advanced courseware features such as assignment drop box, online quiz, forums and chat rooms. We would also keep an eye on the latest IT technologies that could benefit teaching and learning.

SARS left us with a painful memory. No one wishes to experience once again the trauma it brought to the society and difficulty it created to our work. But SARS has taught us a lot. If we are to re-assess today, we know we possibly had not devised the best plan we could. But if the nasty virus is to strike again, we know we are in a much better position and with more confidence to deal with it.

Appendix

Configuration of the IT Systems Mentioned

A. Configuration of Asynchronous Online Learning Platform

Operating system	RedHat Linux 7.3
Online learning application	WebCT Campus Edition 3.8x (http://www.webct.com)
Hardware configuration	Dell Poweredge 6650 Rack Mount Server Dual CPU Intel (R) Xeon Processor 1.6MHZ RAM 4GB Hard Drive 73GB 10K 1" x 4 (RAID) Controller PERC3/DC 128 MB Network Card Intel Pro 100S x 2
Disk Tower	Dell PowerVault 220/221S – 1022GB Hard Drive 73 GB x 14

B. Configuration of Real Streaming Server

Operating system	RedHat Linux 7.2
Streaming application	Real Helix Universal Server
Hardware configuration	Dell Poweredge 4400 Dual CPU Intel (R) Xeon Processor 1.0GHz RAM 4GB Hard Drive 73GB 10k 1" x 6 (RAID) Network Card Intel Pro 1000T
Client side Encoding software	Helix Producer (http://www.realnetworks.com/products/producer/index.html)

C. Configuration of iClass Server

Operating system	Microsoft Windows 2000
Online learning application	iClass (http://www.flexsystem.com/)
Hardware configuration	Dell Poweredge 4600 Dual CPU Intel (R) Xeon Processor 3.0GHz RAM 1GB Hard Drive 146 GB (RAID)

D. Configuration of Campus-wide E-mail Server

	Before and during SARS period	Upgraded after the SARS incident
Operating system	Solaris 2.6	EMC Celerra File Server Version: T5.1.18.804 Redhat 9
E-mail Application	Qpopper 4.0.4 wu-imap 2002.334 sendmail 8.9.3	Qpopper 4.0.5 wu-imap 2003.339 sendmail 8.12.10
File server	Sun Sparc E4500 Dual CPU 400MHx UltraSparc RAM 1GB Hard Drive 576 GB total (RAID) 100 BaseT network	EMC NS600 Dual CPU 2GB Pentium x 2 RAM 4 GB Hard Drive 1.5TB total (RAID) Gigabit network
Mail User Agent	Sun Sparc E420	Dell PowerEdge 2650