ECCS2012 Makes PCs and Printers in Computer Labs Accessible from Off-Campus Environment

Kazutaka Maruyama
Information Technology Center
The University of Tokyo
2-11-16, Yayoi, Bunkyo
Tokyo, 113-8658, Japan
kazutaka@acm.org

Takayuki Sekiya
Information Technology Center
The University of Tokyo
3-8-1, Komaba, Meguro
Tokyo, 153-8902, Japan
sekiya@ecc.u-tokyo.ac.jp

ABSTRACT

Information Technology Center, The University of Tokyo provides Educational Campuswide Computing System (ECCS) to approximately 60,000 users at our university. ECCS includes computer labs for class and self-study and a mail service for staff and students. ECCS2012, launched in March 2012, focuses on integrations of hardware and various channels to access the system. For example, a single kind of terminals in the labs, an integrated file server for the terminals and the mail service, and a printing service portal which connects printers in the labs to off-campus PCs and terminals in the labs to off-campus printers in commercial stores. In this paper, we describe the detail and usage statistics of ECCS2012.

Categories and Subject Descriptors

K.6.2 [**Management of Computing and Information Systems**]: Installation Management; K.6.4 [**Management of Computing and Information Systems**]: System Management; H.4 [**Information Systems Applications**]: Miscellaneous

Keywords

Educational computer system, Remote access, Remote desktop, Printing service, E-money

1. INTRODUCTION

Information Technology Center, The University of Tokyo, provides the *Educational Campuswide Computing System* (ECCS) for students and teaching and faculty staff of the university. Students and teaching staff use ECCS for their classes, and faculty staff use it to read and write e-mails and as a SSL-VPN gateway in order to access web pages only accessible from on-campus PCs. ECCS provides computer lab and e-mail services to approximately 60,000 users.

ECCS2012, which was launched in March 2012, resolved some problems of a prior ECCS, ECCS2008. The problems of ECCS2008 were as follows:

- there were two types of PC terminals for Mac OS X and Windows,

- there were three separate file servers, two for home directories of PC terminals and one for a mail service,

- a mail service consisted of two different systems,

- only a prepaid card was available for payment on a printing service,

- users off-campus could only use the mail service.

In this paper, we describe how ECCS2012 resolved these problems, especially the improvement of services accessible by off-campus users. The rest of this paper is organized as follows. Section 2 describes an overview of ECCS2012 and some subsystems of PC terminals, file servers, a mail service, and a printing service. Section 3 includes the services for off-campus users, remote access to PC terminals, a printing portal, and payment on a printing service by e-money. Section 4 summarizes our achievements and provides future work.

2. OVERVIEW OF ECCS2012

ECCS2012 includes following subsystems:

- PC terminals for classes and private study of students, and related management systems[4],

- a mail service for the PC terminal users and mail hosting service users,

- file servers for the PC terminals and the mail service,

- a printing service[3],

- authentication servers and a user management system,

- network facilities and firewall equipment.

In this section, we describe some subsystems which improved considerably, but do not provide any off-campus services.
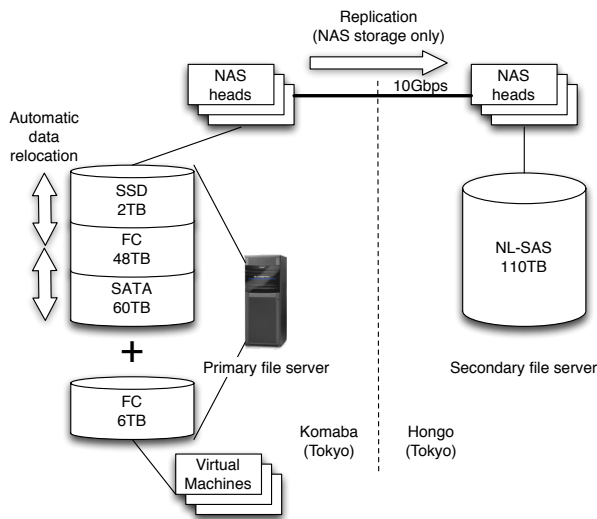
Figure 1: File servers of ECCS2012.

2.1 PC Terminals

PC terminals of ECCS2012 differ from those of ECCS2008, because they are a single type hardware, Apple iMac, which can run both Mac OS X and Windows by Boot Camp. There are 1,300+ PCs located in classrooms and libraries of 18 buildings on three separate campuses, (1) Hongo, Tokyo, (2) Komaba, Tokyo, and (3) Kashiwa, Chiba. Since the six full-time technical staff that maintain them are located only on campuses (1) and (2), remote management systems are required. The following three management systems enable us to update installed operating systems and applications, boot and shutdown terminals and maintain consistency.

- Making an image of a master PC and distributing the image to all other PCs in classrooms and libraries. Canon IT Solutions Inc. provides these features to us as a part of *Total Manager for Mac*. Total Manager for Mac also enables us to boot and shutdown all the PCs remotely.

- Installing and uninstalling separate OS updates and applications into all the PCs by using *Kaseya* of Kaseya Int'l Ltd.

- Keeping the content of PCs stable. *Deep Freeze* of Faronics Corporation is installed on both Mac OS X and Windows partitions.

2.2 File Servers

ECCS2012 requires network attached storage for both the PCs and the mail service. The PCs store users' own files in home directories via NFS from Mac OS X and CIFS from Windows. The mail service, which consists of eight separate Linux servers with a load balancer, also stores mail spools and personal settings of users via NFS. Since ECCS2008 included three discrete file servers, two for the PCs and one for the mail service, the total cost of ownership (TCO) was rather high and any available free space could not be used by the other file servers. ECCS2012 uses a single high-end file server with high performance, availability, and reliability as a primary file server, instead of three mid-range file servers.

Figure 1 shows the structure of the ECCS2012 file servers. EMC Symmetrix VMAX and Celerra VG8, as a primary file server, located at Komaba Campus in Tokyo, provides files to the PCs and the mail servers via NFS and CIFS. The primary server also provides virtual disks for virtual machines via Fiber Channel. EMC VNX 5700, as a secondary file server, located at Hongo Campus in Tokyo at a distance of 9.5 kilometers from Komaba, receives replication data from the primary one. The primary server includes three different types of drives. NAS heads of the server manage 110TB storage, which is put into a single storage pool and whose blocks are relocated automatically according to the statistics of accessing to them by EMC FAST VP. The features of the file servers are as follows.

- Since the PCs and the mail service use the same storage pool, we can assign available free space to either service.

- A combination of different types of drives keeps I/O performance high and saves on installation and electric energy consumption costs.

- A replication from the primary server to the secondary one allows us to eliminate a backup server used in ECCS2008 and gain the additional benefit of disaster recovery (DR). Elimination of the backup server also reduces the management cost of backup schedules to zero.

2.3 Mail Services

ECCS2012 provides mail service to both users of the PCs and of a mail hosting service. The hosting service hosts numerous mail domains used in the university, which are typically sub domains of the university. In ECCS2008 we provided two different types of mail servers to reduce the burden of users' migration, but the TCO was extremely high. In ECCS2012, we focused on reducing our TCO instead of the burden of users and consolidated two mail servers into a single type, DEEPSoft MailSuite. It runs on Linux, not an appliance, and includes not only daemon services for e-mails, but also web mail, anti-virus, and anti-spam.

2.4 Printing Service

The ECCS printing service has provided *on-demand printing* and *printing with a charge* since 2004. On-demand printing in this paper (1) spools a printing job from a user first, and then (2) prints out the spooled job only when the user who sent the job designates "really print" on a *job handling PC* by the side of a printer. On-demand printing and printing with a charge reduce waste and encourage eager students to promote their private study[2].

ECCS2012 provides multi-function printers (MFP) for the following additional requirement of users.

- Digitizing paper materials using an automatic document feeder and an OCR unit.

- Directly printing Word, Excel, and PowerPoint files on users' own USB sticks using job handling PCs, eliminating the need to first log into the PC terminals. A preview of the files appears before printing so that users can check the compatibility of MS Office on the job handling PC.

All other features of the printing service are described in section 3.2.
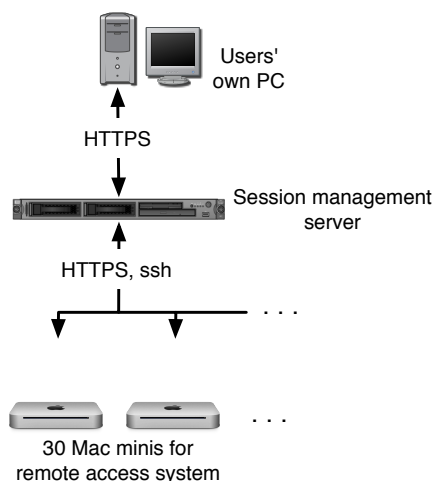
Figure 2: Remote access system of ECCS2012.

Figure 3: Top 30 of total login time.

3. ACCESS FROM OFF-CAMPUS

Most services of ECCS2008 could not be remotely accessed by off-campus users. Now, ECCS2012 makes the graphical desktop of the PC terminals and the printing service remotely accessible to promote greater use of our system.

3.1 Remote Access to PC Terminals

Since applications highly specialized for classes are installed on the PC terminals of ECCS, students are required to come to classrooms or libraries with the terminals when they want to use these applications. ECCS2008 provided only ssh remote access based on a command line method. Graphical applications were available on-campus only. The *remote access system* of ECCS2012 focuses on providing access to these graphical applications to both students at home and part-time lecturers in their own offices without any special clients.

The remote access system consists of 30 Mac minis and a session management server at a server room (Figure 2). Mac OS X provides a VNC server feature and is already accessible remotely. Guacamole[1] enables Mac OS X to be accessible by standard web browsers with HTML5. Therefore, the remote access system requires no additional clients. The session management server acts as a mediator between users' own PCs and the Mac minis. When a user accesses a login page on the server with his/her browser and succeeds in logging into a session, the server picks an available Mac mini from its pool and assigns it to the user. Once the assignment is made, the user's browser displays the Mac mini screen with the standard login window of Mac OS X. He/She enters his/her user name and password again to log into Mac OS X. If the authentication succeeds, his/her desktop, the same as what appears on the PC terminals, appears in his/her browser. When a session unexpectedly disconnects, the server clears the session information and forces the Mac mini to reboot through a ssh connection at which point it is put back into the pool.

1,584 unique users have logged into the remote access system. Figure 3 shows the top 30 of total login time. There are a few heavy users and many light users. About 15% of source IPs are on-campus and 85% are off-campus. The 30
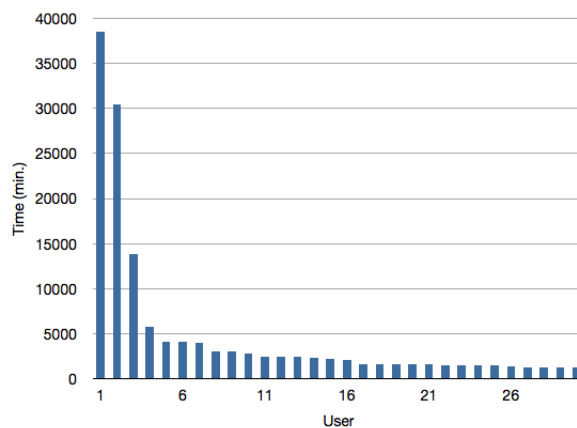
Mac minis are too many because the maximum number of simultaneous login users is only eight.

3.2 Printing Portal and Payment by E-money

The printing service is connected to off-campus resources to allow users to do the following:

1. Printing their jobs to off-campus printers, provided by Net Print Service described below, in the same way as to on-campus printers,

2. Sending print jobs from their own PCs at home or research laboratory to on-campus printers,

3. Paying for printing charges with e-money.

The first and the second above correspond with (1) and (2) in Figure 4 respectively. A printing portal located in Fuji Xerox DC (off-campus) is connected with our printing job spooler via VPN and mediates between on- and off-campus resources. The PC terminals and the users' own PCs with a special printer driver can send a print job to the printing portal. The driver can be set to direct the portal to either send the job to the on-campus spooler and/or the off-campus MFPs. The driver is provided by Fuji Xerox Co., Ltd., which operates *Net Print Service* (NPS) and the MFPs at 7-Eleven Japan stores. NPS is an independent commercial service. If a user uses NPS, he/she does a free registration of NPS, uploads his/her file to NPS via web browsers, and can print it at any 7-Eleven Japan store. ECCS users who wish to print at 7-Eleven stores, need to register NPS and set up the printer driver prior to sending a printing job.

The only printing payment method in ECCS2008 was 1,000 yen prepaid cards. The ECCS2012 printing service accepts e-money, Suica, as well as prepaid cards. Suica, a prepaid and rechargeable e-money card, was developed by East Japan Railway Company, a.k.a. JR East. Since Suica and Suica compatible IC card, are widely used at railway stations and commercial stores in Japan, most students already have these cards. If a user wants to print out only a few pages, all he/she has to do is to put his/her Suica on a reader connected with on-campus MFPs. There is no need to purchase a prepaid card.

The number of printing jobs sent to the printing portal is 1,285 from March 2012 to March 2013. About 9% of them
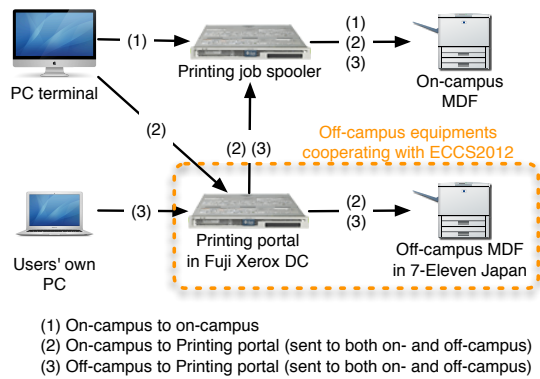
Figure 4: Printing job flows of ECCS2012.

Figure 5: Details of payment methods.

are jobs sent to NPS. The percentage is low because the NPS service charges 20 yen per an A4 monochrome page, double the cost of printing on-campus. NPS may be too expensive for students who do have a less expensive alternative. About 68% of source IPs of connections to the portal are on-campus. This includes users' own PCs connected to the university's Wi-Fi service and PCs located in research laboratories. 32% are located off-campus. These users install the driver on their own PCs and can then send printing jobs to on-campus MFPs.

Figure 5 shows details of payment methods from May 2012 to March 2013. The total printed using prepaid cards is 726,543 pages and the total for e-money is 704,846 pages. The number of pages paid for by e-money appears to be increasing, but the prepaid cards total is still higher. One reason may be that a 1,000 yen prepaid card includes a print allowance equivalent to 1,050 yen.

4. SUMMARY

In this paper, we provide an overview of ECCS2012, especially the ability to connect to off-campus resources, such as the remote access system, the printing portal, and e-money. These services increase usefulness for users. The complexity of the system, however, increases and makes solving problems harder. We will continue to measure the usage of services and provide feedback on the next ECCS.
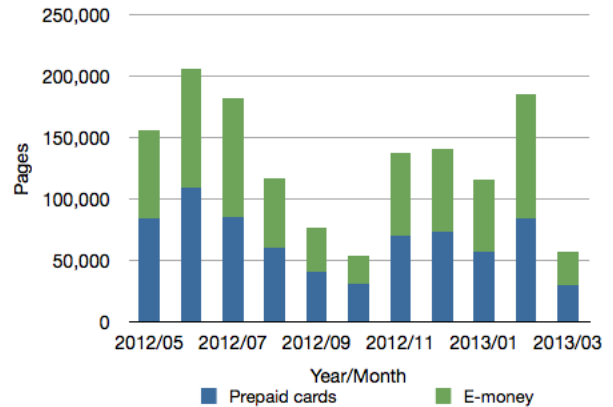
5. ACKNOWLEDGMENTS

6. REFERENCES

[1] *Guacamole - HTML5 Clientless Remote Desktop.* http://guac-dev.org/.

[2] K. Ando and T. Sekiya. New Approach for Printing System Management in University Environment. In *The Special Interest Group Technical Reports of IPSJ*, volume 2005, pages 13–16, 2005. (In Japanese).

[3] K. Maruyama and T. Sekiya. Printing Service for Educational Computer System in Cooperation with Off-campus Services. In *The Special Interest Group Technical Reports of IPSJ*, volume 2012-IOT-16, 2012. (In Japanese).

[4] K. Maruyama, T. Sekiya, T. Imogawa, and Y. Wada. Agent Based Management of Dual Boot PC Terminals in Classrooms. In *Proceedings of Internet and Operation Technology Symposium 2012*, pages 39–46, 2012. (In Japanese).