

In support of the UC Davis strategy to “provide the physical facilities, information resources and technology infrastructure necessary to achieve national and international distinction and leadership in learning, discovery, and engagement,” the campus pursued several initiatives and made a number of advances during the 2006-07 academic year. This section identifies the partnerships that have developed in support of this strategy, and outlines the work of Information and Educational Technology (IET) and other campus units to facilitate the development and implementation of business applications, collaborative programs, and flexible educational technology resources.

MAJOR CAMPUS IT ADVANCES AND ONGOING PROGRAMS

UC Davis information technology stewardship and strategic directions:

Roadmap for administrative IT services. A campus workgroup, endorsed by the chancellor and the Council of Vice Chancellors, was formed in March 2007 to develop a concise roadmap for administrative information technology services at UC Davis. The workgroup is tasked with identifying how the current architectures of core campus administrative IT services serve the UC Davis community; articulating how a coordinated or integrated architectural strategy over the next five years can improve the services from a faculty, staff and student perspective; and documenting a roadmap and a timeline for administrative IT services at UC Davis. vpriet.ucdavis.edu/initiatives.cfm

Administrative computing policy. In spring 2007, a new administrative computing policy defining clear oversight for review and coordination of campus administrative systems that meet one or more specified criteria was circulated for comment. When implemented, the policy is expected to promote a long-term integrated systems approach for the campus. vpriet.ucdavis.edu/adminpolicy.cfm

Cyberinfrastructure. Cyberinfrastructure in support of research, teaching and learning has emerged as a strong theme on the national scene, and at UC Davis. In April, IET and Office of Research hosted a workshop on cyberinfrastructure for researchers. The program featured a series of presentations by representatives from Educause, Office of the President, cyberinfrastructure agencies (TeraGrid, Internet2, CENIC, Open Science Grid) and by UC Davis faculty members representing five different schools and colleges. Existing cyberinfrastructure resources were discussed, along with needs and opportunities. vpriet.ucdavis.edu/cyberinfrastructure.cfm

CalREN high-performance research bandwidth upgrade. A team of IET engineers and technicians upgraded the UC Davis fiber optic connection to the CalREN HPR network, increasing the bandwidth from 1 Gb/sec to 10 Gb/sec. Campus researchers can use the enhanced bandwidth to more rapidly collect and share large-scale datasets in service of numerous research activities. High Energy Physics and Genomics are among the first research groups that are upgrading high performance computing clusters to take advantage of the additional bandwidth.

Data center planning. The growing appetite for data center facilities and services, as well as capacity issues for existing campus facilities, has led to an initiative to identify and analyze short- and long-range solutions. Data center planning has been divided into three phases. The first phase was completed in August 2007. It involved limited renovation of the existing data center, adding power and air conditioning capacity to machine room space as well as capacity for approximately 10 additional racks. Phase II would provide for the additional 24 racks needed to meet projected needs until approximately 2009. Phase III refers to the “long-term” planning horizon (2009 and beyond) and contemplates the construction of a new facility, expansion of the existing facility, and/or other approaches to address anticipated capacity needs over the next ten years.

Telecommunications strategic directions. In Spring 2007, a strategic planning document was developed that outlines the need to tune, reinforce, and develop the campus telecommunications infrastructure over the next several years. The document identifies the current state and limitations of campus telecommunications services and infrastructure and provides a set of alternatives for campus consideration that could mitigate the impact of this aging telecommunications environment on UC Davis' goals for national distinction as an R1 research institution. The strategic planning document was discussed with the Office of Resource Management and Planning and with Interim Provost Horwitz in summer 2007. It will be shared with the campus community in fall 2007.

Information technology in support of campus business:

Kuali. UC Davis, UC Irvine, and UC Santa Barbara are active participants in the development of the Kuali Financial System (KFS), along with Indiana University, University of Arizona, Cornell University, and others. The primary development of KFS will be completed in July 2008. accounting.ucdavis.edu/projects/UCDKuali/

Effort Reporting. A new Effort Reporting System (ERS) was released for campuswide use in March 2007. Effort reporting is the method of certifying to granting agencies (such as the federal government) that the effort required as a condition of a grant award has actually been completed. The new Web-based system replaces the paper Personnel Activity Report (PAR) forms used to certify effort on federally-sponsored research projects. The new system is expected to save time and money. accounting.ucdavis.edu/projects/ERS/

MyTravel. MyTravel, a new Web-based system for reporting travel and entertainment expenses, is gaining ground at UC Davis. MyTravel streamlines the entire reimbursement process from capturing receipts electronically to electronically routing the report through the approval process. The pilot project continues to generate many helpful enhancements and suggestions. As of Spring 2007, about 60 departments were using MyTravel on campus and at the UC Davis Health System. The rollout will continue throughout 2007 and into 2008. travel.ucdavis.edu/mytravel/

Faculty Merit and Promotion Project. In spring 2007, the sponsors of the MyInfoVault project, Academic Personnel and IET, made the decision to delay the release of the next version of the system while critical changes and improvements are made to the software. The new targeted release date is early Spring 2008. As of April 2007, schools and colleges representing 123 departments and 2,800 accounts were participating in the pilot. MyInfoVault will make possible the development, routing, and approval of faculty merit and promotion actions. myinfovault.ucdavis.edu

Electronic Research Administration Project. Once implemented, the eRA system will support all aspects of research proposal development, tracking and administration. The implementation of the "proposal development" phase of the system, which will support system-to-system submissions of federal grants, has been put on hold for a year. Continuous changes with grants.gov, and delays in creating a system-to-system process for all federal granting agencies continue to escalate costs for deployment. Additionally, approximately 60% of campus research proposals are non-federal and will require duplicate data entry in order to capture relevant data within the system. At the end of the year, the campus will reevaluate whether or not it should proceed with the Proposal Development module. The project is sponsored by the Office of Research.

AD and Exchange Service. The collaboration between Office of Administration (OOA) and IET reached several milestones this past year. The entire OOA and IET staff are now using Exchange for their email, calendaring, and file sharing needs. Standardization on methods for group policies, email services, and automated security and system updates are among the benefits for technical staff. End-users benefit from shared calendaring, file sharing, 24/7 remote email and calendar access and centralized security and system updates. The centralized Exchange services, hosted by the Data Center, are also used by Office of Research, Office of Resource Management and Planning, and Student Affairs. xeda.ucdavis.edu

Banner Student Information System. In November 2006, Banner was upgraded to the new Web-based Banner 7 version. The technical team worked with representatives from each of the core offices—Student Affairs Office, Office of the University Registrar, Financial Aid Office, Undergraduate Admissions, Office of Graduate Studies, and Student Accounting. Because upgrading such a highly customized system is complex, the process for implementing the change began several years ago and required extensive coordination. This year, the SIS oversight committee is developing a Banner 'revitalization' plan. sis.ucdavis.edu

GradSMAART. The Office of Graduate Studies has launched an initiative, called GradSMAART, to install a system to improve the management of graduate student admissions, evaluation, and tracking. The components will include an online application process; a custom-developed admission review and evaluation system; a data mart for tracking students, and an alumni tracking database. ccfit.ucdavis.edu/gradsmaat.cfm

Information technology in support of learning and teaching:

New learning management and collaboration system. SmartSite, UC Davis' instance of Sakai, is emerging from its pilot phase and preparing for its official roll-out. To help faculty begin their transition to SmartSite, two trainers were hired in January to develop a curriculum of biweekly SmartSite and educational technology-related classes (trc.ucdavis.edu/TRC/calendar). In addition, tools for exporting course Web sites, tests, and quizzes created in MyUCDavis into SmartSite are now available. As of April 2007, SmartSite had grown to include over 6,000 individual workspaces and approximately 1,000 course and project sites. An extensive awareness, support and training program has been developed in preparation for the official Fall 07 roll-out. smartsite.ucdavis.edu

Online teaching evaluations. Each quarter, more than 8,000 UC Davis courses and instructors are evaluated by students using paper forms. This places a heavy burden on staff who must process forms and transcribe written comments before releasing the evaluations to instructors. Other universities, including three UC campuses, have recognized the inefficiency of the paper-based system for course evaluation and have implemented secure online evaluations. The CCFIT Online Teaching Evaluations Work Group investigated these issues in 2006-07 and submitted a preliminary report in June 2007. ccfit.ucdavis.edu

Podcasting. The popularity of the campus digital lecture recording and distribution program continues to grow. Last Spring, lectures for 18 undergraduate courses were podcast, and a total of 334 lectures were uploaded. Of the 3008 students enrolled in these courses, over 2088 (69% of enrolled students) downloaded MP3 lectures or subscribed to course podcasts. Of the 2088 users, 24% had used the system during an earlier quarter while 76% were new users. podcast.ucdavis.edu

Communication and collaboration tools. A pilot was conducted to test and compare Adobe Connect Pro (previously Macromedia Breeze Meeting) and Elluminate, two top ranked online communications and collaborations applications. Although the user interface for Elluminate was preferred over Adobe Connect in the eight key areas of evaluation (accessibility, video capacity, number of users on campus, cross platform support, performance under increasing concurrent users, standards based development, content development capabilities, and cost), Adobe came out ahead of Elluminate. Therefore, Adobe Connect will be offered to the campus community for both business and instructional uses. iet.ucdavis.edu/teaching/commtool.cfm

Personal response system. After reviewing five different personal response systems (or "clickers"), a group of UC Davis instructors and staffers selected InterWrite's Personal Response System for the 2006-07 academic year. Having a single PRS will benefit students by allowing clickers to work in all UC Davis classes. Instructors coordinate ordering the clickers for their students' use through the UC Davis bookstore. cts.ucdavis.edu/prs/

Classroom and lab upgrades. This past year, a number of upgrades were completed in general assignment classrooms and computer labs. A brief summary follows (see also [statistics](#)):

- o Three laboratory classrooms/lecture halls previously used by the Veterinary Medical Teaching Hospital were renovated, converted into general assignment classrooms, and equipped with complete new A-V systems. This work was done to accommodate the anticipated 1,000 additional students attending Davis and create more classroom space for freshmen courses.
- o Giedt Hall, a new classroom building consisting of three large lecture halls and two 40-seat classrooms, was completed. New media systems were installed -- dual data projection in the three lecture halls with two separate screens, document cameras in all five rooms, and digital recording systems to allow all lectures to be podcast from the three lecture halls.
- o New equipment -- including document cameras, assistive listening devices, and digital recorders -- was installed in various classrooms and lecture halls around campus.
- o Last year, the University Registrar approved funding to replace the audio cassette recorders in 10 lecture halls with digital recorders and to replace the associated audio inputs and outputs in the media cabinets. These units were installed during summer 2006. With the popularity and increasing use of podcasting, digital recorders have since been installed in five more lecture halls, bringing the total number of classrooms with installed digital recording capability to 18.
- o In December, UC Davis medical students gained a large new home, the Education Building and F. William Blaisdell, M.D. Medical Library. At more than 121,000 square feet, the building has become the center of activity and education for the School of Medicine. The building's classrooms share a versatile video communications network and help the school shift its instruction toward interactive learning done in small groups.

In addition to a number of equipment upgrades, improvements were completed in several computer labs: a new computer classroom opened in 2060 SLB; 163 Shields was renovated with new

furniture, an improved layout, and additional stations; and 93 Hutchison was upgraded to accommodate multimedia classes. Wireless printing was introduced in October 2006 as a new service. Laptop users can now print remotely to one of several computer rooms, thereby bypassing long lines at the main computer rooms on campus (wirelessprinting.ucdavis.edu). Also put into effect this year were new printing rates that encourage responsible printing, control costs, and reduce paper waste. iet.ucdavis.edu/rooms/

Campus emergency planning:

UC Davis is developing a multi-faceted plan to prepare for, respond to, and recover from a possible emergency. As part of these planning efforts, the following activities took place in 2006-07:

- IET continues to support the campus emergency planning efforts by working collaboratively with other departments to identify critical functions, mitigation strategies, priorities and interdependencies. Examples of this include the development of the emergency call center for University Communications, participation on the Emergency Phone Committee, establishment of emergency communications for the Executive Policy Team, and ongoing technical support for the Emergency Operations Center.
- In fall 2006, representatives of the Police Department, Operations & Maintenance, Campus Emergency Management, and IET formed a committee to study campus emergency communications. As of late August 2007, negotiations for an automated campus emergency notification system were in the final phase. Using an automated notification system, emergency response coordinators will be able to provide accurate, timely information to any number of subscribers on multiple devices (office phone, home phone, cell phone, email, etc.) with a single outbound call or email. Implementation is expected to begin this fall, once a confidence test has been completed.
- Discussions with the UC Davis Health System about where the two institutions could be mutually supportive in an emergency and about collocation of equipment.
- Implementation and management of the GETS (Government Emergency Telecommunications Service) program. GETS provides key campus personnel a high probability of completion for their phone calls when normal calling methods are unsuccessful. The system is designed for periods of severe network congestion or disruption, and works through a series of enhancements to the Public Switched Telephone Network (PSTN).
- Participation in the UC-wide technical evaluation of "People Locator," a Web-based service developed by UC Berkeley that allows authorized individuals to post messages regarding their health and/or whereabouts for other authorized individuals (e.g., friends, family, and coworkers) to view – much like a public bulletin board.
- Participation in the UC-wide technical evaluation of "ReStarting Berkeley," an application developed at UC Berkeley for business continuity planning. UC Berkeley's Continuity Planning Tool will be converted into a form appropriate for, and available to, other members of the UC system. IET will participate in a test case for the new application.
- Development of emergency Web and bulk email communication processes and policy.

For more information about the campus emergency planning efforts, see safetyservices.ucdavis.edu.

Computing and network security:

UC Davis Cyber-safety program. This year, the UC Davis Cyber-Safety Oversight Committee was established to periodically review program enhancements and reporting efforts. In addition, the UC Davis cyber-safety program features two new components: Whole Disk Encryption Subsidization and Firewall Subsidization, both of which were initiated to assist units previously precluded from complying with campus cyber-safety security standards due to financial constraints. In February, the IT Security Coordinator and the Vice Provost-IET provided campus administrators with a UC Davis information security status report. The discussion included a brief overview of the UCLA security breach, highlights from the 2006 campus security reports, and an outline of 2007 initiatives to help units enhance compliance. In June 2007, campus units were asked to develop their 2007 compliance reports using a secure online survey. The survey was available for report submissions until early September. security.ucdavis.edu/cybersafety.cfm

Identity theft prevention. A campus directive (06-116) released in October 2006 outlined several steps that members of the campus community should take to protect personal information. The directive also encouraged individuals to work with their technical support staff to prevent identity theft. In support of this goal, two security tools, Cornell Spider and PowerGREP, were made available. These tools, free to campus users, make it possible to search systems for files that

contain personally identifiable information such as Social Security and credit card numbers. security.ucdavis.edu/id_theft.cfm

Firewall subsidy program. In March, a new program was launched to help campus units meet UC Davis Cyber-safety policy mandates and to encourage broader campus usage of VLAN firewalls. Through the new Firewall Subsidy program, IET made \$170,000 available each year for the next three years to reimburse campus units for the acquisition and first-year support costs of new VLAN firewalls. security.ucdavis.edu/firewalls.cfm

Security auditing tool. A new resource is available to help technical staff assess the level of cyber-safety compliance in their VLANs. This resource, called the self-directed Nessus scan tool, enables technical staff to scan their VLAN or specific systems on their VLAN with the full complement of Nessus 'safe' plug-ins. The tool provides the option to scan systems immediately or to schedule one-time or recurring scans. Information obtained using the self-directed Nessus scan is intended to complement the data from campus scans. security.ucdavis.edu/patch.cfm

Identity management. In February 2007, an overview of the Burton Group report, which sets forth an identity management architecture and migration strategy for UC Davis, was presented to the Campus Council for Information Technology (CCFIT). This IT advisory group voiced support for this project. Earlier in the year, the Technology Infrastructure Forum (TIF) reviewed the proposed identity management architecture and indicated that implementation of the architecture is the most important information technology project for UC Davis. vpiet.ucdavis.edu/initiatives.cfm

Web single sign-on. The campus' new Web single sign-on service, called CAS (Central Authentication Service), was released in December 2006. CAS provides a robust security architecture and various client modules, and is used by more than 50 universities and organizations worldwide. CAS will eventually replace DistAuth, the current Web single sign-on service for UC Davis. middleware.ucdavis.edu

Security software and training. Several software programs were introduced to the campus community in 2006-07 in support of the cyber-safety program.

- o In December, the Sophos anti-virus software was made available for free to all departments, faculty, staff and students for use on their home or university-owned computers. Sophos will help protect servers, desktops, laptops, and handheld devices for five years. As part of this campus-wide agreement, Sophos Mobile Security is available to students, staff, faculty, and departments for use on university- and personally-owned Pocket PC and Pocket PC Phone editions at no individual or campus-unit cost. In addition, a two-day Sophos training program was offered to campus technical support staff in early summer.
- o In late February, Pointsec encryption products were made available, and a program was launched under which IET covers 100% of the cost of Pointsec for PC whole disk encryption licenses for individuals and departments demonstrating the need for encryption services. As part of this program, IET provides support services including central key retention, consultation and pre-installation assistance. security.ucdavis.edu/encryption.cfm
- o A 90-minute information session was held in March in the Silo Cabernet Room for technical support staff on using Cornell Spider to find restricted data and deploying Pointsec for PC to encrypt a hard drive.
- o In June, IET hosted the 2007 IT Security Symposium. Held on the UC Davis campus, the symposium featured 50 sessions and over 500 hours of hands-on instructional labs and lectures on current security issues. The event provided a valuable venue for campus technical staff shared their security expertise with their colleagues. About 240 attendees from UC Davis and other UC campuses were able to take advantage of the security lectures and training. itsecuritysymposium.ucdavis.edu/

Improvements to campus email infrastructure and services:

Spam filtering measures. On November 29, after consulting with campus constituents, IET implemented new spam filtering measures to give users more control and flexibility with their spam filtering settings, and to reduce the amount of spam processed and stored by the campus email servers. Changes to the filtering service included: automatically rejecting high-scoring spam; filtering low- and moderate-scoring spam to UCD-spam folders; reducing the spam folder storage time from four weeks to two; and eliminating quarantine folders, which previously stored high-scoring spam. email.ucdavis.edu/secure/spamfilter.php

Email architecture. In spring and summer 2007, a new email architecture system, Cyrus, was implemented in an effort to improve email performance and user response time, allow faster access

to mailboxes by Web-based email programs, and improve the system's storage of messages. The move to Cyrus will enable the campus to consider additional improvements, including replacing the locally developed Web-mail program, Geckomail, and increasing mailbox quotas. The conversion to Cyrus was completed in August 2007. vpnet.ucdavis.edu/email.storage.cfm

Email proxy service. A major improvement to the UC Davis email system—the addition of a proxy service—was completed during fall 2006. The proxy service now lets administrators balance UC Davis' increasingly heavy email loads without users having to change any settings, and technical staff can simply use the setting "mail.ucdavis.edu" for all incoming POP/IMAP mail server settings. Except for some brief periods of downtime, moving the servers to the proxy service was invisible for most email users. One exception was for people using older versions of Eudora, which did not recognize the new proxy's security certificate (and didn't satisfy UC Davis' cyber-safety standards). email.ucdavis.edu

Email service for students. An evaluation of options for improving electronic mail services for students was conducted this year. A recent analysis of email accounts indicates that UC Davis has 64,500 personal email accounts, of which approximately 30,000 are student accounts. Most students access email through MyUCDavis, or directly from the Geckomail Web interface. A comprehensive campus consultation process was initiated in early January, and feedback from students was solicited using focus groups and surveys. Following this community feedback phase, the campus is now preparing to pilot Google's GMail program in Fall 2007. vpnet.ucdavis.edu/student.email.cfm

Improvements to telecommunications and networking infrastructure and services:

Indoor cellular coverage. UC Davis is improving cellular coverage by allowing cellular carriers to place cell sites on the main campus. Each carrier will have at least one new cell site on the main campus by the end of 2008. Campuswide indoor coverage on the other hand remains spotty. To address this concern, IET is assuming responsibility to manage and install indoor systems. A team is investigating indoor antenna systems (to enhance the signal of all carriers), developing standards for indoor cellular coverage for new construction, and investigating funding models to install indoor antennas in existing buildings.

Wireless. In January 2007, the Campus Council for Information Technology (CCFIT) established a workgroup to provide ongoing guidance to IET in the prioritization of wireless deployments and to make recommendations to the Vice Provost-IET in two general areas: physical deployment of wireless access points; and centralized management components necessary to provide wireless access to all classrooms, public spaces, and administrative buildings by the end of 2007-08. A recommendation from CCFIT is expected in fall 2007. In parallel efforts, IET deployed a pilot wireless network called Moobilenet-X that uses the 802.1x wireless protocol to provide encryption, enhanced authentication, and improved performance as a parallel service on the existing campus wireless network. vpnet.ucdavis.edu/init_moobilenet.cfm

Student Phone Services. An automated phone ordering system was made available in fall 2006 via MyPhone, a student services Web portal. The system will walk students through all voice service options, create an electronic work order, print out a work ticket for a field technician, close the order, and bill the service to the student's account. This is a prototype for future automated service order processing. myphone.ucdavis.edu

Next Generation Digital Loop Carrier. UC Davis uses NGDLC to provide voice services to eleven campus locations. An implementation strategy has been developed and initial steps taken to convert various off-campus locations, currently served by AT&T CENTREX service, to NGDLC by using dual optical fiber transport paths back to the main switch. In addition, NCDLC will be deployed in remote geographical "districts" on the main campus using a central hub and installing copper cable to the smaller buildings throughout the district.

Voice over IP and 'on-demand/always-on' distribution of video broadcasts. UC Davis is researching the possibility of offering VoIP as a standard phone service to campus. The project team is investigating service requirements (e.g., enhanced 911 auto-location for emergency services, quality of service monitoring and control, phone number format transitions, and ADA compliance). In addition, planning is under way to explore a comprehensive service to distribute video broadcasts to TV broadcast networks, venues on campus, and the UC Davis Medical Center. Broadcast venues would have either "on-demand" or "always-on" connections, depending on what they need. This service would support the campus' growing need to educate, promote, compete and communicate through video broadcasts, both internally and globally.

On-campus telephone and network service at off-campus locations. The campus telephony and network services were expanded to off-campus locations by replacing voice circuits and T-1 network connections subcontracted through AT&T with new UC Davis fiber optic connections. By running digital voice and campus network service through the fiber optic connection to the campus Network Operations Center, the level of telecommunications and network services at off-campus locations was elevated to standards comparable to on-campus service.

STATEMENT OF PLANS FOR 2007-08

In 2007-08, priorities in support of the campus strategic plan will include:

- 1. Develop infrastructure and services in support of teaching, learning, and research**
 - Launch SmartSite in fall, providing numerous methods and opportunities for training and support; evaluate in summer 2008
 - Integrate IET instructional technology units to strengthen collaboration and communications, and ultimately improve services to the campus community
 - Collaborate with the Teaching Resources Center to introduce new technologies in support of teaching and learning -- develop Phase 1 of a web portal for faculty who need to organize, order, request services and/or support for instruction; pilot a CCFIT proposal for Educational Technology T.A.s resident in departments; improve assessment of educational technologies; etc.
 - Explore CCFIT's proposal for online teaching and course evaluation system
 - Collaborate with the Library to evaluate ARTStor/California Digital Library as a digital repository and archiving system.
- 2. Enhance campus IT infrastructure and services**
 - Define and implement new campus telecommunications directions
 - Pursue short- and long-term data center expansion plan (as outlined in "Major IT Advances and Ongoing Programs")
 - Pursue improvements to campus email and calendaring services (Geckomail replacement, Google pilot, Exchange services)
 - Implement venues for cross-campus collaborative IT architecture and application development ('meta-wiki' for developer community)
 - Develop and implement plan to 'revitalize' the Banner Student Information System; identify methods to help make Banner more responsive to the functional needs of the campus.
- 3. Strengthen campus IT planning and coordination**
 - Inventory and review campus IT administrative services (IT roadmap)
 - Develop a UC Davis information technologies strategic plan; integrate recommendations from the 2007 Chancellor's Fall Conference (Theme: "Information Technology: A Vehicle for Innovation at UC Davis")
 - Establish a UC Davis Architectural Design Group to develop an Identity Management Plan for the campus.
- 4. Secure campus resources, systems, and data**
 - Promote campus community compliance with Cyber-safety security standards
 - Enhance campus community reporting on Cyber-safety security standards beyond the seven standards currently subject to reporting requirements.
 - Implement a program to identify and remediate security vulnerabilities in development, test and production Web application environments.
 - Enhance the detection and termination of malicious network traffic at the campus border.

See <http://vpiet.ucdavis.edu/initiatives.cfm> for descriptions and ongoing updates.

2006-07 METRICS

Please see <http://vpiet.ucdavis.edu/metrics.cfm> for 2006-07 and ongoing technology-related metrics.